Critical Reasoning: A User's Manual, v.4.0

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CRITICAL REASONING: A USER'S MANUAL

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Chris Swoyer with Jason Southworth

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Introduction

Teaching critical reasoning is difficult. So is learning to reason more carefully and accurately. The greatest challenge is teaching (and learning) skills in such a way that students can spontaneously apply them outside the classroom once the course is over (teaching people to apply skills in the classroom can be hard enough, but clearly isn't a worthwhile goal in itself).

We (the authors) have learned a good deal about these matters from the students who took courses using earlier drafts of this book, and from colleagues who've taught from it. But one key theme of this book is the importance of actually checking to see what the answers to complicated empirical questions are, rather than blithely assuming we know, and that applies to teaching critical reasoning as much as to anything else. We know more about this now than we did 25 years ago, but there is still much to learn.

One lesson is clear, though. Reasoning is a skill, and there is strong evidence that (like any skill) it can only be acquired with practice. It is important that students work to apply the concepts and principles in a wide range of situations, including situations that matter to them. It is equally important that those teaching critical reasoning design their assessments to model situations and cases where these skills will be of use in real life.

Different routes through the book are possible. One of our colleagues covers virtually the entire book in a single semester. Most of us omit some chapters, however, and the book is designed to accommodate somewhat different courses. A more traditional course would spend a good deal of time on parts two and four (arguments and fallacies), whereas a less traditional course might omit fallacies altogether and focus more on cognitive biases or social aspects of reasoning. It is also possible to go into probability in more or less detail, although we are convinced that some familiarity with basic probabilistic and statistical concepts is extremely useful for much of the reasoning we commonly do. One can teach this without worrying about calculating a lot of probabilities; indeed, it is important for students to see how the basic concepts apply in cases where precise numbers are unavailable, i.e., in almost all cases they will encounter outside the classroom. Still, doing some calculations will deepen students' grasp of the basic concepts.

Part I

Basic Concepts of Critical Reasoning

Part I. Basic Concepts of Critical Reasoning

Most of this module is devoted to a survey of seventeen concepts that will surface repeatedly throughout the course. This will give you some idea of what critical reasoning is and what the course will involve. We then turn to issues involving relativism, dogmatism, and the importance of free inquiry.

Chapter 1

Basic Concepts of Critical Reasoning

Overview: In this chapter, we briefly survey several concepts that will surface repeatedly throughout the book. This will give you some idea what critical reasoning is, and what this course will involve.

Contents

1.1 Basic Concepts

In this section, we briefly survey several concepts that will surface repeatedly throughout the course. This will give you some idea of what critical reasoning is and what this course will involve. The aim here is just to provide some basic orientation, so don't worry about details now.

1. Intellectual Responsibility
2. Reasons
3. Empirical questions
4. Inference and argument
5. Relevance
6. Going beyond the information given
7. The importance of the situation or context
8. Explanation and understanding
9. Prediction
10. Testing
11. Feedback
12. Emotions and needs
13. Quick fixes

14. Persuasion
15. Biases
16. Fallacies
17. Safeguards

We will consider each of these notions briefly (you may find it useful to come back to this list from time to time as you work through later chapters).

In today's rapidly changing world, much of what you learn in college will become outdated rather quickly. Many of your grandparents, and perhaps even your parents, had just one or two jobs during their adult life. But the swift pace of globalization and technological innovation make it likely that you will have a succession of jobs, perhaps in quite different fields, once you graduate. Hence it is important for you to *learn how to learn*, and a key part of this is learning how to think critically and carefully about new things.

Intellectual Responsibility

Adults are responsible for the things they do, and this includes thinking clearly and carefully about things that matter. This is hard work, and no one succeeds at it completely, but it is part of the price of being in charge of your life. In addition to thinking for ourselves, it is important to think well. This means basing our reasoning on how things *are*, rather than how we *wish* they were. It means being open to the possibility that we are mistaken, not allowing blind emotion to cloud our thought and putting in that extra bit of energy to try to get to the bottom of things.

This doesn't mean that we should constantly be questioning everything. Life is too short and busy for that. But in many cases, successful action requires planning and thought. It is also desirable to reflect on our most basic beliefs from time to time, and the college years are an ideal time for this. In the end, you may wind up with exactly the same views with which you began. But if you have thought about them carefully, they will be *your own views*, rather than someone else's, and you will be able to better support them with reasons.

Reasons

Good reasoning is said to be *cogent*. Cogent reasoning is based on evidence, rather than on wishful thinking or rash appeals to emotion. When we evaluate a claim, our first question should be: What are the *reasons* for thinking it is true? If someone tries to convince you to vote for them, or that abortion is immoral, or that God exists, you should ask: *Why*? What *reasons* are there for thinking that this claim is true?

Empirical Questions

Empirical questions are questions about the facts. They are not matters of opinion, and they are not best answered by guessing. They can only be answered by *checking to see* what the facts are. In the sciences, this may involve complex field studies or experiments, but in everyday life the process is often much easier, just looking is enough. As we will see in various places in the following chapters, answers that seem plausible to us often turn out to be wrong.

Inference and Argument

When we arrive at a new belief based on reasons, we are said to draw an **inference**. For example, if we learn that 80% of the people in a carefully conducted poll are going to vote for the Republican candidate for Congress, we might infer (or conclude) that the Republican will win. The results of the poll provide a reason to draw this conclusion. If we learn that three of the University of Oklahoma's starting five are out with the flu, we may infer (or conclude) that they will lose to Missouri. Our knowledge about the two teams, including the information about the ill players, gives us a *reason* to draw this conclusion.

Such reasoning adds up to an **argument**. Our reasons are the *premises* of the argument, and the new belief is the *conclusion*. For example, the inference about the election involves the following argument:

> Premise: 80% of the people surveyed plan to vote Republican
> Conclusion: The Republican candidate for Congress will win

In a good argument, the premises justify or support the conclusion; they provide good evidence for it.

An *argument* is a group of sentences; one conclusion and one or more premises. An *inference* is something we *do* when we draw a conclusion from premises. We will study arguments in detail in the next chapter.

Relevance

If an argument is to be any good, its premises must be *relevant* to its conclusion. Relevance involves a *relationship* between statements. So, a premise can be relevant to one claim while being irrelevant to other claims. It is *irrelevant* if it simply doesn't bear on the truth or falsity of the conclusion, if it's independent of it, or if it doesn't affect it one way or the other.

The premise that there is video evidence of one of the Tsarnaev brothers placing a package at one of the bomb sites *is* relevant to the conclusion that they were responsible for the Boston Marathon Bombing. By contrast, the fact that three people were killed and 264 injured in the bombing is *not* relevant to the claim that they are guilty (though once Dzhokhar was convicted it may have been relevant to questions about the appropriate penalty).

One of the major causes of bad reasoning is the use of arguments whose premises are irrelevant to their conclusions. It is very easy to make mistakes about the relevance of one claim to another. This is especially problematic when the premises "look relevant," even though a more careful examination shows that they aren't. Later we will also see that in some cases the acquisition of information of marginal relevance can lead us to dismiss information that is highly relevant to the problem at hand.

Going Beyond the Information Given

Often our inferences involve leaps from information we are confident about to a conclusion that is less certain. When a pollster conducts a survey to see how the next presidential election is likely to turn out, they ask a few thousand people how they will vote. They then use this information (about the people in the sample) as a *premise* and draw a *conclusion* about what all the voters will do. They have a body of information, what the voters polled say they will do, and then move beyond this to a conclusion about what voters in general will do.

Our inferences frequently take us beyond the information we already have. Figure 1.1 provides a visual representation of this. For example, we often use premises about how things were in the past to draw conclusions about the future. Your doctor relies on their past experience when diagnosing your current ailment, and they prescribe a treatment based on what worked best in past cases. An experienced cook knows a lot about what goes into a balanced dish and makes choices at the market that they conclude would go well together.

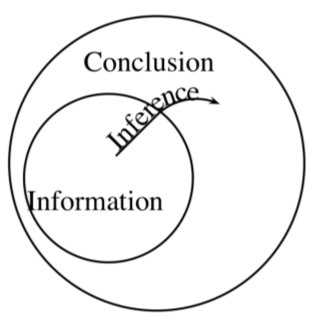


Figure 1.1: Going Beyond the Information Given

We also go beyond the information at hand in our personal lives. In the past, people we know have behaved in certain ways, and we frequently conclude that they will behave similarly in the future. Sally has always kept her word, so you believe that if you confide in her she probably won't tell anyone; Hank, on the other hand, is a different story. Again, in the past Wilbur had bad experiences going out with people he met in bars, so he concludes that this isn't a good way for him to meet people and looks around for alternatives.

When we draw a conclusion that goes beyond the information we have, there is always a risk that we'll be wrong. But if we use certain strategies, we can increase the likelihood that we will be right. In some cases, we can use numbers to measure just how likely this will be. This means that in the chapters on probability you will have to manipulate just a few fractions, though nothing more than what you did in Algebra I in high school.

Inferences that go beyond the information that we have are pervasive; indeed, in Part III we will see that even perception and memory often go beyond the information in much the way that many inferences do. When our inference carries us beyond information, we are sure about, we always run the risk of being wrong, but we will discover some strategies that will reduce this risk.

The Importance of Context

Reasoning, inference, and decision making never occur in a vacuum. We will see over and over again that the **context** or **situation** in which we think about things can strongly influence the *ways* in which we think about them. Indeed, it even affects how we perceive and remember things. Furthermore, our reasoning is sometimes faulty because we underestimate the importance of context. We will see that this is especially true when we are trying to understand the behavior of other people.

Explanation and Understanding

Explanation reflex: we have a strong need to understand and make sense of the world around us

We are constantly trying to make sense of things. We need to *explain* and *understand* the world around us. Almost every time we ask *why* something happened or *how* something works, we are seeking an explanation.

Learning about things and understanding how they work is often rewarding in and of itself, and it is vital if we are to deal successfully with the world around us. If we understand how things work, we will be able to make more accurate predictions about their behavior, and this will make it easier for us to influence how situations will turn out. If you understand how an automobile engine works, you will be in a much better position to fix it the next time it breaks down. If you understand basic principles of nutrition, you will be in a better position to lose weight and keep it off.

We are constantly seeking explanations in our daily lives. The computer worked yesterday; everything seems the same today, so what explains the fact that it won't boot up now? We are particularly concerned to understand the behavior of other people. *Why* did Bret Kavanaugh lie in his confirmation hearing for the Supreme Court about his past alcohol consumption? *Why* did the people in the Heaven's Gate cult so happily die by suicide? *What* was Ben Affleck thinking when he got that dragon tattooed on his back? Such questions also arise closer to home. "*Why* did Sally give Wilbur that look when he said they should go out again; *what* did she mean by it?" In fact, we often have occasion to wonder why we do some of the things that we do; "*Why* in the world did I ever say such an idiotic thing?" We are always looking for reasons, regularities and patterns in the phenomena around us. Much reasoning involves attempts to explain things, and sometimes leads us to see patterns that are not really there, or to accept overly simplified explanations, just to have the feeling that we understand what is going on.

For example, some things really do happen by coincidence. But it can be tempting to seek an explanation for them, for example, to adopt some superstition to account for things that just happened by chance. Again, people who like conspiracy theories want simple, pat explanations for why things are going badly for them. When we later learn what really happened in such cases (like the Watergate cover up), we often find less subtle and intricate conspiracy than we imagined, and more bungling and accident. But a conspiracy would offer such a nice simple explanation of things. So, one goal in later chapters will be to devise good explanations while avoiding bad ones.

Prediction

We use reasoning to **predict** what will happen. If we tighten the bolts, the garden gate will probably last for another year. If you tell Sam what you really think about the ghastly color of his new car, he'll go ballistic. When we make predictions, we use the information that seems *relevant* to us (e.g., information about Sam and his short temper) and draw an *inference* about what *will* happen. We will see that there are common patterns of errors that can arise in this process.

Testing

Our beliefs are much more likely to be true if they are *based on evidence*. It isn't enough for a scientist to just propose a new theory. The theory must be **tested**, and it needs to survive stringent tests. We typically test a theory by using it to make a prediction, and we then see if the prediction comes true. If it does, that provides some (though by no means conclusive) support for the theory; if it does not, the theory is in trouble. For example, the germ theory of disease was only accepted once it had been used to make a variety of successful predictions, e.g., once vaccines were shown to be effective.

Science works as well as it does because it is responsive to evidence in this way. And our views in daily life will also be more likely to be true if we test them. We will see, however, that most of us aren't very good at this.

Feedback

Testing our ideas is one way of getting **feedback**. Without feedback telling us how accurate our reasoning has been, we won't be able to learn from our mistakes. Feedback is often painful; we learn that we didn't do as well as we had thought or hoped—maybe we didn't do very well at all. But reasoning, like so much else, involves trial and error, and unless you know what the errors are, you won't do any better the next time around. So, if we want to improve our ability to reason and make judgments, we must seek feedback.

We often overlook the importance of feedback. For example, people who conduct job interviews may have a good deal of experience. Even so, they typically receive limited feedback on their hiring abilities. Why? Because they do get feedback about the quality of the people that they hire, but they rarely get feedback on the quality of the people they reject.

Emotions and Needs

Emotions are a central part of our lives, and they often play a quite legitimate role in our thinking. Intense emotions, however, can lead to poor reasoning. If we are extremely frightened or extremely angry, we aren't likely to think very clearly. Less obviously, emotions often provide an *incentive* to think badly. For example, the desire to avoid unpleasant facts about ourselves or the world can lead to wishful thinking and to various self-serving biases in our thoughts. We cannot be effective thinkers if we won't face obvious facts, or if we seriously distort them. Good thinking involves reasoning, not rationalization; it is based on what we have *good reasons* to think is true, not on what we would *like* to be true. Throughout this course, we will see how desires, emotions, and moods can impair clear thinking, and we will discuss ways to minimize their effect.

Quick Fixes

We encounter many difficult problems in today's world. The rise in terrorism, racism and racial tensions, the growing sense that jobs are not secure, and the increasing pollution of the environment all present huge challenges. On a more personal level, the desire to save a marriage, quit smoking, or make more money also present challenges. In such cases, genuine solutions are likely to require a great deal of time, effort, or money (or, often enough, all three), and in some cases, it isn't even clear where to begin.

The solutions to problems like these often require us to do things we don't want to do. Most of us don't want to spend a lot of our own money to solve the problems of the world, or to adopt a new lifestyle, even though it's healthier. So, it is not surprising that people who promise us an easier solution—a quick fix—will always find an audience. A **quick fix** is something that is offered as a fast and easy solution to a complex problem. The human tendency toward wishful thinking is one reason why claims by those who offer a quick fix are often accepted, even when there is little *evidence* in their favor. We will find that hopes for a quick fix are responsible for a good deal of careless reasoning.

Persuasion

We often try to **persuade** others to accept our view or position. People in the "persuasion professions" (like advertising, politics, and charity work) do this for a living, but we all do it some of the time. You might want to convince someone to go out with you, or to marry you, or to give you a divorce. There are many different (and often subtle) techniques for persuading people. Some involve offering them reasons; others rely on manipulations. We have noted that people prefer having bad reasons to no reasons, and so manipulation often works best if it is disguised to look like an argument. We want to think that reasons and arguments can be given to support our views, even if those arguments aren't very good. As a result, one very effective way of persuading people is to appeal to their emotions (e.g., their self-interest or their fears) but to dress the appeal up as an argument that doesn't appear to appeal to their feelings. We will encounter various techniques for persuasion throughout the course. Some involve good arguments. Some (called fallacies) masquerade as good arguments (when they really aren't). We will also examine various non-rational ways of persuading people. If we are aware of these, we will be less likely to be drawn in by them.

Biases

Biases are systematic tendencies to reason badly. We will study several biases in the following chapters. All of us are vulnerable to biases; but understanding how they work and seeing how pervasive they are will help us to minimize their influence in our own thinking and to spot their results in the thinking of others.

Fallacies

Bad reasoning is said to be **fallacious**. If our reasoning is biased, we are likely to commit fallacies. In Part Four of the course we will study several common fallacies.

Safeguards

Throughout the course, we will learn various safeguards for counteracting common biases in thought and avoiding fallacies.

1.2 A Role for Reason

Many important issues seem very difficult to settle. We may wonder whether any observations or research or arguments could show that medical aid in dying, abortion, capital punishment, a flat income tax, or the use of marijuana are right (or wrong, as the case may be). There are three ways to avoid wrestling with such difficult issues.

1. We can simply refuse to think about such questions at all.
2. We can embrace some view that furnishes quick and simple answers to these questions.
3. We can choose faith, rather than reason, as our avenue to answering these questions.
4. We can decide that such questions cannot be answered, on the grounds that beliefs about things like morality and religion are simply subjective.

We will consider these in turn.

I Don't Want to Think About It

If we adopt the first option, simply refusing to think about difficult topics, we drift through life like robots. This isn't a good way to live; one way to see this is to ask yourself whether you want to raise your children so that they turn out this way. Moreover, difficult decisions sometimes must be made, and it is a good thing for us to have a voice in those decisions that affect us. Finally, there are cases where we simply can't avoid making a hard decision, cases where tuning out and doing nothing have terrible consequences.

Dogmatism: The True Believer

The dogmatist is a true believer in some theory or doctrine. The key feature of true believers is not *what* they believe, but *how* they believe it. True believers are not open minded; they wouldn't let anything count as evidence against their beliefs. True believers' views provide a set of principles and categories, and they interpret all evidence in terms of them.

It is possible to be dogmatic about all sorts of things. Countless people have been dogmatic about their political views. Many Marxists, Nazis, and others were so certain of their views that they were willing to murder millions of people to translate their theory into practice. One can also be dogmatic about religious views. True believers tend to see things as all black or all white, and so they often think that most questions have simple answers. They are often uncompromising, and sometimes feel that those who disagree with them are not just wrong, but evil – enemies that must be conquered. Sometimes the resistance to the enemy is peaceful, but history shows that it can also be very bloody.

Faith

Some beliefs that are not based on reason and evidence are based on *faith*. Faith may have its place, but we need to be cautious. Since faith only comes into play when *we stop engaging with reason and arguments*, it can be applied equally to any position on any issue, and even to opposing sides of the same issue. The existence of aliens, life beginning at conception, getting an A in your critical thinking class – faith can be used to justify anything. While faith can be very important to people, we should remember that the strength or intensity of a person's faith has *no bearing* on the likelihood that the belief is true. The faith of those who truly believe that they belong to the master race can be just as strong as the faith of the most devout theist.

Relativism: Who is to Say?

In the face of such difficulties, some people adopt the view that values are subjective. It's "all relative;" and "who's to say" what's right and wrong? According to this view, issues of morality are like issues of etiquette. Many people agree that we shouldn't eat peas with a knife and, similarly, many agree that we should help those in need. But this is just an opinion shared by people in *our* culture or society. There are no objective facts about such matters, and other societies might, with equal legitimacy, adopt quite different views.

Relativism can seem appealing because it offers an easy answer to the difficult questions about right and wrong: we don't have to wrestle with them, because they are subjective, simply matters of opinion or taste. It can also seem an attractively tolerant view. Live and let live; we have our views, other groups have theirs, and since there is no fact of the matter about what is right, we should just leave each other alone.

It is possible to extend this relativistic stance to issues besides values. Indeed, an extreme relativist might claim that *everything* is relative, that there are no objective facts at all. But this more extreme version of relativism is incoherent. If everything is relative, then the very claim "everything is relative," is relative too. The claim "everything is relative" can be true for some people and false for others, and there is no fact of the matter about which group of people is correct. The claim undercuts itself.

Relativism about values doesn't collapse as easily as the more extreme relativism, but it sounds much better in theory than it does in practice. It is easy to say things like, "Well, that's a question about values, and those are just subjective," but very few of us would accept the following implications of this view:

1. Since there is no objective answer to questions about right and wrong, it's fine for your grade in this course to be determined by tossing the final exams down a flight of stairs and basing the grade for each exam on the distance it travels before landing.

2. Since everything is relative, it doesn't really matter what your children grow up believing.

3. Since values are subjective, who are we to say that flying airplanes into the Twin Towers of the World Trade Center is wrong?

4. Since values are relative, varying from one culture to another, who is to say that the Nazis were wrong to kill millions of Jews? It might be wrong-for-us, but it was right-for-them.

Tolerance and Open-mindedness

Relativism may sound like a nice, tolerant view, but it really isn't. The claim that we should tolerate others is itself a claim about values, and it cannot be defended by the claim that there really are no (objective) values. Worse, the consistent relativist must grant that intolerant societies (like Nazi Germany) are no more wrong about things than any other society. In the end, according to the relativist, it's just a matter of taste or opinion whether tolerance is a good thing or not.

The claim that there are objective truths does not mean that we have cornered the market on them. In some cases, the truth may be unknown, and in some cases other cultures might be much nearer the mark than we are. But relativism wouldn't allow this. If others can't be wrong, then they also can't be right, and so there really isn't any sense in which we can learn from them.

Fallibility: Commitment with an Open Mind

Most people are neither full-fledged true believers or full-fledged relativists. There are various intermediate positions, but one that fits especially well with a commitment to free, independent, critical reasoning is called *fallibilism*. The fallibilist believes that virtually all our views are fallible –

they could turn out to be false. But this *does not* mean that all our beliefs are equally well supported or equally good. A fallibilist acts on the *best* reasons and evidence they can get, while remaining open minded and willing to change their views if new evidence or arguments require doing so. This often means living with uncertainty, but that is just the human condition.

A free society that is open to dissent makes critical reasoning much easier. In a society where open discussion is allowed, different viewpoints can be aired. Without free expression, the scope of our thoughts will be limited; we will be exposed to fewer novel ideas, and our sense of the range of possibilities will be constricted. Since no one has cornered the market on truth, we should beware of those who would set themselves up as censors to decide what the rest of us can say and hear.

1.3 Improving Reasoning

Critical reasoning is a *skill*, and like all skills it requires active involvement. As you read this book, you will learn how to use various conceptual tools (e.g., logical and probability rules, various rules of thumb, and diagrams) that will help you reason better. But as with all skills, you can only learn by practice. If you just passively read the chapters or absorb lectures you might learn some vocabulary words, but you won't actually develop critical reasoning skills. You can only master these tools by using them in a variety of contexts (including outside the classroom). There are no foolproof rules that will always lead to good reasoning, but there are three things that will help improve your thinking:

Reasoning is a *skill*

1. Be aware of the most common ways in which reasoning can go wrong; this will help you guard against them in your own thinking and spot them in the thinking of others.

2. Use rules of thumb, called *heuristics* (discussed later in the course); this will make it easier for you to reason well.

3. Try to apply the tools you learn in the course outside the classroom.

The third step is the hardest, but it is vital. Many of our actions result from habit, and our habits of relying on past views and acting without really thinking are a chief cause of defective reasoning. Even once we master the material in this course, it is easy to lapse back into auto pilot once we leave the classroom. This is why it is imperative to develop good heuristics. If we consistently and consciously apply our safeguards outside of the classroom, many of them will become rote, and this will improve our auto pilot. Even so, in the midst of our busy lives we will be prone to error, and this can only be avoided if stop and think things through. This will not be easy, but that is what we must do if we are going to think more carefully about the things that matter to us most.

1.4 Chapter Exercises

1. Suppose that you had been adopted at birth by a family very different from your own, and that you had been raised in a very different subculture, or even in a very different country.

    1. Do you think that your political views would have been different? If not, why not? If so, how? Give two concrete examples of beliefs you find important in your own life that you might not have had.

    2. Do you think that your views about right and wrong would have been different? If not, why not? If so, how? Give two concrete examples of beliefs you find important in your own life that you might not have had.

    3. Do you think that your religious beliefs would have been different? If not, why not? If so, how? Give two concrete examples of beliefs you find important in your own life that you might not have had.

2. Give an example of a view you once thought was obviously true, but which you now think might be false. What led you to change your mind?

3. Give an example of a view you once thought was obviously false, but which you now think might be true. What led you to change your mind?

4. Give an example of a view you once thought had a definite right answer, but about which you now think you must reserve judgment. What led you to change your mind?

Part II

Reasons and Arguments

Part II. Reasons and Arguments

An *argument* is a claim that is backed by reasons. In Chapter 2, we'll study the nature of arguments, learn ways to identify them in their natural habitat, and introduce two key notions, deductive validity and inductive strength.

In Chapter 3, we'll learn about one very important kind of sentence – the conditional. Conditionals are *iffy*; they tell us that *if* one thing is true, *then* something else will be true as well. We'll also learn about necessary and sufficient conditions, and study four very important kinds of conditional arguments.

Chapter 2

Arguments

Overview: An argument is a claim that is backed by reasons. In this chapter, we'll study the nature of arguments, learn ways to identify them in their natural habitat, and encounter two key concepts, deductive validity and inductive strength.

Contents

2.1 Arguments

2.1.1 Inferences and Arguments

We draw an *inference* when we make a judgment based on some evidence, assumptions, or reasons. For instance, you learn that 87% of the people in a carefully conducted poll plan to vote for the Republican candidate for Congress. So, you infer (or conclude) that the Republican will win. The results of the poll provide a *reason* to draw this conclusion. Inference is an activity or process, something we do when we draw a conclusion from assumptions or premises.

By contrast, *arguments* (as we will use the term) are not processes but groups of sentences. Still, we can often study and evaluate inferences by looking at the argument patterns they involve. You learn that 87% of voters plan to vote Republican and conclude that the Republican candidate will win. This inference or reasoning follows the contours of an argument. Our reasons are the *premises* of the argument, and the new belief is the *conclusion*. Thus, our inference about the election involves the following argument:

Argument:
1. One or more Premises
2. One Conclusion

> Premise*:* 80% of people surveyed plan to vote Republican.
> Conclusion*:* The Republican congressional candidate will win.

In a good argument, the premises justify or support the conclusion; they provide good evidence for it.

An **argument** consists of two things:

1. a group of one or more sentences – the **premises**
2. one further sentence – the **conclusion**

Any time someone gives reasons to support a claim, they are giving an argument. Their argument *makes a claim*; this claim is its conclusion. The premises are intended to provide reasons (justification, support, evidence) for the conclusion. Some arguments are good and some aren't. In a good argument, the premises really do provide a good reason to think that the conclusion is true. Sometimes we also call premises reasons, or assumptions.

The sentences that make up an argument must all be ones that can be either true or false. So, an argument consists of declarative (or indicative) sentences (rather than commands or questions). In everyday life, we often think of an argument as a dispute or disagreement in which people shout at each other. But for purposes of critical reasoning, an argument is just a group of declarative sentences: one of them is the **conclusion**; the rest are **premises**.

2.2 Uses of Arguments

Arguments can be used for various purposes. You will understand the different functions of arguments better once you have analyzed some examples, but we will mention three of the main functions of arguments here.

2.2.1 Reasoning

We often use arguments when we are engaged in *problem solving* or *deliberation*. We reason about what would happen if we did certain things, or if certain events occurred. In such situations, we are not trying to justify a particular claim. We are instead interested in what would follow if certain things *were* true. This is sometimes called ‘what-if reasoning’. What, for example, would follow if you spend $3,500 on a car this fall? Well, let’s assume that you do. Let’s do a little calculation. That would only leave you $450. Not good. So, what would follow if you spend $2,800? You try out different possibilities and reason about their consequences.

2.2.2 Persuasion

We often use arguments to try to convince or persuade someone that something is true. In such cases, we are trying to get someone to accept the conclusion of our argument by giving them reasons (premises) to believe it. Our audience may be huge (as with the viewers of a presidential debate, or the readers of an editorial in a large newspaper) or small (maybe just one other person – or even just oneself). But in each case, the aim is to make a definite claim and to *justify* it by giving reasons that support it.

2.2.3 Evaluation

Often, we need to *evaluate* other people’s arguments, and sometimes to *refute them*. Is their argument any good? And if it isn’t, it may be important to be able to say just where it goes wrong. In such cases, we need to reason critically to show that the premises of the argument do not adequately support its conclusion. Some of the inferences we draw are good and others are not. Some arguments are strong and others are weak. A chief goal of a book like this one is to help you separate good arguments from bad ones. This will be a goal throughout most of the book, but first we need to know how to identify arguments when we come across them.

2.3 Identifying Arguments in their Natural Habitat

The first step in deciding whether something that you read or hear is an argument is to determine whether it has a conclusion and (if so) what that conclusion is. Once you identify the conclusion, you can usually figure out the premises. So, you should *always begin by looking for the conclusion*.

2.3.1 Indicator Words

Some words are good indicators of a conclusion; the typical job of these words is to say, '*here comes the conclusion*'. To discover what these words are, consider a very simple argument:

> **Premise 1:** All humans are mortal.
> **Premise 2**: Socrates is a human.
> **Conclusion:** __________, Socrates is mortal.

The last sentence of this argument is its conclusion. To discover some conclusion indicators, just ask yourself what words could sensibly be placed in the blank before the last sentence (think about this and write down several before proceeding).

Some natural words and phrases to put in the blank are: 'therefore', 'hence', 'and so', 'thus', 'consequently', and 'it follows that'.

Sometimes the conclusion of an argument comes at the beginning, rather than at the end. In this case, any indicator words will come after the conclusion. To see how this works, we'll just rearrange our argument a bit.

> **Conclusion:** Socrates is mortal.
> **Premise 1:** __________ all humans are mortal [and]
> **Premise 2:** Socrates is human.

What words can sensibly go in this blank (write some down before proceeding)?

Some natural choices are 'because', 'for', and 'since'. These words usually say, '*here comes a premise*'.

Indicator words are a tool for identifying premises and conclusions

Conclusion Indicators: 'therefore', 'thus', 'so', 'hence', 'consequently', 'accordingly', 'entails that', 'implies that', 'we may conclude that', 'this establishes that', 'this gives us reason to suppose that', 'in short', . . .

Premise Indicators: 'because', 'for', 'since', 'after all', 'inasmuch as', 'in view of the fact that', 'in virtue of', 'here are the reasons', . . .

These lists are not exhaustive, but they include the key indicators. In most cases, our rules of thumb for identifying premises and conclusions, based on the occurrence of these indicator words, work well. But there are exceptions, so our guidelines are *never* a substitute for *thinking about the example yourself*.

If arguments came neatly packaged and labeled like the two we've just seen, things would be easy. But in real life, arguments often do not contain any indicator words at all. When this happens ask yourself: what is the other person trying to get me to believe? Once you figure this out, you'll have the conclusion, and then it should be relatively easy to locate the premises.

Sometimes in real life, things are even more unclear. Sometimes a premise of an argument isn't explicitly stated; other times the conclusion is missing. There are often good reasons why parts of the argument aren't stated. Sometimes they are obvious enough in the context that they "go without saying."

One or more *unstated premises* are common when the premises include information that is widely known, obvious, or easily figured out in the context. And an *unstated conclusion* often occurs when the conclusion is thought to follow so obviously from the premises that it would be insulting to your intelligence to spell it out for you.

2.4 Putting Arguments into Standard Form

Although real life arguments rarely come neatly packaged, it will make our task easier if we adopt a clear format for repackaging them. We will say that an argument is in *standard form* if it consists of a list of all the premises, followed by the conclusion. In an argument with two premises, it will take the following form:

1. All Oklahomans are Sooners.
2. Tom is an Oklahoman.

Conclusion: Tom is a Sooner.

The line above the conclusion makes it easy to identify the conclusion at a glance. If there are more than a couple of premises, it is often handy to number them, though in simpler cases it isn't necessary.

2.4.1 Arguments vs. Conditionals

One type of sentence, *conditionals*, are easily confused with arguments. Here is an example of a conditional sentence:

- If we had started to shelter-in-place once we learned about Covid-19, then fewer people would have died.

This is *not* an argument. It does not give reasons to support any claim. It doesn't advance any conclusion. It just says that if one thing is the case, then something else is too. But this is merely hypothetical. You could assert this, but then go on to add, correctly, that people were already dying before most states gave the order, and that once we started sheltering in place we began to flat the contagion curve. Statements that make hypothetical claims like this are called *conditionals*. Such statements are easily confused with arguments, but they do not contain premises or conclusions. So, they aren't arguments.

Compare the above sentence with:

- We started sheltering in place as soon as we learned about Covid-19. Therefore, very few people died.

This *is* an argument (as it stands, it's not a very good argument, but bad arguments are arguments too). It makes two *claims*, and neither is hypothetical at all. It says (falsely) that we started sheltering in place as soon as we learned about Covid-19. It also says (again, falsely) that few people died. The word 'therefore' is a conclusion indicator, and here it signals that the claim that few people died is the conclusion of the argument.

When you are trying to determine whether a passage contains an argument, ask yourself, "What is the other person's *point*; what are they trying to get me to believe?" "What, if anything, is being supported, and what is merely being asserted?" In real life, the conclusion will often come at the very end of an argument. But it can also occur at the beginning. It may even come in between various premises. It may also be the case that some of the material is extraneous filler that really isn't part of the argument at all.

Exercises on Identification of Arguments

For each of the passages below, label each as either 'Argument' or 'Not an Argument'.

Then, for each of the arguments, do the following:

- Circle the conclusion.
- Underline each premise.
- Enclose any extraneous material in parentheses.
- If any premises or conclusions are missing, fill them in.

For each of the non-arguments, explain why they're not arguments.

1. Hillsborough County has issued a safer-at-home order. My neighbor Brian keeps going out in his shaved ice truck. So, he is violating the order.

2. Although Trump did some terrible things, they don't rise to the level of impeachment.

3. As long as members of al-Qaeda are on the loose, we will be in danger.

4. The Zamori tribe will eventually die out, because they initiate their young by putting them to death at the age of four (George Carlin).

5. Akiva grew up in Oklahoma, so he knows what Oklahomans need most from a meteorologist (Channel 4).

6. The race is not always to the swift or the victory to the strong, but that's the way to bet (Dayman Runyan).

7. The ability to hold the breath is important in swimming, since it develops confidence and permits the practice of many swimming skills.

8. *Avengers: Endgame* is the highest grossing movie of all time. So, it must be a great film.

9. Intramural basketball started recently, so the fitness center will be crowded because lots of games will be going on.

10. Blessed are the meek: for they shall inherit the earth (New Testament).

11. Blessed are the meek, but they ain't gonna get rich (J. R. Ewing).

12. The prime numbers can't come to an end. If they did, we could multiply all the prime numbers together and add one, and this would give us a new number. But this new number would be prime, because it would leave a remainder of 1 when divided by any of the prime numbers.

13. The Iowa State Lottery has already contributed over 41 million dollars to Iowa's massive economic development push. The funds have been used all around the state: business incentives, cultural program, agricultural research, trade and export development, education. When you play the lottery, all of Iowa wins.

14. If you are sure, from the betting and the draw, that a player has three of a kind and you have two pairs, even aces over kings, you are a sucker to go for the full house, because the odds against buying that ace or king are prohibitive at 10.8 to 1.

15. Consciously or unconsciously, the reader is dissatisfied with being told only what is not; she wishes to be told what is. Hence, as a rule, it is better to express even a negative claim in positive form.

16. Somebody else will get AIDS, but not me.

17. You can't argue about right and wrong, because it's all a matter of opinion anyway. Who's to say what's right and wrong?

18. Shut the door—if you don't want the dog to get in.

19. If Osama bin Laden planned the attacks, we must track him down. And it's clear that he did. So, we've got to find him.

20. Mexican Coke is better than American Coke because it is made with cane sugar.

2.5 Deductive Validity

Once we determine that something is an argument, we can move on to identifying the type of argument it is. The taxonomy of arguments that we will explore over the next couple of chapters is going to be very useful. When we know what type of argument we are looking at, we are able to determine relatively quickly how to evaluate the success of the argument.

2.5.1 Definition of Deductive Validity

In this section, we will learn about deductive validity. It is easy to define this notion, but it is deceptively abstract and slippery. It takes practice to master it.

Validity: *If* all premises true, conclusion *must* be true

When the premises of an argument support its conclusion in the strongest possible way, we say that the argument is **deductively valid**. There are several different, but equivalent, ways to define deductive validity:

1. A deductively valid argument is one such that, *if* all its premises are true, its conclusion *must* be true.

2. A deductively valid argument is one such that it is *impossible* for its conclusion to be false when all its premises are true.

The most common mistake to make regarding validity is to think that this definition says more than it actually does. It does not say anything whatsoever about the premises (taken in isolation from the conclusion) or about the conclusion (taken in isolation from the premises). Deductive validity speaks only to the *relationship* between the premises and the conclusion. It says that a certain *combination* of the two, all true premises and a false conclusion, is impossible.

True premises in → True conclusion out

Deductively valid arguments are *truth preserving*; if all the premises are true, then the conclusion must be true as well. True premises in, true conclusion out. Since there is only one sort of validity, namely deductive validity, we will often speak simply of 'validity'.

Understanding Deductive Validity

If you spend a few minutes thinking about the following examples, you will begin to get a feeling for what validity really means. Suppose someone makes the following two claims, and that you believe they are true:

1. If it is raining, then the parking lot will be full.
2. It is raining.

Now ask yourself: what can we conclude from 1 and 2? The answer isn't difficult, but it is important to reflect on it.

3. The parking lot will be full.

Note that you do *not* need to know whether premises 1 and 2 are true to see that the claim that the lot will be full follows from them. It is this notion of *following from* that means that this argument is deductively valid.

Now ask yourself: is there any consistent, coherent story that we could imagine in which 1 and 2 were both true, but in which the claim that the lot is full was false? Try it. It can't be done. If you try it and begin to see that it's impossible, you are on your way to understanding deductive validity.

Here's a second example:

1. If Wilbur won the race, he would have called to brag about it.
2. But Wilbur hasn't called.

What follows from this? Is there any possible way that sentences 1 and 2 could both be true while at the same time the following sentence is false?

3. Wilbur did not win.

What about:

1. If a set is recursive, then it is recursively enumerable.
2. The set you mention is recursive.

What follows from this? Note that you don't even need to understand the words 'recursive' or 'enumerable', much less know whether these two sentences are true, to see that sentence 3 follows logically from them.

3. The set you mention is recursively enumerable.

By way of contrast, consider the following argument:

1. If Wilbur won the race, he would have called to brag about it.
2. Wilbur did call to brag.

If we know that 1 and 2 are both true, can we be sure the following sentence is true?

3. Wilbur won the race.

No, we can't be sure. In this case, it *is* possible for the two premises to be true while the conclusion is false. For example, Wilbur might be a compulsive liar who called to brag even though he came in last.

Validity: Less is More

As noted above, it is a very common mistake to think that the definition of deductive validity says *more* than it actually does. It *only* says what must be the case *if* all of the premises are true.

1. The definition does *not* require that either the premises or the conclusion of a valid argument be true.

2. The definition does *not* say anything about what happens if one or more of the premises are false. In particular, it does *not* say that if any of the premises are false, then the conclusion must be false.

3. The definition does *not* say anything about what happens if the conclusion is true. In particular, it does *not* say that if the conclusion is true, then the premises must be true.

The definition of validity only requires that the premises and conclusion be related in such a way that *if* the premises are (or had been) true, *then* the conclusion is (or would have been) true as well.

The definition of deductive validity is hypothetical; *if* all its premises are true, *then* the conclusion must be true as well. The '*if*' here is a big one. It's like the 'if' on the postcard you get that announces: "You will receive ten million dollars from the Publishers' Clearing House—if you hold the winning ticket." This does not mean that you do have the winning entry. And similarly, it does not follow from the definition of deductive validity that all the premises of each deductively valid argument are true.

There can be deductively valid arguments with:

1. False premises and a false conclusion.

2. False premises and a true conclusion.

3. All true premises and a true conclusion.

The only combination that *cannot* occur in a deductively valid argument is all true premises and a false conclusion. This can never happen, because, by definition, a deductively valid argument is one whose form makes it *impossible* for all its premises to be true *and* its conclusion false.

Invalid arguments can have any of these three combinations, plus the combination of all true premises and a false conclusion (which is the one combination that valid arguments cannot have).

2.5.2 Further Features of Deductive Validity

1. Deductive validity *does not come in degrees*. It is all or none.

2. In a deductively valid argument the *conclusion contains no new information*; there is no information in the conclusion that was not already contained in the premises. We won't worry about the second feature now, but it will become important when we turn to inductively strong arguments.

2.5.3 Soundness

An argument is *sound* just in case:

1. It is *deductively valid*, and

2. It has *all true premises*.

Soundness = Validity + all true premises

Once you master the concept of validity (which is tricky), soundness will be easy. The conclusion of a sound argument must be true. Why?

A Note on Terminology

- Only arguments can be valid or invalid; sentences or statements cannot.

- On the other hand, only statements or sentences can be true or false (have a truth value); arguments can be neither.

2.6 Method of Counterexample

We can use the *method of counterexample* to show that an argument is invalid. The method involves telling a consistent story in which all the premises of the argument are true, but the conclusion is false.

The idea behind the method is this. It is *impossible* for a deductively valid argument to have all true premises while having a false conclusion. A counterexample is a possible scenario in which the premises are true and the conclusion is false. So, it shows that it *is* possible for the argument to have all true premises and a false conclusion. And this proves that it is *deductively invalid*.

Counterexample: a consistent scenario in which all premises are true, but the conclusion is false

Consider the argument:

> 1. If Jones drove the getaway car, he's guilty of the robbery.
> 2. Jones did not drive the getaway car.
> So, Jones is not guilty of the robbery.

Counterexample: Suppose that Jones did not drive the getaway car, but he *was* one of the other robbers. In this case, both premises would be true and the conclusion would be false. This means the argument is invalid.

Now here is one for you to try:

> 1. If Musa overslept, he would have been late to work.
> 2. Musa was late to work.
>
> So, Musa did oversleep.

Can you construct a counterexample to show that this argument deductively invalid?

Exercises on Validity

1. What conclusions are obvious consequences of the following sets of premises? (The first one is worked for you, as an example)

    1. 1. If Ivan is from Texas, then Darius is from Alabama.
       2. Ivan is from Texas.
       So, Darius is from Alabama.

2. 1. If Ivan is from Texas, then Darius is from Florida.
   2. Darius is not from Florida.
   3. So…

3. 1. Either Sara is from Texas or she is from Florida.
   2. Sara is not from Florida.
   3. So…

2. Which of the following arguments are valid? In many cases, you won't know whether the premises are true or not, but in those cases where you do, say whether the argument is sound.

1. 1. All Republicans hate the poor.
   2. Marco Rubio is a Republican.
   So, Marco Rubio hates the poor.

2. 1. All Democrats cheat on their spouses.
   2. All men are Democrats.
   Therefore, all men cheat on their spouses.

3. 1. If my alarm breaks, I'm late to work.
   2. I was late to work.
   Therefore, my alarm broke.

4. 1. If my alarm breaks, I'm late to work.
   2. I was not late to work.
   Therefore, my alarm did not break.

5. 1. Many Fords run for years without any problems.
   2. My car is a Ford.
   Therefore, my car will run for years without any problems.

6. 1. Batman and Captain America can't both be the best superhero.
   2. Batman is best superhero.
   Therefore, Captain American isn't the best superhero.

7. 1. OU and OSU can't both win the Big 12 outright.
   2. OU will not win the Big 12 outright.
   Therefore, OSU will win the Big 12 outright.

8. 1. If we don't have free will, we can't be blamed for our actions.
   2. If we can't be blamed for our actions, we shouldn't be punished.
   Therefore, if we don't have free will, we shouldn't be punished.

9. 1. If Sam committed first degree murder, then he intended to kill Ivan.
   2. And he did intend to kill him (he admitted it in his testimony).
   So, Sam is guilty of murder in the first degree.

3. Use the method of counterexample to show that the following arguments could each have all true premises while having a false conclusion. If you succeed, this will prove that they are invalid.

   1. 1. Some politicians are honest.
      2. Will is a politician.
      So, Will is honest.

   2. 1. If Jennifer Lawrence is the U.S. President, then she is famous.
      2. Jennifer Lawrence is famous.
      So, Jennifer Lawrence is President.

   3. 1. Some ethics teachers are not honest people.
      So, some honest people are not ethics teachers.

   4. 1. Whenever Bill is home his car is in the garage.
      2. Bill's car is in the garage.
      So, Bill must be home.

4. Construct a valid argument with at least one false premise.

5. Construct a valid argument with a false conclusion.

6. Is it possible to construct a valid argument with all true premises and a false conclusion? If not, why not?

7. Describe the method of counterexample.

8. When it's properly employed, what does the method of counterexample show?

Answers to Selected Exercises

1. What conclusion are obvious consequences of the following sets of premises?

2. 1. If Ivan is from Texas, then Darius is from Florida.
   2. Darius is not from Florida.
   So, Ivan is not from Texas.

3. 1. Either Sara is from Texas or she is from Florida.
   2. Sara is not from Florida.
   So, Sara is from Texas.

2. You were asked which of these arguments were valid. Explanations are given below the relevant argument.

1. 1. All Republicans hate the poor.
   2. Marco Rubio is a Republican.
   So, Marco Rubio hates the poor.

Valid; but it is unsound because the first premise is false.

2. 1. All Democrats cheat on their spouses.
   2. All men are Democrats.
   So, all men cheat on their spouses.

Valid; but it is unsound because both premises are false.

3. 1. If my alarm breaks, I'll be late to work.
   2. I was late to work.
   Therefore, my alarm broke.

Invalid; it would be possible for both premises to be true and the conclusion false. This would happen if the two premises were both true, but I was late for some other reason, e.g., my car didn't start or it broke down on the way to work.

4. 1. If my alarm breaks, I'm late to work.
   2. I was not late to work.
   Therefore, my alarm did not break.

Valid; this one is harder. Drawing a picture will help. But don't worry a lot about it yet; We'll study arguments like this in Chapter 3.

5. 1. Many Fords run for years without any problems.
2. My car is a Ford.
Therefore, my car will run for years without any problems.

Invalid; the premises could be true but the conclusion false. This would be the case if my car were one of the exceptions, one of the few Fords that were lemons.

6. 1. OU and OSU can't both win the Big 12 outright.
2. OU will not win the Big 12 outright.
Therefore, OSU will win the Big 12 outright.

Invalid; the premises could both be true and the conclusion could still be false. This would be the case if any of the ten teams not from Oklahoma won. It would be the case, for example, if Nebraska won outright.

7. 1. If we don't have free will, we can't be blamed for our actions.
2. If we can't be blamed for our actions, we shouldn't be punished.
Therefore, if we don't have free will, we shouldn't be punished.

Valid; tracing the if-then statements shows that each leads to the other in a way that cannot be false. We'll learn more about these types of arguments in the next chapter.

8. 1. If Sam committed first degree murder, then he intended to kill Ivan.
2. And he did intend to kill him (he admitted it in his testimony).
So, Sam is guilty of murder in the first degree.

Invalid; the premises could both be true yet the conclusion false.

3. Use the method of counterexample to show that the following two arguments could each have all true premises while having a false conclusion. If you succeed, this will prove that they are invalid.

1. 1. Some politicians are honest.
2. Will is a politician.
So, Will is honest.

Here is one counterexample (there are many others). Imagine that Will is a politician who accepts bribes from his constituents. In this case, the premises are true, but the conclusion is false. This provides a counterexample that shows this argument is invalid.

5. Construct a valid argument with a false conclusion.

Both the arguments about Republicans and the argument about Democrats are valid (4). And each of them has at least one false premise, so they both also have a false conclusion (5).

6. Is it possible to construct a valid argument with all true premises and a false conclusion? If not, why not?

This is impossible. The *definition of validity* does not allow this possibility.

2.7 Inductive Arguments

We will study inductive arguments in detail in a later chapter, so we will just briefly consider them here. We talk about inductive arguments in terms of strength and weakness.

An argument is *inductively strong* just in case:

1. It is not deductively valid, and
2. If all its premises are true, then there is a *high probability* that its conclusion will be true as well.

Inductive strength: if premises all true, a high probability conclusion is true

The second item is the important one. The only point of the first item is to ensure that no argument is both deductively valid *and* inductively strong (this will make things easier for us in later chapters).

There are two important ways in which inductive strength differs from deductive validity:

1. Unlike deductive validity, inductive strength *comes in degrees*.
2. In a deductively valid argument, the conclusion does not contain any information that was not already present in the premises. By contrast, in an inductively strong argument, the *conclusion contains new information*.

A deductively valid argument with all true premises *must* have a true conclusion. By contrast, an inductively strong argument with true premises provides good, but not conclusive, grounds for its conclusion.

Since we have defined things such that inductively strong arguments are not deductively valid, we can think of arguments as arranged along a continuum of descending strength:

1. Deductively valid

2. Deductively invalid

    (a) Inductively strong

    (b) Inductively weak

    (c) Worthless

General and Particular

It's not unusual (particularly if you're trying to learn logic using YouTube) to see deductively valid arguments described as proceeding from the general to the specific, and inductively strong arguments proceeding from the specific to the general. This is not a good way to think about the two sorts of arguments, and notions of generality and specificity are completely irrelevant to the two notions. Here is a deductively valid argument that goes from more specific premises to a more general conclusion:

1. 3 is a prime number.
2. 5 is a prime number.

Therefore, all odd numbers between 2 and 6 are prime.

And here is an inductively strong argument that goes from a more general premise to a more specific conclusion.

1. All the crows observed thus far have been black.

Hence, the next crow to be observed will be black.

Deductively Valid and Inductively Strong Reasons

Sometimes it is more natural to speak of reasons, rather than arguments. A group of sentences provides deductively valid reasons for a conclusion just in case it is impossible for all of them to be true and the conclusion false. Valid reasons have this feature because there is no information in the conclusion that was not already contained in the reasons themselves.

Inductively strong reasons: A group of sentences provides inductively strong reasons for a conclusion just in case it is unlikely for all of them to be true and the conclusion false. If a group of inductively strong reasons for a conclusion are true, then there is a good chance that the conclusion will be true as well, but there is still some possibility that it will be false. Inductively strong reasons are not always truth preserving. There is an *inductive leap* from the reasons to the conclusion. Inductive support comes in varying degrees; the stronger the inductive reasons, the less risky the inductive leap.

2.8 Evaluating Arguments

We do much of our reasoning almost automatically, so it is easy to overlook how frequently we engage in it. Any time someone gives reasons to support a claim, they are giving an argument. Much of this course is devoted to the evaluation of arguments, and we will find three key issues that surface over and over again.

Once you have identified an argument, you must ask three questions.

1. Are the premises true (or at least plausible)?

2. Has any relevant information been omitted from the premises?

3. Do the premises support the conclusion?

Are the premises plausible? If the issue is whether you should believe the conclusion, then the first question to ask is whether the premises are plausible. In this context, nothing can salvage an argument if one or more of its premises are false. If the premises of an argument—even just one of them—are false, we have no reason to accept its conclusion.

Sometimes we can't be certain whether the premises of an argument are true, and we must settle for plausibility instead. But the more plausible the premises, the better. If you are simply doing *what-if* reasoning, the plausibility of the premises may not matter; you are just asking what would be true *if* the premises were true, and in this context, it doesn't matter whether they are actually true.

Has relevant information been omitted? When it comes to reasoning, ignorance is not bliss; what you don't know *can* hurt you. An argument may have all true premises and yet omit information that is relevant to our evaluation of it. Suppose Wilbur tells you that Jack would be a good person to buy a used car from because Jack knows a lot about cars and doesn't use high-pressure techniques. These premises may be true, but if Wilbur fails to mention that Jack has done time for fraud, you are in trouble if you accept the conclusion of his argument.

We can’t usually get the whole truth and nothing but the truth; examining all the evidence that might conceivably be relevant would be an endless task. But we should never neglect evidence that we know about, or evidence that seems like it might bear on the issue in a major way.

In many cases, we need a good deal of background knowledge to answer the first two questions. If the argument is about football, we need to know something about football; if it is about cooking, we need to know something about cooking. Logic can’t supply this information, but we will discuss various factors, e.g., evaluation of sources, that can help us answer the first two questions when they arise in real life. We will see that this question doesn’t arise when we are evaluating a deductively valid argument.

How strongly, if at all, do the premises support the conclusion? This is another way of asking whether the argument is deductively valid or inductively strong and, if it’s the latter, just how strong it is.

To master various key concepts, we will sometimes focus on one of these questions without worrying about the others. But when we put things all together at the end, when you are evaluating reasoning in the real world, all three questions are important.

2.9 Chapter Exercises

The following passages contain arguments. For each one, do the following:

(a) Say whether the argument is valid.
(b) If it isn’t valid, say whether it is inductively strong.
(c) If it is inductively weak, say why.
(d) Give a careful analysis of the overall strength of the argument.

1. Over 96% of all Fords sold in 2018 had to go back into the shop in the two-year period from 2019 to 2020. Wilbur bought his Ford in 2018. So, it was supposed to go back into the shop.

2. Wilbur’s last three boyfriends have cheated on him. Wilbur just started dating Carl. So, Wilbur should expect Carl to cheat on him.

3. Only the combined efforts of Godzilla, Mothra and Rhodan could defeat King Ghidorah. King Ghidorah was defeated. So, Godzilla, Mothra and Rhodan joined forces.

4. Mariah Carey has 18 number one songs on Billboard’s Hot 100. Her closest competitors are Rihanna with 16 and Madonna with 12. So, Mariah Carey is the most successful female recording artist of all time.

5. Nothing is better than Thai food. Imani thinks tacos are better. So, Imani is wrong.

Chapter 3

Conditionals and Conditional Arguments

Overview: In this chapter, we will learn about one very important kind of sentence, *conditionals*, and the central role they play in reasoning. Conditionals are iffy; they tell us that if one thing is true, then something else will be true as well. We will also learn about necessary and sufficient conditions and study four very important kinds of conditional arguments. Putting this all together, we will come to a deeper understanding of deductive arguments.

Contents

3.1 Conditionals and their Parts

A **conditional** is a sentence that says something will be true, *provided* that something else is true. All these sentences are conditionals:

1. If it is raining, then the lot is full.
2. If Tom Brady lied about Deflategate, then he should be tried for perjury.
3. If it doesn’t fit, you must acquit.
4. If Wilbur had nothing to hide, he wouldn’t be so sneaky.
5. If he builds it, they will come.
6. If you bomb the final, you’ll fail the course.

7. If a number is divisible by 2, then it isn't a prime number.
8. If you win the Publishers Clearing House Sweepstakes, then you will be rich.

A conditional is a *compound* sentence that consists of two shorter sentences.

When the sentence has an '*if–then*' format:

1. The sentence between the '*if*' and the '*then*' is called the **antecedent.**

2. The sentence after the '*then*' is called the **consequent.**

The antecedent is the part that comes before (think about poker, where you 'ante up' before the hand begins).

The antecedent of sentence 1. is:

- It is raining.

And the consequent is:

- The lot is full.

The words '*if*' and '*then*' are not part of either the antecedent or the consequent. They are just connecting words that glue the two simpler sentences together to form the conditional.

What conditionals do not say

A conditional is *iffy*. It does not claim that its antecedent *is* true or that its consequent *is* true. It is *hypothetical*: *if* the antecedent is true, *then* the consequent will be true too. As we noted above, it is true that *if* you win the Publishers Clearing House Sweepstakes, then you will be rich. But unfortunately, this does not mean that you will win the sweepstakes, or that you will be rich.

Our first example of a conditional:

1. If it is raining, then the lot is full.

tells us what will happen *if* it is raining (the lot will be full). The biggest trouble people have with conditionals is thinking that they say *more* than they do.

1. The conditional does *not* say anything about what happens if the lot is full. (In particular, it does not say that if the lot is full, it will be raining.)

2. The conditional does not say anything about what happens if it is not raining. (In particular, it does not say that if it's not raining then the lot isn't full.)

Our definition of validity is naturally stated as a conditional: if all the premises are true, then the conclusion must be true as well.

3.1.1 Alternative Ways to State Conditionals

There are various ways to state conditionals, and some of them require thought. Ask yourself: could we *rephrase* a sentence as an '*if–then*' claim without changing its meaning? If we can, then the sentence is a conditional.

The following sentences all have the same meaning, so we count all of them as conditionals.

1. If it is raining, then the lot is full.
2. If it is raining, the lot is full.
3. When it's raining, the lot is full.
4. The lot is full, if it's raining.
5. It rains, and the lot is full.
6. Should it rain, the lot will be full.
7. The lot is full, provided that it's raining.

Two Notes on Terminology

1. All arguments have premises and a conclusion. But no argument has an antecedent or a consequent.

2. All conditionals have antecedents and consequents. But no conditional has a premise or a conclusion.

Exercises on Conditionals

Determine whether each of the following sentences is a conditional. If it is a conditional, draw a line under its antecedent and circle its consequent. If it's not a conditional, write 'not a conditional.'

Example: If one more person tells me I must watch *Game of Thrones*, then I'm going to scream.

(a.) This sentence is a conditional.
(b.) One more person tells me I must watch Game of Thrones (antecedent)
(c.) I'm going to scream (consequent)

Note: the words 'if' and 'then' are not part of either the antecedent or the consequent, so should not be underlined or circled.

1. If we run out of gas out here in the desert, we're as good as dead.

2. If you have the time, we have the beer.

3. If Marlena goes to the movies, Ivan will stay home and watch the kids.

4. Marlena will stay home and watch the kids, if Ivan goes to the movies.

5. Ivan will stay home and watch the kids, provided that Marlena calls him on time.

6. When it rains, it pours.

7. Should OU win the rest of their games, they'll win the Big 12 Conference.

8. Give peace a chance.

9. Give me a place to stand, and a tall frosty Bud Light.

10. Give me a place to stand, and I'll move the world.

11. Ivan went to the movies and Marlena watched the kids.

12. Wilbur will fix your car only if you pay him what you owe.

13. Wilbur will fix your car if only you pay him what you owe.

14. If wishes were trees the trees would be falling.

15. If you want to hire Jim Rockford it'll cost you $200 a day plus expenses.

Answers to Selected Exercises on Conditionals

1. If we run out of gas out here in the desert, we're as good as dead.

    (a) This is a conditional.
    (b) Antecedent: We do run out of gas in the desert
    (c) Consequent: We're as good as dead

2. If you have the time, we have the beer.

    (a) This is a conditional.
    (b) Antecedent: You have the time
    (c) Consequent: We have the beer

4. Marlena stayed home and watched the kids, if Ivan went to the movies.

    (a) This is a conditional.
    (b) Antecedent: Ivan went to the movies
    (c) Consequent: Marlena stayed home and watched the kids

6. When it rains, it pours.

    (a) This is a conditional.
    (b) Antecedent: It rains
    (c) Consequent: It pours

8. Give peace a chance.

    (a) Not a conditional.

9. Give me a place to stand, and a tall frosty Bud Light.

    (a) This is not a conditional. In fact, it's not even a declarative sentence.

10. Give me a place to stand, and I'll move the world.

    (a) Although this looks a lot like the previous sentence, this is a conditional. You must focus on what it means. The key is to see that it says the same thing as "If you give me a place to stand, then I'll move the world."
    (b) Antecedent: You give (gave) me a place to stand
    (c) Consequent: I'll move the world

11. Ivan went to the movies and Marlena watched the kids.

    Not a conditional.

12. Wilbur will fix your car only if you pay him what you owe.

    (a) This is a conditional.
    (b) Antecedent: Wilbur will fix your car
    (c) Consequent: You pay him what you owe

13. Wilbur will fix your car if only you pay him what you owe.

    (a) This is a conditional.
    (b) Antecedent: You pay him what you owe
    (c) Consequent: Wilbur will fix your car. [Note the difference between this and the preceding problem]

2. The conditional does *not* say anything about what happens if it is not raining. (In particular, it does not say that if it's not raining then the lot isn't full.)

Our definition of validity is naturally stated as a conditional: *if* all the premises are true, *then* the conclusion must be true as well.

3.2 Necessary and Sufficient Conditions

Sufficient condition: enough, a guarantee

One sentence is a **sufficient condition** for another sentence if the truth of the first would guarantee the truth of the second. The truth of the first is *enough* – all you need, *sufficient* – to ensure the truth of the second. Having your head cut off is a sufficient condition for being dead. There are many other ways to die, but decapitation is enough to ensure it.

Necessary condition: a condition that must be met

And one sentence is a **necessary condition** for a second if the truth of the second sentence is required—is needed, is *necessary*—for the truth of the first sentence. For example, paying your tuition fees is a necessary condition for graduating. If you are to graduate, you must pay your fees.

In the previous example, paying your fees is necessary, but not sufficient, for graduating. It is necessary, because no one graduates without paying their fees, but it is not sufficient because there are other things you must also do (like pass the required number of credit hours).

Requirements and prerequisites are necessary conditions

Requirements and prerequisites are usually necessary conditions. They are things that you must do to achieve a certain goal, but by themselves they do not guarantee success. For example, studying is a necessary condition for passing this course (you must study to pass it), and practicing is a necessary condition for becoming a good basketball player (you must practice). But neither, alone, is sufficient.

How does all this relate to conditionals?

1. The **antecedent** of a conditional is a **sufficient** condition for the **consequent**.

2. The **consequent** of a conditional is a **necessary** condition for the **antecedent**.

We have treated sentences as necessary and sufficient conditions, but it is also useful to think of properties in this way. For example, the property, or characteristic, of being a dog is sufficient for that of being an animal. Having the first property is enough to insure having the second. And the property or characteristic of being an animal is necessary for that of being a dog. Nothing is a dog unless it is an animal.

The antecedent of a conditional is a sufficient condition for the consequent.

The consequent of a conditional is a necessary condition for the antecedent.

Only sentences can serve as antecedents or consequents of conditionals, but we can often turn talk about properties into talk about sentences. For example, instead of saying that the property of being a dog is sufficient for the property of being an animal, we could say that if something is a dog then it is an animal. This involves subtleties you will learn about if you take a course in formal logic, but they aren't relevant here. When we do this, antecedents are still sufficient conditions for their consequents, and consequents are still necessary conditions for their antecedents. The best way to understand these concepts is to work through the following exercises on necessary and sufficient conditions.

Exercises on Necessary and Sufficient Conditions

1. "If you get a cholera shot, then you'll be safe in the villages."

Here the claim is that getting a cholera shot is a ___________condition for being safe in the villages.

2. "You must get a cholera shot, if you're going to get a visa to India."

Here the claim is that getting a cholera shot is a ___________ condition for getting a visa to India.

3. “Lots of people with rich friends do not succeed in national politics. But no one succeeds in national politics without rich friends.”

   Here the claim is that having rich friends is a ___________ condition (but not a___________ condition) for succeeding in national politics.

4. “Show me a good loser, and I’ll show you a loser.”

   Here the claim is that being a good loser is a ___________ condition for being a loser.

5. “Someone is a bachelor if, and only if, they are an unmarried male.”

   Here the claim is that being an unmarried male is a ___________condition for being a bachelor.

6. “OU will go to a Bowl game only if they have a winning season.”

   Here the claim is that having a winning season is a ___________ condition for going to a Bowl game.

7. “OU won’t go to a Bowl game unless they have a winning season.”

   Here the claim is that having a winning season is a ___________ condition for going to a Bowl game.

8. “. . . liberal democracy has arisen only in nations that are market-oriented, not in all of them, but only in them” [Charles E. Lindblom, Politics and Markets].

   Here the claim is that a society’s being market oriented is a ___________ (but not a ___________ condition) for liberal democracy.

9. “If wishes were horses, then beggars would ride.”

   Here the claim is that wishes being horses is a ___________ condition for beggars to ride.

10. “Hard work guarantees success.”

    Here the claim is that working hard is a ___________ condition for being successful.

11. "The defendant is only guilty of first-degree murder if she planned the crime out beforehand."

    Here the claim is that planning the crime out beforehand is a ___________ condition for being guilty of first-degree murder.

12. "I'm not about to run in this heat."

    Here the claim is that the heat is a ___________ condition for not running.

13. "Show me someone who likes your cooking, and I'll show you someone who needs a tongue transplant."

    Here the claim is that liking your cooking is a ___________ condition for needing to get their tongue replaced.

14. "A contract is binding only when there is no fraud."

    Here the claim is that the absence of fraud is a ___________ condition for a contract to be binding.

15. "Nothing ventured, nothing gained."

    Here the claim is that taking a chance is a ___________ condition for gaining something.

16. "You must pass the final to pass this course."

    Here the claim is that passing the final is a___________ condition for passing the course.

17. "You will pass this course only if you pass the final."

    Here the claim is that passing the final is a ___________ condition for passing the course.

18. "You will pass this course if only you pass the final."

    Here the claim is that passing the final is a ___________ condition for passing the course. (This sentence is tricky; compare this sentence to the one right above it.)

19. "You will not pass this course unless you pass the final."

    Here the claim is that passing the final is a __________ condition for passing the course.

20. "John will marry Sue only if she agrees to have three children."

    Here the claim is that agreeing to have three children is a __________ condition for his agreeing to marry her.

21. "You won't be happy, if you buy it at Sturdley's."

    Here the claim is that buying it at Sturdley's is a __________ for being unhappy.

22. "A person is a brother just in case he is a sibling who identifies as male."

    Here the claim is that being a sibling who identifies as male is a __________ condition for being a brother.

Answers to Selected Exercises on Necessary and Sufficient Conditions

1. "If you get a cholera shot, then you'll be safe in the villages."

    Here the claim is that getting a cholera shot is a *sufficient* condition for being safe in the villages. The claim here is that if you get a shot, you'll be safe. So, the sentence says that getting a shot is enough – it's sufficient for being safe.

2. "You must get a cholera shot, if you're going to get a visa to India."

    Here the claim is that getting a cholera shot is a *necessary* condition for getting a visa to India. Requirements and prerequisites are usually necessary conditions. Here the claim is that you must get the shot if you are to get the visa. But there are other necessary conditions as well, e.g., not being a convicted felon. So, getting the shot is not sufficient.

3. "Lots of people with rich friends do not succeed in national politics. But no one succeeds in national politics without rich friends."

    Here the claim is that having rich friends is a *necessary* (but not a sufficient condition) for succeeding in national politics. This sentence says that a requirement, a necessary condition, for success in national politics is having rich friends. But since lots of people with rich friends do not succeed, being rich is not sufficient.

4. “Show me a good loser, and I’ll show you a loser.”

    Here the claim is that being a good loser is a *sufficient* condition for being a loser. *Hint*: it will help here to rephrase the claim in a more explicitly conditional form, as “If you show me a good loser, I’ll show you a loser.”

5. “Someone is a bachelor if, and only if, they are an unmarried male.”

    Here the claim is that being an unmarried male is a both a *necessary* and *sufficient* condition for being a bachelor.

6. “OU will go to a Bowl game only if they have a winning season.”

    Here the claim is that having a winning season is a *necessary* condition for going to a Bowl game.

7. “OU won’t go to a Bowl game unless they have a winning season.”

    Here the claim is that having a winning season is a *necessary* condition for going to a Bowl game.

8. “. . . liberal democracy has arisen only in nations that are market oriented, not in all of them, but only in them” [Charles E. Lindblom, Politics and Markets].

    Here the claim is that a society’s being market oriented is a *necessary* (but not a sufficient condition) for liberal democracy.

9. “If wishes were horses, then beggars would ride.”

    Here the claim is that wishes being horses is a *sufficient* condition for beggars to ride.

10. “Hard work guarantees success.”

    Here the claim is that working hard is a *sufficient* condition for being successful.

11. “The defendant is only guilty of first-degree murder if she planned the crime out beforehand.”

    Here the claim is that planning the crime out beforehand is a *necessary* condition for being guilty of first-degree murder.

12. “I’m not about to run in this heat.”

    Here the claim is that the heat is a *sufficient* condition for not running.

13. “Show me someone who likes your cooking, and I’ll show you someone who needs a tongue transplant.”

    Here the claim is that liking your cooking is a *sufficient* condition for needing to get their tongue replaced.

14. “A contract is binding only when there is no fraud.”

    Here the claim is that the absence of fraud is a *necessary* condition for a contract to be binding.

15. “Nothing ventured, nothing gained.”

    Here the claim is that taking a chance is a *necessary* condition for gaining something.

16. “You must pass the final to pass this course.”

    Here the claim is that passing the final is *necessary* condition for passing the course.

17. “You will pass this course only if you pass the final.”

    Here the claim is that passing the final is a *necessary* condition for passing the course.

18. “You will pass this course if only you pass the final.”

    Here the claim is that passing the final is a *sufficient* condition for passing the course.

3.3 Conditional Arguments

3.3.1 Conditional Arguments that Affirm

Arguments that have a conditional as one premise and either the antecedent or the consequent of that very conditional as the second premise are called **conditional arguments**. The first type of conditional argument we will study has the antecedent of the conditional as the second premise.

1. If you own a *Switch*, then you must buy *Animal Crossing.*
2. You own a *Switch.*
3. Therefore, you must buy Animal Crossing.

The first premise of this argument is a conditional and the second premise says that the antecedent of that conditional is true. The second premise just repeats and affirms the antecedent in the first premise. We say that such arguments **affirm the antecedent**. *All* arguments that affirm the antecedent are *deductively valid*. It is impossible for an argument with this format to have all true premises and a false conclusion. This format is sometimes known by its Latin name *modus ponens*.

Affirming the antecedent—valid
a→b
a
b

In case you are skeptical that this argument structure is valid, remember we can always use the method of counterexample from chapter 2 to check them. Assume that if you own a *Switch* you must buy *Animal Crossing* (maybe some strange law is in place) and assume that you own a *Switch*. Can you think of any way that you don't have to buy *Animal Crossing*? No. If you didn't buy it while owning a *Switch*, then the first premise would be false, but we were assuming it was true. So, if the premises are true then the conclusion must be true, showing that affirming the antecedent is valid.

We can also have arguments where the second half of the conditional – the consequent – is repeated as a premise:

1. If Norman is in Oklahoma, then Norman is south of Kansas.
2. Norman is south of Kansas.
3. Therefore, Norman is in Oklahoma.

The first premise is a conditional and the second premise says that the consequent of the conditional is true. Such arguments **affirm the consequent**. Each and every argument that has this format is deductively invalid. It is possible for such arguments to have all true premises and a false conclusion.

Affirming the consequent–invalid
a→b
b
a

Just to be safe, let's check again, using the method of counterexample. Assume that if Norman is in Oklahoma, then Norman is south of Kansas, and that Norman is south of Kansas. Can you think of any way these premises can be true and it not be the case that Norman is in Oklahoma? Yes. Plenty of places are south of Kansas without being Oklahoma. Norman could be in Texas or Mexico or Brazil (or any number of other places better than Oklahoma). It doesn't matter that we know Norman is in Oklahoma, because validity is just asking us to take for granted that the premises are true and check to see if the conclusion follows from them.

3.3.2 Conditional Arguments that Deny

Negations

We have studied one kind of sentence, the conditional. Now we need to introduce another kind, the *negation*. The **negation** of a sentence is another sentence which says that the first sentence is false. It says the *opposite* of what the first sentence says; it *denies* it. We could express the negation of the sentence:

It is raining.

by any of the following sentences:

1. It is not the case that it is raining.
2. It is not true that it is raining.
3. It is not raining.
4. It isn't raining.
5. It ain't raining.
6. Ain't rainin'.

Arguments that have a conditional as one premise and either the negation of that conditional's antecedent or the negation of the conditional's consequent are also **conditional arguments**. So, there are two conditional arguments that affirm and two more that deny, for a total of four.

Here is a conditional argument in which the second premise is the *negation* of the antecedent of the first premise:

1. If Norman is in Oklahoma, then Norman is south of Kansas.
2. <u>Norman is not south of Kansas.</u>
3. Therefore, Norman is not in Oklahoma.

The first premise is a conditional and the second premise says that the consequent of the conditional is false. Such arguments **deny the consequent**. *Each and every* argument that has this format is deductively valid. This format is sometimes known by its Latin name, *modus tollens*.

Denying the consequent –valid
a→b
<u>~b</u>
~a

Let's use the method of counterexample again to double check that this structure is valid. Assuming that if Norman is in Oklahoma, then Norman is south of Kansas, and that Norman is not south of Kansas, could it be possible for Norman to be in Oklahoma? No. If being south of Kansas is necessary for Norman to be in Oklahoma, and we know that Norman isn't south of Kansas, then there is no way Norman is in Oklahoma.

By contrast, consider this argument:

1. If Norman is in Oklahoma, then Norman is south of Kansas.
2. Norman is not in Oklahoma.
3. Therefore, Norman is not south of Kansas.

The first premise is a conditional and the second premise says that the antecedent of the conditional is false. Such arguments **deny the antecedent**. *All* arguments having this format are *deductively invalid*. Denying the antecedent is always a fallacy.

Denying the antecedent–invalid
a→b
~a
~b

For completion, let's go back to the method of counterexample one more time. Assume that if Norman is in Oklahoma then Norman is south of Kansas, and that Norman is not in Oklahoma. Does this mean that Norman can't be south of Kansas? No. Just like before it could be in Texas, etc.

Here are two more examples:

1. If he builds it, they will come. But they didn't come. So, he didn't build it.

We can repackage the argument into *standard form* like this:

1. If he builds it, they will come.
2. They didn't come.
3. Therefore, he didn't build it.

It is impossible for both premises of this argument to be true while its conclusion is false, and so is deductively valid. The argument *denies the consequent*.

2. If the sawdust is the work of carpenter ants, then we'll need something stronger than Raid to fix the problem. But fortunately, it's not the work of carpenter ants, so we won't need anything stronger than Raid.

In standard form:

1. If the sawdust is the work of carpenter ants, then we'll need something stronger than Raid.
2. The sawdust is not the work of carpenter ants.
3. Therefore, we won't need anything stronger than Raid.

This argument *denies the antecedent*. Hence, it is invalid. But we should be able to see this without knowing the label: if you knew that the two premises were true, you still could not be sure whether the conclusion was true or not. The sawdust might be the work of termites (in which case we'll definitely need something stronger than Raid.)

It is important to remember that you will always be able to work through the argument using the method of counterexample to determine validity and invalidity. But, thinking in terms of shortcuts, you are going to save yourself a lot of time of you memorize these rules.

To recap: affirming the antecedent and denying the consequent are always valid. Denying the antecedent and affirming the consequent are always invalid.

3.4 Chapter Exercises

1. Put each of the following conditional arguments into standard form. Then say which form the argument has, and whether it is valid or invalid. Remember that we have four types of conditional arguments:

- Affirming the antecedent (always valid)
- Affirming the consequent (always invalid)
- Denying the antecedent (always invalid)
- Denying the consequent (always valid)

1. If Arturo had gotten the job, he would have called me to brag about it by now. But he hasn't called. So, he didn't get it.

2. If Nekesa passed the bar exam, she would have called me to brag about it by now. And she did pass it.

3. If Nekesa passed the bar exam, she would have called me to brag about it by now. But she didn't pass it.

4. Your mom offered to buy you a new car if you got an A in your critical thinking class. And I hate to tell you, but you did not get an A.

5. You will do well in Critical Reasoning if you keep up with the assignments, and you do keep up.

6. Tiffany's car only dies when the temperature is below freezing. But it's below freezing today, so it will die.

7. If Smith embezzled the money, then Jones was involved in the crime. But Smith didn't embezzle it. So, Jones wasn't involved.

8. If Wilbur is an uncle, he couldn't have been an only child. And he is an uncle.

9. If wishes were horses, then beggars would ride. But beggars don't ride. So, it looks like wishes aren't horses.

10. If everyone at the school were doing well with the current course requirements, there would be no need to change them. But some people are not doing well.

11. If OU has a winning record in the Big 12, then if all their players are healthy, they will do well in the tournament. And they have a winning record.

12. If Tom's prints are on the gun, then he is guilty. So, he must be innocent, because those weren't his prints on the weapon.

13. If morals could be taught simply on the basis that they are necessary to society, there would be no social need for religion. But morality cannot be taught in that way (Patrick Lord Devlin, *The Enforcement of Morals*).

14. Wilbur is guilty of first-degree murder only if he intended to kill the victim. But he was in such a rage he couldn't really have intended anything. So, he isn't guilty in the first degree.

15. The jury must vote not guilty if they have a reasonable doubt about the guilt of the defendant. And they can't help but have a reasonable doubt in this case.

16. Suppose that you have a pack of special cards, each of which has a letter [either a consonant or a vowel] on one side and a number [either even or odd] on the other. If you have some of the cards lying flat on a table, which ones should you turn over to determine whether cards with vowels on one side always have odd numbers on the other side (this exercise is harder)?
    (a) cards with consonants and cards with even numbers on them
    (b) cards with vowels and cards with even numbers on them
    (c) cards with consonants and cards with odd numbers on them
    (d) cards with vowels and cards with odd numbers on them
    (e) you need to turn over *all* the cards, in order to determine whether or not this is so
    (f) None of the above

2. What is the relationship between sufficient conditions and the rule of affirming the antecedent? What is the relationship between necessary conditions and the rule of denying the consequent?

3. Here are a few more exercises on necessary and sufficient conditions.

    1. "You will not pass this course unless you pass the final."

       Here the claim is that passing the final is a ___________ condition for passing the course.

    2. "Rafael will marry Akiko only if she agrees to have three children."

       Here the claim is that agreeing to have three children is a ___________ condition for Rafael agreeing to marry Akiko.

    3. Vixens are female foxes.

       Being a vixen is a ___________ condition for being a female fox?

    4. "You won't be happy, if you buy it at Sturdley's."

       Here the claim is that buying it at Sturdley's is a ___________condition for being unhappy.

    5. "A person is a brother just in case he is a sibling that identifies as male."

       Here the claim is that being a sibling that identifies as male is a ___________condition for being a brother.

4. If A is a sufficient condition for B, then the negation of B is also a sufficient condition for the negation of A. For example, being a dog is a sufficient condition for being an animal. And not being an animal is a sufficient condition for not being a dog. Explain why this holds in general and draw a diagram to illustrate your points.

5. If A is a necessary condition for B, then the negation of B is also a necessary condition for the negation of A. For example, being an animal is a necessary condition for being a dog. And not being a dog is a necessary condition for not being an animal. Explain why this holds in general and draw a diagram to illustrate your points.

Answers to Selected Chapter Exercises

1. If Arturo had gotten the job, he would have called to brag about it by now. But he hasn't called. So, he didn't get it.

   1. If Arturo had gotten the job, he would have called to brag about it by now.
   2. He hasn't called.
   3. Therefore, he didn't get it.

   The conclusion is that Stan didn't win the race. The argument denies the consequent, so it is valid.

2. If Nekesa passed the bar exam, she will call me to brag about it. And she did pass.

   1. If Nekesa passed the bar exam, she will call me to brag.
   2. She did pass it.
   3. Therefore, she will call me to brag about it.

   The conclusion of this argument isn't included in it. You must supply it. The conclusion is that she called me to brag. The argument affirms the antecedent, so it is valid.

3. If Nekesa passed the bar exam, she would have called me to brag about it by now. But she didn't pass it.

   Invalid. Why?

5. You will do well in Critical Reasoning if you keep up with the assignments. You keep up with the assignments, so you will do well. The first premise says that if you keep up, you'll do well. The second premise says that you do keep up. You must supply the conclusion, which is the claim that you will do well.

   The argument affirms the antecedent, so it is valid.

6. Tiffany's car only dies when the temperature is below freezing. But it's below freezing today, so it will die. *Hint*: what is the necessary condition here?

7. If Smith embezzled the money, then Jones was involved in the crime. But Smith didn't embezzle it. So, Jones wasn't involved.

   Denying the antecedent. Invalid.

8. If Wilbur is an uncle, he couldn't have been an only child. And he is an uncle.

You must supply a missing conclusion here; then it should be easy.

9. If wishes were horses, then beggars would ride. But beggars don't ride. So, it looks like wishes aren't horses.

Denying the consequent. Valid

10. If everyone at the school was doing well with the current course requirements, there would be no need to change the requirements. But some people are not doing well.

Unstated conclusion: we should change the present course requirements. Denying the antecedent. Invalid.

11. If OU has a winning record in the Big 12, then if all their players are healthy, they will do well in the tournament. And they have a winning record.

Affirming the antecedent. Valid.

12. If Tom's prints are on the gun, then he is guilty. So, he must be innocent, because those weren't his prints on the weapon.

Denying the antecedent. Invalid (being innocent is the opposite of being guilty).

3. Exercises on Necessary and Sufficient Conditions

1. "You will not pass this course unless you pass the final."

Here the claim is that passing the final is a necessary condition for passing the course.

2. "Rafael will marry Akiko only if she agrees to have three children."

Here the claim is that agreeing to have three children is a necessary condition for his agreeing to marry her.

3. Vixens are female foxes. Being a vixen is both a necessary and a sufficient condition for being a female fox.

   It is a definition of ‘vixen’, and definitions typically involve both sorts of conditions.

4. “You won’t be happy, if you buy it at Sturdley’s.”

   Here the claim is that buying it at Sturdley’s is a sufficient condition for being unhappy.

5. “A person is a brother just in case he is a sibling that identifies as male.”

   See the answer to the question on vixens above.

Part III

The Acquisition and Retention of Information

Part III. The Acquisition and Retention of Information

Reasoning must begin with something. Arguments require premises. Sometimes the inputs (i.e., the premises) for our reasoning are conclusions drawn in earlier inferences, but in the end, most of our knowledge can be traced back to two sources: observation and the claims of other people.

In Part III of the book, we will study perception, other people as sources of information, the internet, memory, and the effects of emotions on reasoning.

Chapter 4

Perception: Expectation and Inference

Overview: Perception may seem unrelated to reasoning; it's natural to think that if we simply turn our heads in the right direction, we'll take in whatever is there. But in fact, perception involves much more than passively receiving incoming information; perception is something we *do*. Indeed, perception is very much like inference, and it often goes awry because of the same factors – context, expectations, biases, wishful thinking – that lead to flawed reasoning

Contents

4.1 Perception and Reasoning

Perception is related to reasoning in several important ways.

1. Our reasoning is often based on premises that describe what we see or hear (our perceptions). Furthermore, such premises are usually thought to be especially secure and trustworthy.

2. Perception requires us to go beyond the information given to us by the surrounding environment. This leap beyond the incoming information involves something very much like reasoning or inference.

3. This perceptual inference can be influenced by the context, our expectations, and even our biases, desires, and self-interest. These are the very same things that often lead to faulty reasoning.

4. Since perception is susceptible to various sorts of errors, we need critical reasoning to evaluate claims about what we (and others) perceive.

Reasoning must begin with something, and we can trace many of our beliefs back to perception – to information we acquired from our environment. Perception is the interface between our minds and the world. So, by starting with perception, we begin at the beginning. But we will also find that many of the things we learn about perception apply, with modest changes, to many aspects of reasoning.

4.2 Perception is Selective

Filtering and Selection

There is a lot going on in the world around us. But we aren't constantly overwhelmed by sensory overload, because perception is *selective*. Some of the selection and filtering occurs at the neural level. For example, the human visual system is only sensitive to a small band of the electromagnetic spectrum, in the interval between ultraviolet and infrared electromagnetic radiation. We can't see information conveyed by X-rays (like the people in science fiction stories who can see through walls) or by infrared light (unless we wear special goggles, like those that allow us to make out shapes at night). Similarly, we can't hear the high-pitched sounds dogs can hear, or make sense of the intricate pattern of shrieks emitted by bats to navigate in the dark.

Attention: Further Filtering

Some perceptual selectivity is "hard-wired," but some also depends on our beliefs, emotions, desires, and other factors that aren't part of our in-born physiology. When you enter a large room full of noisy people, it's just a loud din. But once you strike up an interesting conversation with someone, you tune out most of the noise around you and focus on them. You have no idea what people across the room are saying – until one of them mentions your name. Then, all of a sudden, their words leap out at you.

Experiments show that this sort of phenomenon is common. We filter out a lot of information, but when it is relevant to us, we often tune it back in. Some of the factors that lead us to focus on some things while ignoring others – things like expectations and emotions and desires – bear on our topic of reasoning, but here we will focus on an even more direct connection.

4.3 There's More to Seeing than Meets the Eye

When we talk about the input to the visual system, we naturally think about the eyes. Light passes in through the lens of each eye and is projected onto rods and cones at the back of the retina. But our perception is much different and much richer than this input. The lens reverses the image from left to right and turns it upside down. The image on the back of the retina is not homogeneous, but punctate (because the rods and the cones are separate, discrete units). Furthermore, the eye is constantly moving around, and we blink frequently.

In short, the image on the back of our retina is two-dimensional, upside down, punctate, and it jumps all over the place. But we see a three-dimensional world, right side up, full of familiar objects that don't constantly leap about.

A related point can be made about *perceptual constancies*, such as size, shape and distance constancies. Hold your hands up in front of your face, with the left hand close to your eyes and your right hand as far away as possible. Do your hands look the same size? Walk over to the wastebasket, then back away while keeping it in view. Does it seem to become smaller as you back away from it? Circle around and view it from different perspectives. Does it seem to change shape as you move? The fact that the wastebasket seems the same size as you back away from it (so that the smaller retinal image of it is smaller) is known as size constancy. The fact that it doesn't seem to change shape as you circle around it (so that the retinal images of it do change shape) is known as *shape constancy*.

Provided you don't get too far away, the size and shape of the wastebasket seem to remain constant; your perception of it is the same. Yet its image on your retina becomes smaller as you back away from it, and the image changes shape as you change your orientation with respect to the wastebasket. Here the *input is different*, but the appearance of the object *remains the same*. So, something is going on that involves more than just the images on your retinas. There is debate over how to explain size constancy, but there is some evidence that in part it is caused by the perceptual system's enrichment of the sensory input.

4.3.1 Information Processing

Information processing: transforming information in the input into information in the output

In the cases considered thus far, the perceptual system seems to *enrich* the visual input. It does not just passively register it, it *does something* to it. It is often useful to think about such processes in terms of information processing. Suppose that you program your computer to accept certain *inputs* (say a series of number between 0 and 100), and then have it manipulate or process them so that it generates a certain output (say the average values of the numbers in the input).

Many cognitive processes also involve information processing. In the case of visual perception, the input consists of the stimulation of rods and cones at the back of the retina, the relative orientation of our eyes to one another, and perhaps various factors involving the orientation of our bodies. And the *output* is the perceptual experience we have when we see something.

Bottom-up processing: transmission of information from sensory receptors up to the brain

In the cases considered so far, the perceptual system enriches the visual input in ways that do not involve our beliefs or desires. This is called **bottom-up processing**. The idea here is that our nervous system records sensory stimulations and passes the information on up to the brain. But we see with our minds as much as with our eyes; we also engage in **top-down processing** that involves something very much like inference. So, before turning to it, it will be useful to recall a few facts about inference.

4.4 Going Beyond the Information Given

The word 'inference' is almost synonymous with 'reasoning'. We draw an inference when we begin with one or more beliefs (our premises) and use them to arrive at a conclusion. We start with a body of information (or perhaps misinformation, or some of each) and arrive at a new piece of information. Suppose that we know that 94% of the people in the critical reasoning class are from Florida, and later we learn that Ramon is in the course. We infer that Ramon is (probably) from Florida. We arrive at this conclusion based on the two earlier pieces of information.

Many inferences are drawn so quickly and automatically that we don't even notice them. Consider a quarterback running an option play. As they run along the line, they must read the location and trajectory of the oncoming defensive players. Then, depending on what is seen, they decide whether to pitch the ball or to keep it. A good option quarterback will usually gather and assess the relevant information very quickly and make the right decision in a split second. When we first learn a skill (like riding a bike or skiing or typing) it seems awkward and unnatural. We must rehearse every step in our minds as we struggle to get the hang of things. But as we become more adept, we no longer need to think about each step consciously; indeed, it often becomes difficult to even say what it is that we do (many good touch typists find it difficult to describe the locations of various keys).

There is some very recent evidence that once we acquire a skill, the ability to use it is relocated in a part of the brain that isn't accessible to consciousness. But the important point here is that many of the skills we acquire involve gathering and assessing information and drawing inferences from it.

Scientists still have much to learn about cognition, but at least this is clear: much inference takes place very rapidly and below the threshold of consciousness. Once we grant this, it won't seem so odd to think that perception often (perhaps always) involves something very akin to inference. In fact, it is so similar that some scientists think of perception as a special kind of inference.

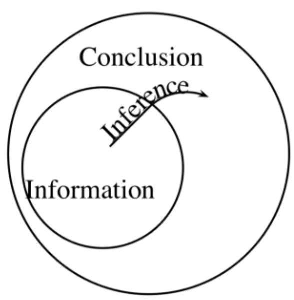


Figure 4.1: Beyond the Information Given

The conclusion of a deductively valid argument doesn't contain any information that wasn't already contained (often in a far from obvious way) in the premises. By contrast, the conclusion of an inductively strong argument does contain new information; its conclusion *goes beyond* the information given in its premises. An inductively strong argument involves a jump, an *inductive leap*, to new information in a way that a deductively valid argument does not. This explains why it is possible to have an inductively strong argument with true premises but a false conclusion.

4.5 Perception and Inference

Perception is a lot like inference that makes an inductive leap. There is a huge amount of information around us, but some of the information we need (or want) is not present in the input to the visual system. We will see why this works in the case of visual perception, then we will briefly note how similar points apply to some of the other senses.

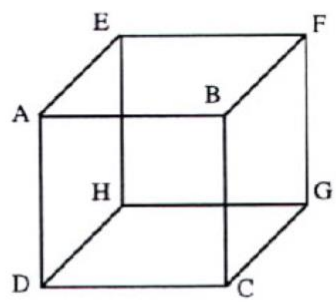
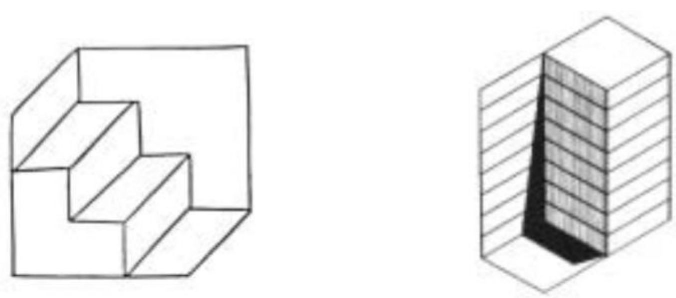


Figure 4.2: Necker Cube

The object in Figure 4.2 is known as a *Necker cube*. We can see it *as* a cube with a given face (ABCD) or, when it reverses, *as* a cube with a quite different face (EFGH).



(a) Reversing Stairs

(b) Shadows

Figure 4.3: Other Reversing Figures

Figure 4.3 shows more dramatic examples of *reversing figures*. The physical input to the visual system is the same whether we see the stairs (in the left subfigure) on the bottom or on the top. So, what *accounts for* the difference when we see it first one way, then the other?

What do you see in Figure 4.4? It can be seen either as two faces peering at each other, or as a vase. Figures like this, which can be seen in more than one way, are called *ambiguous figures*.

Figure 4.4: Faces or Vase?

Now consider Figure 4.5. What sort of person do we have here? Like our earlier figures, she can also be seen in either of two ways. Look at the figure before you read on (she is either a young woman or an old woman; the chin line of the young woman is part of the nose of the old woman).

Figure 4.5: An Ambiguous Woman

Figure 4.6: An Ambiguous Animal

Finally, consider the creature in Figure 4.6. You can see it as a duck (looking off to the left) or as a rabbit (looking off to the right).

4.6 What Ambiguous Figures Show: Expectations and Set

Ambiguous figures are intriguing. They aren't typical of the things we normally see, though, so why spend so much time on them? The answer is that they tell us something very important about the *causes* of our visual experiences.

Let's begin with a simple example of causation. Suppose that you enter the same sequence of numbers on your computer, which you have programmed to calculate averages. Then you are asked to enter the same numbers on my computer, which I tried to program to work the same way that yours does. But the two computers come up with different answers. How might we explain this?

One hypothesis is that you mistakenly entered different numbers in the two computers. But you double check and find that you gave the same input to each computer. Now what could explain the different results? Since the input is the same—it is *held constant*—in the two cases, the difference must have something to do with what goes on inside each computer.

So far, so good. But what is it in the computers that accounts for the different outputs? Perhaps one of the programs has a bug in it. You could test to see whether this was the case by working through each program. If they are the same, then the difference in the two computers' behavior must have something to do with the hardware or the other programs in the computer. (At this point you might want to call in your friendly hacker, Wilbur.)

We often reason about causation in this way. In a later chapter, we will examine the intricacies of such reasoning, but here it is enough to note that ambiguous figures allow us to learn something about the causes of perception in the same way that we learned something about the causes of the different outputs of the two computers.

When you look at the Necker cube, or any of the other ambiguous figures, the *input* to your visual system is the same, no matter how you perceive the figure. It is the same when you see the two faces as it is when you see the vase. Yet your visual experience is different.

Since the *input is the same* in the two cases, the difference must have something to do with what happens inside you *after* the image is formed. It involves the way the input is processed. Moreover, if we can manage to hold further factors constant, we may be able to zero in on the factors that affect the internal processing.

In short, perceptual constancies suggest that we can have *different inputs* while having the *same output* (the same visual experience). This suggests that sameness of input is *not a necessary condition* for having the same experience. And our ambiguous figures show that we can have the *same input* while having *different output* (different visual experiences). This shows that sameness of input is *not* a *sufficient condition* for having the same experience.

1. Perceptual constancies suggest that having the same sensory input is not necessary for seeing the same thing.

2. Ambiguous figures show that having the same sensory input is not sufficient for seeing the same thing.

The moral is that the mind is active. But what determines the nature of the active role it plays? The next few examples give us part of the story.

4.7 Perceptual Set: The Role of Expectations

What is the character in the middle of Figure 4.7? If we block out the 12 on the left and the 14 on the right, we just see the column, and we naturally, almost automatically, see the middle character *as* a B. But block out the A and the C, and it instead looks like a 13.

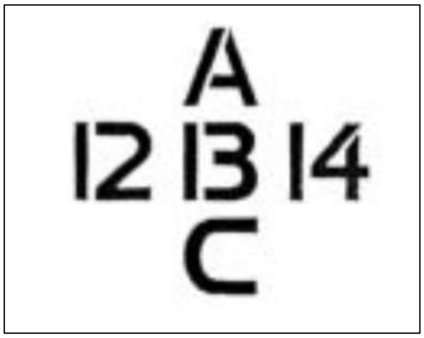


Figure 4.7: What's that in the Middle?

Here the context influences our expectations, so that we tend to see what the context leads us to expect we would see. To test this claim, we could show one group of people the three characters on the row and another group the three characters in the column. When we do this, we find that context does indeed influence how people see things. This example also shows how *cultural issues*, our having the language and alphanumeric characters that we do, affect how we see things.

People from a much different culture might not see this figure as anything but a series of meaningless marks. In fact, there is evidence that the perception of certain visual illusions vary from one culture to another.

Can you think of a context that might lead people to see some of the ambiguous figures in one way rather than another? Figure 4.8 should give us a clue. Here we plop our ambiguous creature down into two different contexts.

Figure 4.8: Two Group Portraits

Now answer the following questions:

1. If you first saw the group portrait of the ducks, how do you think you would have interpreted the picture of the lone creature?
2. What if you had instead seen the group portrait of rabbits?
3. Do you think it would have made any difference if someone had first said to you "I'm going to show you a drawing of a duck?"
4. How do you think that people who had seen lots of rabbits but no ducks would see it?

These are *empirical questions*, and the only way to answer them is to check and see what people in fact do under such conditions. But we know the effect these examples have on us, so we have something to go on. In a moment, we will consider some further cases that will provide more evidence about the correct answers.

What you *expect* to see can strongly influence what you *do* see. Psychologists say that your beliefs and expectations (and, as we will see in a bit, your desires) constitute your **perceptual set**.

Perceptual set: how we are primed to see things in a given setting

The context helps determine your perceptual set, because it influences what you expect to see. In some contexts, you expect to see one sort of thing, say a duck. In other contexts, you may expect to see something else, say a rabbit. In normal situations, you would be upset if coins simply began to vanish into thin air. But when you watch a magician, you expect coins that seem to disappear.

4.7.1 It Just Isn't in the Cards: Classification and Set

Context is one important determinant of perceptual set, but it isn't the only one. An experiment done in 1949 supplies some surprising insights into the way that our expectations are influenced by our ways of classifying things. Jerome Bruner and Leo Postman presented subjects with a series of five-card hands of playing cards that flashed briefly before them for periods of a second or less (nowadays, this would be done on a computer screen). The hands contained many normal cards, but some cards were anomalous. On these cards, the hearts were black and the spades were red.

It took people longer to recognize these trick cards than to recognize normal cards. At one or more points in the experiment, almost all the subjects reported an anomalous card as being normal. For example, they assimilated the black three of hearts to a normal three of hearts (here the shape dominated) or to a normal three of spades (here the color dominated).

The subjects had a system of classification: cards come in four suits (hearts, diamonds, spades, and clubs) with cards in the first two suits being red and cards in the last two suits being black. This led them to expect certain things, and in some cases, these expectations led them to misperceive a trick card.

The influence of our expectations and beliefs and desires on perception involves **top-down processing**. Both bottom-up and top-down processing are important. There is still some controversy about the relative importance of each (and of additional sorts of processing we won't go into here); it might be thought, for example, that top-down processing only plays a substantial role in cases where the object of perception is ambiguous. But even if some scientists overestimate the significance of top-down processing, the following examples show that beliefs and expectations, desires and emotions, can have a substantial impact on how we see and interpret normal objects outside of the laboratory.

Top-down processing: processing of visual information that involves expectations and beliefs

4.7.2 Real-life Examples

There is sometimes disagreement about how to interpret laboratory studies, and even when there isn't, they can seem a bit artificial. But there can be little doubt that our perceptual sets influence the ways that we see things in the world outside the laboratory—sometimes with disastrous results.

It Looked Like a Bear

Elizabeth Loftus and Katherine Ketcham report a case of two men who were bear hunting in a rural area of Montana. After an exhausting day in the woods, night was falling, and they were making the trek home. On the way, they talked about bears. Suddenly, as they rounded a bend, a large, moving object loomed up ahead of them. Both men took it for a bear, raised their rifles, and fired.

It turned out to be a large, yellow tent with its flap blowing in the wind. A couple was inside, and the woman was killed. The hunter who shot her was tried (and convicted) of negligent homicide. The jury found it incomprehensible that he could have mistaken a yellow tent for a bear. But he was primed to see a bear; he had bears on the brain. His perceptual set played a powerful role in leading him to see things in the way that he did.

Most of us have probably made similar mistakes, though hopefully with less tragic results.

Schizophrenic or Normal?

In 1973, researchers had a mentally healthy adult check himself into a mental health facility with complaints of hearing voices. He was classified as having schizophrenia and admitted. Once in the hospital he never said anything about the voices, and he behaved like his usual self. But the members of the hospital staff had been led to expect person with schizophrenia, and that is how they continued to see him.

They recorded his “unusual” behavior (he spent a lot of time writing down his observations), often talked to each other as though he wasn’t present (this is common behavior in psychiatric facilities) and didn’t realize that he was behaving normally. Once they had a label, they didn’t check to see how well it fit. It took, on average, almost twenty days for the subject to get himself released. This is not a case where people misperceived something they only glimpsed for an instant. Here the staff was around the subject for almost three weeks. Interestingly, some of the hospital patients were much quicker to see that the subject’s behavior for what it was (what might explain this?).

Everyday Errors

Misperception is far from rare. Here are three examples; can you think of some more?

- Most of us have seen a person in the distance and thought they were someone we know. When they got closer, we realized that they don’t look anything like the person we expected.

- Proof-reading provides similar examples. As you read back over teh first draft you *expect* to see words spelled in a certain way, and things often look as you think they should. It is very easy to read right past the ‘teh’ there on the page—though once you do notice it, it jumps off the page at you.

- If you don’t normally live alone and find yourself home all by yourself (especially if you have just seen a scary movie), shadows in the backyard and sounds in the attic can take on new and sinister forms.

4.8 There's More to Hearing, Feeling, . . .

4.8.1 Hearing

If you hear people speaking a language you don't understand, you are unlikely to perceive breaks between many of their words; you won't know which sounds are single words and which aren't. Listen carefully to an English sentence spoken at a normal speed, and you'll realize how the sounds run together. But someone who knows the language and expects to hear normal words will perceive discrete words, rather than just one long run-together sound.

Context also affects how we hear things, particularly words. The phrase 'eye screem' is interpreted differently in the sentences 'I scream when someone jumps out and surprises me' and 'I love rocky road ice cream'.

Back in the 1960s, the rock band the Kingsmen had a smash hit with the song "Louie Louie." It wasn't easy to discern the words, and there were various accounts of what they were. The set on the sheet music was harmless enough, but another set, circulating widely in the teenage underground, would have kept the song off the air. It turned out that if you gave people one set of words to read before hearing the Kingsmen's rendition, they would hear those words. But if you gave them the other set, they would hear those.

The Phoneme Restoration Effect

When people hear the following sentence:

> It was found that the *eel was on the __________.

where * is a missing sound, they automatically fill the * in so that they think that they hear a normal English word. The way that they fill it in depends on what word is placed in the blank. When the following words are put into the blank underlined space

1. axle
2. shoe
3. orange
4. table

it determines what people think they hear. For example, they think they hear the word 'wheel' (in the axle case). What words did they think they heard in the other cases?

The * represents what linguists call a 'phoneme', and so this phenomenon is known as the *phoneme restoration effect*. It is particularly interesting because the relevant part of context (the word inserted in the blank) is yet to come when subjects filled in the missing phoneme.

If you remember the internet controversy about Yanny and Laurel, or the scene on Sesame Street when people perceived Grover to be dropping the F-bomb from a few years ago, you can see that this happens even when there isn’t audio information missing. Our minds force order onto the audio stimulus we receive. There are going to be plenty of times when there is ambiguity to the sounds, and people are going to experience them differently.

Similar points apply to other sensory modalities. Suppose that you are squeamish about bugs. You go on a camping trip, and around the campfire people swap stories about scary insects, people they know who died from spider bites, and the like. That night as you are drifting off to sleep, a blade of grass brushes against your cheek—but when you first feel it, it probably won’t feel like a harmless blade of grass. Or you may be enjoying a tasty meal—until you learn it contains some ingredient you don’t like or find disgusting (that burger tasted wonderful—until you learned that it was made from horse meat).

4.8.2 Feelings

Physiological States and Context

Expectations and beliefs can even influence our physiological states. In a study done the in 1970s, two psychologists had male undergraduates take a drink. Some of the drinks contained alcohol and some didn’t. Some people in each group were told that their drink contained alcohol, and some were not told this. Finally, a female assistant then walked in, sat down, looked the subject right in the eye, and begin talking to him—which made many of the subjects nervous.

We all know that nervousness affects heart rate. It turned out that subjects who thought they had been given a vodka tonic showed smaller increases in heart rate than subjects who thought they’d had only a glass of tonic. Whether the subjects *really* had been given alcohol didn’t affect their heart rate. But whether they *thought* they had been given alcohol did.

Expectations and context can exert a powerful effect on our perceptions and feelings. In some situations, they lead to a placebo effect. The **placebo effect** occurs when people are given a pill or a shot consisting of chemicals that won’t affect their illness or disease. If they *think* that it is genuine medicine, they often get better, even though they only took a sugar pill. In a later module, we will see that this effect is so powerful that experiments on the effectiveness of drugs must be designed to guard against it.

4.9 Seeing What We Want to See

Perhaps expectations can affect our perceptions, but can our desires and emotions (which account for so much fallacious reasoning) have an impact on them? There is strong evidence that they can.

The Football Game

In a classic study from the 1950s, Albert Hastorf and Hadley Cantril examined biases and their effect on perception. In 1951, Dartmouth and Princeton met on the football field. The game was unusually rough, and there were several injuries and many penalties on both sides. After the game, partisans of both teams were upset. When Hastorf and Cantril asked two groups of students, one from each university, which team started the dirty play, the groups from the two universities gave quite different answers. Of course, they may have heard about the game from someone else, so to study the effects of actually *watching* the game, Hastorf and Cantril asked a group of boosters of each school to watch a film of the game and record each penalty they noticed. Princeton boosters saw many more Dartmouth penalties than Dartmouth boosters did. Here again, expectations influenced perception. But in this case, peoples' expectations were influenced by the school with which school they identified.

The Biased Media

About ten years ago, several psychologists studied the way that voters viewed the media. It turned out that about a third of the respondents thought that the media had been biased in their coverage of Presidential candidates. There is nothing too surprising about this, but in 90% of the cases where people discerned a bias, they perceived it as a bias against their preferred candidate. This has become known as the *hostile media phenomenon*. Psychologists found this phenomenon regardless of the candidate involved. They also found similar outcomes when the issue was media bias in the presentation of other sorts of news events. Here, one's values and desires play a role in what one sees or, at least, in how one interprets it.

Hostile media phenomenon: most people who think the media is biased think it's biased against their views

Such things also happen closer to home. Most of us are prone to see "bad" officiating calls when they go against our team, but we don't notice many that go against the opponent. After a game, people often complain that their team lost because of poor officiating, but few say that bad officiating gave their team the victory. One way to see the influence of this bias is to try to imagine how the officiating calls in a game would be viewed by one of the opposing team's fans.

The influence of our desires on perception isn't limited to the sports world. Many parents are unable to see what their children are doing (e.g, abusing drugs) because they can't bring themselves to believe their child would do that. People in a relationship may be unable to see obvious flaws in the person they care about. Of course, not all biases lead us to think the best of someone else. If Wilbur is prone to jealousy, harmless and friendly behavior on his boyfriend's part may look like flirting to him.

Person Perception

Our perceptions of other people are influenced by our perceptual set just as much as any of our other perceptions are. For example, our perceptual set may be influenced by stereotypes and biases that lead us to expect to see certain things, and sometimes this can lead us to see them in that way. We also have stereotypes about people who dress in certain ways, sport certain hair styles, have certain body types, and so on, and these also influence our perceptual set.

It is natural to wonder about the effects of over-simplified classifications, expectations fostered by parents or peer groups, and how biases and desires might affect our perception of people of different races or from opposing political groups. The topic is so important that we will reserve an entire chapter for it later in the course.

But it is important to note now that the things we have learned about in this chapter are not just about ambiguous figures. They turn up in all sorts of situations, including the social situations that matter most to us.

4.9.1 Perception as Inference

It is difficult to escape the conclusion that perception works a lot like inference that goes beyond the information that we have. In fact, one school of thought, beginning with German scientist Hermann von Helmholtz in 1866, holds that perception is a species of inference. But for our purposes it is enough to realize that in one very important way perception is like inference. The input from the outside world, consisting of light rays and probably some less obvious things, is analogous to the *premises* of the inference. And the actual perceptual state we experience is analogous to the *conclusion*.

4.9.2 Seeing Shouldn't be Believing

We will see over and over how biases, self-interest and wishful thinking lead to fallacious reasoning. And the fact that they can influence what we see, or at least *how* we see it, suggests that perception can be flawed for many of the same reasons that reasoning can. This is a serious problem, because we have a very strong tendency to think that our perception is accurate. Indeed, we even tend to put a lot of faith in what other people claim to see (eyewitness testimony carries great weight in the courtroom).

But errors are very possible here, and so we often need to subject our perceptual beliefs to scrutiny.

Much of what we have learned about perception will turn up repeatedly in our study of reasoning. Here is a list of some of the key points we will meet on future occasions.

1. It is important to us to make sense of the world around us, to explain what happens and to fit it into a coherent and organized pattern. In perception, we strive to make sense of the things we see and hear. Memory and inference involve similar attempts to make sense of things.

2. Perception, memory, and inference are strongly affected by several factors, which often lead to errors. These factors include:

    1. Context
    2. Our beliefs and expectations
    3. Our wishes and desires

3. Our perceptions and reasoning can be influenced, even distorted, by these factors, but there are limits to their influence. If our beliefs and desires did completely determine what we saw, we wouldn't be able to function on our own for even a day. Not all visual illusions involve ambiguous figures, and some of them actually demonstrate the *limitations* of perceptual set. Figure 4.9 is known as the M¨uller-Lyer illusion. The line with the out-going fins looks longer than the line with the in-going fins, but if you measure them, you will find that they are the same length. Even once you know this, however, your belief that they are the same length and even a strong desire to see them as having the same length are not enough to enable you to see them as having the same length.

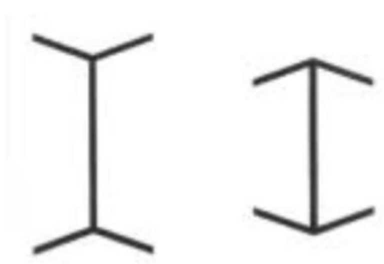


Figure 4.9: M¨uller-Lyer Arrow Illusion

But although there are limits on how wrong we can be, we often do make mistakes, even in situations that matter greatly to us. Knowing about these pitfalls in perception is a first step in guarding against such errors.

4.10 Chapter Exercises

1. Think of a case where you were certain that you saw something or someone, but where on closer examination, you discovered that you hadn't really seen that person or thing at all (or at least that the thing or person you saw looked very different from the way that you first thought they did). Write a paragraph describing this situation; include a discussion of factors that might have led to the misperception.

2. We have some tendency to selectively perceive what we expect and hope to see. Describe, and comment on, an example in which you (or a person close to you) have done this. What cognitive or motivational factors were at work in your perception?

3. Context can influence our expectations and so it can influence our perceptual set. Describe one way in which you might set up a context in which you think people would be more likely to see the vase rather than the face. Now describe a context where people might be more likely to see the face. How would you test your hypotheses about this?

4. Context can influence our expectations and so it can influence our perceptual set. Describe one way in which you might set up a context in which you think people would be more likely to see the old woman rather than the young woman. Now describe a context where people might be more likely to see the young woman. How would you test your hypotheses about this?

5. The employees of mental health facilities took, on average, three weeks to discover that the mentally healthy person who had been admitted with schizophrenia did not actually have that diagnosis. The patients were much quicker to see through the ruse. What do you think explains this difference?

6. Describe a case where your expectations or desires or the context you were in seems to have led you to interpret something you felt (with your skin, your tactile sense) one way that, with different expectations or set, might have been interpreted another way.

    1. What do you think caused you to interpret it the way that you did?

2. How could you test the hypothesis you constructed to answer the previous question? Give similar examples involving taste and smell.

7. Describe a case where your expectations or desires or the context you were in seems to have led you to interpret your emotions or mood one way that, with different expectations or set, might have been interpreted another way.

    1. What do you think caused you to interpret it the way that you did?

    2. How could you test the hypothesis you constructed to answer the previous question?

Chapter 5

Evaluating Sources of Information

Overview: Most of our knowledge and reasoning is based on information we learn from other people. In this chapter, we will focus on other people as sources of information. Information acquired in this way is often reliable, but it isn't foolproof; people make mistakes, and sometimes they intentionally misrepresent things. So, we need ways to decide when it is reasonable to accept their claims and when it is better not to. In this chapter, we will examine various sources of information and develop some guidelines for separating reliable sources of information from unreliable ones.

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5.1 Other People as Sources of Information

In this chapter, we will focus on other **people as sources of information**. People's claims are sometimes called *testimony*, but don't let this word mislead you. We will use it to cover any information (and misinformation) we acquire from other people. In this sense, testimony includes the things we hear directly from others, read in newspapers or books, see on television, find on websites, and so on. Think about how much of your knowledge is acquired from others. Your friends tell you about things they have seen or heard. You learn new things when you read the morning paper or a chapter in a textbook or an email message from someone far away. You acquire information when you watch the news or surf the net.

A large society like ours consists of a vast social network in which everyone relies on others for information, and written records and oral traditions extend this network back into the past. If you suddenly forgot all the things you learned from others, there wouldn't be much left. You wouldn't even have a language in which you could ask yourself how much you knew. In today's rapidly changing world, much of what you learn in college will become outdated rather quickly. Hence, it is important for you to learn how to acquire and evaluate information.

5.1.1 Information: We Need Something to Reason About

Testimony bears on reasoning for two closely related reasons.

1. The *premises* of our reasoning are very often based on things we learn from others.

2. We frequently need *background information* to know whether the premises of an argument are plausible or whether they omit relevant information, and often we must rely on others to supply this information.

Our premises are often based on the claims of others. Many of our arguments rely on premises that we get from others. To create jobs, suppose your City Council proposes that a nuclear power plant or a toxic waste dump be built near your community. Most of us would care enough to argue for our position on this issue. But we would have to rely on the claims of experts about the risks and reliability of such facilities to support our conclusions about whether a potentially dangerous plant should be built.

Evaluation of arguments often requires background knowledge obtained from testimony. There are three critical questions to ask about any argument we encounter. Do its premises support its conclusion? Are its premises plausible? Has any relevant information been omitted? Often, we cannot answer the last two questions without having a good deal of background knowledge, and frequently we must rely on other people to supply it.

Here's an example of an issue you could face as a parent. The average child will see over 8,000 depictions of murders on television before they graduate from grade school. Suppose your neighbor urges you to sell your TV so that your little Wilbur won't grow up to be an axe murderer. In trying to evaluate the argument that TV violence is dangerous for your children, you need background information about the lasting effects of seeing frequent violence on television. Will seeing violent acts on TV make Wilbur more violent?

Or, suppose someone argues that we should retain capital punishment because it deters murders. Here you need background knowledge to determine if their premise that capital punishment really does deter murders is true. And you also need to know whether they have omitted information; for example, it may seem to deter murders in one state (which they mention), but not in other states (which they don't).

In a heterogeneous, highly technological society like ours, experts are an especially important source of information. We rely on our dentist when we break a tooth, on the telephone repairperson when our phone goes dead, on ESPN.com for the score from last night's game, on *Consumer Reports* for help in buying a used car.

It requires *effort* to obtain useful information. If we sit around passively and hope that useful information will come our way, we will be in trouble. But effort alone isn't enough. It is often difficult to distinguish genuine experts from self-styled experts who don't really know what they are talking about. Furthermore, even genuine experts are sometimes biased, and in many cases the experts disagree with one another. Finally, on some matters there may not be any experts at all. This means that we need techniques for identifying experts, and we also need to know what to do when they can't be found or when they disagree with each other.

We will begin by examining experts in recognized fields like medicine, law, and professional football. We will then consider several factors that make people appear credible; the goal here will be to discover ways in which people can appear to be experts when they really are not. We will then turn to testimony more generally. We will find that the issues that arise in evaluating the claims of experts resemble those we should use for evaluating any sort of testimony, whether it comes from a top expert in some field or a stranger on the street.

5.2 Expertise

The **identification of credible experts** involves determining what makes someone an expert on a given topic. This may require us to separate genuine experts from frauds, quacks and charlatans. We often have no alternative but to rely on experts, but in the end, it is still up to each of us to decide *when* we will rely on experts, which experts we will rely on, and *what to do* when the experts disagree. In the end, we must decide for ourselves, and in matters of importance it is best to base our decision on the best information we can get.

5.2.1 What is an Expert?

An **expert**, or **authority**, is someone who knows a lot about a field. We will use the words 'expert' and 'authority' in a broad sense, so that we can consider a wide variety of **sources of information** as potential authorities. So, when we talk about an authority, we don't mean an authority figure who supervises other people, but someone (or something) who is an authority in their field. In this sense, authorities include individual people, newspapers, textbooks, encyclopedias, TV programs, websites, think tanks, and so on.

Sometimes expertise may be embodied in a skill that is difficult to describe. A doctor who has seen many patients with a certain disease may be able to recognize it even if she has trouble saying precisely how she does so. Still, if she is usually right, she is an expert at recognizing the disease. There are two important facts about experts.

> *Experts needn't be infallible*—who is? If this were a requirement, then there wouldn't be any experts. But an expert will still be a better source of information than someone who isn't an expert. Indeed, if the experts were right about something important 60% of the time, whereas non-experts were only right 50% of the time, you would still be better off relying on an expert.
>
> *Expertise comes in degrees*. Most dentists are experts on teeth. But a conscientious dentist who has practiced for twenty years is likely to know more about molars and bicuspids than a lackadaisical dentist who has been practicing for three days. But when you break a molar, a mediocre dentist will probably be better than no dentist at all.

5.2.2 Fields of Expertise

An expert can only be relied on in areas that fall within her **field of expertise**. Someone who is an expert in one area needn't be an expert in other areas, and no one is an expert in every field. When a person gets outside their area of expertise, their often don't know any more than anyone else. For example, a good dentist is an expert on teeth, but probably not about the pancreas or the wishbone formation.

5.3 Evaluating Claims to Expertise

Appeals to experts can be thought of as arguments with the following form:

> Premise: An expert on the subject says that X is true.
> *Conclusion:* Therefore, X is true.

Or, breaking the premise up into smaller parts:

> *Premise 1:* E is an expert on subject S.
> *Premise 2:* Claim X involves subject S.
> *Premise 3:* E says that X is true.
> *Conclusion:* Therefore, X is true.

Good sources:
1. factual reliability
2. personal reliability

We don’t usually say this sort of thing explicitly when we cite an expert to convince others that X is true. But we usually go through this *sort* of reasoning (though not always consciously or explicitly) any time we rely on an expert. Such arguments are not deductively valid. Why not? Because even the best experts can be wrong. But in the case of *legitimate* appeals to authority, the argument will often be inductively strong. The better the authority, and the more the authorities agree about the issue in question, the stronger the argument will be.

When evaluating the claims or advice of a potential expert, we should ask ourselves the following seven questions:

1. Do we care enough about the issue to try to evaluate those who claim to be experts about it?

2. Is the field one in which there even are experts?

3. Is the source an expert on the relevant issue?

4. Has the source been quoted accurately?

5. Is the issue one in which the experts are (mostly) in agreement?

6. Is the source’s claim one that is very unusual or surprising?

7. Is there any reason to think that the source might be biased or mistaken in this case in particular?

We will consider these matters in turn.

Is the Issue Important to us?

Information is often very valuable. What you don't know *can* hurt you. It can even kill you. Suppose tests show that you (or your ten-month-old daughter, or your sixty-year-old grandfather) have a serious form of cancer. Various treatments are available, each with its pluses and minuses. Here, you would want to find out what the experts thought about the merits of various treatments before you decided what to do. Indeed, it would be very sensible to get more than one opinion.

What you don't know can hurt you

But information is not intrinsically valuable. More isn't always better. The trick is to know when you need information and when you don't (an even bigger trick is mustering the energy to go get it when you know you need it). Lots of information is useless. No normal person will feel the need to know the exact number of blades of grass in their front yard, at least not enough to count them. Lots of information isn't relevant to our concerns. Moreover, even when it is, there is usually a *cost* to acquiring it. It takes time and effort to read the relevant things and to talk to the relevant people, and in many cases the return on this investment is not large enough to justify the effort.

Information is also not intrinsically important. What information is important to you at a given time depends on your needs and interests at that time. If Wilbur makes a claim about OU's record in football ten years ago, you may doubt his recollection, but the topic probably doesn't matter enough for you to check. But *if* you have a lot of money riding on a bet about OU's record over the past decade, it would be important to find out if Wilbur really is reliable about such things. Whether this is so or not depends on your priorities and the situation. It is possible to spend too much time gathering information that we don't need and too little time gathering information that we do need. But most of us err much more in the direction of obtaining *less* information than we need, rather than obtaining too much. So, we'll focus on that here.

Information costs: costs in time and energy to obtain information

There are also cases where we need more information but there isn't time to get it. If you are driving down a country road and find someone who is bleeding badly after a motorcycle accident, it would be very useful to know a good deal about first aid. But you don't have time to acquire the information you need. It is useful to acquire such skill in first aid, but there will always be situations we aren't prepared for, and here we must do the best that we can.

Are There Even Experts in the Relevant Field?

In some areas, there may not be any experts at all. Are there people we can rely on to tell us the best name to give our new cat, or if Captain America and Superman would be friends if they were real people? In extreme cases, people claim to know things that couldn't possibly be known, at least not now. No one, for example, can now know whether there is intelligent life on other planets (though some people can make more informed estimates about such things than others). In cases where you can't be certain who, if anyone, is an expert, it is best to keep an open mind and remain undecided or, if you feel you must have some view, to accept an opinion very tentatively and provisionally.

Is the Source an Expert on the Relevant Issue?

We can only rely on an expert on matters that fall within their **field of expertise**. So, it is always important to ask whether the source is likely to be reliable about the subject matter at hand. Advertisements featuring celebrity endorsements often show people who aren't experts about the products they hawk. Lebron James probably knows a lot about nutrition, but he can't be relied on to know whether Wheaties are more nutritious than comparable cereals.

In most cases, though, the ad is probably not really designed to strike us as an appeal to expertise. It is so obvious that celebrities are rarely experts about the things they sell that we aren't likely to be taken in by them. Such advertisements are probably aimed more at getting us to identify emotionally with a product because we like (or want to be like) the celebrity selling it.

The views of famous people are often cited on matters where there are not experts. Albert Einstein is one of the greatest physicists who ever lived, and he did think carefully about many things. Even so, there is little reason to think that he discovered deep truths about religion or ethics. With the knowledge explosion, there are also people who were experts in a field, but who didn't keep up with things. If their information is sufficiently out of date, they may appear to be experts when they no longer are.

Is the Expert Quoted Accurately?

It should go without saying that the source needs to be quoted accurately, but we often fail to do this. Usually no one bothers to check, and so a misquotation or inaccurate paraphrase easily escapes notice. Misquotation is sometimes intentional; it can be useful to cite some respected person to help make our case. But human memory is very fallible, and a misquotation often results from an honest mistake. It is also possible to quote someone accurately, but to take their remark out of context or to omit various qualifications they would make. Such quotations are also of little value in constructing a good appeal to expertise.

Are the Experts in Substantial Agreement?

Experts in any area will disagree now and then, but in some areas disagreement is the typical state of affairs. For example, there is considerable disagreement among good economists on long-range economic forecasts or on the trends the stock market will take. There is little consensus among meteorologists about long-range weather forecasts. Able scientists disagree about the likelihood that there is life on other planets. When such disagreement is widespread, some of the experts are bound to be wrong, and we cannot reasonably expect that the expert we happen to rely on will be one of those who turns out to be right.

We can't expect total agreement among all the experts, of course, so again we face a matter of degree (the more agreement among the experts the better). In cases where reasonable disagreement is inevitable, it is impossible to rely uncritically on experts, and you must obtain as much information as you can and think critically about the issues for yourself.

Is the Claim Unusually Surprising?

When someone makes a claim that almost everyone agrees is true (e.g., that United States is in North America), they don't need to build a case for it. Life is short, and we don't want to hear arguments to support everything anybody says. But if someone makes a surprising or controversial or implausible claim (e.g., that vaccines cause autism), then it is *their* responsibility to give reasons for their claim.

The more implausible the claim, the heavier their burden of proof. The basic point is that people can be wrong, and if a claim is extremely surprising, it may be far more *likely* that the source made a mistake (or is lying) than that the surprising claim is true (we will return to this topic when we discuss appeals to ignorance in chapter 10.)

Is the Expert Likely to be Biased or Mistaken?

Experts are only human, and they are subject to the same biases and flaws as the rest of us.

Vested Interests

In some cases, an expert may have a reason to deceive us. There is a sucker born every minute, and experts can use their credentials to take advantage of this. There will always be people with advanced degrees or years of training who offer a quick fix in exchange for a fast buck. Doctors working for tobacco companies did many studies that allegedly failed to establish the harmful effects of smoking.

If it is obvious that someone stands to gain if we follow their advice, we are likely to be suspicious. But it isn't always clear when this is the case. For example, a skilled financial advisor often gets a cut if you invest your money in the mutual funds he recommends. The adjustor from the insurance company may well be an expert on roofs, but it can be in their interest to have the insurance company pay you as little as possible. Of course, such people are often honest and do give good advice, but it is always important to know whether others have something to gain before we follow their advice.

It is also important to keep in mind that we often have biases without even realizing it. We will talk about this in detail in chapter xx, but for now it is enough to note that a person's vested interest may be so engrained in how they view the world that they may not even realize it is leading to biased recommendations.

Honest Mistakes

Sometimes an expert has good intentions but is still prone to error for some reason or another. A referee who is usually good at telling whether a basketball player was guilty of charging may miss a call because they didn't see the action clearly. A conscientious psychiatrist who is adept at spotting problems in adolescents may have a blind spot when it comes to their own children.

5.4 Who Do We Listen To?

We are more likely to believe someone we regard as an expert than someone we don't. In numerous studies, people have been given a passage containing claims or arguments. Some of them are told that the passage is by someone they are likely to regard as an expert, e.g., a medical doctor writing in the *New England Journal of Medicine*, or a professor doing biological research at Harvard University.

Other subjects are told that the very same passage was from a source they are not likely to regard as an expert, e.g., that it's a translation from Pravda or the latest offering on Wilbur's Home Page. People are much more likely to accept the claims and arguments when they are attributed to the more credible source.

There is nothing inherently wrong with this. But this very sensible phenomenon creates an opening for people who want to influence or manipulate us. We can't usually identify an expert solely by what they say—if we knew enough to do this, we probably wouldn't need an expert in the first place. We have no recourse but to rely on characteristics that often accompany expertise—characteristics like title and the recommendations of others—that are good indicators of expertise. And so, someone who appears to have these characteristics can pass themselves off as an expert even when they really aren't.

5.4.1 Faking Expertise: The Aura of Authority

Halo Effects

When a person seems to have one positive characteristic or trait, we often assume that they have other positive characteristics or traits. This is called the **halo effect**. One positive trait seems to set up a positive aura or halo of other positive characteristics around the person (we will study halo effects in more detail in Chapter 15). It is legitimate to infer the presence of one positive feature based on other positive features only if there is a strong, objective connection between the two traits (we will see later that such a connection is called a *correlation*. Some traits, like a person's title and or institutional affiliation, *do* correlate well with expertise. But the correlation isn't perfect, and sometimes people with an impressive title or prestigious job are not experts at all. Moreover, some people will pretend to have characteristics that are good indicators of expertise as a way of taking advantage of us.

Titles

Medical doctors, lawyers, professors and so on have titles that often do signal expertise. Such titles also create such a strong halo that it extends to completely irrelevant matters. In an experiment conducted in Australia, a man was introduced to five different college classes as a visitor from Cambridge University, but different titles were attributed to him in the various classes. The titles were ones common in British and Australian universities. In the first class, he was introduced as a student, in the second as a demonstrator, in the third a lecturer, in the fourth as a senior lecturer, and in the fifth as a professor.

When he left, the students were asked to estimate his height. With each step up the ladder of status, he gained about half an inch, so that when he was a professor, he seemed to be two and a half inches taller than when he was a student. Since titles can create a halo that involves quite irrelevant factors like height, it is not surprising that they can create a halo that extends to expertise and, perhaps, even to traits like honesty. But unfortunately, although years of training often lead to expertise, they don't always lead to personal reliability. Late-night television is full of infomercials in which real doctors hawk quick fixes to help you lose weight, quit smoking, or get off the sauce. It is also possible to fake having a title. Con artists do it all the time. So, when someone claiming an impressive title offers us advice, it is always worth asking ourselves whether they really do have the training they claim to have and, if so, whether there are reasons why they might be biased or mistaken in the current situation.

Additional Indicators of Expertise

There are also **institutional halos**. We tend to think that members of prestigious institutions, e.g., Ivy League universities, are likely to be experts because of their affiliation. This is usually very reasonable, because institutional affiliation often is a sign of expertise. As with titles, however, it can be exploited by people with affiliations looking to make a fast buck, and it can even be faked by those who are skilled (and unscrupulous) enough to do so.

Self-assurance and confidence can also make a person's claims seem more credible. President Lyndon Johnson used to say, "Nothing convinces like conviction," and studies show that the more confident and certain a witness in a courtroom appears, the more believable others find her (though there is little correlation between confidence and accuracy). This seems to extend to experts in general. It is very easy, even natural, to think to ourselves: "That person wouldn't be sounding so sure of things unless they really knew, so…". But as we will see, the correlation between confidence and accuracy is far from perfect.

Clothes, jargon, non-verbal cues (e.g., "body language") and other image-enhancing devices can also be used to create an aura of expertise. The clothes we wear serve as indicators of status, which we in turn use as an indicator of expertise. One high-status "uniform" in our society is the business suit. In one study, it was found that people were over three times as likely to follow a jaywalker across a busy street if it was a man in a business suit.

It is no accident that people in commercials and ads often wear a white lab coat and sit in a book-lined study or an impressive looking lab. Such props create an atmosphere of expertise, and this can lead us to suspend careful and critical examination of their claims.

Intimidation

A fake expert can sometimes do a snow job by using a lot of technical jargon. Indeed, even genuine, well-meaning experts sometimes intimidate us with a barrage of technical terms. We are frequently reluctant to ask for an explanation that we can understand because we don't want to look ignorant or stupid. You may have experienced this on a visit to a doctor. They quickly describe what is wrong, often in words you don't understand, then confidently tell you what to do, while hurrying off to see their next patient.

In cases like this, it is important to stick to your guns. There is no reason why we should understand the jargon it took experts years to master. You are the one paying the expert, so you have a right to hear their opinion in terms you can understand, as well as to hear the reasoning behind their recommendations. Some people find it easier to do this if they write out a series of questions in advance. And if it turns out that the expert isn't genuine (an unlikely event in the case of most doctors), having to explain their terms may expose their lack of knowledge. Keep in mind if you are talking with an expert who is committed to you understanding, they will not be annoyed by your asking questions, because they want you to understand. Furthermore, truly committed experts are already trying to avoid jargon whenever possible when talking with lay people.

Stereotypes

Many people harbor stereotypes and prejudices which lead them to see members of certain groups as more likely to be experts than members of other groups. In our society, other things being equal, women are less likely to be viewed as competent experts than men. For example, male and female groups are more likely to adopt a suggestion if it is presented by a man, as opposed to the exact same suggestion, presented by a woman. Stereotypes can lead people to see members of certain racial or ethnic groups, people with regional accents, and even people with physical disabilities as less likely to have genuine expertise. (We will talk about biases in more detail in Chapter 17).

5.4.2 Appearing to Go Against Self-interest

We all know that if someone stands to profit when we take their advice, we should think twice before taking it. But it is possible to exploit the fact that people without a vested interested are viewed as more objective authorities. The trick is to appear not to be acting from self-interest while really doing just that.

Not long ago, a friend went shopping for a new television. The salesperson began by telling them that the Mitsubishi was the most expensive television the store carried, and that it was what the boss wanted pushed. Then, after looking around conspiratorially to make sure the boss wasn't within earshot, they confided that the Mitsubishi wasn't as good a bargain as a slightly cheaper model by Sony.

Although we can't know for certain what the salesperson's motives were, the claim seemed well-calculated to show that they were honest and had only the customer's best interests at heart. After all, if they were simply out to make a fast buck, they wouldn't have mentioned the defects of the Mitsubishi. But of course, the commission wouldn't have been much less for the Sony (which turned out to be the second most expensive model on the floor).

The psychologist Robert Cialdini took a job in a restaurant to study the techniques waiters used to maximize their tips. He found that the most successful waiter often used this sort of strategy. A large group would be seated. Then the waiter would tell the first person who ordered that the dish they asked for hadn't turned out very well that evening and would recommend something slightly cheaper. This would ingratiate them to the customers, sending the message that they were looking out for the table's interests, even at the cost of a larger tip. But it turned out that these waiter's tips were higher on average than the servers who did not do this.

A credible expert needs to have factual reliability and personal reliability. It is often possible to simulate the appearance of both, and many people make their living doing exactly that. In later chapters, we will see how easy it is to do this, but if you think about it you can find plenty of examples in your own experience. The less we think about the things we hear, the easier it is to be a patsy. As always, the moral is to think; the more tuned in we are, the easier it will be to think critically about what an alleged expert is telling us, and the better we will be able to evaluate it.

5.5 Evaluating Testimony in General

We constantly rely on the claims of people who are not experts in any well-established field. We ask a stranger for directions to the Student Union. We ask friends and acquaintances which restaurants are worth going to and which are best avoided. If we are contemplating dating someone, we might ask their exes how things worked out.

We also appeal to people in general; "They say that…". When we appeal to the fact that people in general (or people in some group we care about) think some claim is true, we are employing an appeal to authority called an **appeal to popularity**. Such appeals are common, and they *can* be very effective. In extreme cases, a **bandwagon effect** occurs, in which large numbers of people embrace a view (or support a cause, like a political candidate) because other people have done so. Some people jumped on the bandwagon, and since others don't want to be left behind, they jump on too. We should always be careful not to rely on popularity alone to establish the truth or falsity of a claim. It is important to remember popularity itself doesn't justify a view. If someone makes an appeal to popularity, we should ask ourselves why it is popular and if those reasons support the position independently.

When we appeal to the fact that people have traditionally thought that some claim was true, we are employing an appeal to authority called an **appeal to tradition**. Such appeals *may* be legitimate, but they *often are not*. It depends on whether the group, either people now or people in the past, are reliable judges regarding the issue in question.

Normally we believe much of what we hear, and unless there is a good reason not to, that is entirely sensible. But anyone can be mistaken, and sometimes people lie. Furthermore, there are various pitfalls, including halo effects. Just as we are more likely to take the word of people who seem to be experts, we are more likely to change our views due to claims by someone to whom we feel similar. We will also see that one of the strongest halos is created by physical attractiveness, and it has been found that people are more persuaded by people they find physically attractive.

Most of the considerations that are relevant to evaluating the reliability of experts also apply when evaluating the reliability of your roommate, your Aunt Sally, or even a stranger on the street. Indeed, we could regard such people as experts about some limited subject matter, like the restaurants in Norman, or romantic interludes with Wilbur.

The Seven Questions Revisited

Now, let's quickly run back through the seven questions to ask about alleged experts and see how they apply to testimony in general, regardless of the source.

1. Do we care enough about this issue to try to evaluate the likelihood that a given source about it is accurate?

    The general point here is the same, whether the potential source is a world-class expert or just someone we meet on the street. But the costs of getting information from someone you know or encounter by chance may be lower than the costs of getting information from an expert, so it may be reasonable to collect more information from those around you.

2. Is the issue one in which anyone can really be relied on to know the facts?

    The point here is the same, regardless of the source. If there are no experts in the field, then there is little likelihood that your friends and acquaintances will be particularly good sources of information about it.

3. Is the source generally right about this sort of issue?

    Perhaps Anne has always given good advice on fixing computers, while Sam has often been wrong. Sally has always provided good advice about who to date, while Wilbur's advice is hopeless. In such cases, we should consider the sources with the best track records to be the most trustworthy.

4. Is the issue one where people would mostly agree?

If there is little agreement among others about something, you are on your own.

5. Is the source's claim very unusual or surprising?

The point here is the same regardless of the source. If a claim is sufficiently unlikely, it is more probable that the source is wrong than that the claim is true.

6. Is there any reason to think that the source might be biased or mistaken in this case?

Breona is a good judge of people and full of insights about their personalities, but she has a blind spot about Eduardo. Dalton usually gives good advice, but he's really been stressed out lately. John saw the car that sideswiped me, but it was dark, and he could have made a mistake about its license number. Indeed, as we will see later in this module, even honest eyewitnesses are much less reliable than people commonly suppose.

7. Has the source been quoted accurately?

Xavier tells us that Breona said that Carmen and Jasmine are back together again. Is there any reason to think Xavier might be getting it wrong? As we add more people to the chain of testimony, we increase the possibility for error and as a result, our concern about the veracity of the claim.

5.6 Safeguards

The following steps will help us spot, and so resist, fallacious appeals to expertise.

1. **Actively evaluate** claims and arguments that matter to you.

2. Check the alleged source's **credentials** and **track record.**

3. Check **multiple and independent sources**, particularly if the stakes are high and/or the issue is important to you.

4. Determine whether it is in the experts' self-interest to **deceive** us (e.g., are they trying to sell us something?).

5. Determine whether there is some special reason why they might be mistaken on this occasion (even if they are usually credible).

6. Develop **your own expertise**.

7. Try to look at the issue from **multiple perspectives**.

1. Tune in

One of the greatest obstacles to evaluating potential sources of information is that we often listen to them with our mind out of gear. Many people for many different reasons want us to follow their suggestions, and this works best if we go along, passively, mindlessly, without really thinking about what they are saying. Habit, routine, and laziness encourage this. It requires an effort to think about things. But the more we do it, the easier it will become.

2. Check the Track Record

Check the alleged expert's credentials and track record. If they have a history of making mostly true claims in an area, that gives us a reason to trust their claims in this instance. If several of your friends have had good experiences with a doctor when they had colds, it's sensible to go to that doctor when you have a cold. If Jalen's claims about which courses to take have always been wrong, he's not a good person to ask the next time around. The track records of many publications are reasonably good, whereas the track record of the *National Inquirer* is not. Checking a track record can be difficult, but if the issue is one that really matters to us, it is worth trying to do.

3. Check Multiple and Independent Sources

When you are uncertain whether an expert's claim is correct, it is prudent to check several sources. Get a second opinion (and, if the issue really matters to you, a third or a fourth). But you must take care to find sources that are *independent* of each other. There is little point in checking several copies of today's *Washington Post* to be sure that the first copy was right. And if you ask six different people about the date of the final exam, but they all got their information from Wilbur (who misread the syllabus), you will still be misinformed.

When independent sources agree, you can have more confidence in their joint testimony than you could in the testimony of any one of them alone. In many cases, it is difficult to find multiple sources, but on the internet, where credentials and track record can be difficult to assess, finding multiple authorities is often quite easy. Indeed, you can use the internet to get a second opinion after someone you know has given you a first.

4. Consider Possible Biases

Ask yourself whether there is any reason why the alleged expert might be biased about this case. Do they have a financial stake in it? In the case of celebrity endorsements and infomercials, the biases are usually obvious. The person stands to make a fast buck from us if we believe what they tell us. But in other cases, vested interests may be less obvious. Indeed, in some cases, the vested interest may simply be the desire to seem right.

5. Consider Possible Sources of Error

Can you think of any reasons why the expert might make an honest mistake in this case? Might they have some sort of blind spot about it (as many of us do when it comes to our loved ones)? Are there reasons why the observations or tests might not be reliable (perhaps they are a good lab technician, but the police did a sloppy job gathering the DNA samples)?

6. Develop Your Own Expertise

In cases that really matter to you, you need, to some degree, to become your own expert. It is increasingly clear, for example, that people need to learn more about healthy lifestyles and how to manage their own medical conditions. In doing this we should of course rely on experts, but we have more firsthand knowledge about ourselves than others do, and we have a greater interest in obtaining accurate information about it.

7. Consider Multiple Perspectives

One of the best ways to avoid flawed reasoning is to think about the issue from more than one point of view. This strategy is less relevant to testimony than it will be to some of the things we will study later, but it is still useful to try to put yourself in the position of the source you are evaluating. Can you think of other perspectives from which the expert’s claims would seem less plausible? Would they have some reason to make this claim if it weren’t true?

In short, the key is to find *good authorities* who don’t have any reasons to misrepresent the facts. If the matter is important to us (as some medical questions are), we should also try to obtain several independent opinions from different sources. And we should always tune in when the topic is relevant to us. As we work our way through the course, we will find certain sorts of errors that we all tend to make. In cases where such errors are likely, it is important not to accept someone’s claim too quickly. But before turning to errors, we will devote a chapter to one of the most important sources of information in today’s world: the internet.

5.7 Chapter Exercises

1. For each of the following areas, answer these questions:

    1. Can there really be experts in this area? If not, why not?

    2. What sorts of people (if any) would be good experts in the field?

    3. What sorts of people might falsely bill themselves as experts about the topic?

    4. How could you try to determine whether an alleged expert in the area is a genuine expert (and, if so, how good an expert they are)?

1. How televisions work.
2. College football.
3. College football recruiting.
4. Shakespeare's plays.
5. Who's two-timing who in Belleville, Kansas [population 1,991].
6. Whether gay marriages should be legal.
7. The effects of your astrological sign on your behavior.
8. The existence of God.
9. Whether creationist theories about the origin of the universe are true.
10. How many days it will be until there is another mass shooting in the United States.
11. The artistic value of 1950's rock and roll music.
12. The precise number of people who lived on earth exactly 100,000 years ago.
13. Whether an accused murderer was criminally insane at the time she allegedly took the pickaxe to her victims.

14. The safety of nuclear power plants.

15. The morality of abortion.

16. Losing weight and keeping it off.

17. Whether gun control is a good thing.

18. Which majors are most likely to get well-paying jobs after graduation.

2. The following passages contain appeals to authority. Say whether the appeal is legitimate or not, and defend your answer. (from S. Chaiken "Communicator Physical Attractiveness and Persuasion," Journal of Personality and Social Psychology 37 (1979); 1387–1397)

    1. Most people who teach critical reasoning are very skeptical of astrological predictions. But people have been using the stars to make predictions for hundreds and hundreds of years. They surely wouldn't do this if there weren't something to it.

    2. Recent polls show that many people believe vaccinating children from measles causes autism.

    3. According to Einstein, the idea of absolute motion is incoherent. And that's good enough for me. (This is one where background knowledge is needed.)

    4. Both the Surgeon General and the American Heart Association insist that smoking is a leading cause of heart attacks. So, it's a good idea to quit smoking.

    5. The following passage appeared in Phil Dalton's column in *The Oklahoma Daily* (9/24/97, p. 4); how plausible is it?

        > I am not arguing for the legalization of marijuana. Instead, hemp should be legalized to help protect forests and woodlands and our rivers. (And yes, I did get all this information form the National Organization for Reform of Marijuana Law Website).

    6. Suppose that U.S. Senator Elizabeth Warren, who champions campaign finance reform, is arguing that the huge campaign contributions that large companies give to political candidates lead to a substantial amount of corruption in the American

political system (e.g., by influencing which laws get made). What questions should you ask to evaluate her argument? How might you go about finding information supporting the other side (that it really doesn't lead to much corruption)? How would you evaluate what you hear or read on this issue?

7. Give your own example of an area where there are experts, but where it is likely that they will frequently disagree with one another. If you had to make a decision that required you to know something about the field, what would you do?

8. Give your own example of an area where there really does not seem to be experts at all. If you had to make a decision that required you to know something about the field, what would you do?

9. The average child will have seen at least 8,000 murders and 100,000 other acts of violence depicted on television before they graduate from elementary school. Suppose someone uses this to argue that we should restrict violence on television. What sorts of information would you need to evaluate their argument? Could you get it without relying on others? What people would be likely to have accurate information about the matter?

10. Wilbur and Wilma are discussing capital punishment.

    1. Wilbur argues that capital punishment should be retained because it deters terrible crimes like murder. How might we decide whether he is right? Are there any experts who might have useful information on the matter? If so, what sorts of people are likely to be experts here?

    2. Wilma counters that we should abolish capital punishment because it is morally wrong. How might we decide whether she is right? Are there any experts who might have useful information on the matter? If so, what sorts of people are likely to be experts here?

11. Give an example of a celebrity endorsement. Do you think that such endorsements are an effective way of advertising? If you think that they are, explain why you think they work.

12. Suppose that you wanted to know about the long-term behavior of the stock market, so that you could begin investing a modest amount of money now, while you are still a student. Are there people who would know more about this than you do? If so,

who? Are these people likely to be experts? If not, why not? If so, how might you try to check the claims of one of the experts about how you should invest your money?

Answers to Selected Chapter Exercises

In many of the following cases there is no one right answer, but some answers are certainly better than others (and many possible answers are wrong).

1. How televisions work

(a) Likely experts: people who repair televisions, scientists and engineers who design televisions, some (though not all) people who sell televisions.

(b) Some salespersons act like they have more expertise than they do.

(c) Salespeople do often have something to gain by getting you to buy a television. Other things being equal, you would probably trust a salesperson who doesn't work on commission. But there is a great deal of variation among salespeople, and you cannot make a blanket generalization about them.

2. College football

(a) Likely experts: College football coaches, sportswriters and sportscasters. Even the experts will disagree about some things here, but coaches who are successful year in and year out have something going for them.

(b) Monday morning quarterbacks consider themselves experts.

3. College football recruiting

(a) Sports journalists, high school coaches, and perceptive fans may have a good idea about recruiting, but the best experts here are probably good recruiters.

(b) Fans who consider themselves experts.

5. Who's two-timing who in Belleville, Kansas [population 1,991]

(a) The point of this example is to emphasize that there are experts on all sorts of things. If you grew up in a small town (I did grow up in Belleville), you know there are town gossips who have all the dirt on everybody.

(b) Some gossips like to pretend they have the dirt even when they don't. If you want accurate rumors, it's best to find a reliable gossip (of course, as tabloid journalism attests, rumors are often more fun when they are inaccurate).

6. The effects of your astrological sign on your behavior.

   (a) There are no experts on this, because the planets and stars have no discernible impact on your character or behavior. Astrology is a pseudoscience.

Chapter 6

The Internet: Finding and Evaluating Information Online

Overview: The internet is an unparalleled source of information, but it can be difficult to track down what we want because there is so much information out there, with so little quality control. In this chapter, we learn how to search efficiently for information online and how to evaluate it once we find it.

Contents

6.1 The Internet

The internet is an unparalleled *source of information*. With computers in our homes and smart phones in our hands, we can instantly find information about almost anything – not trip to the library needed. But there are two problems you face as soon as you start looking.

Problems with researching online:
1. Information Overload
2. Quality Control

1. There are now several hundred million pages online, and about a million new pages are added every day. There is so much

information that locating what you need can be like looking for a needle in a haystack.

2. Anyone can set up their own website, so it is not surprising that there is almost no quality control. Even once you find information on the topic you want, it can be difficult to judge how accurate and complete it is.

In this chapter, we will learn about common pitfalls that can occur when using the internet as a source of information, and how to solve these problems.

6.2 Search Engines

A **search engine** is a piece of software that helps you find things. As internet access has become near ubiquitous in the industrialized world, we have come to take for granted that any time we want to know something we can just ask the magic box. Understanding how to use the tool and understanding how the tool works are different things, though.

6.2.1 How they Work

A search engine does not go out and search the web each time you type in a word or phrase. It is a service that indexes, or stores, a huge amount of information about the contents of many websites. This information is stored in a *database*. The database of a search engine contains a list of all the words in all the web pages that the engine knows about. If you type in a keyword or phrase, e.g., 'Mexican drug cartel,' the search engine will consult its database and give you a list of links to sites that contain information about Mexican drug cartels. These indexes are formed and updated by *web crawlers* – programs that copy webpages and repeatedly check for changes. New pages are found by the crawlers by following all links found in a page they have already copied, and the process just keeps on going. The end result is that a lot of webpages get indexed. In 2014, Google, the largest search engine in the world, estimated that they had indexed 35 trillion webpages. While this enormous number might make you feel like we've got the internet completely indexed, this only represents around 4% of the information that exists on the internet. When you hear people talk about the '*deep web*,' or the '*dark web*,' they are talking about the unindexed portions of the internet (the difference being the deep web is the part that hasn't been gotten to yet by crawlers, and the dark web is the part that is being intentionally hidden).

Deep web: Unindexed portions of the internet

Dark web: Intentionally hidden parts of the internet

The list of sites you are given by the search engine is ordered by the site's **algorithm**. The point of the algorithm is to organize the results of the search in an effort to get you to the information you want as quickly as possible, rather than a random list of pages containing the terms in any order. These algorithms are proprietary, so we don't know all of the factors that go into the ranking or the way these factors are prioritized. It makes sense that these businesses want to keep the full details of their programs a secret from their competitors, although the major ones have shared some insights into the process. Microsoft's Bing, for instance, includes click-through-rates as a part of its algorithm (pages move up and down the results page based on the frequency they get clicked), while Google does not. Conversely, Google relies heavily on what they call 'clean backlinks' (pages move up the ranking the more they are linked to by sites already trusted by Google, and down if they are linked to by disreputable sites) and there is no evidence that Bing cares about this.

Now all of this was likely more information than you wanted, but it's important understand how search engines work so we can make informed decisions about what search engine to use. Most of you likely default to using Google or Bing to conduct your searches. Do you have principled reasons for using the search engine that you do? Have you even thought about it? Well, now you know each search engine has its own index and its own algorithm, and that these can seriously impact the results we get. In the last chapter we discussed how, when an issue is important enough to us, the best safeguard you can employ is becoming an expert yourself. Unfortunately, this is going to be one of those issues. You might find it boring, but you need to learn a bit more about the ways the various algorithms work, or you won't have good reasons to trust the results of your searches. We're not here to tell you which search engine to use, but you should be making a considered decision on what to use, rather than just operating on default.

6.2.2 Some Additional Concerns

Search Engine Optimization

Another reason it's important to know how various search engines work is because it has become a big business to attempt to manipulate the results. Most people won't investigate below the first handful of listings in a search. Given this, it becomes very important for business to be as near the top of the list as possible (especially in large fields). This has given rise to *search engine optimization*, or SEO. SEO is the process whereby a website attempts to improve its ranking in searches. The way this is done is by leveraging what we know about the various algorithms. So, rather than creating its content and letting the algorithms work as intended, business are paying consulting firms to increase click-through-rates, clean backlinks, and all sorts of other maneuvers to trick the algorithm – and as a result, you as well – into thinking they are the best place to obtain the information.

Privacy

You should also spend some time thinking about your online privacy. Remember most search engines are a business. You are not being charged to use the service they provide, which should tell you the search engine isn't the product – you are. If you are logged into Google or Bing, then they are recording your search histories. These companies like to say they don't sell your personal information and that's true, but it isn't the whole story. They don't want to sell your information because what they are selling is the services that they provide with your data. The primary form of this is targeted ads. By understanding your viewing habits, these search companies can provide targeted ad services. You end up seeing more ads for things you are likely to be interested in, and as a result you are more likely to click on them and spend your money.

Your search history is by no means the only data these companies keep on you. Your whereabouts are tracked, as is your YouTube history (by Google), your video game habits (by Microsoft), the apps you use on your phone, and a myriad of other things you may not have realized. If you go to https://account.microsoft.com/account/privacy you can check you all the data Microsoft has been collecting about you through Bing and other means. You do the same for Google at https://myaccount.google.com./data-and-personalization. Both sites also offer you options to limit the data they collect and ways to delete already obtained information.

Investigate how search engines are tracking and monitoring you

If any of this makes you a bit squeamish then you might want to look into Startpage (https://www.startpage.com). Startpage.com is an alternative search engine that literally runs on Google's results. Instead of offering users their own algorithm, what they offer is privacy. Startpage doesn't record your IP address and it doesn't use tracking cookies. So, if you like how Google's algorithm works, but would like to avoid advertisements in your results and your search history being tracked and stored you have a simple alternative. Qwant (https://www.qwant.com) does much the same thing, using Bing's algorithm.

Global Perspectives

One final thing worth considering is that your understanding of search engines is going to be largely shaped by your background. As mentioned above most Americans default to using Google or Bing. While these search engines exist all over the world, they compose a relatively small share of the market in many countries and in some places, like China, they are actually banned. Understanding the other options out there and how they work can you help make better sense of how people in other places are getting their information. At times this might also help you find more accurate results. If you are looking to find the best borsht while visiting Moscow, you should probably be using Yandex and not Google.

6.3 Looking at Search Results

If you put in the hard work recommended in the last section, then you have a search engine that you trust. Once you've run your search, though, you still need to figure out what to do with the results you get. You could click randomly through the results, or you could just decide to go with the first one. Assuming you want to increase your chances of finding good and useful information, there are some more targeted strategies you can employ.

1. **Skip the promoted searches**
   This might seem obvious, but it we've all fallen for them at some time or other. In all major search engines, it will say in very small print under the web address if the listing is an ad, or "sponsored" "promoted" content.

2. **Read multiple results**
   It is fine to trust your preferred algorithm to give you the best results towards the top, but we need to also be mindful of search engine optimization. The best way to protect yourself from stealth marketing is to look at more than one result.

3. **Remember how to evaluate testimony**
   Last chapter we took a careful at how to evaluate the claims of others. Search results are just sources of information, and we still need to apply the appropriate level of scrutiny before we can trust them.

4. **Be willing to move on**
   While it is easy to find information on the internet, it is not always easy to evaluate the sources of information we find there. In cases where the author's credibility is difficult to establish (or when their identity is hidden) the best course of action is to move on and try another source.

6.4 Popular, but Troublesome Internet Resources

There are a lot of sources people consistently rely on to get their online information. We will look at some good places to go in section 6.5. For now, we are going to concern ourselves with some popular, yet unreliable sources of information online. This section is not intended to be exhaustive (there is a lot of bad stuff out there), but you should be able to learn broader lessons from this discussion that can be applied broadly. (We are not linking to these websites as, to varying degrees, we are encouraging you *not* to use them).

Wikipedia

Of all the sources of information we will consider in this section, Wikipedia is the most reliable. For those unfamiliar, Wikipedia is an internet encyclopedia. What sets it apart from other encyclopedias is that all its content is generated by its users. So, while a traditional encyclopedia pays experts and researchers to write entries, literally anyone can create or edit the entries on Wikipedia. This may sound like a receipt for disaster, but research has found that, for most entries, Wikipedia does a reasonably accurate job. You can test the site by going to an entry on a subject about which you are an expert and reading what it says.

That said, plenty of people do create *intentionally inaccurate* entries. The entry for the first law of thermodynamics was edited to say that “the first law of thermodynamic is do not talk about thermodynamics” and at one-point Mariah Carey’s entry was edited to say that she died of embarrassment. These edits are often obvious and can be amusing pranks. Still, it isn’t all that helpful if you’re looking for accurate information.

And things have gone far beyond pranks at times. Media critic Anita Sarkeesian was the subject of an organized online harassment campaign, and as a part of it, her entry was repeatedly edited to show pornographic images and threats of sexual assault. Wikipedia is also a very popular location to dox (releasing personal information, like home addresses) public figures.

Companies and individuals have also been known to alter entries as a form of marketing. In 2019, North Face changed images on entries for outdoor activities to promote their products. More sinisterly, Kim Schelble was found to have submitted an edit for a medical procedure that framed things in a light that was beneficial for the company he worked for. He attempted to change “controversial” to “well documented and studied.” Where Schelble failed others succeed, and there are now people who do this professionally.

Moving past intentionally false information, there are also issues with *inaccurate posts*. The more complicated or nuanced the topic, the fewer people there are who understand the subject well enough to explain it clearly. Most academics and professional researchers don’t consider updating Wikipedia pages to be a valuable use of their time, and the result is those updates come from passionate lay people. Almost every teacher has at least one story of someone who quoted a Wikipedia entry that says something wildly off base.

You should also be *mindful of bias* from editors in the way they present material. The more controversial the topic, the more likely it is that, intentionally or not, an editor has framed an issue in a way that doesn’t accurately depict the research. The decision to list arguments for a view can make it look like it is legitimate, even if those arguments are discredited. Sometimes attempting to avoid accusations of bias can do the same thing. At the time of this writing, the Wikipedia entry for abortion says, “the health risks of abortion depend principally upon whether the procedure is performed safely or unsafely.” This sentence tells us nothing useful (everything is safe when it is done safely) and certainly doesn’t tell the reader what they want to know, which is how safe is having an abortion (the answer is, very – you are 14 times more likely to die from childbirth).

Lastly, you should be aware that posts are only as accurate as their most recent update. So, in fields and areas undergoing rapid change, entries can become outdated pretty fast. This is especially true when the topic is one that doesn’t have a lot of interest.

Facebook

As a living person, you know what Facebook is. There are a lot of problems with this company, and you would likely find yourself much happier if you *stopped using it*, but we are going to focus on the problems with using Facebook as a source of information.

As with all social media, if you get your information about the world primarily from Facebook, you run the risk of finding yourself in a *bubble*. The people you are friends with on Facebook are people with whom you have elected to interact. As such, you are overwhelmingly likely to be interacting with people who think like you. If you are getting your news through Facebook, you are getting it through a filter that is overwhelmingly predisposed to your way of thinking. This means you are less likely to encounter new ideas, and it means you are less likely to encounter ideas that make you question your current beliefs. As if this weren’t bad enough, it also leads you to a lot of confirmation for views you support. This leads a lot of people to make appeals to popularity about things that may not even be that popular.

When you mostly see content that expresses the same views and opinions you are *in a bubble*

The problem is compounded by how Facebook works. The site makes it very easy to share posts, and the algorithm they use actually *promotes content* based on how likely it is to go viral (based on how similar it is to past viral content). This means that posts which invoke high emotional reactions are more likely to be seen and more likely to be shared. Just because a post makes a person feel like sharing it doesn’t mean it’s likely to be true, though. In fact, the opposite is probably the case.

In April 2020, Facebook announced there were over 40 million separate posts made with false information about Covid-19. 40% of these posts stayed up even after Facebook was notified by multiple organizations. This is the heart of why *you should avoid Facebook*. Users are largely left on their own to sort credible claims from misinformation. As a result, Facebook has been a breeding ground for conspiracy theories and organized misinformation campaigns. Studies out of Oxford and Princeton both founds that Facebook spreads fake claims faster than any other website or social media platform. The Princeton study found that Facebook referred users to untrustworthy news sources 15% of the time and they only referred to trustworthy sites close to 6% of the time (so this also means most of what you see is also coming from an unverified source).

Twitter
Twitter is a social media platform that is just microblogging. Users compose short posts, no more than 280 characters, and they show up in interface for people who "follow" them (although they are viewable to others if they search for them or if someone they follow aggregates them by 'retweeting'). Users are also able to respond to the posts of others. What is really great about this is it allows for relatively fast and easy communication between the generators of content and the audience.

Many of Twitter's problems overlap with Facebook. Because you must opt in to following a person, most Twitter users find themselves in a *bubble*. Misinformation also spreads quickly on Twitter because posts can be aggregated very easily. With just the click of a button something you see can be shown to all your followers. The result is many users see something they think is important and share it without ever verifying if the content is correct. Beyond the echo chamber and misinformation, we also need to be concerned about how commonplace the views we see are assumed to be. While a lot of people use Twitter (22% of adults in the U.S.) most of the content is created by the same very small group of people. Pew Research Center found that 80% of tweets are made by just 10% of users. This means that the views of a select few are amplified over everyone else, and we are likely to make wrongheaded appeals to popularity if use what we see as evidence for those arguments.

Unfortunately, there is more to Twitter's problems. While people are encouraged to interact on the platform as themselves, users can create anonymous profiles. When users post anonymously or using pseudonyms, it can be incredibly *hard to verify* their credibility on an issue. Twitter does allow for people to verify their identity (and they are awarded a blue checkmark to indicate this next to their username), but the process is difficult, and typically a person needs to have some level of celebrity. This means that even when a normal person appears to be posting under their real name/identity we can't be certain. A user may claim to be speaking from experience as a nurse, mother, teacher or whatever, but we as other users can't ever trust that this is the case. Users have even been caught using alternate accounts to post positive replies to posts made on their main accounts to manufacture a perception of credibility. The anonymity offered

It is all but *impossible* to verify the credibility of an anonymous user to users on twitter also encourages *harassment and trolling* since it is virtually impossible to hold nameless people accountable. We will discuss trolling more in section 6.6.

Reddit

Reddit is an incredibly popular message board community. *Message boards* have been around since the earliest days of the internet, but they had largely fallen out of favor until Reddit came along. The way message boards work is they divide their site into threads, and each of these threads houses a different conversation. If you've ever taken an online class with discussion boards, the structure is a lot like that. You have the main page that houses all the separate boards where conversations on different topics take place. Part of what makes Reddit different than message boards of the past is its scope. There are over 100,000 separate threads on Reddit (they call them '*subreddits'*). Whatever your interests, there is likely at least one subreddit about it. Seriously. Any topic. At the time of this writing, there are 13 separate subreddits on pimple popping. None of them have fewer than 100 members, and the largest has almost 16 million members.

The fact that Reddit has allowed people with similar interests to find each other certainly counts in its favor (even if it is incredibly weird that what brings some of them together is watching and talking about pimple popping). Unfortunately, much of how Reddit is structured makes it an *incredibly unreliable* source of information. For starters, users on Reddit are anonymous. Every user needs to set up a username, but that name does not identify you as a person in the real world. Just like with Twitter, this causes real problems for anyone trying to evaluate the claims made by a person. If you have a medical question and you ask it on the appropriate subreddit (which people do all of the time), you will get responses from people who claim to be doctors or to have the condition in question. There is no way for you to know if 'Windycitymayhem' is an expert, a blowhard, or a troll. Any information you get from Reddit will need to be independently verified to have any confidence in it – so you might as well skip over the anonymous advice.

Popularity ≠ accuracy

Another issue is that the site is literally run as a popularity contest. The posts made within a subreddit are displayed based on a popularity score given to them by users. If someone likes a post, or thinks it's interesting, they can 'upvote' it, which helps it move up the page, or 'downvote,' which moves it down. The lower on page a post is, the less likely it is to be seen. Answers/replies to posts work the same way. Users up/downvote replies, and they are displayed accordingly. For obvious reasons, this system is *not particularly effective* at identifying intelligent conversations or accurate answers. This system also means that content is strongly filtered based on the *biases* of users. Reddit users are overwhelmingly young (under 30), male, and white. As a result, posts concerning other groups (women, people of color, etc.) are often downvoted, as the average Reddit user sees them as unimportant. At its worst, this behavior elevates to outright harassment, with female users getting their posts in male-dominated subreddits (sports, videogames, etc.) downvoted into obscurity.

Earlier we said it was a good thing that Reddit allows people to find each other, but there is a pretty serious caveat to that claim – it also helps repugnant people find each other. Because the site allows subreddits to be created about virtually anything, the site has become a meeting ground for conspiracy theorists, white supremacists, misogynists, and every other type of bigot. These malignant views fester in the echo chamber Reddit gives them until they spill over to into the real world. And it does spill over. Gamergate, Pizzagate, and QAnon are all examples of dangerous conspiracies that gestated on Reddit and resulted in real world violence.

YouTube

There is some really good stuff on YouTube. If you have an interest in philosophy (and who wouldn't) you can watch the excellent Crash Course Philosophy. The problem with YouTube, as with so much on the internet, is its *algorithm*. More than 70% of the content viewed on YouTube comes from recommendations from the algorithm. This means that much of what we get out of the site is a function of what the site itself presents to us. A big part of what gets recommended has to do with "engagement" – how many likes and comments the video has gotten, how many times it has been watched, how often its host channel posts new content, etc. If you've ever asked yourself why most people end their videos with an appeal to "rate, review and subscribe," this is why. The more people interact with the video, the more other people will see it.

One consequence of this system is that videos from people with loyal and active fanbases are recommended at a very high rate. If all you are doing is killing time, this might seem good to you. Maybe one of these videos will be recommended to you, and you can become one more fan. If what you are looking for is accurate information, the system *doesn't really help you*. There is no reason to think that popular videos have good information. If you've ever watched videos from a popular YouTuber on a topic you know a lot about you have probably found yourself thinking "this person is full of it." It's because they are charismatic – not necessarily an expert.

Another issue is the algorithm has the effect of preferencing controversial videos. If you go to YouTube looking to learn about something you don't know much about, you are likely to find yourself watching videos that do not accurately represent reality. At the time of this writing, the top ten results for 'vaccinations' resulted in 5 videos touting false dangerous conspiracy theories, 3 arguing against the conspiracy theories, 1 explaining dog vaccinations, and 1 music video for a band called the Vaccines. Leaving aside the band and the dogs, all of the videos address conspiracy theories. If you searched looking to learn about how vaccines work or what they are, you would have failed, and this is pretty typical of the YouTube experience.

This problem is bad enough when dealing with searches, but the algorithm also has a tendency to move you away from accurate content if you do manage to find it. The issue is, the recommendations that come on the side bar (and that auto-play after your initial video is over) are being recommended with the same algorithm. So, even if you start by watching a quality post recommended to you by your instructor, you are only three or four videos away from garbage. In your authors' field, philosophy, it is shocking how quickly you are moved from lectures from highly regarded professors to pseudointellectuals arguing in favor of racism, misogyny and countless other forms of bigotry. These low quality and outright toxic videos benefit from a halo effect that comes from being associated with the original quality content – making people who don't know any better treat them as reliable.

6.5 Some Resources Worth Your Time

Having spent the last several pages cautioning you against sources you might have previously relied on, it is worth directing you to some resources that you can rely on.

Snopes and Politfact

Use respected *fact checkers* when information costs are high

As we have established, there is a tremendous amount of misinformation on the internet. Researching claims can be time consuming, and part of how we end up accepting false claims is by deciding that investigating them isn't worth the *information costs*. A reasonable safeguard we can employ is finding a reputable fact checker that we can trust to do the investigating for us. Two sites we recommend for fact checking are Snopes (https://www.snopes.com/) and Politifact (https://www.politifact.com). Both of these sites fact check all sorts of claim, but Politifact's focus is on political claims, while Snopes tends to have a broader scope. The way they both work is they explain the claim (including where it originated), give a rating as to how truthful it is, offer a full explanation of why they rated it the way they did, and provide citations for the sources they used to make their determination. When an issue is important enough to you, it is always best to do your own research. Snopes and Politfact are tools you can use to make your life easier, but they shouldn't replace your own research and judgment.

Digital Encyclopedias

Depending on the issues you are investigating, there is likely a reliable online encyclopedia. The benefit of a traditional encyclopedia is that the entries are going to be written by academics with expertise in the area, and they are going to be edited by other academics who know what to look for to ensure a fair and unbiased explanation. The authors of this text are philosophers, and we strongly recommend the Stanford Encyclopedia of Philosophy (https://stanford.library.sydney.edu.au/index.html).

Websites for Credible Print Media

If you want to know what is going on in the world, you should consult credible news sources. One good heuristic for finding a credible news source online is to consult the website of a credible print newspaper. The *New York Times* (https://www.nytimes.com), *The Washington Post* (https://www.washingtonpost.com) and *The Wallstreet Journal* (https://www.wsj.com) are all well regarded newspapers with large stables of excellent journalists. All things being equal, these sources are going to be far more reliable than the average online only source. (We don't mean this to be an exhaustive list – there are many excellent local and regional newspapers as well). Keep in mind, the credibility of the paper should be understood as stopping at the news division. Editorial pages are a different thing entirely, and you should hold the claims of editorials to the same level of scrutiny you would apply to any blog post.

6.6 Trolling

As mentioned in 6.4, online *anonymity* has allowed for people to engage in disturbing and repugnant behavior. Because we can't confirm the identify the users on most platforms, we can't hold them accountable for the things they say. The lack of accountability has allowed for trolling to become common place. Internet trolling occurs when users attempt to upset users rather than engage in an honest exchange of ideas. Trolling can take many forms. It can be as simple as sending insulting or harassing messages to a user, but it can also take relatively sophisticated forms that look to exploit how we reason in an attempt to disrupt open discussion and harm others. The following are some forms of trolling you should be on the lookout for:

Trolling = Harassment

> **Gaslighting** is a form of manipulation where the goal is to make the other person question their basic experiences and memories. This can be accomplished through a variety of methods. Most commonly you can see it in the form of gaslighters outright denying that they or others said or did things (even when there is written or video evidence to the contrary). Confronted with the evidence, they will claim that it is fake or taken out of context. It is also common for people engaging in this behavior to intentionally contradict themselves by expressing support "conceptually" for the views they are actively criticizing or working against. You can see this aspect of gaslighting when misogynists talk about their love and respect for

women, or when racists talk about all the people of color they are friends with. The final component of gaslighting is aggressive accusation. It is important to the strategy to put the other person on the defensive. As a result, gaslighters will accuse the other person of lying, engaging in bad faith arguments, and even the very behavior of which the gaslighter was initially accused. This may seem like it is merely irritating, but over time it has the effect of making honest, self-reflective people feel helpless to understand their own experiences, and it is a crucial component of virtually all abusive relationships.

Sealioning occurs when a user poses as if they are acting in good faith (trying to have a legitimate conversation), but instead they are trying to tie up the other user's time. When people request evidence, ask questions or attempt to get the initial user to respond to hypotheticals (sometimes referred to as 'whataboutism') it is often a sign that they are sealioning. This type of behavior can be incredibly frustrating, because all the things they are doing *could* be done in good faith. Users are being put in a position where they can invest time and energy engaging in the hopes of helping a person come to a better understanding, but if they are being sealioned, they are just wasting time. Over time, people who are victims of this type of harassment tend to stop interacting with people, and that is bad for anyone who thinks an open discourse is good.

Tone policing happens when a troll attacks a person for how they say something rather than what they say. When it is successful, a conversation can be hijacked from a real discussion about an issue and turned into a conversation about decorum. Tone policing is most often directed at women and people of color because it tends to leverage implicit biases about how groups of people are "supposed to act". We'll look at implicit biases more in Chapter 25.

Shitposting uses sarcasm, irony or absurdity in an attempt to get a reaction out of the person with whom you are interacting. It is often said that the goal of shitposting is to cause the biggest possible reaction with the least amount of effort. This behavior, when it is most successful, forces victims to respond to absurd accusations. Jo Swinson, a British politician, was accused of killing squirrels for fun so often online that she was asked about it in multiple interviews. In their most pernicious form, shitposts can even turn into conspiracy theories. Shitposts claiming that Hilary Clinton was a pedophile were circulated so widely many people began to believe them, and a man even attacked a pizza place named in the conspiracy while "investigating" the accusations.

It is also important to note that much of the trolling on the internet is organized. Twitter in particular allows for the creation of lists that group users. These lists can then be followed by users. This can be helpful if you are interested in engaging with a topic that is new to you. The problem is, white supremacists, men's rights advocates, anti-trans bigots, and all sorts of other malicious actors use these lists to direct others toward people to harass. Over the next several chapters, we will learn about how we think and process new information. These lessons will shed some light on why we should be concerned about trolling, and why it is so effective.

6.7 Chapter Exercises

1. The only way to get better at evaluating information online is to develop good habits. Try to find the answers to each of the following questions online and explain in a sentence or two how you found the answer, and how you decided your source was credible.

    1. Who is the highest paid player in the National Football League? How much did they make last year?
    2. What is the best recipe for chocolate chip cookies?
    3. Where is Kosavo?
    4. How many gun deaths have there been this year in the US?
    5. What is the graduation rate for your college?
    6. What is the weather going to be like tomorrow?
    7. What restaurant has the best Thai food in Tampa?
    8. What are the symptoms of breast cancer?
    9. How many people in the United States are attacked by sharks each year? How many are killed by sharks?
    10. Who played Michael Myers in the original *Halloween*?

2. Use Snopes and Politifact to investigate the following claims. For each, say if they are true, false, or partially true, and explain why.

    1. The moon landing was faked.
    2. Beyoncé is really an Italian woman.

3. There are only 18 minutes of action in a baseball game.

4. President Obama is secretly a Muslim.

5. Speaker of the House Nancy Pelosi was once drunk on the House floor.

6. A baby was born holding an IUD.

7. We only use 10% of our brains.

8. A shark was photographed swimming down the street in Puerto Rico after Hurricane Irene.

Chapter 7

Memory and Reasoning

Overview: Our memories do not store exact copies of data in the way that video tapes or CDs do. Memories are not fixed, inert encodings of information. Memory is active. It fills in details to make sense of data; it involves elaboration and reconstruction. This "filling in" is akin to inductive inference. The way we fill in the gaps, and even rewrite the past, is influenced by our expectations, emotions, and other features of the context in which we remember something.

Memory plays a key role in our thoughts, and so it is an important part of our study of critical reasoning. In this chapter, we will examine the infirmities of memory and learn some ways to guard against them.

Contents

7.1 Memory and Reasoning

The study of memory bears on our study of reasoning in three ways:

1. We often base the **premises** of our reasoning on what we think we remember. Since we usually trust our memories, such premises are usually thought to be especially secure.

2. Memory involves **inference**. This inference is influenced by our expectations, ways of labeling data, and even our biases, desires, and self-interest— the very things that so often lead to faulty reasoning.

3. Memory is susceptible to various sorts of errors, so we need critical reasoning to **evaluate** claims about what we remember.

Human memory is extremely impressive, but it can trip us up, and some of its errors lead to errors in reasoning. How good are our memories? We have all used hundreds of phones. What letters go on which buttons (figure 7.1)?

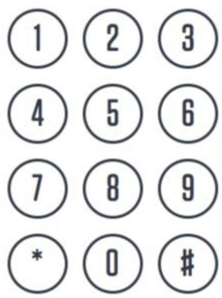

Figure 7.1: What's on the Phone?

We have seen thousands of Lincoln-head pennies. Which image is correct (Figure 7.2 on the next page)?

If we can't remember the details of very familiar objects like phones and pennies, we may wonder how accurately people remember the details of things they see only briefly. How reliable, for example, is eyewitness testimony likely to be?

7.2 Stages in Memory

Remember your old view about memory? Well forget it.

Most people think of memory as a storage device. It's like an information bank: we perceive something, store the information away in memory, and withdraw it later. We sometimes forget, to be sure, but when we don't forget, our memories are pretty reliable. On this view memory is passive; it is a record of things we experienced or learned. But this view is wrong. Perception, as we saw earlier, doesn't work like a video camera. And memory doesn't work like a video tape. Memory is active, and it involves reconstruction on our part. What we remember is jointly determined by the information that does get stored in our brains *and* by our reconstruction of it when we remember something.

Figure 7.2: Which Penny is Right?

Memory is not a single, unitary process or system. In the 1960s, psychologists thought that memory consisted of short-term memory, which fades very rapidly, and long-term memory, which is more permanent.

Nowadays, they more frequently draw a distinction between *working memory*, which holds a small amount of information for a short period of time (like the phone number we keep repeating to ourselves as we scramble for the phone), and long-term memory. But there are increasing signs that working memory and *long-term memory* each consists of further subsystems. We don't need to worry much about this, however, and a simple three-part division will serve our purposes here.

We can think of memory as involving the following three stages:

1. **Encoding:** occurs when we perceive something

2. **Storage:** which often involves

    (a) *Elaboration* (adding information to the memory)

    (b) *Revision* ("rewriting" the memory)

3. **Retrieval:** when we access/use our memories

    (a) *Recall*

    (b) *Recognition*

Encoding ⟶ Storage ⟶ Retrieval

Figure 7.3: Stages in Memory

7.2.1 Where Things Can Go Wrong

The *output* of memory—the thing we think we remember—is often different, sometimes dramatically different, from the *input*, and errors can creep in at all three stages in the process. This isn't to say that our memories are wildly inaccurate. Creatures with extremely unreliable memories couldn't survive for long. Still, important errors often occur.

This is easy to overlook, because we often fail to notice when our memories are inaccurate. After all, our memories usually do seem very accurate to *us*. Moreover, the details often don't much matter, so we don't notice when they are wrong. Finally, it is often difficult, or even impossible, to check a memory against what really happened.

7.3 Encoding

We encode information when we perceive something, and if we misperceive something, then our memory of it will likely be distorted. Errors in the input usually lead to errors in the output. In the chapter on perception, we saw ways in which perception—including perception in the extended sense that encompasses our emotions and feelings—can be mistaken, so inaccuracies and biases can be encoded at the very beginning of the memory process.

For example, many of the spectators at the Princeton-Dartmouth game perceived things in a biased way, so it is little wonder that later they didn't have accurate memories of what occurred. But the relationship between perception and memory is a two-way street. Perception is the input for memory. But memory provides the basis for our perceptual set—what we expect to see is determined by our memories—-so it in turn influences perception.

7.4 Storage

The chapter on perception shows that we sometimes inaccurately encode information, but once information is stored in the brain it might seem safe. Even here, however, our memories are active, and over time we unconsciously elaborate and revise the information we have stored. Since this occurs outside the realm of consciousness, it is sometimes difficult to determine whether the revisions occur during storage or during retrieval (for our purposes, it won't usually matter which is involved), but in many of the examples in this section, errors clearly occur during the storage phase.

7.4.1 Editing and Revising

A central theme of this book is that we have a strong need to make sense of our world, to understand why the things that matter to us (including other people and ourselves) behave as they do. This drive for explanation and understanding is so strong that it sometimes leads us to see patterns and reasons even where they don't exist, and to construct explanations even when we don't have enough evidence to warrant them. It can lead us to fill in gaps in our memories even when we have little objective basis for doing so. This will be clearer if we consider several examples that illustrate the varied ways we do this.

The Ants

Subjects in an experiment heard a story that contained sentences like:

- The ants ate the jelly.
- The ants were in the kitchen.

Later they were asked to identify the sentences they had heard. Most thought they remembered:

- The ants ate the jelly in the kitchen.

But this sentence wasn't in the story. What happened?

The subjects had, automatically, filled in gaps based on what they knew made sense. They didn't store what they had literally heard, but an organized, meaningful version of the story. This filling in of gaps is a type of *inductive inference*. It is a way of *updating* the information stored in our heads. In this case, the subjects had some stored information and then inferred things that seemed to follow from it. For example, they inferred that the ants ate the jelly in the kitchen. But this wasn't a conscious inference; they genuinely thought they remembered hearing the sentence.

The Graduate Student's Office

In another study, undergraduates were asked to wait in a graduate student's office. Later they were asked what was in the office, and most of them mentioned books. In fact, there weren't any books in the office. What happened? The subjects' memories had added a detail, based on the subjects' expectations about graduate students' offices.

The Dictator

In another study, people heard a fictitious story about a dictator. In one version, he was called 'Gerald Martin'; in another he was called 'Adolph Hitler'. The story didn't mention Jews. Many students in the group who heard the Hitler version of the story thought it contained the sentence:

- He hated the Jews.

Students who heard the other version did not. What happened? Students in the first group filled in a detail based on what they knew about Hitler. They drew an inference, unconsciously, based on common knowledge.

The Labels

In yet another study, people were shown several fuzzily drawn figures (figure 7.4). Half of the people were shown the figures with one set of labels; the other half were shown the very same figures, but with different labels. For example, a figure that was labeled as a barbell for the first group was labeled as a pair of glasses for the second. The people were later asked to draw the figures they had seen. What do you think happened? As you might have predicted, the pictures they drew were heavily influenced by the labels they had seen. What they remembered seeing was partly determined by the way in which they had labeled or classified it.

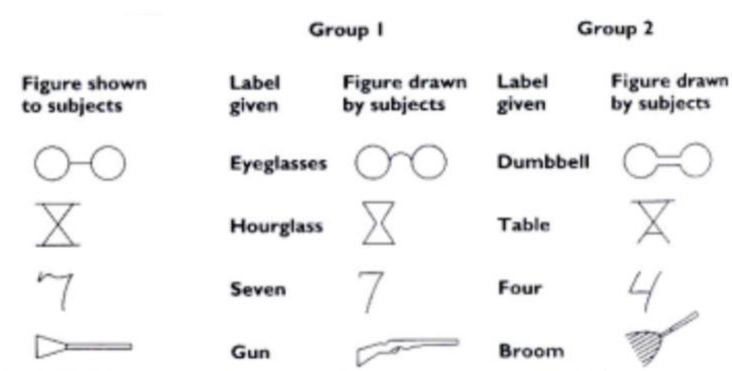

Figure 7.4: Classification and Memory

The Lecture

A group of people attended a lecture. Some of them later read an inaccurate press report about it. Those who read this report tended to remember the lecture as it was described, even though the description was inaccurate. They unconsciously edited their memories to match the report.

These five examples suggest a moral. Memory is not passive. It involves active reconstruction to make as much sense of the data as we can. This reconstruction is influenced by our expectations and what we know. In the next section, we will see that it can be affected by other factors as well.

7.5 Retrieval

There are two forms of retrieval. In **recall**, we actively remember a fact, name, etc. The example of the phone buttons requires you to recall which letters go with which numbers. By contrast, in **recognition**, we need only recognize something when we perceive it. The Lincoln-head penny example doesn't require you to describe or recall the face of a penny; it simply asks you to recognize the correct picture when you see it.

Although *retrieval* is a natural word for the elicitation of information from memory, reconstruction would often be more accurate. Retrieval is the joint effect of what is stored in the brain *and* of our present inferences about it. You can begin to see this if you try to remember the things you did yesterday and the order in which you did them. Yesterday's events do not pop up in memory, one by one, in the right order. You have to do some reasoning to see what makes sense. It might go something like this:

> Well, let's see, at noon I drove to Wendy's, but since I stopped by Homeland on the way I must have gone there before Wendy's. Then I went to the bank. Hmmm . . . . No that can't be right. That doesn't make sense, since I was broke and I had to go get money from the bank to pay for my moon pie and fries. So, I guess I went to the bank between going to Homeland and Wendy's…

The way we reconstruct items in memory is influenced—sometimes dramatically— by the context in which we remember. One way context affects memory is by providing retrieval cues. **Retrieval cue**s are features of the situation that help us retrieve information from memory. For example, if you are trying to recall someone's name, picturing them or recalling other information about them often helps you to remember.

Memory of an event occurs (by definition) *after* that event, and many things going on at the later time affect what we remember, how we remember it, and the way that we organize it into a meaningful pattern. Not only do we fill in gaps to help make sense of the earlier event; our memory of an earlier event is also colored by our attempts to make sense of the present.

Many features of a context can influence our reconstruction of the past. These include our current beliefs and attitudes, emotions and moods, expectations and set, motivations and goals (including the goals to look good and maintain self-esteem), the way questions are worded, and other peoples' suggestions. We will now examine the ways such factors can influence our memories.

Current Attitudes and Beliefs

We tend to remember our earlier beliefs, opinions, attitudes, and even our behavior as being more like our current beliefs and attitudes than they in fact were. Greg Markus conducted a ten-year study of changes in people's political attitudes over time. In 1973, he surveyed a group of graduating high school students, along with many of their parents. He asked them about their attitudes toward the legalization of marijuana, women's rights, affirmative action programs, equality for women, and several other social issues. Ten years later, he asked the same people (1) what their *current* attitudes on these issues were, and (2), what their earlier attitudes, in 1973, had been. Both the students' and the parents' memories of their earlier attitudes were *much* closer to their current attitudes than to the attitudes they had really expressed back in 1972.

In another study, people were asked to report on their political views in 1972. Four years later, they were asked what their current views were and what their earlier views had been. Many people's views hadn't changed, and 96% of the people in this group (correctly) reported that their views had remained constant. But some people's views had changed, and 91% of them (incorrectly) reported that their views had *not* changed.

How you remember things has a lot to do with how you see yourself now

People sometimes also remember their earlier behavior as being more in line with their current views and behavior than it really is. Linda Collins and her coworkers asked high school students about their use of tobacco and alcohol. Two and a half years later they asked them (1) what their current patterns of use were, and (2) what their *earlier* pattern of use, two and a half years earlier, had been. Their memories of their earlier pattern of use were closer to their current pattern than to the pattern they had reported earlier.

These results may explain why each generation of parents and teachers wonder why the current generation seems to be going to hell in a handbasket: "Why can't today's teenagers be more like we were when we were young?" Parents and teachers may be comparing their remembered version of their past (which is much more like their current views than their own past really was) with today's generation, rather than comparing how things really were in the past with today's generation. The effects discussed here are relatively modest, and people often do accurately recall their earlier views. But there is a definite tendency to see our earlier beliefs and attitudes as more like our current beliefs and attitudes than they really were. This fosters the view that our beliefs and attitudes are more stable and consistent over time than they are. This can lead us to suppose that our *future* beliefs and attitudes will be more like our present ones than they will turn out to be. To the extent that this happens, we have an inaccurate picture of ourselves.

Current Moods and Emotions

Cognition and emotion—thought and feeling—are more intertwined than we sometimes suppose, and our moods and emotions can affect memory. Although the evidence is cloudy, there is some evidence that people who learn material in one mood recall it more easily when they are in that mood. And studies of actual patients over a several year period showed that when people are sad or depressed they tend to remember more negative things. For example, they are more likely to remember their parents as unsupportive, rejecting, even unloving, then people who aren't depressed. This raises the question whether people are depressed because they had a bad childhood *or* whether they tend to remember having a bad childhood because they are depressed (it could be a bit of both).

7.5.1 Context and Retrieval Cues

It is often easier to remember something if we are in the context where we experienced it. This is called **context-dependent retrieval**. Being back in the original context jogs the memory by providing more *retrieval cues*. For example, you would probably find it easier to remember names of last year's acquaintances if you walked back through your old dormitory; it's full of cues that would help you remember the people who lived there. Or suppose that you are in your kitchen and think of something that you need do on the way to campus. You walk into the hall and can't remember what it was. Often going back to the kitchen helps you recall; it contains cues that help you remember what you forgot.

The importance of context shows up over and over. For example, students do better when they are tested in the room in which they learned the material. And smells are particularly powerful at evoking memories that are associated with them; they provide a cue that can awaken memories that are hard to access in other ways. It is also easier to remember something if we are in the same physiological state that we were in when we learned it. Here the context is physiological, inside our skins, and our own internal states provide a retrieval cue. This is called **state dependent retrieval**. For example, if you learned something after several drinks or cups of coffee, it will probably be easier to remember under those conditions.

Framing Effects: The Collision

When someone asks us to remember something, the way they word or frame their request can influence what we remember. Half the people in a group were asked, "How frequently do you have headaches?" and the other half were asked, “If you occasionally have headaches, how often?” The average response of the first group was 2.2 headaches a week, while that of the second group was 0.7 headaches a week. Similarly, it has been found that if you survey the people coming out of a movie and ask half of them, “How long was the movie?” and the other half, “How short was the movie?” those asked the first question will think the movie was longer.

In a study having more obvious real-life implications, Elizabeth Loftus and her coworkers asked subjects to watch a film of a traffic accident. Later they were asked:

- How fast were the cars going when they ______________ each other?

The blanks were filled in with different verbs for different groups of subjects. When people were asked how fast they had been going when they “smashed” each other, subjects remembered them going faster than when they were asked how fast the cars were going when they “contacted” each other. The results were:

1. smashed: 40.8/mph
2. hit: 34.0/mph
3. contacted: 30.8/mph

They were also more likely to remember seeing broken glass at the scene, even though none was present, when the collision was described in the more violent terms. Here, the experimenter’s wording affected what people remembered. If such small changes of wording can produce such dramatic effects, we must wonder what effects leading questions from a skillful lawyer, hypnotist, or therapist might have.

7.5.2 Schemas

We can tie some of these examples together with the notion of a *schema*. Our beliefs about the world in general also play a role in our construction of memories.

Consider the sentence:

- Wilbur was annoyed when he discovered he had left the mustard out of the basket.

What is the setting? Why should the mustard have been in the basket? Where is Wilbur likely to be when he discovers the mustard isn’t there? Someone from another culture might have trouble answering these questions, but you saw straightway that Wilbur has gone on a picnic and that he left the mustard out of the picnic basket. That was easy—but *how* did you know this?

There is now considerable evidence that we have well-organized packets of generic knowledge about many things, including picnics, graduate student offices, classrooms, visits to restaurants, and so on. These packages of information are called **schemas**. We won't worry about the exact nature of schemas, which isn't well understood in any case, but the basic idea will be useful.

Most of us have a packet of information about the typical picnic, a picnic schema. In the typical picnic, we pack food in a picnic basket, take along ketchup and mustard, eat outside, and so on. We can have picnics without any of these features, but such things are part of our picture of a typical picnic.

Schemas are very useful because they help us organize our knowledge and automatically fill in many details. A little information may activate the schema, and then we use the generic knowledge in it to quickly draw further *inferences* about the situation. For example, mention of a basket and mustard activate our picnic schema, and we can then use it to draw inferences about what Wilbur is up to. Similarly, your schema for a graduate student office probably includes having books in it, so it is natural to infer that it does.

Schemas enable us to form accurate expectations about a situation based on just a little information about it. These expectations may be wrong, but we will often be surprised if they are. For example, our schema of a classroom includes having a roof, and if you walked into a classroom and found no roof, you would be surprised.

Schemas figure in memory in the following way. If you remember a few fragments of experience that activate a schema, you then tend remember other things that are included in that schema. The knowledge in the schema helps you to fill in the gaps. Often this filling in is accurate. Most graduate student offices do contain books. Again, it is part of many people's schemas of classrooms that they have fluorescent lighting. It turns out that many people think they remember that a given classroom had fluorescent lighting, even if they didn't notice the lighting. In most cases classrooms *do* have such lighting, so this gap in memory would usually be filled in accurately. But we will be mistaken when we are asked about a classroom with some other sort of lighting.

Stereotypes

Not all schemas are accurate. **Stereotypes** are schemas, mental pictures we have of clusters of traits and characteristics that we think go together. Most

of us have various racial, ethnic, and gender stereotypes. Many of these are inaccurate, and they can lead us to perceive and remember and infer things in a distorted way. For example, you may have a stereotype about the typical New Yorker that includes being rude and pushy. If so, you are more likely to predict that a given New Yorker will be pushy, more likely to interpret a New Yorker's behavior as pushy, and more
likely to remember the behavior as pushy.

In later chapters, we will explore in more detail how the stereotypes and biases involved in racism and sexism work, along with how they impede judgment and safeguards to protect ourselves from these schemas.

7.6 Summary: Inference and Influences on Memory

The examples we encountered show that memory involves a good deal of reconstruction or inference, and this reconstruction is highly sensitive to context. What we remember can be influenced by:

1. Obvious inferences (the ants)
2. Common knowledge (Hitler story)
3. Expectations (graduate student office)
4. Labels and concepts (labeled figures)
5. Subsequent information (the lecture)
6. Current attitudes and beliefs (attitudes towards drugs)
7. Current moods and emotions (attitudes of depressed people)
8. Nature of retrieval cues, e.g., subsequent framing (the collision)

In short, there is a good deal of evidence that when we remember something we are engaged in a sort of inference that moves from information stored in our brain and the features of the situation in which we remember to a conclusion about what we originally saw, heard, or learned. This isn't a defect of memory. Indeed, it shows some intelligence to automatically try to make sense of things and fill in gaps and focus on essentials rather than on irrelevant details (like the exact wording of the sentences about the ants). It's just that sometimes the inferences lead us astray.

Many of the factors on this list can also influence reasoning, and memory is susceptible to many of the same kinds of errors that impact reasoning and inference. Because of this, memory can be critically evaluated just like any other source of information can. In the next chapter, we will examine common errors in memory and learn about some ways to avoid them.

7.7 Chapter Exercises

1. The way we word questions can affect the way people remember things. Give two examples of different ways of wording the same question that might elicit different memories. How could you test whether your questions really did this?

2. Rhea was walking home late last night after a few too many drinks. They see someone who may just have broken into their neighbor's house but can't remember much about the burglar. Under what conditions might they be more likely to remember?

3. Most of us have trouble with the penny identification exercise. This is nothing to be worried about; people who spent much time memorizing the details of such things need to get a life. Typically, we only need to know enough to recognize pennies when we see them in the real world. But when the situation changes, things that were unimportant may become important. For example, no one cared much about the appearance of quarters until the Susan B. Anthony $1 coin was introduced. It quickly fell out of favor because it was easily confused with a quarter. Give another example where remembering the details about something didn't matter until the situation changed. What is the moral of such examples?

Answer to Selected Exercises

1. There is typically little reason to remember much about how someone we see at a glance really looks. But if we learn they are the kidnapper, it becomes relevant. But think up an example of your own. One important moral of such cases is that what is important and relevant often depends on context.

Chapter 8

Memory II: Pitfalls and Remedies

Overview: In the previous chapter, we learned about several basic features of memory and a few of the ways they can trip us up. In this chapter, we will learn about additional pitfalls and some remedies for them.

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8.1 Misattribution of Source ("Source Amnesia")

Often, we remember something accurately, but we forget what the source was. We may even form quite mistaken beliefs about the source. We are wrong about where we learned it, when, and who we learned it from. For example, Ronald Reagan was fond of telling a story about a World War II gunner whose plane was severely hit by enemy fire. His seat ejection device malfunctioned, and the commander said, "Never mind, son, we'll ride down together." The commander, Reagan said, was awarded the Congressional Medal of Honor for this heroic act.

Misattribution of source: forgetting where we first learned something

It turned out that no medal had ever been awarded for this action, but that the scene had occurred in the 1944 movie *A Wing and a Prayer*. Reagan correctly remembered the story, but he was wrong about its source.

In extreme cases, we may not know whether the source of a current "memory" is an earlier event or something we merely imagined. And in some cases, where we can't remember a source, we (unconsciously) invent one. The hypnotist tells me that when I come out of my trance I will crawl around on the floor when he snaps his fingers. I later react to his cue when he snaps his fingers and someone in the audience asks me why I am crawling around on the floor. I will very likely make up an explanation right there on the spot—I'm looking for a pen that I dropped— and what's more, *I'll* believe it. In this case, I am the one taken in by the story I invent.

It is easy to laugh at some **misattributions of sources**, but we all make mistakes of this sort. Often our errors are harmless, but sometimes they aren't. It is likely that some cases of plagiarism involve source amnesia. An author gets an idea while reading, then later forgets that they read it and think that the idea is their own. Or we may think we learned something from a reliable source when in fact we got it from someone unreliable, which will make us more confident in our belief than we should be.

8.2 The Misinformation Effect

The psychologist Elizabeth Loftus had subjects view a simulated automobile accident at an intersection near a stop sign. Later, the experimenters suggested to one group that the sign was a yield sign. Still later, when subjects in this group were asked about the sign, many thought that they *had* seen a yield sign (subjects who had not heard this false suggestion were much more accurate about the sign).

In another study, Loftus showed subjects a videotape in which eight demonstrators burst into a classroom and disrupted things. Afterwards, she asked half of the subjects whether the leader of the twelve demonstrators was male and she asked the other half whether the leader of the four demonstrators was male. A week later she asked the two groups how many demonstrators there were. The average response of those who had been ask about four demonstrators was 6.4; the average for the half who had been asked about twelve was almost 9.

Misinformation effect: after exposure to subtle misinformation, people

Subjects in these studies were victims of the **misinformation effect**. When we are exposed to subtle, even barely noticeable misinformation, the misinformation often influences our memories. This occurred when subjects revised their memory of a lecture after a later report that they read about it. We could think of leading questions as a form of subtle suggestion, so the subjects who were shown the film of a collision were also victims of this effect. Clearly, our ability to reason critically and accurately will be impaired when our beliefs about the past are distorted by other people's manipulations, whether intentional or not, of our memories.

8.3 Confidence and Accuracy

8.3.1 Flashbulb Memories

Memories of some highly emotional moments seem particularly vivid and indelible; we are very certain that we accurately remember the details surrounding them. Most of you will have a clear and confident answer to the first question (and if you are old enough, to the other two as well).

1. Where were you when you learned about the Boston Marathon Bombing (April 15, 2013)? How did you hear about it? What else was going on around you then?

2. Where were you when you learned that two airplanes had crashed into the World Trade Center
(September 11, 2001)? How did you hear about it? What else was going on around you then?

3. Where were you when you learned that the Challenger spacecraft had exploded (January 28, 1986)? How did you hear about it? What else was going on around you then?

The events are so dramatic that it feels like a mental flashbulb went off, freezing a snapshot of things indelibly in our minds.

How likely is it that your memory about how you learned of the bombing is mistaken? How would you feel if it turned out to be dramatically wrong?

The day after the Challenger disaster, the psychologists Ulric Neisser and N. Harsch asked a large group of undergraduates to write down where they were when they learned about it, who they heard it from, and so on.

Two and a half years later, these people were again interviewed about the setting in which they learned about the explosion. The accounts of over one third of the people were quite wrong, and another third were partly wrong. When they were shown the statements they wrote right after the explosion, many of the people were very distressed. Most of them preferred their recent account to the original one; they thought it more likely that they had been mistaken the day after the disaster than two and a half years later.

We are so confident of these memories that the possibility they could be distorted disturbs us. But it turns out that there is not a high correlation between the vividness of a person's memory and its accuracy. Nor is there a high correlation between a person's confidence in a memory and its accuracy. Confidence and vividness are very fallible indicators of the accuracy of a memory.

8.4 False Memories

It is one thing to misremember the details of something; it is quite another to think you remember something that never happened at all. Fortunately, the former is far more common than the latter, but the latter does occur. For example, there are people who think they remember being abducted by aliens or having a past life or (closer to home) events from their childhood that never occurred. A **false memory** is one that is very inaccurate; it may even be a "memory" of something that didn't happen at all.

False memory: thinking we remember something that in fact never happened

Corroboration by another person is one of the most potent causes of false memories. Many other factors, even imagining something or recounting stories about it, can lead to false memories. For example, Maryanne Garry asked students about various kinds of events that occurred when they were children. Two weeks later, she had students vividly imagine that they had experienced various events occurring as children, e.g., that they hit a window, broke the glass, and cut their hand. Some of the students came to *believe* that they really had experienced such events, after imagining that they had done these things years before. One of the chief problems in assessing the accuracy of memories is that *false memories often feel just like accurate memories*.

8.4.1 Motivated Misremembering

Our desires and motives also sometimes lead us to misremember things. Most of us like to see ourselves in a good light, and so we are likely to remember things in a way that will protect our self-image and self-esteem. To see how common this is, just remember some situation where two people who live together argue about something, e.g., who did their fair share of the housework, or who is to blame for various problems. The two people probably had rather different memories about who did what, and each remembered things in a way that put them in a better light. Often both people's claims are sincere—they really think that their memories are accurate—but they can't both be right.

Sigmund Freud thought that we used defense mechanisms to protect our view of ourselves. A **defense mechanism** is something we do (typically unconsciously) to keep from recognizing our actions, motives, or traits that might lower self-esteem or heighten anxiety. Some defense mechanisms involve distortions of memory. The most extreme case is repression, forgetting things that are unpleasant to remember or face. This is the opposite of a false memory. Rather than remembering something that didn't happen, we erase the memory of something that did. It isn't clear how often repression occurs, but our memories are often clearly self-serving. We reconstruct the past in a way that puts us in a good light.

8.4.2 Childhood Trauma and False Memory Syndrome

False-memory syndrome: a pattern of feelings and thoughts based on false memories

In recent years, some psychologists have argued that certain childhood events (e.g., sexual molestation) may be so traumatic that people repress them. The memories would be so painful that the victims simply forget that they ever happened. But although they can't bring the experience into consciousness, its traces still linger in some form that leads to long-term problems like low self-esteem, depression, and sexual dysfunction.

Many people, often with the aid of therapy, have uncovered what they think are memories of childhood traumas like sexual abuse. How accurate are these memories? It is known that children are sexually molested more often than society used to suppose, and in some cases very traumatic events are forgotten. So, some of these memories are probably accurate.

Recently, however, some psychologists have argued that many of the reawakened memories are false memories, and they argue that the victim is actually suffering from false-memory syndrome. **False memory syndrome** is a pattern of feelings, emotions and thoughts based on distorted or entirely false memories.

This phenomenon is clearly seen in the Satanic Panic that swept through the US and Canada in the 1980's and 1990's. In Martensville, Saskatchewan for instance, more than a dozen people were charged with over 100 crimes stemming from accusation of being involved in a satanic cult. When the Royal Canadian Mounted Police took over the investigation, however, they concluded that literally no crimes were committed. How did this happen? A combination of poorly trained police investigators, psychologists asking children leading questions, positive reinforcement being given when allegations were made, and the fragility of early childhood memory are among the reasons (although many other biases we will discuss later also come into play).

Experts in false memory syndrome are quick to point out that although traumatic events are sometimes forgotten, they are usually remembered all too well. Furthermore, childhood memories of events that occurred before age three are very unreliable (the parts of the brain needed to store memories simply haven't developed enough before then). Later childhood memories are often accurate, but source misattribution and misinformation effects plague us all. Children have been shown to be particularly suggestible, and they often receive subtle—and sometimes not-so-subtle—suggestions from a parent, therapist or other authority figures. Suggestibility is a less serious threat in older patients, but anyone could have a motivation to misremember in ways that help us make sense of our experiences and preserve our self-identity.

8.5 Belief Perseveration

There are additional problems with memory that pose obstacles to clear and careful thinking, and we will examine several of them in the remainder of this chapter. Many studies, and much ordinary experience, show that we tend to retain a belief even after our original reasons for thinking it true have been undermined. Such beliefs are so thoroughly entrenched that they are impervious to evidence that would discredit them. This phenomenon is known by the ugly name of **belief perseveration**. Once something gets into memory, whether it is accurate or not, it can be difficult to get it out.

Belief perseveration occurs in many psychology experiments. If the subjects in certain psychology experiments knew the true purposes of the studies, they might act in ways that would undermine the experiments, so they are often given a false cover story. For example, people in an experiment about conformity might be told that they are in a study about perception. That way, subjects are more apt to behave as they normally would. Once the experiment is over, the experimenter is required to "debrief" the subject, to explain the real purpose of the experiment. But it has been found repeatedly that even when the true purpose of the experiment is explained in detail, many subjects persist in thinking that the earlier account, the false cover story, was right. They are victims of belief perseveration.

Belief perseveration: tendency to continue to believe something even after we get evidence it isn't so

Many of our stereotypes are also resistant to change, even after we encounter numerous examples that don't fit our stereotypes. We will examine some of the reasons our beliefs are resistant to change in later chapters.

8.6 Hindsight Bias

When we learn some fact or the outcome of some event, we have a strong tendency to think that we would have predicted it beforehand. This "I knew it all along" syndrome is called **hindsight bias**. Hindsight bias has been found in elections, medical diagnoses, sporting events, and many other settings. A consequence of this phenomena is it confirms a base belief that we almost all have that we are right ("I knew that would happen") more often than we really are. This makes it more difficult to correct our mistakes by learning from past errors, since we don't even notice them. As a result, people who find themselves falling victim to hindsight bias frequently are less likely to be fallible about any of their beliefs.

Hindsight bias: I knew it all along

Remedies

Warning people of the dangers of hindsight bias has little effect. But we can reduce it by considering how past events might have turned out differently. Ask yourself what alternatives might have occurred, and what factors would have made it likely that they would have happened. Additionally, if you are making a prediction that is genuinely important to you, a written record can work as a real safeguard.

8.7 Inert Knowledge

We have a great deal of knowledge stored in memory that we can't access when we really need it. We know it, but we just don't think about it in cases where it applies. The philosopher Alfred North Whitehead called this **inert knowledge**.

Most of you remember the Pythagorean theorem. It tells us how to calculate the length of any side of a right triangle if we know the length of the other two sides (if *h* is the length of the hypotenuse and *a* and *b* are the lengths of the other two sides, then $h_2=a_2+b_2$). On two different occasions, I have seen people engaged in minor construction (building a doghouse and building a bookcase) who went to all sorts of trouble to figure how long various boards should be cut. They could easily have answered their questions by using the Pythagorean theorem, but it just didn't occur to them to do so. When I mentioned the theorem, they remembered it, but they hadn't realized that it applied in the case at hand. They didn't "code" the situation as one where it was relevant, so their knowledge of the formula remained inert, or dormant.

Inert knowledge: knowledge we can't access when we need it

The chief problem with many courses, including critical reasoning courses, is that the knowledge you acquire in them will remain inert. When you take a class, you usually remember things when you need them on a test. But the material is useless unless you can also apply it outside of class. It is surprising, and depressing, how difficult this is. Some of you will become teachers, and this will be a problem you will constantly face. It helps if you think of examples of things, e.g., belief perseveration, from your own life and if you watch out for them outside of class. It also helps if you learn to recognize cues that signal the relevance of something you have learned (like the rules for calculating probabilities, which we learn below) to a given problem.

8.8 Eyewitness Testimony

Many crimes would never be solved without eyewitness testimony. But how good is it? Study after study shows that people in general, and particularly jurors, put great confidence in the testimony of eyewitnesses. It has also been found that the more confident a witness sounds, the more persuasive they are.

But it has also been found that witnesses who seem the most confident are by no means always the most accurate. Indeed, eyewitnesses, whether confident or not, are often mistaken. Even when they make every attempt to be honest and conscientious, as most do, their memories are subject to all the infirmities discussed earlier in this chapter. Indeed, many studies show that the descriptions of eyewitnesses are often dramatically wrong, and many innocent people have been convicted on the basis of well-meaning, but inaccurate, eye-witness testimony.

By now the fallibility of eyewitnesses shouldn’t seem that surprising. After all, they often get only a quick glimpse of the perpetrator. In the case of violent crimes, they are likely to feel stress and fear, which degrade the ability to remember details. There are further problems with police line-ups. Most witnesses believe that the guilty person is in the line-up, so they often select the person who looks most like the person they saw. Furthermore, police prompting or leading questions can lead to misinformation effects.

You have now learned enough about memory that you should be able to think of various things that would enhance the reliability of eyewitnesses and, indeed, of anyone else who is trying to remember some event. What might you do? Could you employ retrieval cues? What things should the questioner avoid doing? We will return to these questions below, but you should try to answer them now.

8.9 Primacy and Recency Effects

8.9.1 The Primacy Effect

John is envious, stubborn, critical, impulsive, industrious, and intelligent. In general, how emotional do you think John is? (Pick one).

Not emotional 1 2 3 4 5 6 7 8 9 Extremely emotional

Some memory effects depend on time, on the temporal context. Particularly, early items in a list like this influence our impressions and inferences about someone much more strongly than later items do. This stronger influence of earlier items or situations is called the **primacy effect**. The primacy effect means that events or features appearing early in a series are easier to remember than later ones.

Primacy effect: early items influence us more than later ones

Other things being equal, first impressions (and to a lesser extent, second and third impressions) have a stronger impact on people than later impressions. There are many situations where this is relevant, including the first impression you make on a date or at a job interview. The first sentence, paragraph and page of a paper make a first impression on its readers, and if it is bad, they are likely to judge the whole paper as bad. The first quiz or exam you take in a course might also influence the professor's evaluation of your work generally (which is why good teachers should grade blind).

One plausible explanation for the primacy effect is that we have a limited amount of time and attention, so we can't constantly monitor everything and update our views. If this is correct, the effect may involve attention and perception as much as memory, but it shows up when we think back over the series of things. By giving more weight to early impressions than to later ones, we rely on a *biased sample*. This leads us to draw inferences based on inductively weak reasons. Such inferences are flawed. But if we are aware of this tendency, we can try to avoid it in ourselves. We can also try to create the best first impression that we can.

8.9.2 The Recency Effect

Although the first items in a series tend to be given more weight than later ones, items at or near the end of the series may also be given more weight than average. This seems intuitive: items near the end are fresher in our minds.

Recency effect: later items also influence us more than ones in the middle

Which effect is stronger? There is some evidence that when presentations are involved, there can be a strong recency effect. But when we judge other people, the primacy effect is much stronger. But even this depends on the context. Early in a relationship, first impressions loom large, and initial attraction can overpower red flags. But after thirty years of marriage, the first impression won't matter as much as later impressions.

In a detailed study, Miller and Campbell edited court transcripts in a case seeking damages due to a defective vaporizer. All the material supporting the plaintiff was placed together in one long block, and all the material supporting the other side was placed in another long block. The existence of primacy and recency effects depended on delays in the process.

1. If people heard each side's case and then made a judgment about them, neither a primacy nor a recency effect was observed.

2. If people heard both messages back-to-back, then waited a week to make a judgment, there was a primacy effect (the view presented first did better).

3. If people heard one message, waited a week to hear the second, then immediately made a judgment, there was a recency effect (the view presented last did better).

What might explain this? When there was a week between presentations, people remembered much more about the side presented last. This seems to explain the recency effect in these conditions. What might explain the primacy effect where it occurs? The study suggests a bit of advice. Speak first if the other side will speak right afterwards and there is a delay in the response to the presentations. But speak last if there will be sometime between the two presentations and the response to the presentations will come right after the second.

One great thing about understanding primacy and recency effects is this is an area where obvious safeguards present themselves. The more information is presented in relatively brief chunks, the more beginning and ends there are for the primacy and recency effect to take hold. The middle is where more information is lost, so by minimizing the amount of middle, we minimize loss. This explains why the information in this text is presented in so many sections. You can use this to your benefit as well, by pausing between sections to reflect on the material before moving on to the next section. You have likely noticed that when you sit down and just read a chapter of any textbook in one sitting, very little of it manages to be encoded.

8.10 Collective Memory

Individuals have memories that are stored in their brains. Societies and cultures, have a sort of collective memory that is embodied in their beliefs and legends and stories about the past. Social scientists have found that collective memories change over time, and such memories are often quite different from the original events that gave rise to them.

Collective memory: how an entire group remembers something (often inaccurately)

Sometimes people in power, particularly in totalitarian societies, set out to revise collective memory. There are many techniques for doing this, including rewriting textbooks, constantly repeating the rewritten version of history, and forbidding discussion of what really happened. Some of the things that lead to distorted memories in individuals are different from those that lead to distortions in collective memory. But can you think of any similarities?

8.11 Remedies

Hypnosis is not the Answer

We often hear that people can recall things under hypnosis that they couldn't otherwise remember, and to some extent this is true. But hypnosis does not provide a magic route into memory. In fact, people under hypnosis are particularly susceptible to misinformation effects, often stemming from leading questions from the hypnotist. They are also susceptible to misattribution of source, since an accomplished hypnotist can often get them to believe that they really remember something which the hypnotist in fact suggested to them while they were hypnotized. Indeed, hypnosis is often an effective technique for implanting false memories. Hypnotists can induce their subjects to "recall" all sorts of outlandish things while under hypnosis, including alien abductions and events from "previous lives."

8.11.1 Safeguards

We can put the elements we have learned together by asking what makes memories more accurate and what make them less so. The lessons are completely general, but to make this more concrete, think about eyewitnesses. What would help make eyewitnesses more accurate? From what we have learned, it would be useful to encourage them to use *retrieval cues* by asking the witness to visualize the crime scene, recall the weather and time of day, remember their mood, sounds, the obvious things that they saw, and so on.

What would make eyewitnesses less accurate? We should avoid asking leading questions or making even vague suggestions that could lead to source misattribution or misinformation effects. It would be better to encourage the witness to recount their memories without any interruption and noting every detail, however trivial. We should only ask questions after they have completed their story. These techniques do improve the reliability of witnesses, in some studies by as much as 50%. The idea is simply to use the elements that improve memory, (e.g., retrieval cues), while steering clear of the more easily avoided phenomena, (e.g., leading questions), that lead to mistakes. The lessons here are perfectly general. They apply to a therapist trying to find out about a client's childhood, in daily life when we wonder if someone else's memories are accurate, and to ourselves when we are trying to remember some fact or event.

8.11.2 Ways to Improve Memory

There are many techniques for improving your memory. We will focus on those that are especially relevant to college students, namely doing a better job of remembering what you learn in your courses, but many of the points apply to a much wider range of settings.

Be Active

It is almost impossible to remember (or even to fully understand) material if you are passive. If you just sit back and listen, you will retain very little of what you hear. Being active doesn't mean multitasking, though. If you are watching tv and reading your textbook, you aren't likely to remember much of either. Being active means doing the following:

Integrate the Material with What You Already Know

We remember what we are actively involved with. So, organize material in a way that allows you to fit it into a pattern that connects with things you already know. We are much better at remembering things we understand. So, you need to integrate new material with your current knowledge. Think about ways to apply what you are learning in this class to things that are important to you. In a later chapter, we will discuss probabilistic reasoning. While this might seem boring, if you play poker or other card games you are going to see a marked improvement if you manage to integrate the new information. Similarly, while the authors have worked hard to give you examples for the concepts in this text, coming up with your own examples is going to improve retention considerably. Integrating the material with the rest of the things that you know will help you see patterns and connections, and that will help you remember and apply it.

We remember what we understand

To integrate new information with things you already know, you need to put things in your own words, think of examples from your own life, and ask how the principles would apply outside of class. Otherwise, the material will simply seem to be a series of isolated, unrelated facts that don't add up to anything. This explains why so many students struggle in classes like math and English – it can be hard to see how the content has a direct impact on your life.

Here's an example from earlier in this class. Most of you can repeat the definition of a *valid argument*. But unless you understand why validity is so important and learn to distinguish valid from invalid arguments, you won't really understand the definition or be able to integrate it with other things you have learned. In fact, you won't even be able to remember the simple definition for very long.

Lectures

You will play a more active role in your own learning if you sit near the front of the classroom and get involved. You should take notes; this not only gives you a record to study later, but it reduces passivity. But the notes should be brief, in an outline style. Write them as if you were writing newspaper headlines: pack as much information as you can into the fewest words. You should also put things down in your own words. This requires more mental effort, but this effort will make it easier to understand and remember the material.

Asking questions and giving examples when a teacher asks is also important. When you ask questions about things you don't understand you are actively working to learn the information. Don't assume it will click eventually—ask! Similarly, framing the material into your own examples forces you think about the material as it is being discussed, and it gives you immediate feedback about how well you understand.

Most forgetting takes place soon after learning. So, it is very useful to quickly review your notes soon after a lecture. It is also better to spend a few minutes reviewing it several times than to spend a lot of time reviewing it once.

Recordings Aren't Much Good

Recording lectures is a very bad way to learn. It encourages passivity. You just sit back, tune out, and let the recorder do the work. But the recording can't distill and organize material, much less put things into your own words. You also lose out on the visual information, which is better for conveying certain concepts and principles than words are. Finally, the recording of all the lectures between two exams will be 20 or 30 hours long, and the chances that you—or anyone—would really listen to all of them are very slim. And even if you do, you will be so overwhelmed by 20 hours of tapes that you won't be able to remember much of what you hear.

Reading

Quickly skim through section titles to get a sense of organization. Then read with your mind in gear; if something is unclear, try to understand it before going on to the next thing. Finally, after each section, pause and ask yourself what its main points were and try to think of ways the material is relevant in your life outside the classroom.

8.12 Chapter Summary

1. Memory involves a good deal of reconstruction, which is highly sensitive to context.

2. What we remember is affected by our expectations, emotions, labels, and the context in which we remember it.

3. Hence, memory is susceptible to many of the same kinds of errors that reasoning and inference are.

4. Because of this, memory can be critically evaluated just like any other source of information can be.

8.13 Chapter Exercises

1. If a professor is trying to learn the names of their students, which names do you think they'll find it easiest to learn? Would names at the beginning be easiest? The middle? The end? Why? How would you test a hypothesis about this?

2. If you are interviewing for a job, would you like your interview to come near the beginning? The middle? The end? Why? How would you test a hypothesis about this?

3. Imagine you meet someone who claims to have a very vivid memory that they heard about Kennedy's assassination during their lunch break. What might we do to discover whether this is accurate or not?

4. Suppose that you were teaching a course in critical reasoning. What would you do to combat the problem of inert knowledge?

5. Give a specific, detailed (half a typed page) example of an assignment on the concept of deductive validity that is designed to give students a working (rather than merely inert) grasp of the concept.

6. Give a specific, detailed (half a typed page) example of an assignment about some topic in this chapter that is designed to give students a working (rather than merely inert) grasp of the concept.

7. Think of a case where you held some belief long after the evidence suggested that you should abandon it. Write a paragraph describing this situation; include a discussion of factors that might have led to the perseverance of this belief.

8. One problem in assessing reported memories of childhood traumas is that we usually can’t check a person’s childhood to see whether the reported memory is accurate. But sometimes we might be able to gather evidence that would help us evaluate such a claim in a rational way. Give some examples of ways in which we might be able to do this.

9. Give some examples of the collective memory of people in the United States. Clearly some of the issues involving memory distortion in individuals are different from those in distortions in collective memory. But can you think of any similarities?

10. Think of a case where you thought that you remembered some event but later learned that the event had occurred rather differently from the way that you first thought. Write a paragraph describing this situation; include a discussion of things that might have led to the mistaken memories.

11. Look up the case of Ronald Cotton. Explain how this wrongful conviction happened using the concepts from this chapter.

12. Explain the concept of source amnesia (i.e., misattribution of source), and give an example. Then discuss how it could be a danger in some concrete situation.

Chapter 9

Emotions and Reasoning

Overview: Human reasoning never occurs in a vacuum; it is done by real people with needs, desires, feelings, emotions, and moods. Many emotions are extremely valuable, and our goal should not be to set them aside every time we engage in reasoning. But intense emotions like anger and fear can cloud our judgment, and other people can exploit this to derail a discussion or, worse, to manipulate us without our even realizing it. Moreover, some emotions provide an *incentive* to think badly to avoid unpleasant facts about ourselves or the world. In this chapter, we will study some of the ways that emotions can impede clear thinking; we will then examine strategies to minimize their damage.

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9.1 The Pervasiveness of Emotions

Good thinking involves reasoning, not rationalization. It is based on what we have *good reasons* to think is true, not on what we would like to be true. This shouldn't lead us to abandon emotions when we are thinking about things—we couldn't do so even if we tried. Emotions are a very central and important part of being human, and we are not like Mr. Spock on *Star Trek*, who is largely unaffected by feelings, nor would we want to be. Furthermore, emotions play a central role in *motivating* our actions. If we love someone, that will lead us to treat them in certain ways; if we hate them, we will treat them quite differently. If we lacked emotions, we wouldn't be motivated to do much of anything.

Emotions are a very mixed bag; they include joy, love, compassion, sympathy, pride, grief, sorrow, anger, fear, jealousy, envy and hatred. Although it is sometimes useful to speak as though emotions were one thing and thought was another, there really isn't a very clear line between the two. Emotions are not simply non-rational states that just happen to us. They can be more or less rational, more or less supported by the evidence, and they are susceptible to rational evaluation. It makes sense, for example, to be angry in some situations but not in others. If I have evidence that Wilbur has punched Sam simply because he likes to hurt people, it makes sense to be angry with Wilbur. But if I'm angry with Wilbur just because I don't like his looks, anger doesn't make sense. In some cases, jealousy has a basis in fact—a person really has taken up with someone else; in other cases, someone dreams things up simply because they are insecure. Jealousy may not be a good emotion in either case, but it makes more sense in the first case than it does in the second.

It is entirely reasonable to let our emotions and needs play a role in our plans and decisions; the fact that you love your child or take pride in your work gives you an excellent reason to take care of your little Wilbur and to do your job well. The fact that you are afraid of lung cancer gives you a good reason to stop smoking. The pity you feel for starving children is a good reason to donate money to charities that give them food. Indeed, without emotions you probably wouldn't care enough about anything to bother taking an action. But it's important to guard against the intrusion of emotions into places where they don't belong.

9.1.1 Emotions and Information

Emotions can affect all the other factors that we examined earlier in this module.

Perception

Our moods influence how attentive we are to our environment. People who are elated or depressed are often preoccupied with how they feel, and they focus less on what's happening around them. Emotions also affect our perceptual set, and so they color how we perceive things. For example, the people who watched the Princeton and Dartmouth football game (p. xx) probably saw it differently because of how they *felt* about their team. They identified with their university and its team, and most people tend to see the groups they identify with as good.

If you find yourself home alone at night after watching a scary movie, shadows and sounds in the backyard or attic can assume new and sinister forms. Your fear and anxiety lead you to perceive familiar surroundings different than the way you ordinarily do. Or if you have become jealous, a harmless and friendly conversation between your significant other and a friend may look like flirting.

Testimony

If we like someone, we may give too much weight to their testimony, and if we don't like them, we may give it too little weight. We are likely to give the testimony of someone we have come to trust in one area extra weight in other areas as well, even if there is no reason to suppose they would be particularly reliable in that area. If we feel especially threatened or frightened by the world around us, it may even be tempting to give too much weight to the claims of demagogues or others who see conspiracies everywhere they turn. We *want* an easy answer to our problems, and that's just what they offer.

Memory

As we have already addressed in chapter xx we are constantly elaborating on the information we've stored in our memories. As we saw, our emotions and moods can affect the ways we fill in details. For example, our memories are sometimes selective and distorted in ways that protect our own self-image or self-esteem; we sometimes remember things the way we would like for them to have been, rather than the way that they actually were.

Fallacies and Biases

In the next chapter, we will study several fallacies, which are ways in which reasoning can go wrong. Our emotions often give rise to fallacious reasoning. In still later chapters, we will see how emotions often lead to various self-serving biases in our thinking.

9.2 Stress

We all know that intense emotions like anger and fear can cause us to make all sorts of mistakes, so it isn't surprising that they can lead to flawed reasoning. Other emotions, like jealousy or grief, can also cloud our thinking. This is just common sense, but stress can pose a less obvious, more long term, danger.

Stress is an adverse reaction to the perception of a situation as harmful or threatening. It may involve physiological changes (e.g., tension headaches, sleep disturbances, trembling), and behavioral changes (e.g., inability to concentrate). It can also impair our ability to think quickly or clearly. In extreme cases like panic, people often suffer dramatic lapses in judgment. But even when stress is less severe, it can lead to slips in reasoning, and it is never a good idea to make important decisions when under severe stress.

We should also be cautious when evaluating the claims people make when they are under a lot of stress. In the previous chapter, we saw that eyewitnesses to crimes are less reliable than people commonly suppose. There are various reasons for this, but one seems to be that witnessing a crime, especially a violent one, produces stress. This in turn affects the witness's perception, memory, and reasoning.

Stress Management

It is not uncommon for college students who are away from home for the first time and facing many new challenges to have a problem with stress. There are various steps one can take to **manage stress** better, including exercise, relaxation techniques, and discussing one's problem with friends.

Most of these steps take some time and effort, so it is easy to turn instead to people who promise a quick fix. In evaluating their claims, we should ask the questions (listed in Chapter 5) that are always appropriate for evaluating self-styled experts. But help needn't be expensive. If you think that stress is a problem for you, you should consult a trained professional—for example, someone from student health services—who has experience dealing with it.

9.3 Legitimate Appeals to Emotion

Some emotions are typically positive, and some are typically undesirable (happiness is usually good, but it's not healthy if you feel happy when you watch other people suffer, for example). But most emotions are neither intrinsically good nor intrinsically bad. An emotion may be appropriate in one situation but not in another.

For example, anger is appropriate if we learn that someone has badly abused a subordinate, but it isn't appropriate if someone was three minutes late for a meeting because they stopped to help the victim of a traffic accident. Weeks of grief are appropriate when a loved one dies, but not when your neighbor's pet gerbil dies. So, it shouldn't be surprising that there is nothing intrinsically wrong with people appealing to our emotions.

When a person relies on the expected emotional response to a situation as part of an argument, they are making an appeal to emotion. The person on the phone may appeal to my compassion and sympathy to get me to canvass my block for a political candidate. Coaches appeal to their players' pride to spur them to play harder. A civil rights worker appeals to our sense of justice and fair play to induce us to behave differently toward members of a disadvantaged group. The problem begins when someone appeals to emotions that aren't relevant in the situation, and it is especially serious when they manipulate our emotions without our realizing it.

9.4 Illegitimate Appeals: The Exploitation of Emotion

If we can't see a way to support our own view (or to refute someone else's view) using good arguments, it may be tempting to try to arouse emotions in the person we are trying to convince. This diverts attention from the real issues so that people won't notice the weakness of our case.

Such diversion is particularly effective if the attack triggers intense emotions, like anger or fear, because when we are angry or anxious it is harder to remain focused on the real issues, and to think about them clearly. People may try to capitalize on any number of our emotions, such as guilt, jealousy, envy, or greed, but here we will focus on three of the most dangerous appeals, to pity, fear, and anger.

9.4.1 Pity

Sometimes people appeal to our sense of pity. "It's true that I didn't do the homework for this course, but I've had a really bad semester, so can't you raise my F to a D?" "My client, the defendant, had a terrible childhood; you won't be able to hear about it without crying."

Appeals to pity and mercy are often legitimate, but they become problematic if we let our gut reaction dictate our response. We should instead evaluate the case on its own merits. Perhaps the defendant did have a terrible childhood. But we must stop and think about what this should mean, rather than being moved solely by feelings of compassion or pity. One's childhood is *not* relevant to the question whether the defendant is guilty of the crime. But it may be relevant in trying to decide what punishment is fair. Evaluating these appeals can be tricky, and may require that we rely on some skills we have already begun working on in the course by doing some research or consulting with experts.

9.4.2 Fear

Fear affects our thinking, so if someone can arouse our fear, they have a good chance of influencing what we think and, through that, how we behave. An appeal to fear is also the basis of the use of scare tactics in advertising and other forms of persuasion. If someone can frighten us, that is a good way to make us draw a hasty conclusion without carefully evaluating the facts.

Appeals to emotions often involve exaggerations of various sorts, and an especially popular version of this is the **scare tactic**. The scare tactic aims to bypass reason and manipulate us directly through our emotions. It plays on our fears, trying to convince us that we are in danger that can only be averted if we do what the other person suggests. It is common in advertising, including political advertisements. Here are some examples:

1. We risk being social outcasts if we don't use a certain deodorant or mouth wash.

2. Life insurance commercials and tire commercials are especially adept at exploiting our anxieties and fears.

3. In politics, negative campaigning is often combined with the scare tactic by alleging that some terrible thing will happen if a candidate's opponent is elected.

4. Demagogues try to exploit common fears and popular prejudices to entice us to support them; very often this involves placing the blame for our problems on others (e.g., members of another race or nationality).

5. One especially popular method in the age of the sound bite is to use words that trigger emotions like anger and hatred and fear. Of course, different words set off different people, but 'communist', 'atheist', 'bleeding-heart liberal', and 'redneck bigot' will be triggers for many.

As with pity, we may not be in a great position to judge how much fear is rational, and we will again have to fall back on research and evaluating the claims of experts.

9.4.3 Anger

One of the surest ways to derail an argument you are losing is to make the other person angry. They will then be more likely to lose sight of the real issues, and the fact that your case is weak will be forgotten once everyone has descended to accusations and name-calling.

For example, although debate over abortion is often conducted in a way that stays focused on the real issues, attacks on one's opponent are common here. Those who believe that abortion is permissible under some circumstances may be vilified as anti-life, cruel and heartless people, even murderers. Opponents of abortion may be said to be authoritarians who want to dictate how other people should live, and as people who are only too happy to trample all over a woman's right to decide what she does with her own body.

None of this means that emotions should be set aside when discussing abortion. The fact that we have the feelings we do about human life (actual and potential) *is* relevant. But if open-minded discussion and mutual understanding are the goals, we need to discuss these things in a way that doesn't deteriorate into a shouting match.

When the prosecutor shows the jury photographs of the mutilated victim of grisly murder, he is appealing to emotions like anger, revulsion, and shock. The jury already knew the victim was murdered, but seeing the pictures arouses deeper feelings that mere descriptions of the murder scene ever could, and this can easily become prejudicial.

9.5 Self-serving Biases

Although there will always be people ready to exploit our emotions to further their ends, emotions and needs can lead us to reason badly without any help from anybody else. They can lead us to fool ourselves to avoid unpleasant facts about ourselves or the world. We cannot be effective thinkers if we won't face obvious facts, or if we seriously distort them. We will study some of the mechanisms of self-deception at great length later, but we should take a brief look at some of them now.

Wishful Thinking

We engage in *wishful thinking* when we disregard the evidence and allow our desire that something be true to convince us that it really is true. Do you remember all the people who went to church on Easter Sunday during the Covid-19 pandemic? For many of them, their desire to believe that they were safe overrode all the evidence to the contrary (to deadly results). True believers in a cause are especially prone to wishful thinking, but we are all susceptible, and in its more minor forms, it is common.

The human tendency to wishful thinking is one reason why claims by pseudoscientists, advertisers, and others are accepted even when there is little evidence in their favor. There are many examples of this, and you can probably think of some from your own experience. For example, smokers find evidence that smoking is harmful to be weaker than nonsmokers do. People often greatly overestimate their chances of winning at games of chance or of winning a lottery (we will see later that the chances of winning a large state lottery are almost infinitesimally small).

Defense Mechanisms

Defense mechanisms are things we do, typically unconsciously, to keep from recognizing our actions, motives, or traits that might damage our self-esteem or heighten anxiety. Most defense mechanisms involve *self-deception*.

Rationalization

Rationalization is a defense mechanism in which a person fabricates "reasons" after the fact to justify actions that were really done for other, less acceptable, reasons. We are all familiar with cases where people (probably even ourselves, if we think back on it) come up with a good "reason" for cheating on an exam or a diet, failing to do their homework, continuing to smoke despite their resolution to quit, or lying to a friend. Few of us like to view ourselves as dishonest, so, if we do cheat a customer or lie on our tax return, we are likely to rationalize it: everybody does it, they had it coming, they would have cheated me if they'd had half a chance, I really needed the money, and I'll never do it again.

Repression

In the previous two chapters, we studied the tricks memory can play. One of the easiest ways to avoid having to think about something is to simply forget it. It is unclear how frequent repression is. As we noted in the previous chapter, some childhood events (e.g., sexual assault) may be so traumatic and disturbing that people repress them. In recent years claims about repressed memories of childhood abuse have attracted a good deal of attention, but there is also some evidence that this occurs less often than people think, and some scientists think that many such reports are really cases of "false-memory syndrome."

The important points here are that repression does seem to occur sometimes, but it is an empirical question how often it does. We can't answer such questions by taking a vote or by going with our gut feelings. We can only answer them by a careful consideration of the relevant evidence.

Denial

Denial is a refusal to acknowledge the existence or actual cause of some unpleasant feature of ourselves or the world. Here unacceptable impulses and disagreeable ideas are not perceived or allowed into full awareness. Denial is a defense mechanism that is far from rare. For example, it is common for those with serious drug or alcohol problems to deny (even to themselves) that they really have a problem ("I could quit any time I wanted to"). Often those close to the person engage in denial concerning these issues too. We have all engaged in denial at some point, whether it be a refusal to accept responsibility for the consequences of our actions or a steadfast inability to accept a foreseeable tragic outcome, such as the immanent death of an ill loved one.

Self-deception

Self-deception occurs when someone fools themselves into believing something that is not true. For example, many people have unrealistically high opinions of themselves. People often engage in self-deception to boost their ego or enhance their self-esteem, but they may do so for other reasons as well. For example, a mother may be unable to believe that her son has a drug problem, even though she has found syringes in his room several times.

Wishful thinking, rationalization, and denial shade off into one another, and we won't worry about making fine distinctions among them. It is an empirical question just how widespread they are, but there is good evidence that they are common. What is clear is that they pose problems for clear and accurate thought. They *all* lead us to ignore what is really going on, which means that we can't reason about it clearly.

The Lake Wobegon Effect

A large majority of adults in this country think that they are above average in a variety of ways, and only a very small percentage think that they are below average. For example, a survey of a million high-school seniors found that 70% rated themselves above average in leadership skills, while only 2% felt they were below average. And *all* of them thought that they were above average in their ability to get along with others. Most people also think of themselves as above average in intelligence, fairness, job performance, and so on through a wide range of positive attributes. They also think they have a better than average chance of having a good job or a marriage that doesn't end in divorce. This finding has been called the Lake Wobegon effect, after the fictional town of Lake Wobegon in Garrison Keillor's *A Prairie Home Companion*, a place where "the women are strong, the men are good-looking, and all the children are above average." (We would be engaging in denial here if we failed to acknowledge that Keillor was creditably accused of sexual harassment and fired from Minnesota Public Radio – it is unfortunate this concept bears the name of one of his creations).

Lake Wobegon effect: well over half of us think we are above average in various

Self-serving Biases

All these factors can promote self-serving biases. We will see many examples in later chapters, so one example will suffice now. People have a strong tendency to attribute their successes to their own positive features (good character, hard work, perseverance) while attributing their failures to external conditions beyond their control (bad luck, other people didn't do their share of the work). "I did well on the first exam because I'm bright and I studied really hard." "I did poorly on the second exam because I felt sort of sick, and besides the exam wasn't fair." As we will see, we aren't usually so charitable with others. "I was late to work because the traffic was really bad." "Sam was late to work because he just can't get it together to organize his time."

Emotions are an important part of life, in many ways *the* most important part. But as we have seen in this chapter, they can also cloud our reasoning in ways that are harmful to others, and to ourselves.

9.6 Chapter Exercises

1. Explain the role that emotions played in some of the arguments used by people who supported sheltering-in-place during the Covid-19 pandemic. Then explain the role that emotions played in some of the arguments used by people who opposed sheltering-in-place.

2. Should a prosecutor be allowed to show the jury grisly photographs of a murder victim? What reasons can you think of for not allowing the pictures to be displayed. What reasons can you think of for allowing it? Would it make a difference whether the pictures were shown during the first part of the trial (before the jury has found the defendant innocent or guilty) of in the sentencing phase (after they have found her guilty and are trying to decide on the appropriate punishment)?

3. Give an example of someone engaging in self-deception or wishful thinking. What do you think leads them to do this, and how might they avoid it?

4. Give an example of an appeal to pity. Should it move us? Under what conditions are such appeals legitimate? Under what conditions do they seem inappropriate?

5. Discuss some ways in which wishful thinking has affected your own thought (or those of others). How might you (or they) have avoided its unhealthy effects. Can you think of cases where wishful thinking might lead to good outcomes?

6. Analyze each of the following dialogues.

    1. *Edna*: So, how'd the logic class go?

       Wilbur: It really sucked.

       Edna: What grade did you get?

Wilbur: I flunked. But it wasn't my fault. The teacher was a complete loser. Anybody who passed that course would have to be a real idiot.

2. *Edna*: I'm sorry to have to put it like this, but since you just keep pushing, you don't really leave me any choice. I just don't want to go out with you. I'm sorry.

   Wilbur: Well, I didn't want to go out with you either. I just asked you out because I felt sorry for you.

3. *Edna*: Isn't that your eleventh beer this evening?

   Wilbur: What's it to you? It's been a lousy semester, what with my pet hamster Emmy Lou dying and that disgusting logic class. So, I deserve to unwind a little. Anyway, I could quit drinking any time I wanted—if I wanted.

4. *Logic Teacher*: Please put your homework in the "In" folder.

   Wilbur: I pulled a real late nighter and finished all the homework. But after I typed it all up I lost it all.

   Logic Teacher: That's the third time this semester.

   Wilbur: I know. It's like the computer's out to get me.

5. *Edna*: How did the job interview go?

   Wilbur: It went well. I have a really good feeling about it.

   Edna: But didn't you feel the same way after those other interviews you had, the ones where they never called back? How many was it anyway, eighteen?

   Wilbur: Twenty. But I really, really feel good about this one. I just know I'll get it.

7. In what sorts of situations or circumstances is it reasonable to let our emotions influence us; in what ones is it not such a good idea? Give some examples of each and defend your choices.

8. Think of an instance in your own life where you later felt that you may have used a defense mechanism, perhaps to boost your ego. What might have led to the self-deception?

9. Discuss some ways in which strong feelings of guilt might impair clear thinking.

10. Write a dialogue that illustrates the bad effects of self-deception on reasoning. The write a second dialogue that illustrates wishful thinking, and a fourth that illustrates denial.

Part IV

Relevance, Irrelevance, and Fallacies

Part IV. Relevance, Irrelevance, and Fallacies

In reasoning and argumentation, it is important to stay focused on the topic at issue. This means giving reasons, or evidence, that are relevant to the topic. This sounds easy, but a great deal of bad reasoning occurs because we don’t stay focused. In chapter 10, we will study relevance and several common ways in which reasoning goes awry when we use premises or evidence that aren’t relevant. Bad reasoning is said to be *fallacious*. Some fallacies are simple to spot, but others give the appearance of being good arguments, and it is easy to be taken in by them. In chapter 11, we will learn about three fallacies: begging the question, the either/or fallacy and, more briefly, the fallacy of the line. We will also note problems involving inconsistency.

Chapter 10

Relevance, Irrelevance, and Fallacies

Overview: In reasoning and argumentation, it is important to stay focused on the topic at issue. This means giving reasons, or evidence, that are relevant to the topic. In this chapter, we will study relevance and several common fallacies of relevance; these are common ways in which reasoning goes awry when we use premises or evidence that are not relevant to our conclusion.

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10.1 Relevance

In reasoning and argumentation, it is important to stay focused on the topic at issue. This means giving reasons or pieces of evidence that are *relevant* to the topic. This sounds easy, but a great deal of bad reasoning occurs because we don't stay focused on the issues.

Relevance is important in all communication, even when we are not constructing arguments or trying to persuade other people. In a normal conversation, each person typically says things that are relevant to the general topic and to what the other person has been saying. Slight departures from relevance are alright but conversing with someone who keeps bringing in irrelevant points is difficult.

A statement is not relevant all by itself, in isolation from anything else. Relevance instead involves a relationship between one statement and another. So, a premise can be relevant to one conclusion, but completely irrelevant to others. It is irrelevant if it simply doesn't bear on the truth or falsity of the conclusion, if it is independent of it, if it does not *affect it one way or the other*.

Relevance is a relationship between sentences

Examples of Relevance

1. The premise that there have been multiple credible allegations against him is relevant to the conclusion that Supreme Court Justice Bret Kavanaugh has committed sexual assault.

2. The premise that Wilbur has failed his first two exams in Chemistry 1113 is relevant to the conclusion that he will fail the course.

3. The premise that the death penalty deters murder is relevant to the claim that we should retain capital punishment for murder.

4. The premise that the death penalty does not deter murder is relevant to the claim that we should retain capital punishment for murder.

Examples of *Ir*relevance

1. The fact that President Donald Trump believed he was innocent of any wrongdoing is not relevant to claims about Kavanaugh's guilt or innocence.

2. When a reporter asks a politician a tough question, the politician often gives a long response that really doesn't answer the question at all. Here the politician acts as though what they are saying supports their position, but it may be completely irrelevant to it. This happens when they put a "spin" on things that shifts the focus from the real issue to something else.

3. Many advertisements use celebrity endorsements. Often, the fact that a famous person endorses a product is altogether irrelevant to the claim that it's a good product. For example, the fact that Michael Jordan plugs a certain cologne isn't likely to be relevant to the conclusion that it's a good cologne.

4. In everyday conversations, people are often at "cross purposes," they "talk past each other." This can occur when they think they are discussing the same claim or issue, but in fact the two of them are concerned with somewhat different issues. In such cases, the things each person says in support of their own views may seem irrelevant to the other person.

Relevance vs. Other Concepts

Relevance is Not the Same as Truth

A premise can be true, but irrelevant to a give conclusion.

> *Example:* it is *true* that Bret Kavanaugh has a certain astrological sign, but this is irrelevant to the claim that he is guilty of sexual assault (or that he would be a good justice).

Irrelevance is Not the Same as Falsity

A premise can be false, but still be relevant to a given conclusion. To say that it is relevant is to say that *if* it were true, it would make the conclusion more (or less) likely to be true.

> *Example:* The claim gun owners are less likely to die from gun violence than non-gun owners is false. But it is relevant to the claim that we should not make it harder for people to acquire guns.

Relevance is Not the Same as Importance

An *important* claim can be *irrelevant* to a give conclusion.

> *Example:* It is a very important fact that many people were murdered in the Boston Marathon Bombing, but this is irrelevant to the conclusion that the Tsarnaev brothers planted the bombs.

An *unimportant* claim can be relevant to a conclusion.

> *Example:* The fact that there are over ten thousand blades of grass in Rodney's lawn isn't very important to anyone, but it is highly relevant to the claim that there are over nine thousand blades of grass in his lawn.

Relevance is Not the Same as Conclusive Support

Relevance comes in degrees. Some premises are highly relevant to a given conclusion, others are somewhat relevant, and yet others are completely irrelevant. So, to say that a premise is relevant to a conclusion is not to say that it provides conclusive support for the conclusion.

> *Example:* The claim that John had been involved in a long-running feud with the murder victim is relevant to the conclusion that he committed the crime. But it does not prove that John was the murderer.

Relevance Can be Positive or Negative

Any claim that provides evidence for, or against, some other claim is relevant to it. It has positive relevance if it supports it or counts in favor of it. It has negative relevance if it makes it less likely or counts against.

> *Example:* The claim that John's fingerprints are on the murder weapon is relevant to the conclusion that he committed the crime. It makes it more likely, and so has positive relevance for this conclusion.

> *Example:* The claim that John was seen in another state at the time of the murder is also relevant to the conclusion that he committed the crime. It makes it less likely, and so has negative relevance for this conclusion.

Irrelevant Claims are Independent of One Another

If two claims are irrelevant to each other they are sometimes said to be *independent* of each other. The truth-value of one has no effect, influence, or bearing on the truth-value of the other. Knowing that one is true (or false) tells you nothing whatsoever about whether the other is true (or false). Irrelevance is a two-way street: if one thing is irrelevant to a second, the second is also irrelevant to the first.

> *Example 1:* If you are flipping a fair coin, the chances that it will land heads on any given flip is 1/2. The outcomes of successive flips are independent of each other, so the outcome on the previous flip is irrelevant to what you'll get on the next flip.

> *Example 2:* If you and your spouse are going to have a child, the chances that it will be a girl are very nearly 1/2. The outcomes of successive births are independent of each other, so the sexes of your previous children are irrelevant to the sex of your next child.

Exercises on Relevance

1. Write a sentence or two explaining why each of the following claims is either relevant or irrelevant to the claim that Florida should abolish the death penalty.

    1. Innocent people have sometimes been executed.

2. Statistics show that the death penalty deters (decreases) murder.

3. Some people really enjoy watching executions.

4. Statistics show that the death penalty does not deter murder.

5. Executions make the warden sick to his stomach.

2. Say whether the members of the following pairs of statements are positively relevant, negatively relevant, or simply irrelevant to each other, and explain why.

1. The President resigns. The Vice President becomes President.

2. Jesse “The Body” Ventura is elected President in the next election. I roll a 3 on the first roll of a die.

3. Jesse “The Body” Ventura is elected President in the next election. The economy goes south.

4. I get a head on the next flip on a coin. I get a head on the flip after that.

5. I pass all the exams in this course. I pass the course itself.

6. I miss a lot of classes. I pass the course.

7. There are many valuable things about sports. Names of sports teams like “Redskins” aren’t demeaning to Native Americans.

3. Give two premises that are relevant (in the sense discussed in class and in the text) to the following conclusions. Then give two premises that are irrelevant.

a. We should not shelter-in-place during the Covid-19 pandemic.

b. President Trump should have been impeached.

c. I’ll probably not get an “A” in my chemistry course.

Answers to Selected Exercises

1. Write a sentence or two explaining why each of the following claims is either relevant or irrelevant to the claim that we should abolish the death penalty in Florida.

1. Innocent people have sometimes been executed.
   - Relevant (various analyses possible, but you need to defend your answer)
2. Statistics show that the death penalty deters murder.
   - Relevant (various analyses possible, but some analysis needed). Note that relevance can be either positive (supporting a view) or negative (weakening the case for it).
3. Some people really enjoy watching executions.
   - Irrelevant (various analyses possible, but some analysis needed).
4. Statistics show that the death penalty does not deter murder.
   - Relevant (various analyses possible, but some analysis needed). Note that relevance can be either positive (supporting a view) or negative (weakening the case for it).

10.2 Fallacy of Irrelevant Reasons

If the premises of an argument are irrelevant to the conclusion, then the argument is flawed. The premises may well be true, important, and perhaps even relevant to other conclusions we care about. But if they aren't relevant to the conclusion we are thinking about, then the argument is bad. Bad reasoning is said to be fallacious, and some bad patterns of reasoning—fallacies—occur so frequently that it is useful to give them names. This helps us to spot them and to avoid them in our own thinking.

Fallacies: common and tempting ways of reasoning badly

We commit the **fallacy of irrelevant reason** (or irrelevant premise) if we offer a premise to support a conclusion when the premise is irrelevant to the conclusion. Relevance is *not sufficient* for premises to support a conclusion, but it is necessary.

Fallacy of irrelevant reason: using an irrelevant premise to support a claim

The fallacy is also known by its Latin name, non sequitur ("it doesn't follow"). So, when someone draws a conclusion from irrelevant premises, we say that it's a *non sequitur*. The fallacy of irrelevant reasons is also sometimes called the *red herring fallacy*. This name is a reference to the fact that people who were fleeing from trackers with bloodhounds would sometimes wipe a dead animal across the path to throw the dogs off their trail.

The name *irrelevant reason* is a sort of catch-all label. All the fallacies that we will study in this chapter have premises that are irrelevant to the conclusion. But if we have a more specific name for a fallacy (and we won't, until we get further into this chapter), we will use the more specific label.

Motivations behind the fallacy

If we can't supply relevant reasons to support a conclusion, it is tempting to bring in something that is irrelevant. This deflects attention from the fact that we don't have good reasons for our view. This is especially effective if the irrelevant reasons have emotional impact, because these make it particularly easy to focus on things that are not relevant to the real issue.

Sometimes responses are so irrelevant that they really don't look like reasons at all, but they can still deflect attention from the real issue. Jokes, ridicule, sarcasm, flattery, insults, and so on can deflect attention from the point at issue. A joke can be particularly effective, since if you object that it isn't relevant, you can then be accused of lacking a sense of humor. But you can laugh at the joke and then return to the issue.

Safeguards

1. Whether reasons are relevant to a conclusion depends on the conclusion and the way it is stated. So always stay focused on the conclusion.

2. Don't allow jokes, insults, or the like to deflect your attention from the issue. You can appreciate the joke, but then return to the point at issue.

3. Be sure that you and the person you are talking to really are considering the same claim, rather than talking at cross purposes. If you are, try to explain your view to the other person *before* defending it. This doesn't guarantee the two of you will come to an agreement, but the discussion will be more productive.

Exercises

1. Identify the fallacy (if any) in the first two passages.

- R. Kelly is innocent. The charges against him are made up.

- R. Kelly is innocent. He's a very famous person and is a fantastic musician.

2. Which of the following are relevant to the conclusion that we should not have laws making handguns harder to get?

    (a) The Bill of Rights says that we have a right to bear arms.

    (b) Many people have avoided serious injury because they had a gun and were able to frighten off an intruder.

    (c) Many of the people who favor gun control are just frightened by guns.

    (d) Many children are accidentally killed each year by guns in their homes.

    (e) It's a lot of fun to go out and try to shoot stop signs with a handgun.

3. Give several premises that are relevant to the following conclusion. Then give several that are irrelevant:

    Abortion should be illegal.

10.3 Arguments Against the Person

We commit the fallacy of an **argument against a person** whenever we launch an irrelevant attack on that person, rather than on their position or argument. The Latin name for this fallacy, *ad hominem*, is still in common use, so we will use it too. This is one type of the fallacy of irrelevant reason, since when we attack a person, we shift our focus from issues that are relevant to the conclusion to another issue that is not relevant; in this case, we shift our focus to the person we are attacking. If we disagree with a position, or if an argument has a conclusion we reject, it is perfectly reasonable to try to show that the position is false or that the argument is flawed. But when we can't see a way to do this, it may be tempting to instead attack the person who holds the position, or who gave the argument.

Argument against the person: attacking a person rather than their argument

This diverts attention from the real issue, shifting the focus elsewhere, so that people won't notice the weakness of the case. And one of the most effective ways to shift the focus is to attack the other person in a way that triggers various emotions like anger, because when we are angry or otherwise negatively emotionally aroused, it is difficult to remain focused on the real issue.

The simplest way attack a person is to simply throw terms of abuse at them. These range from 'fool' or 'idiot' to derogatory labels based on the person's race, nationality, gender, or sexual orientation. We are all familiar with cases where discussion or debate degenerates into name calling.

For example, debate over affirmative action programs is often conducted in a way that stays focused on the real issues, but attacks on one's opponent are not uncommon here. Champions of affirmative action are sometimes accused of being bleeding heart liberals who really want to discriminate against white males, while opponents of affirmative action are sometimes accused of being rednecks or bigots who only want to hold on to a situation that benefits them at the expense of others.

One label has undergone an interesting seesawing of fortune; several decades ago, many considered it a good thing to be a *liberal*. The term originally signified those who favored liberties and freedoms (for example, freedom of religion). But in the last century, partly due to Roosevelt's New Deal, many people came to see liberals as champions of a "tax and spend" approach to government. Now we are in a political era where values are again shifting, and those same policies and principles exemplified by the term 'liberal' under Roosevelt are again being seen in a positive light by many. This was a long way to go to point out that context matters a lot. Depending on the time and place, a term or label may move from being a neutral description, to a slur or insult, and back again.

It is also possible to attack someone by pointing out that they are associated with a group we don't like. Such attempts to show guilt by association commit the *ad hominem* fallacy if they take the place of a reasonable examination of the other person's argument or views.

A subtler version of the *ad hominem* fallacy occurs when we ignore someone else's argument for a given position and instead charge that they only favor the position because it is in their *self-interest* to do so. The following dialogue represents a typical instance:

> *Burt*: Well, anyway, there you have my arguments for opposing gun control laws.
>
> *Ali*: Well, all those fancy statistics and detailed arguments sound good. But when you get right down to it, you really oppose gun control because you sell guns, and you'd lose a bundle if any laws were passed that cut back on their sales.

Here Ali has simply ignored Burt's arguments for his position and attacked Burt instead.

In some cases, attacks on a person may be hard to resist. Suppose, for example, that someone gives us a good argument, based on lots of statistics, that we should wear seat belts. Later we learn that they always ride their motorcycle without a helmet. This does show some inconsistency, and perhaps even hypocrisy, in their behavior. But it doesn't show that their argument for wearing seat belts is bad. Not all "attacks" on a person are irrelevant. If someone purports to be a good *source of information* about something, it is perfectly reasonable to expose them if they really aren't a good source.

> *Example 1:* If someone purports to be a highly trained expert in some field (e.g., they claim to have a medical degree) when in fact they lack the training they claim to have, this is worth noting, and it does damage their credibility.
>
> *Example 2*: If a source has repeatedly been incorrect, for example if a tabloid website has frequently been wrong in its claims about Hollywood stars, then it is not a good source of information. Here it is relevant to point out that the source has a poor track record, since that should affect our assessment of their current claims.
>
> *Example 3:* If an eyewitness to a murder is testifying in court, it is reasonable to offer testimony to show that their eyesight is poor, their memory faulty, or that they have a reason to lie.
>
> *Example 4:* If a person or group has repeatedly shown biases or prejudice about certain issues or against other groups, it is unwise to trust them when they make further claims about those issues or groups. When it became clear during the O. J. Simpson trial that the policeman Mark Furhman had repeatedly used racial slurs, his testimony came into serious doubt.

We only commit the *ad hominem* fallacy if we ignore someone's arguments or reasons and instead attack them. Of course, life is short, so if someone is known to be biased or unreliable, that *does* justify spending our time doing better things than thinking about their argument. But it does *not* justify concluding that their *argument* is no good.

Exercises

Say whether each of the following passages contains an ad hominem fallacy. If it does, explain how the fallacy is committed and how an attack on the argument, rather than on the arguer, might proceed.

1. You just think the school should adopt a pass/fail grading system so you won't have a bunch of Ds.

2. Well, of course professors here can cite all sorts of studies and give all sorts of arguments that they deserve a pay increase. After all, they are

trained to do that stuff. But at the end of the day, they are just like the rest of us, looking out for old number one.

3. You know the Pope's arguments against birth control. But, you know, I say if you don't play the game, don't try to make the rules (Dick Gregory).

4. The witness of the defense is hard to take seriously. He testifies as an "expert witness" for the defense in over a hundred trials a year, and they always pay him big bucks to do it.

5. Who are you to tell me not to smoke a little dope. You knock off nine or ten beers a day "to relax."

6. Look, I hear all your arguments that abortion is wrong. But you're a man, and you can't be expected to understand why a woman has a right to choose what to do with her own body.

10.4 The Straw Man Fallacy

We commit the **Straw Man Fallacy** when we distort or weaken someone's position or argument to discredit it. When this happens, we are not really countering the person's actual views, but are merely assailing a feeble version of them. We are said to be *attacking a "straw man"* (it might seem more accurate to say that we are attacking a straw argument, but the term 'straw man' is the traditional label for this fallacy).

Straw Man fallacy: distorting someone else's position to make it easier to attack

This is another type of fallacy of irrelevant reason, since when we attack a weakened version of a view or argument, we shift attention from issues that are relevant to the conclusion, the real argument that is given for it, to other issues, the weakened caricature of the argument.

When we are confronted by a position that conflicts with our own, it is often tempting to characterize the position in the weakest or least defensible light. We make our own view *look* strong by making the alternative look weak (rather than showing that our view *is* strong by building a solid case for it). By distorting the opposing position, we make it easier to answer, or even to dismiss, the view and those who subscribe to it. This saves us the trouble of having to think seriously about it and spares us the possibility of having to acknowledge that we might be wrong. These are scarcely good things to do, but perhaps even worse, we show the other person a lack of respect by not taking them seriously; we don't like it when someone else does this to us, and others won't like it when we do it to them.

Examples

Many campaign ads, especially "attack ads," go after straw men. For example, someone who opposes the death penalty is likely to be accused of being soft on crime, or of favoring the rights of criminals over the rights of victims. Someone who favors certain welfare programs may be accused of wanting to tax and spend to give people handouts and discourage their sense of responsibility, while someone who favors cutting back on the same programs may be accused of trying to help the rich at the expense of the poor. And a person who advocates decriminalization of drugs may be accused of favoring the use of drugs.

But politicians are not the only people who commit this fallacy; all of us do it at one time or another. It's not difficult to find people who say things like, "I'm sick of all those self-righteous people arguing that Florida shouldn't have dog racing. They just think that anything enjoyable is a sin." While there may be some killjoys who oppose dog racing because they hate fun, most of its critics oppose it for more serious and substantial reasons, like the animal abuse.

Attacks on a person are like attacks on a straw man insofar as both ignore a person's actual argument or position. But they differ in an important way:

1. Someone commits the straw man fallacy when they ignore a person's actual argument and attack a weaker, distorted version of it.

2. Someone commits the *ad hominem* fallacy when they ignore a person's actual argument and attack the person instead.

Like the other fallacies, we may commit the straw man fallacy intentionally. But human nature being what it is, it is all too easy to commit the fallacy without really thinking about it. We do it, for example, if we thoughtlessly restate our partner's views about something in a way that makes them seem less plausible or compelling than they really are.

More Subtle Versions of the Straw Man Fallacy

There are several special cases of the straw man fallacy that can be especially difficult to detect.

Taking Words out of Context

Taking someone's words out of context also allows us to quote them in a way that can make their position look weaker than it really is. We can leave out the qualifications and complexities of the view that would allow it to withstand the criticisms that we direct against the weaker version.

Example: A Senator who voted for a bill containing many provisions (including a small tax increase which, taken alone, they opposed) might be characterized as favoring higher taxes.

Treating an Extreme Case as Representative

It can be particularly effective to treat the views of an extreme member of a group as representative of those of the entire group, since this allows us to literally quote someone. We use their own exact words, in a way that appears to convict the entire group. The fact that we use their own words makes it seem more likely that we are being fair. Since we don't like the view, perhaps we couldn't be expected to give a fair summary of it, but here we seem to have the view right from the horse's mouth.

For example, opponents of gun control laws can find people who would like to ban all guns, and they may quote their views as though they were representative of the views of all people who favor some restrictions on guns. At the same time, people on the other side of this issue sometimes quote members of the more extreme militia groups as though they were representative of all of those who think gun control laws can be overdone. The internet has also helped make this easier to do. People on Redditt, Facebook, and Twitter are very happy to shout their uninformed views into the void, and we should be careful to not take them as being representative (especially when we may not even be able to establish if they are a troll or a part of a disinformation campaign.)

Criticizing an Early or Incomplete Version of a View

Criticizing an early or sketchy version of a view, rather than considering it in its current, stronger form, also make it much more vulnerable to attack. For example, Burt might attack the theory of evolution by quoting Darwin and showing that his views on some detail of the theory are now known to be wrong. But Darwin wrote well over a century ago, and the theory has undergone many refinements and improvements since his day. You may not like the theory, but if you want to show that its wrong, you must consider the strongest version of it.

Criticizing a Deliberately Simplified Version of a View

Sometimes people state their position in a simplified way to get their basic ideas across in a short time. When someone is clearly doing this, their opponents should go after the more complex version of their views. This is most likely to happen when a person is explaining a relatively uncommon view to a person or group largely unfamiliar with it. Advocates for prison abolition, for instance, are arguing for a pretty sophisticated restructuring of society, so it's going to be best to listen to the full argument in all its complexity, rather than just jumping in and accusing them of looking to set serial killers loose on your neighborhood tomorrow.

Safeguards

Several points can help us to spot, and to avoid committing, the straw man fallacy.

1. Be aware of the natural human tendency to characterize opposing views in a way that makes them easier to attack or dismiss.

2. Be fair. Try to find the strongest version of the view in question and consider it. Give the other person the benefit of the doubt. This will require you to think harder, but if you do, your own views and your reasons for holding them will be more secure.

3. Do not rely on the critics of a view to state the view fairly. They may do so, but you can't count on it. This is especially true when the point at issue is highly controversial or arouses intense emotions.

Exercises

In each of the following passages:

A. Determine whether it contains a straw man fallacy. If there is:

B. Explain the way in which it commits the fallacy.

C. Note ways in which the passage could be revised to be fairer to the view under consideration.

1. The problem with people in the environmentalist movement is that they lack common sense. They think that protecting the environment for the spotted owl is more important than allowing people to make a living cutting timber in the owl's habitat.

2. A bill that would allow school prayer would be very bad. Its supporters would like to have everyone involved in religion, and in fact in the Christian religion. This would violate the rights of those who aren't Christians.

3. People who are against school prayer really want to get rid of all religion. At bottom they are atheists, or at least agnostics.

4. Champions of campaign finance reform have a hopeless view. They seem to think that if there were limits on contributions to political candidates

there would be no more corruption in politics and the poor could afford to run for office. But we will always have corruption, and it will always be easier for the rich to get elected.

Answers to Selected Exercises

You were asked to determine whether each passage contains a straw man fallacy (is there an attack on a straw man?). If it did, explain the way in which it commits the fallacy. Finally, note ways in which the passage could be revised to be fairer to the view under consideration. You can think about the last part for yourself; here are answers to the first two parts.

1. The problem with people in the environmentalist movement is that they hold that protecting the environment for the spotted owl is more important than allowing people to make a living cutting timber in the owl's habitat.

    - This passage attacks a straw man. A few environmentalists may think this, but most do not hold the extreme position that the owl is more important than human livelihood.

2. A bill that would allow school prayer would be very bad. Its supporters would like to have everyone involved in religion, and in fact in the Christian religion. This would violate the rights of those who aren't Christians.

    - It may be that this characterization of the position of proponents of school prayer accurately captures the position of a few of them. But most people who favor school prayer do not have any extreme view of this sort, so the passage attacks a straw man.

3. People who are against school prayer really want to get rid of all religion. At bottom they are atheists, or at least agnostics.

    - The problem here is like the problem in 2, but now the fallacy is being committed by people on the other side of the school prayer issue.

10.5 Appeal to Ignorance

Every Halloween night, in the comic strip "Peanuts," Linus van Pelt makes his yearly pilgrimage to a local pumpkin patch to await the Great Pumpkin's arrival. Many of his friends are skeptical (although Sally Brown usually accompanies him), but Linus remains convinced.

Now suppose someone offered you $50 to prove, right here on the spot, that the Great Pumpkin does not exist. Could you do it? Could you even come up with good evidence to show that the Great Pumpkin probably doesn't exist? I can't. But if you can't, does that mean that you should see the issue as an open question, that you should regard it as a 50/50 proposition? No. Linus is a kid, but suppose he had to enter the real world, grow up, and go off to college. What would you think about him if he still believed in the Great Pumpkin when he was 32? What would you think if you arrived at college and found that your new classmate believed in the Great Pumpkin?

What is the moral of this story? Most of us cannot give strong evidence that the Great Pumpkin doesn't exist, but we would regard anyone who thinks that it is a completely open question as much too gullible. Of course, we don't encounter adults who believe in the Great Pumpkin. But we all encounter people who make some claim that seems implausible. Then, instead of building a positive case to support their claim, they suggest that since we can't show that it's wrong, it is probably true. We all have heard the refrain: "Well, you can't show I'm wrong…"

This fallacy often occurs regarding claims of "things unseen," such as elusive creatures like Bigfoot, or behind the scenes government activities and other conspiracies. When claims are about something being kept secret, it is easy to see why this fallacy would occur frequently.

10.5.1 Burden of Proof

When you make a claim that everyone agrees is true (e.g., that on earth the sun rises in the east and sets in the west), you don't need to do much to build a case for it. When everybody already thinks something is so, you don't need much in terms of evidence to show that it is. It is good for you to have reasons, but if you are never called to defend the claim, you won't have much use for them. But if you make a surprising, controversial, or implausible claim (e.g., that several students have been abducted from campus by Martians), then things are a bit different. Now you have a strong *responsibility* to give reasons for your claim, and you are for sure going to be called to account for those reasons. The more implausible the claim, the heavier your burden of proof becomes. So, the fact that you can't produce evidence that the Great Pumpkin does not exist gives you absolutely no reason to think that it really does.

Burden of Proof: when someone makes a surprising claim, it's their job to defend it

When someone defends a view by pointing out that you can't show that it's false, they are committing the **fallacy of appeal to ignorance**. The fact that you are ignorant (don't know) of evidence that would show they are wrong does not mean they are right. This is a fallacy of irrelevance, since the fact that I cannot show that some claim is false is not relevant to showing that it is true.

When someone makes a surprising claim, then adds, "Well, you can't show that I'm wrong," they are unfairly shifting the burden of proof to you. We often are in no position to prove that their claim is false. For example, if someone makes a claim about aliens from outer space infiltrating our critical reasoning course, we cannot prove that there haven't been any. How could we? But the claim is implausible, and until someone gives us reasons to believe it, it's reasonable to believe that it is false. This is worth repeating. The reasonable attitude here is not complete open-mindedness. It is not sensible to conclude that it's a 50/50 proposition that creatures from outer space are stalking our campus. Until we are given some reason to believe this claim, it is much more reasonable suppose that it is false.

Appeal to Ignorance: justifying your view by claiming others can't prove you wrong

There are many cases like this. You are not now in any position to show that the Great Pumpkin doesn't exist. But if you went around thinking that it was a 50/50 proposition that there was a Great Pumpkin, people would have serious doubts about you (and well they should). Of course, most of us aren't worried about the Great Pumpkin. The fallacy is worth studying because there are many other, less obvious, cases of the same sort. In short: absence of evidence that X is false is not evidence that X is true. The fact that we cannot cite conclusive evidence for our view that there is not a Great Pumpkin is not evidence that there is a Great Pumpkin.

Absence of evidence that X is false ≠ evidence that X is true

Note that an appeal to ignorance does not involve saying that someone else is ignorant, misinformed, or just plain dumb. The word 'ignorance' has a special meaning here. Someone commits the fallacy of an appeal to ignorance when they suggest that the fact that they haven't been shown to be wrong is somehow evidence that they are right.

Positive vs. Negative Claims

Let's call a claim that there are Xs a *positive existence claim* and a claim that there are not any Xs a *negative existence claim*. To show that a positive existence claim is true, it suffices to point to an example of X. If a biologist claims that they have discovered some new, unsuspected strain of virus, they can prove their case by producing a sample of it and allowing other scientists to test it.

But it can be very difficult to prove that a negative existence claim is false, particularly if it says that there are no Xs anywhere at all. For example, you cannot really look everywhere to determine that there are no Xs; you cannot look everywhere and then report that there wasn't a Great Pumpkin anywhere you looked. Nevertheless, the claim that there is one is implausible; no credible witnesses have seen it, and science gives us no reason for believing in it.

Open-mindedness

Open-mindedness is a good trait to have, but it does not require us to seriously entertain any claim that comes down the pike. It does require us to remain ready to reevaluate any of our beliefs if new evidence or arguments come along and being willing to change our beliefs if the evidence requires it. But that doesn't mean having such an open mind that you consider everything everybody says a serious possibility.

Implausible and Novel Claims can be True

A surprising, controversial, or implausible claim may, of course, turn out to be true. When great breakthroughs in science, medicine, technology and other fields were first announced, they often seemed implausible. History presents a sorry record of discoveries the society of the time wasn't ready to accept; for example, the Catholic Church required Galileo to renounce his claim that the Earth moved around the Sun.

It is extremely important that such ideas be given a fair and open hearing, and that they be accepted if the evidence supports them. But this does not mean that every time someone comes up with a new idea it should be taken as seriously as ideas that are already supported by mountains of evidence. When the first vaccines were developed, the burden of proof was on those who developed them to show that they worked. In fact, they shouldered this burden and provided evidence to back up their claims. But it would have been rash for someone to have gotten an injection just because someone in a lab coat handed them a needle syringe and offered the comforting words: "Well, you can't prove that it won't work." And for the record, the burden of proof is now on the people claiming that vaccines are dangerous and cause side effects like autism.

Reserving Judgment

In many cases the evidence on both sides of an issue is inconclusive. In such cases, it is best to suspend belief, to refuse to conclude that either side is correct. For example, there is not much strong evidence on either side of the claim that there is life on other planets. Of course, we may eventually find evidence that settles the matter (this would be much easier if there were extraterrestrial life and some of it showed up around here). But until then, it is reasonable to conclude that you just don't have enough to go on, and so you just don't know.

We are often in no position to disprove a surprising or implausible claim. But it isn't our responsibility to do so. Our failure to supply evidence *against* the claim does not somehow provide evidence *for* it. If someone else wants to convince others that a novel claim is true, it is up to them to provide evidence *for it*.

Burden of Proof and the Law

An extremely important part of our legal system is that a defendant is presumed innocent until proven guilty. This means that the burden of proof is not on the defendant to show that he or she is innocent. The burden is on the prosecutor to show that the defendant is guilty. This makes sense, because the burden of proof is on the person who makes a claim (the claim here being that the defendant is guilty) rather than on the person on the other side.

To say that the defendant is presumed innocent is just another way of saying that we can’t use an appeal to ignorance to convict someone. We can’t argue, “well, they can’t show they didn’t do it, e.g., they don’t have an alibi, so they must be guilty.”

We typically have a higher standard for the burden of proof in the courtroom than in daily life, because the costs of mistakes are so high. In many cases, especially criminal cases, we require that the evidence be clear beyond any reasonable doubt. Because the burden of proof lies with the state, a defendant is under no compulsion to testify at all. But juries, being human, often see failure to testify as some indication that the defendant is guilty. And this gives us the last important lesson about burden of proof. The greater the consequences of a decision, the greater the burden of proof is on the issue.

Exercises

1. Appeals to ignorance do not just arise with the Great Pumpkin. It is common for companies to argue that it has yet to be demonstrated that certain things are dangerous (e.g., smoking cigarettes, nuclear power plants, certain sorts of landfills, and toxic waste dumps), and so we should continue to build or manufacture such things. Do such cases involve a fallacious appeal to ignorance (the answer may be different in different cases)?

2. Conspiracy theories often trade on appeals to ignorance. Since investigators haven’t been able to show that something isn’t the case, it is suggested, there is strong reason to think that it is. Give an example of this (it can be one you have read about or one you invented).

3. Appeals to authority are sometimes legitimate. Can you think of any special circumstances where an appeal to ignorance might be legitimate?

4. When the people on both sides of an issue are making claims that aren’t at all obvious, then the burden of proof falls on them both. Give an example of this sort.

And then, of course, we have these two claims:

5. It’s reasonable to conclude that God exists. After all, no one has ever shown that there isn’t a God.

6. It’s reasonable to conclude that God does not exist. After all, no one has ever shown that there is a God.

10.6 Suppressed (or Neglected) Evidence

We commit the fallacy of **suppressed** or **neglected evidence** when we fail to consider (or simply overlook) evidence that is likely to be *relevant* to an argument. In this case, we may include premises that are relevant, but we commit a fallacy because we leave out other information that is also relevant. Of course, we cannot look at all the evidence that might conceivably be relevant (that would be an endless task). But we should never neglect evidence that we know about or evidence that seems quite likely to bear on the issue.

Suppression of evidence: withholding relevant information because it counts against your conclusion

The fallacy of suppressed (or neglected) evidence is a generic, catch-all label. So even where none of the names of fallacies we have learned seems quite appropriate, remember that we need to consider as much of the relevant evidence as we can when we evaluate an argument.

One of the easiest ways to make our position look good and to make alternative positions look weak is to suppress evidence that tells against our view, as well as evidence that supports the alternative. So, it is not surprising that relevant evidence is constantly suppressed in partisan disputes. In the courtroom, lawyers only present evidence that will make their own case look good. In advertisements, only one side of the picture is presented. In political debates, candidates almost always present only one side of the issue. In discussions about public policy, the partisans on each side of the issue often cite only those statistics that support their side of the case. In churches, you don’t hear a lot of discussion about children dying from disease and poverty.

In many cases, it would be expecting too much to think that those engaged in intense debates over such matters would present both sides of the issue in a fair and even-handed way. But there is often a big difference between winning an argument and thinking clearly, and if we must make up our own minds on the matter (as we must when we serve on a jury or vote in an election), we must consider as much of the evidence on each side of the issue as we can. And (as we noted when discussing the strawman fallacy), we cannot rely on the critics of a view to state it fairly, especially when the point at issue is highly controversial or arouses intense emotions.

Remember not to simply invoke the fallacy of suppressed (or neglected) evidence each time you see an argument that overlooks something that seems likely to be relevant. If the argument commits one of the fallacies we have studied, it is important to note that fact. And it is even more important to explain in some detail why the argument is weak. We will study this fallacy in greater detail in a later chapter on sampling.

10.7 Chapter Exercises

The task in this exercise set is to spot any of the fallacies we have studied thus far. To make things more interesting, it may be that some passages do not commit any fallacy at all. Identify any fallacies by name, then explain in your own words and in detail what is wrong with the reasoning in those cases where it is bad.

1. Before the elections last November, some Democrats argued that the Republican revolution had to be stopped. After all, they said, the Republicans want to phase out health care for the elderly and on top of that, they want to take school lunches away from kids.

2. Before the elections last November, some Democrats claimed that the Republican revolution had to be stopped. After all, they said, almost all the Republicans in Congress are rich and they only care about making things better for themselves.

3. If twenty is greater than ten, it is certainly greater than eight and twenty is greater than ten.

4. We really do have to conclude that R Kelly is guilty. After all, he couldn’t provide any alibi for where he was when the crimes were committed—he claims he was not the man on the video tape engaged in sexual acts with a person who says they are fourteen—and the defense never suggested who else might have committed the crime if the defendant didn’t.

5. Those who want to allow trans people to serve in the military forces hold an unreasonable and unacceptable position. They want trans people to be automatically accepted into the military, and want no restrictions on sexual relationships, whether on or off duty.

6. There is no way there was Russian involvement in the 2016 presidential election. If they had, someone would have been able to prove it by now.

7. From a letter condemning hunting: “Please . . . don’t try to ennoble your psychotic behavior by claiming that you are trimming the herd for the benefit of the herd.”

8. Champions of campaign finance reform have a hopeless view. They seem to think that if there were limits on contributions to political candidates there would be no more corruption in politics and the poor could also afford to run for office. But we will always have corruption, and it will always be easier for the rich to get elected.

9. Who are you to say that I drink too much? You aren’t exactly Ms. Sobriety yourself.

Answers to Selected Exercises

1. Straw Man fallacy. The Democrats in question were not personally attacking Republicans, so it is not an ad hominem fallacy. But their characterization of the Republicans’ position is unfair; it distorts their view in a way that makes it appear much more frightening, and hence easier to attack.

2. Ad hominem fallacy. Here the Democrats in question were attacking the Republicans themselves, rather than their arguments.

3. This argument affirms the antecedent, and so it is valid. Both premises are true, so it is also sound. It is not a very interesting argument, but there is nothing substantive that is wrong with it. It’s thrown in here just to remind you of fallacies we saw near the beginning of the course.

4. Taken just by itself, this argument commits the fallacy of appeal to ignorance. The mere fact that Kelly can’t show that he is innocent does not show that he is guilty. In a larger context, where we know of positive evidence against Kelly, the lack of alibi does become a problem for him.

5. Straw Man fallacy. This passage is an unfair, distorted characterization of the views of most people who think that trans people should be allowed to serve in the armed forces.

6. Taken just by itself, this commits the fallacy of appeal to ignorance. The fact that evidence hasn’t turned up doesn’t mean that it won’t. But in a larger context, if people have been looking very hard in the places where evidence would be (if it exists at all) and they have come up empty, it gives some support to the claim that they are is innocent.

7. Attack on the person (ad hominem)

8. Straw Man, combined with an Either/or fallacy. Why?

Chapter 11

Fallacies: Common Ways of Reasoning Badly

Overview: Bad reasoning is said to be fallacious. Some fallacies are simple to spot, but others give the appearance of being good arguments, and it is easy to be taken in by them. In this chapter, we will learn about three more fallacies: begging the question, the either/or fallacy and, quite briefly, the fallacy of the line. We will also note problems involving inconsistency.

Contents

In this chapter, we will study four of the most common ways that reasoning and argumentation can go awry—four common fallacies—and discuss some ways to spot, and to avoid, them.

11.1 Begging the Question

You and Tina are chatting in your dorm. She's a rabid UCLA fan and is telling you how well their football team will do this season. But you're skeptical. In exasperation, she works the following argument into your conversation.

> *You:* I just don't see UCLA having a winning season in football. They weren't very good last year, and they lost a some really good players.
>
> *Chidi:* You're wrong, and I can show it. UCLA will have a winning season.
>
> *You:* Why?
>
> *Chidi:* Because they will.

When we put Chidi's argument in standard form it looks like this:

> *Premise:* UCLA will have a winning season.
> *Conclusion:* Therefore, UCLA will have a winning season.

Are you convinced? Of course, not—but why not? What's wrong with the argument? Let's begin by asking whether the argument has some of the good features we've learned about so far.

Relevance: Is the premise relevant to the conclusion? Well, if the premise is true, so is the conclusion, so the premise could scarcely be more relevant.

Validity: Is the argument valid? Well, if the premise is true, then the conclusion must be true (since the premise and the conclusion are the same). So, the argument is valid.

Soundness: Is the argument sound? That depends on whether the premise is true or not. We may not be sure about that, but we can see that there is something wrong with this argument even if the premise is true, by devising a similar argument with a true premise.

Suppose you aren't sure who the U.S. President was in 1922, and Jordan argues:

> The President in 1922 was Warren G. Harding. Therefore,
> the President in 1922 was Warren G. Harding.

Here the premise is true, so, the argument is sound. But if you were in doubt before, should this argument convinces you that Harding was president in 1922? This argument is no better than Tina's argument above.

The premises of the winning-season argument are relevant to the conclusion, the argument is valid, and it might even be sound. Still, something is very wrong with it in the context of your discussion. What is it (try to answer this question before going on)?

Using Arguments to Convince

Arguments have various purposes. Sometimes we just use an argument to see what follows from what (if I spend $50 on weed this week, how much will that leave me for food?). But one of the main functions of an argument is to convince someone of something that they do not already believe (if they already accept our claim, there is no point trying to convince them).

When we try to legitimately convince someone with an argument, we are trying to get them to accept a claim (the conclusion) by giving them reasons (premises) to believe it. But if we are to accomplish this, we must use premises that the other person accepts. After all, if we use premises that they don't accept, then even if our argument is deductively valid, there is no reason for them to believe that our conclusion is true.

What counts as a legitimate premise depends on the context. If you are arguing with someone who already believes that Democrats always make better public officials than Republicans, then you could use the claim that we should have a Democratic majority in the United States Senate in arguments with that person. You both agree on this premise, it is common ground, so it is quite reasonable to use it in this context. But if you are arguing with someone who doesn't believe that Democrats always make better officials, you cannot use this premise. If the other person doesn't think your premise is true, then no matter how elaborate your argument, they won't have any reason to accept your conclusion.

So, it is fair to assume different things in different contexts. But if someone doubts that your view is true, it will never be appropriate to use your view as a premise to convince them that your conclusion is true. No matter what the context, if you doubt that OU will have a winning football season, Wilbur cannot reasonably use the claim that they will have a winning season as a premise in arguing for his conclusion that they will have a winning season.

Of course, no one would be taken in by Wilbur's argument, but we will see that it is often possible to give the sort of argument that Wilbur gave, but to disguise it, so that it's defects are much harder to spot.

Begging the Question

We commit the fallacy of **begging the question** when we assume the very thing as a premise that we're trying to show in our conclusion. We just assume the very thing that is up for grabs. This is a fallacy, because if a certain point is in dispute, we cannot fairly assume it in our discussion.

Let's continue for just a moment with our blatant example from above, in which the problem is obvious. We will then and work our way up to more difficult cases.

> *Premise:* UCLA will have a winning season.
> *Conclusion:* Therefore, UCLA will have a winning season.

If you were in doubt about the conclusion, you won't accept the premise, and so you won't be persuaded by this argument. After all, the reason given for accepting the conclusion is the very point at issue in your discussion.

Begging the question: assuming what you are trying to prove

Of course, no one is fooled by such an obviously bad argument. In real life, begging the question is often subtler. But before looking at examples, we should note a very important point that emerges from our discussion thus far.

Arguments that beg the question have premises that are relevant to their conclusions, they are deductively valid, and many of them are even sound. For example, the argument, "Two is an even number; therefore, two is an even number," is sound. Does this mean that relevance, validity, and soundness don't matter after all? No. It merely shows that in some contexts there are additional things that matter in an argument.

11.1.1 Variations of Begging the Question

Begging the Question by Rephrasing the Conclusion

Sometimes people rephrase the conclusion (put it in different words), and then use the result as a premise. This can be confusing if they use technical jargon or puts things in a long-winded way. Consider the following dialogue:

> *Llona:* One of these days I think we'll have a successful communist country.
>
> *Zoe:* Communism will never succeed, because a system in which everything is owned in common will never work.

In standard form Zoe's argument looks like this:

Premise: A system in which everything is owned in common won't work.
Conclusion: Therefore, communism will never work.

The conclusion of this argument may well be true. But the very point at issue between Llona and Zoe is whether communism could work. And in this context, Zoe's premise cannot be used to support her conclusion, since it simply restates the conclusion in different words. To see this, note that:

- communism = a system in which everything is owned in common, and

- will never succeed = will never work

This argument is no better than the argument that OU will win because they will win. But when the premise restates the conclusion in different words, the fallacy can be harder to detect.

Here is another example:

Ali: I don't know about all the things in the Bible. Like the song says, it ain't necessarily so.

Burt: That's wrong. The Bible is the word of God.

Ali: How in the world do you know that?

Burt: Well, the Bible says that it's the word of God, and it's divinely inspired.

In standard form:

Premise 1: The Bible says that it's the word of God.
Premise 2: The Bible is divinely inspired.
Conclusion: Hence, the Bible is the word of God.

Ali and Burt will agree that the first premise of the argument is true. But since the point at issue here is whether the Bible is the word of God, Burt's second premise begs the question. To view Premise 2 as evidence for the existence of God, you already must *believe* in the existence of God.

Put another way, anyone (like Ali) who doubts that the Bible is the word of God will also doubt whether it is divinely inspired. Since being divinely inspired and being inspired by God are the same thing, the two claims here say virtually the same thing. This doesn't mean that Burt's conclusion is false. But if the goal is to convince Ali, then Burt needs *independent* support for his claim. He could either:

1. Employ some other premise Ali will accept, or

2. Defend premise 2 (using premises Ali will accept)

Here is another argument that suffers from the same malady: "Democracy is the best form of government, since the best system is one in which we have government by the people." Before moving on, put this argument into standard form and analyze it.

Begging the Question by Generalizing the Conclusion

A trickier form of begging the question arises if we generalize the conclusion and
use the result as a premise. This problem is illustrated in the following dialogue:

> *Destiny:* There's nothing wrong with a couple of cold beers on a hot summer day.
>
> *Dominique:* Oh no. Drinking beer is wrong!
>
> *Destiny:* Why in the world is that?
>
> *Dominique:* Well, because drinking alcohol is wrong.

In standard form Dominique's argument looks like this:

> *Premise:* Drinking alcohol is wrong.
> *Conclusion:* Therefore, drinking beer is wrong.

Here Dominique's premise does not simply restate her conclusion. But it does generalize it (since beer is one type of alcohol). Destiny surely knows that beer is one variety of alcohol, and since the point at issue is whether drinking beer is wrong, she won't accept the more general claim that drinking alcohol is wrong.

Begging the Question in More Subtle Ways

It is also possible to beg the question in more subtle ways. For example:

> *Deja:* I know abortion is a terrible thing, but I don't think it should be illegal.

> *Minh:* But you're overlooking the fundamental point. Abortion is murder. And we certainly should have laws against that. So, we should have laws against abortion.

In standard form Minh's argument looks like this:

> *Premise 1:* Abortion is murder.
> *Premise 2:* We should have laws against murder.
> *Conclusion:* So, we should have laws against abortion.

We can assume that Deja and Minh and virtually everyone else agrees that we should have laws against murder, so it is perfectly appropriate for Minh to assume this as their second premise. But the point at issue is really whether abortion is wrong in a way that would justify having a law against it. Deja denies that this, so she certainly wouldn't accept Minh's premise that abortion is murder. In this context, Minh's first premise assumes the point at issue, and so begs the question.

Of course, Minh's first premise might be true. But since Deja would not accept it at this stage of their discussion, Minh needs to give some further argument to support it. If they can do this, then Deja will almost certainly accept Minh's further claim that we need laws against abortion.

Some people draw a distinction between the fallacy of begging the question and the fallacy of circular reasoning. We needn't worry about such fine distinctions here, though, so we'll use these two labels interchangeably to stand for the same fallacy.

Question Begging Labels

Sometimes we characterize a view or group or person in a loaded way, with a label that begs the question against it (or them). This happens when the label only makes sense if the view or group or person is defective in some way. For example, labels like 'redneck' and 'welfare queen' suggest that members of a group are guilty of certain practices or have dangerous views.

It is also possible to use labels to beg the question in favor of a position, group, or person. For example, labels like 'The moral majority' suggests that the group's views represent those of the majority, and that they are right. Perhaps they do, but you can't use a label to settle the question.

Of course, no one would think that a label completely settles the matter, but labels do predispose us to think about issues in certain ways. At their worst, question begging labels so warp the way people conceptualize an issue they can't even see that question begging is going on. Many people who hear the label 'illegal immigrant' take this to be a legitimate descriptor of people who enter the country without formally immigrating first. The label suggests that crossing into the country without first immigrating is an illegal action. The issue is that, while some people entering the country without first immigrating might be up to illegal ends, many others are seeking asylum, a process that requires that an individual has fled their country of origin due to fear of persecution. In other words, it is a legal process that requires the person first enter the country without permission.

Exercises

1. In each of the following, determine whether a question is begged. If it is, say as precisely as you can just how the fallacy is committed (Does the premise restate the conclusion? Does it just generalize it? Is something subtler going on?).

    1. All freshmen should have to attend computer orientation, because all college students should go to such an orientation.

    2. All college students should have to attend computer orientation, because without it they won't be prepared to use computers, and they'll have to master that skill to have a decent job.

    3. Capital punishment is morally wrong, because the Bible says that it is.

    4. The belief in God is nearly universal, because nearly everybody, in every culture and every historical period, has believed in God.

    5. It is important that we require handguns to be registered, because it keeps guns out of the hands of children (they are too young to be registered) and dangerous criminals (since a background check is required for registration).

    6. It's important that we require handguns to be registered, since we need some sort of record who the owners of firearms.

    7. Capital punishment is morally wrong, because it's always wrong to take the life of another person.

    8. God exists, because nearly everybody, in every culture and every historical period, has believed in God.

2. Give an example of a question-begging argument where one of the premises simply restates the conclusion.

3. Give an example of a question-begging argument where one of the premises simply generalizes the conclusion.

4. What sorts of premises is it legitimate to assume in a certain context? How can you determine whether a premise is legitimate or not?

Answers to Selected Exercises

1. In each of the following, determine whether a question is begged. If it is, say as precisely as you can just how the fallacy is committed (Does the premise restate the conclusion? Does it just generalize it? Is something subtler going on?).

1.1 All freshmen should have to attend computer orientation, because all college students should go to such an orientation.

> This begs the question. The conclusion generalizes the premise, and anyone who doubted that freshmen should attend a computer orientation would (probably for the same reasons) doubt that all college students should.

1.2 All college students should have to attend computer orientation, because without it they won't be prepared to use computers, and they'll have to master that skill to have a decent job in the coming century.

> The premise offers an independent reason why freshmen here should go through computer orientation. Perhaps the argument has flaws, but it doesn't beg the question.

1.3 Capital punishment is morally wrong, because the Bible says that it is.

> This argument does not beg the question. Perhaps it has other flaws, but the premise does not restate or generalize or presuppose the conclusion. It tries to provide independent support for it.

1.4 God exists, because nearly everybody, in every culture and every historical period, has believed in God.

> This argument does not beg the question. It offers a reason that is quite independent of the conclusion as support for the conclusion. The argument is a version of an argument from authority (an appeal to tradition and to what most people think).

11.2 The Either/Or Fallacy

Disjunctions

Earlier, we encountered a type of compound statement called a conditional. In this module, we will be concerned with a second kind of compound sentence; it's called a *disjunction*.

A **disjunction** is an "either/or" sentence. It claims that (at least) one or the other of two alternatives is the case. For example:

Disjunction: an either/or sentence

1. Either the butler did it, or the witness for the defense is lying.
2. Either I have a throat infection, or I have the flu.
3. "'Hey,' I said, 'When you [write novels], do you sort of make it up, or is it just, you know, like what happens?"' [Martin Amis, *Money*]
4. We will either balance the federal budget this year, or we will stand by and watch our country go broke sometime in the next quarter century.
5. Either the dead simply cease to exist and have no perceptions of anything, or else they go on to a better life after death. [Socrates, from Plato's dialogue, the *Apology*]

The two simpler sentences that make up a disjunction are called disjuncts. The order of the disjuncts in a disjunction doesn't matter (you can reverse their order, and the resulting disjunction will mean the same thing as the original disjunction). The first sentence in the list above says that either the butler did it or the witness for the defense is lying. So, it will be true if the butler did do it or if the witness is lying. And it will be false if both these disjuncts is false.

The Either/Or Fallacy

We commit the **either/or fallacy** when we assume that there are fewer alternatives than there are, typically two. When this happens, we mistakenly suppose that a disjunction is true when it is false. The either/or fallacy gets its name from the fact that we act as though *either* the one alternative is true or else the other alternative is, though in fact there are more than just these two alternatives. In such cases, we have overlooked some third alternative. For example, in sentence 1. (about the butler), we may have overlooked the possibility that the witness made an honest mistake (maybe her eyesight isn't what it used to be).

Either/Or fallacy: assuming there are fewer alternatives than there actually are

The either/or fallacy goes by a variety of names. It is sometimes called the *false dilemma fallacy*, the *black and white fallacy*, or the *fallacy of false alternatives*. It often results from what is called all-or-none thinking.

These names reflect the nature of the fallacy. For example, talk of black or white thinking suggests a tendency to think in extremes, to see things as definitely one way or else definitely the other, without any room in between for various shades of gray. And talk of all-or-none thinking suggests a tendency to believe that things must be all one way or all another (when in fact the truth may lie somewhere in the middle). Let's see how some of the sentences in the list above might involve the either/or fallacy.

1. Either the butler did it, or the witness for the defense is lying.

As we noted above, the butler may be innocent, and the witness may simply be mistaken for some reason or another.

2. Either I have a throat infection or I have the flu.

Perhaps I have correctly narrowed the possibilities down to these two, in which case the disjunction is true. But I may have jumped to the conclusion that I have one or the other of these infirmities, when it fact it is only my allergies acting up again (perhaps the pollen count has been high lately).

3. "'Hey,' I said, 'When you [write novels], do you sort of make it up, or is it just, you know, like what happens?'" [Novelist] "Neither" [Martin Amis, *Money*, p. 87]

Here John Self, a character in Martin Amis's novel, *Money*, asks a novelist whether he just makes everything up or whether it he writes about things that have really happened. The novelist replies that he doesn't do either of the two. Real life events give him lots of ideas, but he is constantly changing them in his imagination as he writes. The novelist is pointing out, in his one-word response ('Neither"), that Self is committing the either/or fallacy.

4. Either the dead simply cease to exist and have no perceptions of anything, or else they have a good life after death.

Socrates asserts this disjunction in an argument which concludes that death is nothing to fear. He seems to overlook the possibility that there is life after death, but that it will be unpleasant.

Examples of the Either/Or Fallacy

Since the either/or fallacy makes things look simpler than they really are, it makes for pithy, memorable slogans. You will be familiar with some of the following examples:

- America: Love it or Leave it.
- You are either part of the solution or you are part of the problem.
- You are either with us or against us.

Another common pair of slogans several decades ago were:

- “Better dead than red.” (a favorite of proponents of the arms race at the height of the cold war), and
- “Better red than dead.” (a favorite of their opponents)

Both these slogans rested on the assumption that there were only two alternatives: either we engage in an escalating arms race with the Soviet Union, or they will crush us. Such claims often do make a point, but snappy slogans by themselves rarely make for good reasoning.

More Complex Examples of the Either/Or Fallacy

Many examples of the either/or fallacy can be more difficult to spot. For example, one frequently hears the following sorts of claims in current debates over policy issues.

1. Either we keep teaching the Western Canon (the great literary and philosophical works of the Western world), or we just let each professor teach whatever junk they want.

2. We either must institute the death penalty, or we will have to live with the same people committing terrible crimes over and over (each time they are released from prison).

With a little thought, we can see that there are more than two alternatives in each case. But when we hear such claims in conversation, they often go by so fast, and may be asserted with such confidence, that we don’t realize how much they oversimplify the situation.

The either/or fallacy is often committed alongside the straw man fallacy. For when we simplify someone’s views into two easily attacked alternatives, we typically substitute a weakened version of their view for the view that they really hold.

11.2.1 Clashes of Values

Many of the difficult moral and political issues of our day involve clashes of values. Virtually all of us think that the following values are important:

1. Freedom (liberty)
2. Security
3. Majoritarianism (majority rule, i.e., democracy)
4. Equal opportunity
5. Community moral standards

For example, virtually all of us believe that democracy, the rule of the many, is a good thing. But democracy can be in tension with other values, most obviously, individual rights and liberties. A majority can tyrannize a minority just as much as a dictator can. For example, until the 1960s, poll taxes and other public policies made it almost impossible for African Americans in many parts of this country to vote (and gerrymandering and other manifestations of institutionalized racism continue to contribute to the disenfranchisement of people of color today).

Freedoms, or liberties, are in tension with other values. Giving people a great deal of freedom can make our lives less secure in various ways. Indeed, various types of liberty can even be in tension with each other. Unlimited freedom of the press may infringe on a person’s right to have a fair trial, for example, or violate people’s rights to privacy.

Most of us think that it is also important to make sure that everyone in our country (especially children) have a decent standard of living (enough food to survive, basic medical care, etc.). But the two values, freedom to spend one’s money as one likes, and helping others, are in tension, because in our society the only way to ensure that everyone has a reasonable standard of living is to tax people and redistribute the money to people who don’t have enough of it (in the form of food stamps, welfare payments, etc.).

In such cases, it may be tempting to pose the issues in terms of two stark alternatives: freedom (to keep what one owns) vs. everyone having a reasonable standard of living. These cases are difficult, because both values are important to most of us. But there is a definite tension between them, and finding satisfactory ways to reconcile them is difficult.

Disjunctions in the Guise of Conditionals

Disjunctions can be restated as conditionals. For example, we can restate the claim: “Either you are part of the solution or you are part of the problem” as the conditional:

- If you are not part of the solution, then you are part of the problem.

And we can restate the claim: “Either I have a throat infection or I have the flu,” as the conditional:

- If I don’t have a throat infection, then I have the flu.

If I assert either of these conditionals, I may be just as guilty of the either/or fallacy as if I had asserted the original disjunction, but it is harder to spot this fallacy when we are dealing with a conditional. If you come across the claim:

- If we don’t balance the federal budget this year, then we will have to stand by and watch our country go broke sometime in the next twenty-five years.

It may be far from obvious that this passage involves the either/or fallacy. To see that it does, we must see that it is just another way of saying, “We will either balance the federal budget this year, or we will stand by and watch our nation go broke sometime in the next twenty-five years.”

Finally, we should note that the either/or fallacy could be involved if someone said that there were only three alternatives when in fact there were four. Indeed, the fallacy is committed whenever someone claims that there are fewer alternatives than there are.

Why it’s Easy to Commit the Either/Or Fallacy

1. It takes less energy and imagination to suppose that there are only two alternatives than to try to figure out whether there are additional possibilities.

2. Language is full of simple opposites—good vs. bad, right vs. wrong, us vs. them—and this can encourage us to think in oversimplified terms.

3. It is easier to persuade others to accept our view about something if we can convince them that the only alternative is a very extreme position. So, characterizing the situation in terms of a limited number of options often makes it easier to defend our position.

4. Prejudices and stereotypes can make it easier to think in all-or-none fashion (we will return to this in a later chapter). For example, extremists of various sorts tend to see issues in very

simple terms; it is either us or them. For this reason, such people are often unwilling to compromise.

5. There are two kinds of deductively valid arguments that involve disjunctions, and below we will see how these sometimes encourage us to commit the either/or fallacy.

11.2.2 Safeguards

There may only be two alternatives in any given case, and there are certainly issues on which we should not be willing to compromise. But we shouldn't assume this without considering the matter. Here are some safeguards against the either/or fallacy.

1. When you encounter a disjunction (or a conditional), consider the possibilities. Has the other person overlooked some genuine alternatives?

2. Avoid the temptation to think in extremes. Difficult issues rarely have simple solutions, so we need to at least consider a range of options.

3. Be especially wary if someone argues that the only alternative to their position is some crazy-sounding, extreme view.

Arguments involving Disjunctions

There are two kinds of arguments that involve disjunctions. They are relevant here, because when we use them, it can be easy to commit the either/or fallacy.

In Chapter 3, we studied conditional arguments. Here we will learn about two kinds of disjunctive arguments, two important argument forms or formats that involve disjunctions

Disjunctive Syllogism

1. Either the butler did it or the witness is lying.
2. The witness isn't lying (she's as honest as the day is long).
So (3) The butler did it.

Disjunctive Syllogism-valid
A or B
Not -A
So, B

Arguments having this form are called **disjunctive syllogisms**. *All* arguments with this form are deductively valid. They involve a simple process of elimination; one premise says that there are only two possibilities and the second premise eliminates one of the two. This leaves only one possibility as the conclusion.

Disjunctive syllogisms have the form:

1. Either A or B.
2. But A is not true.
So, (3) B is true.

Constructive Dilemmas

Socrates gives the following argument for the conclusion that death is nothing to fear (Plato reports the argument in his dialogue the *Apology*).

1. Either the dead simply cease to exist and have no perceptions of anything, or else they go on to a better life after death.
2. If the dead simply cease to exist, then death is nothing to fear [it would be like a long, restful sleep].
3. If the dead go on to a better life, then death is nothing to fear.
So, (4) Death is nothing to fear.

Constructive Dilemma-valid
A or B
If A then C
If B then C
So, C

In the first premise, we narrow the range of alternatives down to two. Then, even if we don't know which of the two is the case, we claim (in premise 2) that if the first alternative is true, then such and such follows. We repeat this strategy, adding (in premise 3) that if the second alternative is true, then (the same) such and such follows. So, if either of them is true, such and such must follow (in this case, that death is nothing to fear).

Constructive dilemmas have the form:

1. Either A or B
2. If A, then C
3. If B, then C
So (4) C

All arguments with this form are deductively valid.

Disjunctive Arguments and the Either/Or Fallacy

When we encounter either type of disjunctive argument, we should ask whether its disjunctive premise is true, or whether we have an either/or fallacy. Such fallacies are especially easy to overlook in such contexts because the argument may be good in several ways that lead us to overlook the false disjunctions. Particularly:

1. Both sort of arguments is always deductively valid, so the formal reasoning is correct.

2. All the premises other than the disjunction may well be true.

3. The person giving the argument may spend a lot of time defending the non-disjunctive premises. This may focus our attention on them, leading us to overlook potential problems with the disjunction. In Socrates' argument about death, for example, a lot of time might be spent defending the claim that an eternal sleep is not to be feared, and this may lead us to overlook problems with the first, disjunctive, premise.

Exercises

When you encounter a disjunction (or a conditional) it is always worth asking whether it commits the either/or fallacy. Thought is required; we want to be alert to the possibility that this fallacy has been committed, but we don't want to jump too quickly to the conclusion that it has been.

In each of the following passages, determine whether the either/or fallacy has been committed or not. In those cases where it has (a) say precisely how it has been committed, and (b) explain what might be done to strengthen the argument so that it doesn't commit this fallacy.

1. Mother to son: "Are you going to college, or are you going to be a bum like the Jones boy?"

2. "Hallmark. When you care enough to send the very best."

3. Either a positive integer is even or else it is odd.

4. Roseanne: "How bad is it? I mean, are we going to have to eat cat food, or just the kids?"

5. If you can't beat 'em, join 'em.

6. If God doesn't exist, then anything is permitted.

7. We obviously cannot legalize recreational drugs, as some people recommend. For if drugs aren't illegal, we will be encouraging people to use them. And it is clear that drugs are extremely dangerous. So, it's better to live with the current situation than to try to change things in this extreme sort of way.

8. We will either balance the federal budget this year, or we will stand by and watch our country go broke sometime in the next quarter century.

9. Either there is a God, or there isn't.

10. Either the dead simply cease to exist and have no perceptions of anything, or else they go on to a better place after death.

11. Either we keep teaching the Western Canon (the great literary and philosophical works or the Western world), or we just let each professor teach whatever garbage they like.

12. Either we must institute the death penalty, or we will have to live with the same people committing terrible crimes over and over (each time they are released from prison).

13. Polling questions and opinion surveys often require you to select from a restricted set of alternatives (e.g., should we increase defense spending or should we lower it?). Give examples, either ones that you have encountered or ones that you construct, which illustrate this.

Answers to Selected Exercises

In each of the following passages, determine whether the either/or fallacy has been committed or not. In those cases where it has (a) say precisely how it has been committed, and (b) explain what might be done to strengthen the argument so that it doesn't commit this fallacy.

2. "Hallmark. When you care enough to send the very best."

> This is a nice advertising hook. The conditional, "When you care enough to send the very best, you send Hallmark," is equivalent to the disjunction, "Either you don't care enough to send the best, or you send Hallmark." So, if you send any card that isn't a Hallmark card, you really don't care much about the person you send it to (you louse). This commits the either/or fallacy.

3. Either a positive integer is even or else it is odd.

> This does not commit the either/or fallacy. There really are only two alternatives here. A positive integer must be one or the other. The claim here is perfectly true, and it doesn't involve any fallacy whatsoever.

5. If you can't beat 'em, join 'em.

> The key to working this is to note that the conditional here is equivalent to the disjunction: Either you beat them or you join them.

11.3 Drawing the Line

When there are borderline cases, cases where we can't be sure whether a word applies to something or not, the word is **vague**. Vague words are not completely precise. For example, the word 'bald' is vague. There are many people who have a bit of hair, and they are not clearly bald or clearly non-bald. Again, some things are clearly red and some are clearly not red, but at the edges (near shades of orange and shades of purple), there are unclear cases.

When we encounter a vague word, there is usually no need to try to make it precise (and in fact any way of doing so would be somewhat arbitrary). Indeed, although precision is often desirable, it is good that many of our words are vague. If we had to learn exactly how many hairs someone needs to be non-bald, or precisely what shades counted as red, we could never learn to use these words. In fact, most of the adjectives (and some of the other words) in our language are vague.

Drawing the line fallacy: claiming that vagueness prevents a distinction from being made

It is not uncommon to hear people argue as follows:

> You cannot draw a definite line between X and Y, so there really is no difference between Xs and Ys.

We call this the **line-drawing fallacy**. There are a great many cases where we cannot draw a definite, non-arbitrary, line between two things, but there are still many clear cases of Xs and Ys (even though there are borderline cases as well).

For example, it is true that we cannot draw a line that neatly separates each person into either the group of people who are for sure bald or else into the group of people who are certainly not bald. There are borderline cases here. But this doesn't mean that there are not clear cases of bald people (e.g. Patrick Stewart) and clear cases of people who are not bald (e.g., Conan O'Brien). Again, it isn't possible to draw a precise line between day and night, but it is for sure day at 2:00 P.M. and for sure night at 2:00 A.M.

No one would agonize much over these examples, but there are other cases involving line-drawing that matter more. For example, you probably cannot draw a precise, non-arbitrary line that will separate all weapons into those that should be legal (e.g., hunting rifles) and those that should not be (e.g., nuclear warheads), but this doesn't mean that there aren't clear cases of each.

Again, someone might argue that there is no way to draw and line between a fetus that is one day old and a fetus that is nine months old. Indeed, this could be part of an argument against abortion; we can imagine someone urging, “Abortion shouldn’t be allowed, because there is no place where you can draw a line between the fetus being a person and it not being one.” But there are certainly important differences between a very undeveloped fetus and a newborn infant. Often, we can’t draw a precise, non-arbitrary line that separates everything neatly into either Xs or Ys. But that does not mean that there are not many completely clear cases of each. Moreover, it does not follow that just any place we draw the line is as good as any other. Any attempt to distinguish day from night that counts 1:00 P.M. as night is simply wrong.

11.4 Inconsistency

We will discuss issues involving inconsistency at length in Chapter 19. For now, it is enough to recognize that the key point is that when some person (or group) is inconsistent, *at least one of the things they say must be false*.

People are rarely blatantly inconsistent. We don’t often say something in one breath and then say the exact opposite in the next. But people do sometimes say one thing in one setting and then deny it in another. Politicians, for example, often tell different audiences what they believe the audiences want to hear, but all of us are susceptible to the temptation to do this.

People also sometimes promise to do several things that cannot all be done together. For example, someone running for office may promise to cut taxes, keep Social Security and Medicare spending at their current levels, and beef up defense. It is unlikely that all three things can be done at once.

Organizations can also send inconsistent messages. For example, one member of a large organization may make an announcement in a way that allows other members to maintain “deniability” (i.e., that allows them to avoid taking responsibility for it).

To test your understanding, say what is wrong with the following argument:

> “Well, I agree that your argument is deductively valid and that all of its premises are true. But I still think that its conclusion is false, and who are you to say I’m wrong?”

11.5 Chapter Exercises

The task in this exercise set is to spot any of the fallacies we have studied thus far. To make things more interesting, it may be that some passages do not commit any fallacy at all. Identify any fallacies by name, then explain in your own, detailed words what is wrong with the reasoning in those cases where it is flawed. Some fallacies from earlier chapters may appear here.

1. We can never bring complete peace to countries like Albania. There has been ethnic strife there for centuries. We can't undo all that damage. So, we should just stay out of it.

2. *Alice*: Derrick and I both endorse allowing prayer in public schools, don't we Burt?

   Derrick: I never said any such thing.

   Alice: Hey, I didn't know you were one of those atheist types.

3. This is one argument I'm going to win. My point is very simple. Either OU will win their division of the Big 12 outright (outright means that they win it without a tie) or else they won't."

4. If the prosecution fails to prove beyond a reasonable doubt that the defendant is guilty, then we ought to find the defendant not guilty. So, we should indeed return a verdict of not guilty, since the prosecution has failed to offer convincing proof of the defendant's guilt.

5. Either we allow abortion or we force children to be raised by parents who don't want them.

6. We must not legalize marijuana. The legalization of marijuana would mean that it would not be a criminal act to possess marijuana. But certainly, it is, and must remain, a criminal act to possess an illegal drug like marijuana. So, we should oppose legalizing it.

7. The views of those who favor the mandatory use of seat belts are ridiculous. They claim that if everyone is required by law to wear seat belts when riding in a car, then there will be no more automobile fatalities, and that serious automobile injuries will be eliminated. But that is a ridiculous view. For clearly some auto accidents are so bad than even the best seat belts would not prevent injury or death. So, it is silly to have a law requiring the use of seat belts.

8. Almost every advertisement you see is obviously designed, in some way or another, to fool the customer: the print that they don't want you to read

is small; the statements are written in an obscure way. It is obvious to anybody that the product is not being presented in a scientific and balanced way. Therefore, in the selling business, there's a lack of integrity. — Richard P. Feynman

9. *Burt*: Unless we construct a dam and a power plant in this area within the next ten years, we won't be able to meet the significantly growing demand for electrical power.

   Wilbur: What you're saying is that you couldn't care less what happens to the plant life and wildlife in this area, or even to human lives that might be dislocated by building the dam.

10. When you are buying a new car battery, it's hard to know which battery you should choose. But remember one thing: Chuck Yeager says that AC Delco batteries are the best you can buy. And Chuck Yeager is one of the greatest test pilots of all time.

11. Abortion shouldn't be allowed, because there is no place where you can draw a line between the fetus being a person and it not being one.

12. *Reporter to participant in a cow-chip throwing contest*: "Why would anyone want to throw pieces of dried cow dung?"

    Contestant: "Well, it beats the hell out of standing around holding them."

13. This piece of legislation is designed to exploit the poor. After all, it was written and sponsored by one of the richest people in the state.

Answers to Selected Exercises

1. Either/or fallacy. This passage presents us with only two alternatives: either we can bring complete peace or we should just stay out. It is fallacious because it overlooks various intermediate possibilities. For example, we might be able to stop a good deal of the murder of innocent people, even if we can't stop all of it.

2. This passage doesn't contain a complete argument, but what Alice says does suggest that she is committing the either/or fallacy. She claims, in effect, that either you support prayer in public schools or else you are an atheist. Also, it probably attacks a straw man.

3. The speaker asserts that a disjunction (and "either/or") sentence is true. In this case, there really are only two options: either OU wins their

division outright or else they won't (if they tie for first, then they don't win outright). There is no either/or fallacy here.

4. No fallacy.

5. Either/or fallacy. Presents only two alternatives, when in fact there are several more.

11.6 Summary of Fallacies

Fallacy of irrelevant reason (or irrelevant premise)

We commit this fallacy if we offer a premise to support a conclusion when the premise is irrelevant to the conclusion.

Fallacy of Argument against the Person

An irrelevant attack a person, rather than on their position or argument. The fallacy's Latin name, ad hominem ("against the person") is still in common use.

Straw Man Fallacy

We commit this fallacy if we distort or weaken someone's position or argument to discredit it. It is often tempting to do this, because it is much easier to attack a distorted version of a view than to attack the real thing. The chief safeguards here are to (1) be aware of the natural human tendency to characterize opposing views in a way that makes them easier to attack or dismiss, (2) discuss the strongest version of a view you don't like, and (3) do not rely on the critics of a view to state it fairly.

Suppressed (or Neglected) Evidence

We commit this fallacy if we fail to consider (or simply overlook) evidence that is likely to be relevant to an argument. Like the generic fallacy of irrelevant reasons, the fallacy of suppressed (or neglected) evidence is a generic, catch-all label.

Begging the Question

Assuming (without argument) the very point that is up for grabs in a discussion.

Appeal to Ignorance

We commit this fallacy if we defend a view by pointing out that others can't show that it is false. The fact that they are ignorant (don't know) of evidence that would show we are wrong does not mean we are right.

Either/or Fallacy

We commit this fallacy if we assume that there are fewer alternatives than there are. The chief safeguards are to (1) consider all the genuine alternatives in a case, (2) avoid the temptation to think in extremes, and (3) be wary if someone urges that the only alternative to their view is some crazy-sounding extreme view.

Fallacy of the Line

We commit this fallacy when we argue that because we cannot draw a definite, non-arbitrary line between two things, there really isn't any difference between them.

Inconsistency

The basic problem with an inconsistent set of claims is that at least one of them must be false. In this module, we learned about several ways of camouflaging inconsistencies.

Part V

Induction and Probability

Part V. Induction and Probability

Life is uncertain, and we often must act in cases where we can't be sure about the effects our actions will produce. Still, some outcomes seem much more likely than others. In this module, we will examine a range of cases where it is possible to measure how probable something is; we call the numbers used in such measurements *probabilities*.

In Chapter 12, we will get a quick overview of the general issues.

In Chapter 13, we will learn rules for calculating the probabilities of certain important types of sentences.

Finally, in Chapter 14, we will learn how to deal with conditionals, probabilities, and some related concepts.

Chapter 12

Induction in the Real World

Overview: In this chapter, we introduce the notion of probability and see how it affects every aspect of our lives.

Contents

12.1 Life is Uncertain

Almost everything in life is uncertain, so we can't help but deal with probabilities. We don't have any choice. Still, some outcomes are much more likely than others. It is reasonably probable that there will be at least a little snow in Norman, Oklahoma, sometime this year, less probable that there will be over six inches of snow this January, and very improbable that there will be any snow at all in June. In this module, we will study the notion of probability.

Many of the examples in this module involve games of chance. We employ such examples because they are relatively simple, and many of you are familiar with them already. But probability is important in many other settings, and once we learn how it works in these simpler cases, we will see that it turns up almost everywhere. Here are a few of the many cases where we must make important decisions based on uncertain information.

Visiting the Doctor: Often, a person's symptoms and test results are compatible with several different diagnoses, but some of the diagnoses may be more probable than others. Furthermore, the outcomes of many medical treatments are uncertain. You or a loved one may one day be forced to consider the probability that a risky treatment will improve a very bad medical condition.

Example: suppose that you must weigh the odds of a type of operation in which 65% survive with a much higher quality of life—but 5% of the patients die in surgery.

Selecting a Major: A college degree will make it easier for you to get a job, but it requires a lot of time and money, and it won't guarantee a good job once you graduate. And once you do decide to attend college, you must select a major. Perhaps the fields you like best offer fewer job opportunities than fields you like less. How should you decide what to major in?

Divorce: There is a reasonable chance that if you get married you will end up getting divorced. According to the US Census Bureau, Florida has the seventh highest divorce rate in the nation. 41% of first marriages end in divorce (along with 60% of second marriages and 73% of third marriages). Of course, few people think that they will be among the casualties, but many of them will be.

Staying Healthy: Smoking cigarettes is risky, but it does offer several short-term benefits. They help you stay calm and relaxed in moments of stress, they keep you alert, and they help prevent overeating. Moreover, there is always someone's Aunt Edna who smoked four packs a day and lived to be 95. Besides, it is hard to kick the habit (over 70% of people who quit are back on cigarettes within three months). Are they so dangerous that it's worth trying to quit?

- *Similar long-run risks*: overeating or excessive drinking pose a risk over the long run. But a little alcohol each day is relaxing and may be good for your health.

- *Similar short-term risks*: drinking too much before driving or having sex without a condom pose a risk even in the short run.

Raising your Children: There are many gambles here. How strict should you be? What risks should you let them take? How much should you allow them to make their own decisions?

Insurance: When you buy insurance for your car, your home, or yourself, the insurance company is betting that you will not need it. You are hedging your bets by buying it. (This is one bet you hope to lose).

Starting a Business: You would like the independence of owning your own business. Moreover, some small businesses do very well and you could make a lot of money. But many new businesses fail. Is it worth the risk? How can you even determine what the risk is?

Drilling for Oil: Drilling a new well is a risky proposition. It is expensive, and many wells never produce. But some locations are much more likely to yield oil than others. The relevant facts in determining such probabilities include the geological makeup of a region and the number of successful wells in the area.

The Used Car Dealer: You show up on the lot and want to buy a used pickup truck. It looks o.k., you hear that it only has 60,000 miles on it, and the price is right. But there isn't any long-term warranty.

Seat Belts: Seat belts save many lives. But some people die because they wore a seat belt. Moreover, if you don't like to be bothered putting them on, they involve costs in time and irritation. And even if you wear seatbelts, you run some risk every time you go somewhere in your car. There are many examples of this sort – wearing a helmet when you ride a bike or a motorcycle, driving way above the speed limit.

Investments: If you begin saving money soon after you graduate, you will have fewer worries about putting your children through college and you will provide for your retirement years. But as the collapse of Enron reminds us, the investments that promise the most gains are typically the riskiest. What should you do?

The Stock Market: No one is sure what the market will do. If it does well, you can make much more money than you could with most other investments. But if the market takes a big dip, like it did in October of 1997 or April of 2000, you can also lose your shirt.

In short, we all must make important decisions that involve uncertainty. For college students, these include questions about what to major in, which courses to take, whether to go to graduate school, whether to study for an exam or hit the bars, whether to end a relationship, and so on.

12.2 Inductively Strong Arguments

When things are uncertain in these ways, we usually cannot expect to find deductively valid arguments. At most we can hope to find arguments that are inductively strong. In an earlier chapter, we saw that an argument is **inductively strong** just in case:

1. If all its premises are true, then there is a *high probability* that its conclusion will be true as well.

2. It is not deductively valid.

The first item is the important one (the point of the second item is to ensure that no argument is both deductively valid and inductively strong; this makes things easier for us in various ways).

There are two important ways in which inductive strength differs from deductive validity:

1. Unlike deductive validity, inductive strength comes in *degrees*.

2. In a deductively valid argument, the conclusion does not contain any information that was not already present in the premises. By contrast, in an inductively strong argument, the conclusion *contains new information*.

Inductive strength: if premises all true, a high probability the conclusion is true

Since the conclusion contains new information, we go beyond the information that is stated in our premises. Inductively strong arguments and reasons can take many different forms; in this module, we will focus on those that involve probability.

We can also speak of *inductively strong reasons*. A group of sentences provide inductive reasons for a conclusion just in case it is unlikely for all of them to be true and the conclusion false. There is always an *inductive leap* from the inductively strong reasons to the conclusion. The stronger the inductive reasons, the less risky the inductive leap.

Kinds of Reasoning

We can make a sharp distinction between deductively valid arguments, on the one hand, and those that are merely inductively strong, on the other, and it is important to be clear about the difference. But in everyday life there is often no very clear distinction between deductive and inductive reasoning. What might seem to be invalid might become valid if we supply plausible missing premises, for example. Still, a great deal of our reasoning involves arguments and evidence that are inductively uncertain. Life is full of risks and uncertainty, and so is our reasoning about it. No methods are foolproof, but some are much better than others.

12.3 Chapter Exercises

1. List three real life cases that involve probabilities and gambles. How do you try to determine how likely various outcomes are in these cases?

2. What are some of the factors that are relevant in trying to decide whether to quit smoking?

3. Would you want to live near a nuclear power plant? How dangerous do you think such plants are? How could you find out more about how hazardous they are?

4. What connections are there between probabilities and the assessment of risks (like being in an automobile accident or receiving anthrax-contaminated mail)?

5. If an argument is deductively valid, then adding additional premises to it cannot destroy its validity. By contrast, inductively strong arguments can be weakened by adding the right sorts of premises. Give an example of how an argument that isn't valid but is inductively strong can be made weaker, then stronger, then weaker again, by the addition of premises.

Chapter 13

Rules for Calculating Probabilities

Overview: In this chapter, we introduce notation for expressing claims about probabilities and learn six rules for calculating the probabilities of three important types of sentences.

Contents

13.1 Intuitive Illustrations

Taking a Jellybean from a Bag

Suppose we have an opaque bag of twenty red and green jellybeans. Suppose that there are eight red jellybeans and twelve green ones in the bag.

Red: 8

Green: 12

You mix the jellybeans thoroughly, reach in and, without looking, draw one jellybean from the bag. What is the probability that you draw a red one? There are twenty jellybeans, eight of which are red. So, there are eight ways of getting a red jellybean out of twenty possible cases. We can express this as a fraction, 8/20 (which reduces to 2/5). We will say that the probability of drawing a red jellybean is 2/5.

What is the probability of drawing a green jellybean? Since there are twelve green out of the twenty, there are twelve chances in twenty. So, the probability of drawing a green jellybean is 12/20, which reduces to 3/5.

What is the probability that you will draw *either* a red jellybean or a green one? Since all the jellybeans are either red or green, you are certain to pick one color or the other. The probability is 20/20, which reduces to 1. What is the probability that you will draw a jellybean that is neither red nor green? None of the jellybeans satisfy this description. Put another way, 0 out of 20 satisfy it. So, the probability is 0/20 which is just 0.

Rolling Dice

You are rolling a fair die (one that isn't loaded). What are the chances that you will roll a 3? A die has six sides, marked with the numbers 1, 2, 3, 4, 5, and 6. So there is one chance out of six of getting a 3. We say that the probability of rolling a 3 is 1/6.

What are the chances or rolling an even number? There are three ways to roll an even number: rolling a 2, 4, or 6. So the probability is 3/6 (which reduces to 1/2).

13.2 Probabilities are Numbers

Probabilities are numbers from 0 to 1

We think in terms of probabilities more than you might suppose. We often do this, for example, when we talk about percentages. When something could just as easily turn out either of two ways, we say that it's a 50/50 proposition. We could express the same claim by saying that there is a probability of .5 that either of the two outcomes will occur. The meteorologist says that there is a 65% chance of showers later today. We could instead say that the probability of showers is .65. In general, we can translate claims about percentages into corresponding claims about probability by dividing the percentage by 100; this just means adding a decimal point (and perhaps one or more zeros) at the appropriate place. Thus 90% means a probability of .9, and 3% means a probability of .03.

Polls and surveys also report percentages that can be translated into probabilities. Many of the sciences, from psychology to genetics to physics, make heavy use of probability and statistics (which is itself based on the theory of probability). We are all concerned with the likelihood of various possibilities every day. Is rain so likely that we should cancel our hike? Are allergy shots sufficiently likely to help with my allergies that they are worth the time and bother? How likely is this prisoner to commit another crime if they are paroled this year? How likely is Wilbur to go out with Wilma if she asks him for a date?

Probabilities measure how likely things are

Probabilities are numbers that represent the likelihood that something will happen. Probabilities are measured on a scale from 0 to 1. If something is certain to happen, it has a 100% chance of occurring, and we say that it has a probability of 1. And if something is certain not to happen, it has a 0% chance of occurring, and we say that it has a probability of 0. The numbers 0 (“no way”) and 1 (“for sure”) nail down the end points of this scale, so it is impossible to have probability values of 13, 2, or 54. Since life is usually uncertain, we are most often dealing with probabilities greater than 0 and less than 1.

13.2.1 Notation

In our first example, the probability of drawing a red jellybean is 2/5. We might write this as: “Probability (Drawing a red jellybean) = 2/5.” But it will save a lot of writing if we introduce two sorts of abbreviations. First, we abbreviate the word ‘probability’ with ‘Pr’. Second, we abbreviate sentences by capital letters. You can use any letters you please (so long as you do not use one letter to abbreviate two different sentences in a problem). But it’s best to pick a letter that helps you remember the original sentence. For example, it would be natural to abbreviate the sentence, ‘I rolled a six’ by ‘S’.

If we abbreviate the sentence, ‘I drew a red jellybean’ as ‘R’, we can write our claim that the probability of drawing a red jellybean is 25 like this:

$$\Pr(R) = \frac{2}{5}$$

If we flip a fair coin it is equally likely to come up heads or tails, so we say that the probability of getting heads on the next toss is .5. We write this as: $\Pr(H) = .5$ (or $\Pr(H) = 1/2$). In general, we write:

$$\Pr(S) = n$$

to mean that the sentence S has a probability of n of being true.

Exercises

Use this notation to express the following claims:

1. The probability of rolling a six is 1/6.

2. The probability of drawing an ace of spaces from a full deck is 1/52.

3. The probability of rolling a five or a six is 2/6 (i.e., 1/3).

4. The probability of drawing either a red jellybean or a green jellybean is 1.

5. The probability of getting both a red and green jellybean on the same draw is 0.

Answers

There isn't a uniquely correct way to abbreviate the simple sentences in this exercise, but the following ways are natural.

1. Pr(S) = 1/6

2. Pr(A_s) = 1/52

3. We have to sneak an 'or' into our abbreviated sentence: Pr(F or S) = 1/3

4. Pr(R or G) = 1

5. Pr(R and G) = 0

13.3 Rules for Calculating Probabilities

Because probabilities are numbers, we must use a bit arithmetic to calculate them. Don't worry if numbers make you nervous; we will only need some basics, such as multiplying fractions, which you learned long ago. Still, it may have been awhile since you worked with fractions, so if you don't feel confident about them, take a few minutes to work through the appendix, which reviews the basic arithmetic that you'll need.

Cards and Dice: The Basics

Some of the problems we will consider involve cards and dice; here is the makeup of a standard deck of cards (with the jokers removed) and the possible outcomes when you roll a pair of dice.

Die One:	1	2	3	4	5	6
Die Two:	1	2	3	4	5	6

Figure 13.1: Outcomes of Rolling Dice

♣	♢	♡	♠
Ace	Ace	Ace	Ace
King	King	King	King
Queen	Queen	Queen	Queen
Jack	Jack	Jack	Jack
10	10	10	10
9	9	9	9
8	8	8	8
7	7	7	7
6	6	6	6
5	5	5	5
4	4	4	4
3	3	3	3
2	2	2	2

There are fifty two cards, thirteen in each suit (with the jokers removed).

Figure 13.2: Makeup of a Standard Deck of Cards

13.3.1 Absolutely Certain Outcomes

We will now introduce eight rules that will help us calculate probabilities. This presentation follows that of Brian Skyrms's excellent book *Choice & Chance: An Introduction to Inductive Logic*. It is important that you learn and understand these rules. If you don't, you simply won't be able to work the problems.

- **Rule 1.** (*for events that are certain to occur*): If something is certain to happen, its probability is 1. If the sentence A is certain to be true:

$$\Pr(A) = 1$$

*Example***:** If you draw a jellybean out of the bag described above, you are certain to get either a red or a green jellybean: $\Pr(R \text{ or } G) = 1$.

- **Rule 2.** (*for events that are certain not to occur*): If something is certain *not* to happen, its probability is 0. If the sentence A is certain to be false:

$$\Pr(A) = 0$$

Example: If you draw a jellybean out of the bag, there is *no way* that you will get one that is *both* red *and* green; Pr(*R* & *G*) = 0.

13.3.2 Negations

The negation of a sentence says that the negated sentence is false. For example, 'I did not draw a red jellybean' negates the sentence 'I drew a red jellybean'. We will use ~ to signify negation. So, we express the negation of the sentence *S* by writing ~*S*.

Example: If '*A*' stands for the claim that I drew an ace, ~*A* says that I did *not* draw an ace.

Probabilities of sentences and their negations are like people on a seesaw (Figure 13.3). The lower you go, the higher the person on the other side goes. And the higher they go, the lower you go. Similarly, the lower the probability of a sentence, the higher the probability of its negation. And the higher the probability of a sentence, the lower the probability of its negation. If you come to think it more likely that you will pass Chemistry 101, you should think it less likely that you will fail.

The "amount" of probability is limited. A sentence and its negation have a total probability of 1 to divide between them. So, whatever portion doesn't go to a sentence, goes to its negation. In other words, the probabilities *S* and ~*S* always add up to 1.

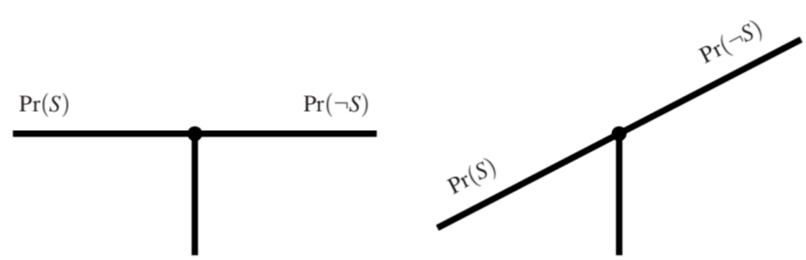

Figure 13.3: A Sentence and its Negation Split One Unit of Probability

- **Rule 3.** (*negations*): The probability of a negation is 1 minus the probability of the negated sentence.

$$\Pr(\sim A) = 1 - \Pr(A)$$

Example 1: If the probability of drawing an ace is 1/13, then the probability that you will *not* draw an ace is 12/13.

Example 2: If a coin is bent so that the probability of tossing heads is .4, then the probability of not getting a head on a toss is .6.
The circle labeled *A* on Figure 13.4 represents the cases in which A is true. For example, it might mean that we draw an ace from a deck of cards. The region of the rectangle that is not in *A* represents the negation of *A*. The rectangle represents a total probability of 1, and it represents the amount of the rectangle not in *A* is 1 minus the amount of the rectangle that is in *A*.

In simple cases, we can represent probabilities by Venn diagrams like that in Figure 13.4. The rectangle represents all the things that could possibly happen. It has a total probability of 1. Think of it as having one bucket, one unit, of mud spread over its surface. The mud represents the probability. Several situations are possible in Figure 13.4.

- All the mud might be *in*side the circle *A*; this represents the case where the probability of *A* is 1 (it has the entire unit) and that of ~*A* is 0.

- All the mud might be *out*side the circle *A*; this represents the case where the probability of *A* is 0 and that of ~*A* is 1 (it has the entire unit).

Some mud may be inside *A* and some outside. Then neither *A* nor ~*A* have probabilities of 1 or of 0. The more mud inside *A*, the more probable it is.

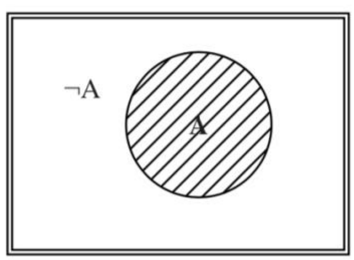

Figure 13.4: Negations

Exercises

1. Suppose 2/3 of the mud in Figure 13.4 is placed inside circle A. What are the probabilities of *A* and ~*A*, given this representation?

2. Suppose virtually all of the mud in Figure 13.4 is placed outside circle *A*. What does this tell us about the relationship between the probabilities of *A* and ~*A*?

13.3.3 Disjunctions with Incompatible Disjuncts

As you likely recall, a disjunction is an "either/or" sentence. It claims that either one, or both, of two alternatives is the case. Here are two specimens:

1. Either the butler did it or the witness for the defense is lying.

2. Either I'll roll a five or I'll roll a six.

The two simpler sentences that make up a disjunction are called *disjuncts*. The order of the disjuncts in a disjunction doesn't matter. Note that we interpret disjunctions so that they are true if both disjuncts are true. Either/or has the same meaning as the phrase *and/or*, so a disjunction claims that *at least one* of the disjuncts is true.

Incompatibility

Two things are **incompatible** just in case they cannot both occur (or cannot both be true) together. It is impossible for them both to happen in any given situation. The truth of either excludes the truth of the other, so incompatible things are sometimes said to be mutually exclusive.

Incompatible sentences: cannot both be true at the same time

Incompatibility is a two-way street: if one thing is incompatible with a second, the second is incompatible with the first. If *A* and *B* are incompatible, then no *A*s are *B*s, and no *B*s are *A*s. So, if *A* and *B* are incompatible, Pr(A & B) = 0.

Example 1: Getting a head on the next toss of a coin and getting a tail on that *same* toss are incompatible. Getting either excludes getting the other.

Example 2: Getting a head on this toss and getting a tail on the *subsequent* toss are *compatible*. These two outcomes are in no way inconsistent with each other. Neither precludes the other.

Exercises

Which of the following pairs are incompatible with each other?

1. Getting a 1 on the next die roll. Getting a 3 on that same roll.

2. Getting a 1 on the next die roll. Getting a 3 on the roll after that.

3. Wilbur graduates from OU this spring. Wilbur fulfills his life-long dream and begins a career as a movie usher.

4. Wilbur graduates from OU this spring. Wilbur flunks out of OU this spring.

5. Wilbur turns twenty. On that very day, he gets the good news that he has just become the President of the United States.

6. Wilbur passes all of the exams in this course. Wilbur passes the course.

7. Wilbur gets a very low F on all of the exams in this course. Wilbur passes the course.

Answers

1. Incompatible. You can't get a 1 and a 3 on the very same roll.

2. Compatible. No side of the die has both a 1 and a 3 on it.

3. Compatible.

4. Incompatible. Graduating and flunking out exclude each other; if either happens, the other cannot.

5. Incompatible. The President has to be at least thirty-five. So being twenty and being President preclude each other. You can't be both at once.

6. Compatible.

7. What do you think?

The Probability of a Disjunction with Incompatible Disjuncts

What is the probability that a disjunction, A or B, with incompatible disjuncts, is true? We can represent the situation with Figure 13.5.

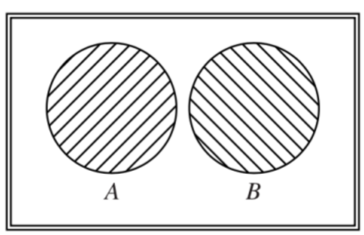

Figure 13.5: Disjunctions with Incompatible Disjuncts

Our question about the probability of the disjunction *A* or *B* now translates into the question: What is the total area occupied by the two circles? And the answer is: it is just the area occupied by *A*, added to the area occupied by *B*. In terms of muddy diagrams, we take the total amount of mud that is on either *A* or on *B* and add them together.

- **Rule 4.** (*disjunctions with incompatible disjuncts*): The probability that any disjunction with incompatible disjuncts is true is the sum of the probabilities of the two disjuncts.

$$\Pr(A \text{ or } B) = \Pr(A) + \Pr(B)$$

Example: No card in a standard deck is both an ace and a jack. So, drawing an ace is incompatible with drawing a jack. If the probability of drawing an ace is 1/13 and the probability of drawing a jack is 1/13, then the probability of drawing either an ace or a jack is 1/13 + 1/13 = 2/13.

We can extend our rule to disjunctions with more than two alternatives (disjuncts). As long as each disjunct is incompatible with all of the other disjuncts, we can determine the probability of the entire disjunction by adding the individual probabilities of each of its disjuncts. For example, the probability that I will draw either a king or a queen or a jack on a given draw is 1/13 + 1/13 + 1/13 = 3/13.

Exercises

1. Remove the jokers from a standard deck of playing cards, so that you have 52 cards. You are drawing one card at a time (and each card has an equally good chance of being drawn). What is the probability of drawing each of the following? In cases where more than a single card is involved, specify which rules are relevant (you will be able to calculate some of these without using the rules, but you won't be able to do that when we get to harder problems, so it is important to begin using the rules now).

    1. A jack of diamonds.
    2. A jack.
    3. A king or a jack.
    4. A two of clubs.
    5. The jack of diamonds or the two of clubs.
    6. A red jack.
    7. A card that is not a red jack.
    8. A face card (king, queen or jack) or an ace.

9. A card that is either a face card or else not a face card.

10. A card that is both a face card and not a face card.

2. You are going to roll a single die. What is the probability of throwing:

    1. A one.

    2. A three.

    3. A one or a three.

    4. An even number.

    5. A non-three.

    6. A two or a non-even number.

3. With Rule 4 (our new rule for disjunctions) and Rule 1 (our rule for sentences that must be true) we can prove that R3, our rule for negations, is correct. Try it.

Answers to Selected Exercises

3. Here's how to use Rule 4 and Rule 1 to show that Rule 3, our rule for negations, is correct. First note that each sentence is incompatible with its negation, so *A* and ~*A* are incompatible. Moreover, the sentence '*A* or ~*A*' is certain to be true. Hence:

    1. Pr(~*A* or *A*) = 1 [by Rule 1]

    2. Pr(~*A* or *A*) = Pr(*A*) + Pr(~*A*) [by Rule 4]

    3. So Pr(~*A*) + Pr(*A*) = 1 [from 1 and 2]

    4. Hence, Pr(~*A*) = 1 - Pr(*A*) [by subtracting Pr(*A*) from both sides]

13.4 More Rules for Calculating Probabilities

13.4.1 Conjunctions with Independent Conjuncts

A **conjunction** is an and-sentence. The sentence, 'Wilbur passed the final and Betty passed the final' is a conjunction. The two simpler sentences glued together by the 'and' are called *conjuncts* (the order of conjuncts in a conjunction doesn't matter). A conjunction is true just in case *both* of its conjuncts are true; if either conjunct is false, the whole thing is false. We will use ‘&’ to abbreviate ‘and’.

Independence

Independent sentences: are completely unconnected, irrelevant to one another

Two sentences are **independent** (of each other) just in case they are completely
irrelevant to each other. The truth-value of one has no effect or influence or bearing on the truth value of the other. Knowing that one is true (or false) tells you nothing about whether the other is true (or false). Independence is a two-way street: if one thing is independent of a second, the second is also independent of the first.

> *Example 1:* You are drawing cards from a deck, and after each draw you replace the card and reshuffle the deck. The results of the two draws are independent. What you get on the first draw has no influence on what you get on the second.

> *Example 2:* You are drawing cards from a deck without replacing them. What you get on the first draw changes the makeup of the deck, and so the outcome of the first draw does bear on the outcome of the second. The outcome of the second draw is (to some degree) dependent on the outcome of the first.

Do not confuse incompatibility with independence. They are completely different.

1. Two things are **incompatible** just in case they cannot both be true at the same time; the truth of either excludes the truth of the other.

2. Two things are **independent** just in case the truth-value of each has no bearing on the truth value of the other.

> *Example:* Getting a head on the next toss of a coin and a tail on that *same* toss are incompatible. But they are *not* independent.

Exercises

Which of the following pairs are incompatible? Which are independent?

1. Getting a 1 on the next roll of a die. Getting a 3 on that same roll.

2. Drawing an ace on the first draw from a deck. Drawing a jack on that same draw.

3. Getting a 1 on the next roll of a die. Getting a 3 on the roll after that.

4. The former host of *Celebrity Apprentice* is reelected President. I roll a 3 on the first roll of a die.

5. Getting a head on the next flip on a coin. Getting head on the flip after that.

6. Passing all of the exams in this course. Passing the course itself.

Rule for Conjunctions with Independent Conjuncts

- **Rule 5**. (*conjunctions with independent conjuncts*): If the sentences *A* and *B* are independent, then the probability that their conjunction, *A* & *B*, is true, is Pr(*A*) times Pr(B).

$$\Pr(A \,\&\, B) = \Pr(A) \times \Pr(B)$$

So, when two things are independent, the probability of their joint occurrence is determined by the simple multiplicative rule: multiply the probability of one by the probability of the other.

Example: What happens on the first toss of a coin has no effect on what happens on the second; getting a head on the first toss of a coin (H_1) and getting a head on the second toss (H2) are independent. Hence, $\Pr(H_1 \,\&\, H_2) = \Pr(H_1) \times \Pr(H_2) = ½ \times 1/2$ (= ¼)

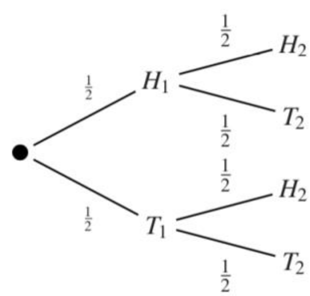

Figure 13.6: Tree Representation of the Probability of a Conjunction

The tree diagram (Figure 13.6) represents the possible outcomes. The numbers along each path represent the probabilities. The probability of a heads on the first flip (represented by the first node of the top path) is 1/2, and the probability of a second head (represented by the node at the upper right) is also 1/2. There are four paths through the tree, and each represents one possible outcome. Since all four paths are equally likely, the probability of going down any particular one is 1/4.

We can present the same information in a table (Figure 13.7) that shows more clearly why we *multiply* the probabilities of the two conjuncts. The outcomes along the side represent the two possible outcomes on the first toss, and the outcomes along the top represent the two outcomes of the second toss.

	H_2	T_2
H_1	H_1 & H_2	H_1 & T_2
T_1	T_1 & H_2	T_1 & T_2

Figure 13.7: Table Representation of the Probability of a Conjunction

We can extend our rule to conjunctions with more than two conjuncts. Provided each conjunct is independent of all the rest, we can determine the probability of the entire conjunction by multiplying the individual probabilities of each of its conjuncts. For example, the probability that I will get heads on three successive flips of a coin is 1/2 x 1/2 x 1/2.

Our work will be much simpler because of the following facts.

- **Incompatibility is only relevant for disjunctions**. We do not need to worry about whether the conjuncts of a conjunction are incompatible or not.

- **Independence is only relevant for conjunctions**. We do not need to worry about whether the disjuncts of a disjunction are independent or not.

Incompatibility: only matters for disjunctions.

Independence: only matters for conjunctions.

Winning the Lottery

The chances of winning a state lottery are very low; you have much better chances of winning in almost any casino in the world. To see why, imagine a lottery where you must correctly guess a one-digit number. There are 10 such digits, so your chances are 1 in 10, or .1. So far, so good. But now imagine that you must guess a two-digit number. There are ten possibilities for the first digit and ten possibilities of the second. Assuming the two digits are independent, this means that the chances of correctly guessing the first digit *and* the second digit are 1/10 x 1/10 = 1/100. You would win this lottery about once every 100 times you played. This may not sound so bad. But most state lotteries require you to match about twelve one-digit numbers. In this case, we determine the probability of winning by multiplying 1/10 by itself twelve times. When we write $1/10^{12}$ out the long way, it turns out to be:

$$\frac{1}{1{,}000{,}000{,}000}$$

which is almost infinitesimally small.

13.4.2 Disjunctions with Compatible Disjuncts

Whenever the disjuncts of a disjunction are incompatible, R4 applies, but when they are compatible, we need a subtler rule.

It will help you to see why if we consider the following example. We are going to flip a quarter twice. What is the probability of getting a head on at least one of the two tosses; what is Pr(H_1 or H_2)? The probability of getting heads on any particular toss is 1/2. So, if we used our old disjunction rule (Rule 4., for incompatible disjuncts), we would have Pr(H_1 or H_2) + Pr(H_1) + Pr(H_2), which is just 1/2 + 1/2, or 1. This would mean that we were *certain* to get a head on at least one of our two tosses. But this is obviously incorrect, since it is quite possible to get two tails in a row.

Indeed, if we used our old disjunction rule to calculate the probability of getting a head on at least one of three tosses, we would have 1/2 + 1/2 + 1/2, which would give us a probability greater than 1.5 (and this could never be correct, since probabilities can *never* be greater than 1).

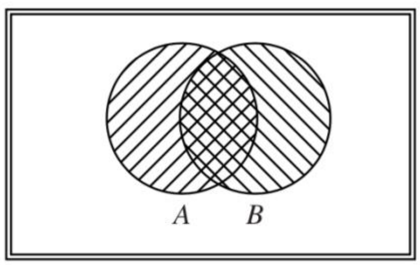

Figure 13.8: Disjunctions with Compatible ("Overlapping") Disjuncts

If *A* and *B* *are* compatible, it is possible that they could occur together. For example, drawing an ace and drawing a black card are compatible (we might draw the ace of spades or the ace of clubs). We indicate this in Figure 13.8 by making the circle representing *A* and the circle representing *B* *overlap*. The overlapping, cross-hatched, region represents the cases where *A* and *B* overlap.

In terms of muddy diagrams, we add the weight of the mud on *A* to the weight of the mud on *B*, but when we do this, we weigh the mud where they overlap twice.

So, we must subtract once to undo this double counting. We must subtract the probability that *A* and *B* both occur, so that this area only gets counted once.

The General Disjunction Rule

- **Rule 6**. (*disjunctions*): The probability of any disjunction, incompatible or compatible, is the sum of the probabilities of the two disjuncts, minus the probability that they both occur.

$$\Pr(A \text{ or } B) = \Pr(A) + \Pr(B) - \Pr(A \,\&\, B)$$

Example 1: Drawing an ace and drawing a club are not incompatible. So, $\Pr(A \text{ or } C) = \Pr(A) + \Pr(C) - \Pr(A \,\&\, C)$; so it equals 1/13 + 1/4 - 1/52. We subtract the 1/52, because otherwise we would be counting the ace of clubs twice (once when we counted the aces, and a second time when we counted the clubs).

Example 2: Getting heads on the first and second flips of a coin are compatible. So to calculate $\Pr(H_1 \text{ or } H_2)$, we have to subtract the probability that both conjuncts are true. We must consider $\Pr(H_1) + \Pr(H_2) - \Pr(H_1 \,\&\, H_2)$, which is 1/2 + 1/2 - 1/4 (= 3/4).

Rule 6 is completely general; it applies to *all* disjunctions. But when the two disjuncts are *in*compatible, the probability that they are both true is 0, so we can forget about subtracting anything out.

13.5 Chapter Exercises

1. You roll a pair of dice. Assume that the number that comes up on each die is independent of the number that comes up on the other (which is the case in all normal situations).

    1. What is the probability that you roll two sixes ("box cars"). Hint: this is a "one-way" point; both dies must come up sixes.

    2. What is the probability that you roll two ones?

    3. What is the probability that you not roll a double six?

    4. What is the probability that you will either roll two sixes or else roll two ones?

    5. What is the probability that you roll a five?

    6. What is the probability that you roll a seven or eleven?

2. You are going to draw one card from a standard deck of playing cards. Once you see what the card is, you replace it, then draw a second card.

Determine the probabilities of each of the following, say which rules are relevant, and explain how you use the rules to obtain the results.

1. What is the probability that you get a jack on the first draw?

2. What is the probability that you get a diamond on the first draw?

3. What is the probability that you get a jack of diamonds on the first draw?

4. What is the probability that you get a jack or a diamond on the first draw?

5. What is the probability of a queen on the first draw and a jack on the second?

6. What is the probability of getting one jack and one queen (here the order in which you get them doesn't matter)?

7. What is the probability of getting two aces?

8. What is the probability of drawing exactly one ace?

9. What is the probability of getting at least one ace?

10. What is the probability of not getting an ace on either draw?

3. Pr(*P*) = 1/2, Pr(*Q*) = 1/2, and Pr(*P* & *Q*) = 1/4.

1. Are *P* and *Q* incompatible? Why or why not?

2. What is the probability of *P* or *Q*?

4. Consider the following possible outcomes of flipping a coin three times, where H = Head and T = Tail.

HHH, TTT, HTH, THT

You know that if the coin is fair, the probability of all four sets of outcomes is the same: 1/2 x 1/2 x 1/2 = 1/8. Now calculate the probabilities for each of the outcomes when the coin is biased, and the probability of getting a head on any flip is 0.70.

5. What is the probability of getting a head on the first flip or on the second when you flip the biased coin described in the previous problem two times?

13.6 Appendix: Working with Fractions

But I hate math . . .

You knew all the arithmetic you will need for this course by the end of ninth grade, but it's easy to get rusty. Don't worry if you are, but do review the following material. If you have a little "math anxiety," keep in mind that the key is to approach things *slowly*. Each of the basic concepts is relatively easy, and if you work to understand each point before going on to the next, you will be able to master the material. In fact, the only algebra you will need is the very minimal amount required to add and multiply rather simple fractions.

Try to work through it in small steps, rather than trying to grasp everything all at one. As with much else in this course, you will also need to work through problems on your own. The most important factor in mastering any skill is practice.

How Fractions Work

A fraction consists of a *numerator* and a *denominator*. The numerator is the number on the top and the denominator is the number on the bottom. So, the numerator of 5/7 is 5, and the denominator is 7. Two fractions have a common denominator just in case they have the same denominator; 5/7 and 3/7 have a common denominator (namely 7), but 5/7 and 8/11 do not. It is often easier to work with fractions if we convert them into their decimal equivalents. To find the decimal equivalent for a fraction, divide the numerator by the denominator. For example, to convert 1/4 to a decimal, divide 1 by 4 (to get .25). To convert 3/5 to a decimal, divide 3 by 5 (to get .6). Such conversions are easy if you use a calculator (which you are encouraged to do).

Adding Fractions

To *add* two fractions that have a common denominator, you simply add their numerators and write it above their denominator. For example, 3/7 + 2/7 = 5/7. And 4/52 + 3/52 = 7/52.

If you want to add fractions that have different denominators, you must find a common denominator. Once you do this, you simply add their numerators and write the result above the common denominator. In many cases, finding a common denominator is straightforward, but you can avoid such worries if you replace the fractions by their decimal equivalents and simply add those.

> *Example:* Add 3/5 + 1/4. You can either find a common denominator or you can add their decimal equivalents.

Common Denominator

The lowest common denominator of 3/5 and 1/4 is 20. So, we can express 3/5 as 12/20, and 1/4 as 5/20. And 12/20 + 4/20 = 17/20.

Decimal Equivalents

The decimal equivalent of 3/5 is .6 (divide 3 by 6 to get this) and the decimal equivalent of 1/4 is .25 (divide 1 by 4). So, 3/5 + 2/3 = .6 + .25 + .85

We can check our two approaches by seeing whether they yield the same result; is .85 equal to 17/20? To answer this, we divide 17 by 20, which is .85, just as it should be.

Multiplying Fractions

To *multiply* fractions, you just multiply their numerators to get the new numerator and you multiply their denominators to get the new denominator.

> *Example:* What is 3/5 x 3/4? Multiply the two numerators (3 x 3) to get the new numerator, which is 9, then multiply the two denominators (5 x 4) to get the new denominator, which is 20. Putting these together, the answer is 9/20.
>
> *Example:* What is 4/52 x 3/51? Multiply the numerators to get 12, and the denominators to get 2652. So, the answer is 12/2652 (which reduces to 1/222).

You can also always convert fractions to their decimal equivalents and then multiply them. We won't worry much at the beginning about reducing fractions.

But do note that when you multiply fractions you must multiply their denominators as well as their numerators. 4/52 x 3/52 is *not* 12/52 (it's 12/(52 x 52)). Probabilities range from zero to one, and most of our calculations will involve fractions between zero and one. There are two very important points to remember about such fractions.

1. When you *add* one such fraction to another, the result will be larger than either fraction alone.

2. When you *multiply* one such fraction by another, the result will be smaller than either fraction alone.

Exercises

Find the value of each of the following:

1. 2/3 + 1/3

2. 2/6 + 1/6

3. 2/3 + 1/6 (you need a common denominator here)

4. 4/9 + 11/20

5. 2/3 x 1/3 (the denominator here will be 9, not 3.)

6. 2/6 x 1/6

7. 2/3 x 1/6 (when we multiply fractions we don’t use a common denominator).

8. 2/6 x 1/3

9. 4/9 x 11/20

10. 4/52 x 1/51

Chapter 14

Conditional Probabilities

Overview: In this final chapter on probability, we will learn how to deal with conditional probabilities, the probabilities of conjunctions whose conjuncts are not independent, and the relationship between probabilities and odds.

Contents

14.1 Conditional Probabilities

As the world changes, probabilities change too. The probability of drawing an ace from a full deck of cards is 4/52. But if you draw two aces and don’t replace them, the probability of drawing an ace changes. We say that the *conditional probability* of drawing an ace, given that two aces have been removed, is 2/50.

The probability of something being the case given that something else is the case is called a **conditional probability**. We express the conditional probability of *A* on *B* by writing $\Pr(A|B)$. We read this as ‘the probability of *A given B*’. In the example above, we are interested in the probability of drawing an ace *given that* two aces have already been drawn.

Much *learning* involves conditionalization. As we acquire new information, our assessments of probabilities change. You always thought Wilbur was very honest, but now you learn that he stole someone's wallet and then lied about it. This leads you to reassess your belief that he has probably been honest on other occasions. You *conditionalize* on the new information about Wilbur, *updating* your views about how probable things are in light of the new evidence.

> *Example 1:* Your friend asks you to pick a card, any card, from a full deck. How likely is it that you drew a king? Now your friend looks as the card and declares that it's a face card. This new information changes your estimate of the probability that you picked a king. You are now concerned with the probability that you drew a king, given that you drew a face card.

> *Example 2:* The probability of getting lung cancer (C) is higher for smokers (S) than for nonsmokers. In our new notation, this means that $\Pr(C|S)$ is greater than $\Pr(C|{\sim}S)$.

> *Example 3:* You are about to roll a fair die. The probability that you will roll a four is 1/6. You roll too hard and it tumbles off the table where you can't see it, but Wilbur looks and announces that you rolled an even number. This thins the set of relevant outcomes by eliminating the three odd numbers. Figure 14.1 depicts the possibilities before and after Wilbur's announcement. Before the announcement, the probability of rolling a four was 1/6. But once you thin out the relevant outcomes (by conditionalization), there are only three possibilities left, and only one way out of those three of rolling a four. When we restrict our attention in this way, now focusing only on the even numbers, we are said to conditionalize on the claim that the number is even.

$\boxed{1,\ 2,\ 3,\ 4,\ 5,\ 6 \quad \Pr(4) = 1/6}$

(a) Before

$\boxed{\cancel{1},\ 2,\ \cancel{3},\ 4,\ \cancel{5},\ 6 \quad \Pr(4) = 1/3}$

(b) After

Figure 14.1: Thinning the Relevant Outcomes

14.1.1 Characterization of Conditional Probability

The next rule gives the definition for conditional probabilities.

- **Rule 7**. (*conditional probability*): The probability of A given B is the probability of the conjunction of A & B, divided by the probability of B.

$$\Pr(A|B) = \frac{\Pr(A\&B)}{\Pr(B)}$$

In Rule 7, we must also require that the probability of B is *not zero* (because division by zero is undefined).

The idea behind Rule 7 is that conditional probabilities change the set of relevant outcomes. When your friend tells you that you selected a face card, the set of relevant possibilities shrinks from 52 (it might be *any* of the cards in the deck) down to 12 (we now know that it is one of the twelve face cards).

We put *A* & *B* in the *numerator*, because we have now restricted the range of relevant cases to those covered by *B*. This means that the only relevant part of the region for A is the part that overlaps *B*, which is just the part where the conjunction *A* & *B* is true. So, in terms our diagrams, Pr($A|B$) is the amount of *B* occupied by *A*.

And we put Pr(*B*) in the denominator because we want to restrict the range of relevant possibilities to those in which *B* is true. This is just what it means to talk about the probability of *A given B*. It may not be obvious that these numbers do the desired job, though, so we'll work through an example to see exactly how things work.

How the Numbers Work

Suppose there are 100 students in your English class. There are 50 men (*M*), and 20 of them are Texans (*T*). We can use these probabilities and Rule 7 to determine the probability of someone being a Texan given that they are male, i.e., Pr($T|M$). We have:

> Pr(*T* & *M*) = $\frac{20}{100}$ (the probability—or proportion—of people in the class who are male *and* Texans).
>
> Pr(*M*) = $\frac{50}{100}$ (the probability—or proportion—of males in the class).

We then plug these numbers into the formula given by Rule 7 on the left to get the actual values at the right (Figure 14.2).

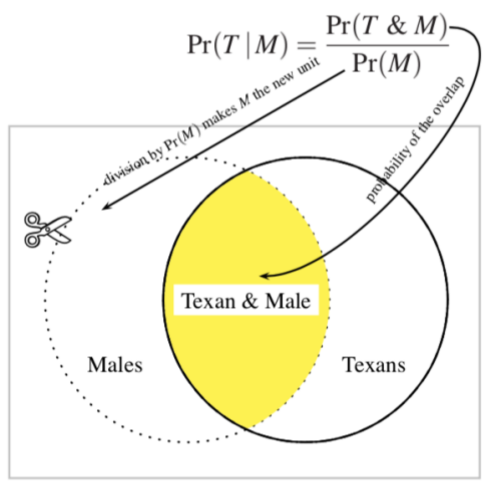

Figure 14.2: Conditionalization Trims out a New Unit

$$\underbrace{\Pr(T\mid M)=\frac{\Pr(T\,\&\,M)}{\Pr(M)}}_{\text{By Rule 7}} = \overbrace{\frac{20}{100}\Big/\frac{50}{100}}^{\text{plugging in the numbers}} = \underbrace{\frac{20}{100}\times\frac{100}{50}}_{\text{division by }\frac{50}{100}\,=\,\text{multiplication by }\frac{100}{50}}$$

So, the probability of someone in the class being a Texan if they are male is 20/100 x 100/50 = 20/50 (the two 100s cancel) 2/5 = .4.

What the Numerator Does

We disregard everyone who is not male (some of whom may, but need not, be Texans). Figure 14.2 represents this by cutting out the circle of Males. We are then only interested in the percentage of Texans among males, which is given by the probability of someone in the class being both Texan and Male. We represent this as Pr(T & M). It's just the overlap between the Texans and Males.

What the Denominator Does

M only had half of the probability before, but once we focus on Males, once we conditionalize on this, trimming away everything else, the probability of M should become 1. So, we need to increase the probability of *M* from 1/2 (what it was before) to 1 (what it is once we confine attention to males). Dividing by a fraction yields the same result as inverting and multiplying by it. So, things work out because dividing by 50/100 is the same as multiply by 100/50, i.e., it's the same as multiplying by 2. This ensures that we can treat *M* as now having the entire unit of probability (once we conditionalize on *M*).

In terms of mud, when we shear off everything outside *M* we must also throw away all the mud that was originally outside *M*. We then think of M as the new total area, and so we now view the amount of mud on it as one unit. Another way to see that M should now have a probability of 1 once we conditionalize on *M* is to note that Pr(*M*|*M*) = 1.

In

$$\Pr(A|B) = \frac{\Pr(A \,\&\, B)}{\Pr(B)}$$

the less probable *B* was before we conditionalized, the more we have to multiple Pr(*A* & *B*) to inflate the new probability of *B* up to 1. If the probability of *B* was 1/2 we divide by 1/2, which has the effect of multiplying by 2. If the probability of *B* was 1/5 we divide by 1/5, which has the effect of multiplying by 5. Here 1/5 x 5/1 gets us back to 1 unit of probability. In short, division by the old Pr(*B*) makes the new (post conditionalization) Pr(*B*) = 1.

In general, Pr(*A*|*B*) is *not* equal to Pr(*B*|*A*). The probability that someone is a male given that he plays for the New York Yankees is 1. But the probability that someone is a Yankee given that he is male is very small. We will see in a later chapter that Pr(*A*|*B*) = Pr(*B*|*A*) just in case Pr(*A*) = Pr(*B*). More importantly, we will see that confusing these two probabilities is responsible for a good deal of bad reasoning.

14.1.2 The General Conjunction Rule

By rearranging the terms in Rule 7, we obtain a general rule for conjunctions (divide both sides of the equality in Rule 7 by Pr(*B*)).

- **Rule 8**. (*conjunctions*): The probability of the conjunction *A* & *B*, where the conjuncts need not be independent, is the probability of *A* multiplied by the probability of *B given A*.

Pr(*A* & *B*) = Pr(*A*) x Pr(*B*|*A*)

This rule is more general than Rule 5. It applies to *all* conjunctions, whether their conjuncts are independent or not. Unlike Rule 7, we will often use Rule 8 in our calculations.

> *Example*: You draw two cards from a full deck, and you don't replace the first card before drawing the second. The probability of getting a king on both of your draws is the probability of getting a king on the first draw times the probability of getting a king on the second draw, given that you already got a king on the first. In symbols: Pr(K_1 & K_2) = Pr(K_1) x Pr(K_2|K_1).

Now that we have conditional probabilities, we can *define* independence quite precisely. *A* and *B* are independent just in case the truth (or occurrence) of one has no influence or effect on the occurrence of the other.

Independence: *A* and *B* are *independent* just in case Pr(*A*) = Pr(*A*|*B*). Whether *B* occurs (or is true) or not has no effect on whether *A* occurs (or is true). If we learn that *B* is true (or false), that should do nothing to change our beliefs about the probability of *A*.

Rule 5 tells us that *if A* and *B* are independent, then Pr(*A* & *B*) = Pr(*A*) x Pr(*B*). This is just a special case of the more general Rule 8. It works because if *A* and *B* are independent, Pr(*B*) = Pr(*B*|*A*). So instead of writing Pr(*B*|*A*) in the special case (independent conjuncts) covered by Rule 5, we can get by with the simpler Pr(*B*).

Rule 8. tells us that Pr(*A* & *B*) = Pr(*A*) x Pr(*B*|*A*). But we know that the order of the conjuncts in a conjunction doesn't affect the meaning of the conjunction: *A* & *B* says the same thing as *B* & *A*. So Pr(*A* & *B*) = Pr(*B* & *A*). This means that Pr(*A* & *B*) = Pr(*B* & *A*) = Pr(*B*) x Pr(*A*|*B*). The value for this will be the same as the value we get when we use Rule 8, though in some cases one approach will be easier to calculate and in other cases the other one will be.

14.2 Analyzing Probability Problems

You must know the rules if you are to calculate probabilities.

Summary of the Rules for Calculating Probabilities

1. **Events that are Certain to Occur:** If *A* is certain to be true, Pr(*A*) = 1.

2. **Events that are Certain *not* to Occur:** If *A* is certain to be false, Pr(*A*) = 0.

3. **Negations:** Pr(~*A*) = 1- Pr(*A*).

4. **Disjunctions with Incompatible Disjuncts:** If A and B are incompatible, Pr(*A* or *B*) = Pr(*A*) + Pr(*B*).

5. **Conjunctions with Independent Conjuncts:** If A and B are independent, Pr(*A* & *B*) = Pr(*A*) x Pr(*B*).

6. **Disjunctions:** Pr(*A* or *B*) = Pr(*A*) + Pr(*B*) - Pr(*A* & *B*).

7. **Definition of Conditional Probability:** Pr(*A*|*B*) = Pr(*A* & *B*)/Pr(*B*).

8. **Conjunctions:** Pr(A & B) = Pr(A) x Pr($B|A$).

How to Approach a Problem

The key is to analyze a problem *before* you begin writing things down. The first question to ask yourself is: Am I calculating the probability of a negation, a disjunction, or a conjunction? The answer to this will tell you which rule is relevant to the problem; if you get this right, you are well on your way to a successful solution. In a complicated problem, you may have to use several of these rules in your calculations, but always begin by asking which rule applies first.

Begin by thinking through these steps:

1. If the sentence is a **negation**, use Rule 3.
   - Find the probability of the sentence that is being denied and subtract it from 1.
2. If it is a **disjunction**
   - Are the disjuncts incompatible? If so, use Rule 4.
   - Are the disjuncts compatible? If so, use Rule 6.
3. If it is a **conjunction**
   - Are the conjuncts independent? If so, use Rule 5.
   -
   - Are the conjuncts dependent (= not independent)? If so, use Rule 8.

The tree diagram in Figure 14.3 represents the same information pictorially.

14.2.1 Examples of Problem Analysis

Problem A. Suppose that you have a standard deck of 52 cards. You will draw a single card from the deck. What is the probability of drawing either an ace or a jack? Analysis of the problem:

1. You want to know about the probability of drawing an ace or drawing a jack, so you have a *disjunction*. The first disjunct is, “I get an ace,” and the second disjunct is, “I get a jack.” We could symbolize this as (A or J).

2. Are the disjuncts incompatible? Well, if you draw an ace you cannot also draw a jack (on that same draw). Getting an ace *excludes* getting a jack (and getting a jack excludes getting an ace). So, the disjuncts are incompatible, and you use R4 (the rule of disjunctions with incompatible disjuncts).

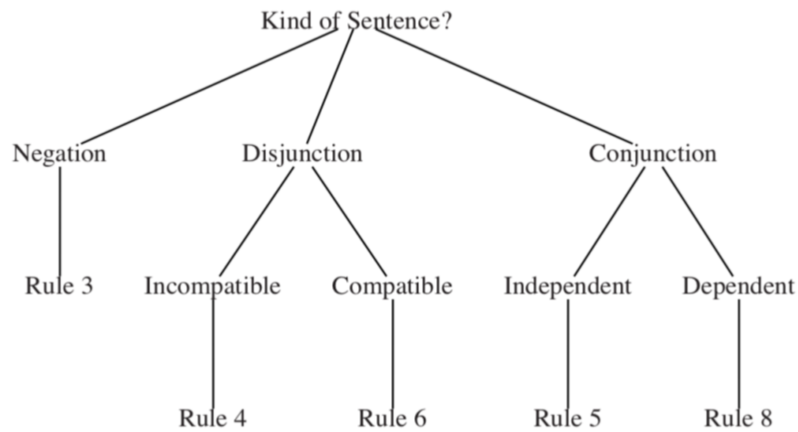

Figure 14.3: Tree Diagram of Probability Problem Analysis

3. The rule says to *add* the probabilities of the two disjuncts:
Pr(*A* or *J*) = Pr(*A*) + Pr(*J*)

4. There are exactly four aces out of 52 cards, so Pr(*A*) (the probability of drawing an ace) is 4/52 (which reduces to 1/13). There are also four jacks, so Pr(J) is the same as that of drawing an ace, namely 1/13.

5. Rule 4 tells us to add these probabilities: Pr(*A* or *J*) = 1/13 +1/13(= 2/13).

Problem B. Suppose that you have a standard deck of 52 cards. You will draw a single card from the deck. What is the probability of drawing either a jack or a heart? Analysis:

1. You want to know about drawing a jack *or* drawing a heart, so you again have a *disjunction*. The first disjunct is, “I get a jack” and the second disjunct is, “I get a heart.” We symbolize this as (*J* or *H*).

2. Since you have a disjunction, the relevant rule will be one of the two Disjunction Rules. Which one it is depends on whether the disjuncts are incompatible.

3. Are the disjuncts incompatible? Well, if you draw a jack, does that exclude drawing a heart? No. You might draw the jack of hearts. So, the disjuncts are *not* incompatible, and you must use Rule 6 (the general disjunction rule).

4. This rule says to add the probabilities to the two disjuncts, but then "subtract out the overlap." In other words, you must subtract out the probability that you get both a jack and a heart, and this is just the probability of getting the jack of hearts. So we have Pr(*J* or *H*) = Pr(i) + Pr(*H*) - Pr(*J* & *H*).

5. There are four jacks out of 52 cards, so Pr(*J*), the probability of drawing a jack is 4/52. And there are 13 hearts, so Pr(*H*), the probability of drawing a heart is 13/52. Finally, there is just one possibility for getting a jack and a heart, namely the jack of hearts, so Pr(*J* & *H*) is 1/52.

6. The General Disjunction Rule then tells us Pr(*J* or *H*) = 4/52 + 13/52 - 1/52 (we won't worry about actually calculating such things until we get the basic concepts down—and even then you can use a calculator).

Exercises

1. The chances of there being two bombs on a plane are very small, so when I fly, I always take along a bomb. —Laurie Anderson. What should we make of Anderson's advice (given what we have learned thus far)?

2. What is the numerical value of $\Pr(A|A)$? Explain why your answer is correct.

3. Suppose you are going to flip a fair coin. Which of the possible sequences is/are the most likely?

    1. HHHHTTTT

    2. HTHTHTHT

    3. HTHHTHTH

    4. HTHHTHTHT

    5. No one of these is any more likely than the others.

4. Suppose that you are about to turn over four cards from the top of a standard deck. Which of the following series of cards (in the order given) is the most likely?

    1. Ace of hearts, king of diamonds, queen of spades, jack of hearts
    2. Ace of heart, king of hearts, queen of hearts, jack of hearts
    3. Ace of hearts, eight of spades, jack of diamonds, four of clubs
    4. No one of these is any more likely than the others.

5. If two sentences are incompatible, then:
    1. They must also be independent.
    2. The truth of one is completely irrelevant to the truth of the other.
    3. They cannot also be independent.
    4. None of the above.
6. You have an ordinary deck of 52 cards. You will draw a card, lay it on the table, then draw another card. (It is important to use the rules in these calculations.)
    1. What is the probability of two kings?
    2. What is the probability of a queen on the second draw given a king on the first?
    3. What is the probability of a king on the first draw?
    4. What is the probability of the king of spades and the king of hearts (in either order)?
    5. What is the probability of a king and a queen?
    6. What is the probability of the jack of diamonds and a spade (where the order in which you get the two doesn't matter)?
    7. What is the probability of not drawing a five at all?
7. Suppose that I am planning what to do this coming weekend, and the weather forecast is for 40% chance of rain on Saturday and 40% chance of rain on Sunday (40% chance = .40 probability). What is the probability that it will rain sometime or other during the weekend (assume that it's raining or not on Saturday won't make it any more or less likely to rain on Sunday)?

8. What is $\Pr(S|S)$? What about $\Pr(\sim S|\sim S)$. Explain and defend your answers.

9. You and your friend Wilbur are taking a multiple-choice exam (and you are working independently, and your answers are independent). There is exactly one correct answer to each question, and your task is to select it from five possible answers, ‘a’, ‘b’, ‘c’, ‘d’, and ‘e’. You get to the third question and have no idea what the correct answer is, and the same thing happens with Wilbur. You guess ‘a’, and Wilbur guesses ‘c’.

    1. What is the probability that at least one of you got the correct answer?

    2. What is the probability that neither of you got the correct answer [the answer here is *not* 4/5 x 4/5].

    3. You also guessed on the fourth problem. What is the probability that you got at least one of your two guesses is right?

10. Most automobile accidents occur close to home. Why do you suppose this is true? How could you explain what is involved using the notion of conditional probabilities?

14.3 Odds and Ends

In many situations, we translate probabilities into the **odds** for or against a given outcome. For example, the probability of rolling a two when you roll a fair die is 1/6, and the probability of not getting a two is 5/6. We say that the odds of rolling a two are 1 to 5 and the odds against it are 5 to 1. The odds in favor of a two is the ratio of the number of ways of getting a two (one way) to the number of ways of not getting a two (five ways). And the odds against rolling a two are the five chances that some other side will come up against the one chance that a two will come up.

The relationship between odds and probabilities is a simple and straightforward: $\Pr(A) = m/n$ if and only if the odds in favor of A are m to $n - m$.

From Probabilities to Odds

If the probability of something is 1/36 (as is the probability of rolling box cars), then the odds in favor of it at 1 to 35 and the odds against it are 35 to 1. We convert probabilities to odds with the following rule: if the probability of a given outcome is m/n, then the odds in favor of it are m to $n - m$ and the odds against it are $n - m$ to m.

From Odds to Probabilities

If your friend says that the odds of OU's beating Texas A&M are 1:5, what does she think the probability of A&M's winning is? We get the denominator for this probability by adding the two numbers in this ratio, so the number on the bottom is 6. Your friend believes that there is one chance in 6 that OU will win, which translates into a probability of 1/6. And she also believes that the probability of A&M's winning is 5/6. If the odds in favor of S are m to n, then the probability of S is the first number (m) over the sum of the first and second numbers ($m + n$).

Fair Bets

Fair bets are based on the odds. If you want to make a *fair* bet that a two will come up when you roll a fair die, you should bet $1 that you will get a two and your opponent should bet $5 that you won't. If you both always bet these amounts, then over the long run you will both tend to break even. Gamblers call such a bet an *even-up proposition*.

By contrast, if you were to bet $1 that you would roll a two and your opponent bets $6 that you won't, then over the long haul you will come out ahead. And if you bet $1 that you will roll a 2 and your opponent bets $4 that you won't, then over the long haul you will lose.

Organized gambling usually involves bets that are not even-up. A casino could not pay its operating expenses, much less turn a profit, if it made even-up bets. The house takes a percentage, which means paying winners less than the actual odds would require. The same is true for insurance premiums. It is also true for state lotteries, which in fact offer far worse odds than most casinos. If you gamble in such settings long enough, you are virtually certain to lose more than you win. Of course, if you enjoy gambling enough, you may be willing to accept reasonable losses as the price of getting to gamble.

Example: Roulette

Roulette is a gambling game in which a wheel is spun in one direction and a ball is thrown around the rim into the wheel in the opposite direction A roulette wheel has many compartments, and players bet on which compartment the ball will land in. In the U.S., roulette wheels have thirty-eight compartments. They are numbered from 1 through 36; there is also a thirty-seventh compartment numbered 0 and a thirty-eighth numbered 00.

There are various bets players can place, but here we will focus on the simplest one, where a player bets that the ball will land on one specific number (say 14), from 1 through 36. Although the game can be complex, the following discussion gives the basic points.

Since there are thirty-eight compartments on the wheel, the probability that the ball will land on any given number, say 14, is 1/38; Pr(14) = 1/38. Hence, the true odds against rolling a 14 are 37 to 1. If you played the game over and over, betting at these odds, you would break even. You would win once every thirty-eight times, and the casino (the “house” or “the bank”) would win the other thirty-seven times. But when you did win, they would pay you $37, which would exactly compensate you for the thirty-seven times that you lost $1 (37x $1 = $37). We say that your bet has an expected value $0.0.

But of course, the house does not pay off at the true odds of 37 to 1. Instead, the house odds or betting odds against rolling a 14 are 35 to 1 (the house has the advantage of the 0 and 00). When you lose, this doesn’t make any difference. But when you win you get only $36 (the $35 plus the original $1 that you bet). This is $2 less than you would get if you were payed off at the true odds of 1 to 37. Since the house keeps $2 out of every $38 that would be paid out at the true odds, their percentage is 2/38, or 5.26%. All but one of the bets you can make at roulette costs you 5.26% over the long haul (the remaining bet is even worse, from the player’s point of view).

If you play just a few times, you may well win. Indeed, a few people will win over a reasonably long run. But the basic fact is that your bet on 14 has a negative *expected payoff* of -5.26%. This means that over the long run you will almost certainly lose at roulette. The odds are against you, and there are no systems or strategies or tricks that can change this basic fact. Simply put, there is absolutely no way you can expect to win at this game. There are a few *highly* skilled people who make a living playing poker, blackjack, or betting on the horses. But no one can make a living playing casino games like keno, craps, or roulette.

Exercises on Odds and Probabilities

Calculate the odds and probabilities in each of the following cases.

1. What are the odds against drawing a king of spades from a full deck of playing cards?

2. What are the odds against drawing a king from a full deck?

3. What are the odds against drawing a face card from a full deck?

4. What are the odds against drawing a king if you have already drawn two cards (one a king, the other a six)?

5. You have a bent coin. The odds of flipping a head are 3 to 2. What is the probability of tossing a tail?

6. In Europe, a roulette wheel only has thirty-seven compartments, one through 36, plus 0. They pay off at the same odds as U.S. casinos. How would this change the probabilities and the odds?

7. If the probability of Duke winning the NCAA basketball tournament championship is 0.166 (= 1/6), what are the odds that they will win? What are the odds against their winning? What are the fair bets for and against their winning? Defend your answers.

14.3.1 Sample Problems with Answers

In each case, explain which rules are relevant to the problem. Your analysis of the problem is more important than the exact number you come up with.

1. You are going to roll a single die. What is the probability of rolling a two or an odd number?

    1. You are asked about the probability of a disjunction; What is Pr(*T* or *O*)?

    2. Are the two disjuncts incompatible?

    3. Yes. So, we can use the simple disjunction rule (R4).

    4. It says that Pr(*T* or *O*) = Pr(*T*) + Pr(*O*).

    5. And Pr(*T*) + Pr(*O*) = 1/6 + 3/6 = 4/6 (= 2/3).

2. You are going to draw a single card from a full deck. What is the probability of getting either a spade or a three?

    1. You are asked about the probability of a disjunction; What is Pr(*S* or *T*)?

    2. Are the two disjuncts incompatible?

    3. No. They overlap because of the three of spades.

    4. So we must use the more complex disjunction rule (R6), in which we subtract out the overlap.

    5. It says that Pr(*S* or *T*) = Pr(*S*) + Pr(*T*) - Pr(*T* & *S*).

    6. Pr(*T* & *S*) is just the probability of drawing the three of spades, which is 1/52.

7. So Pr(*S* or *T*) = Pr(*S*) + Pr(*T*) - Pr(*T* & *S*) = (13/52 + 4/52) - 1/52.

3. You are going to draw two cards from a full deck without replacing the first card. What is the probability of getting exactly one king and exactly one queen (the order doesn't matter)?

    1. You are asked about Pr(*K* & *Q*), where order doesn't matter.

    2. There are two different ways for this to occur:
        (a) King on first draw and queen on second: (K_1 & Q_2)
        (b) Queen on first draw and king on second: (Q_1 & K_2)

    3. So we must calculate the probability of a disjunction: What is Pr[(K_1 & Q_2) or (Q_1 & K_2)]?

    4. The two disjuncts are incompatible, so we use the simple disjunction rule (R4).

    5. But each disjunct is itself a conjunction, and the conjuncts of each conjunction are not independent.

    6. First disjunct is: Pr(K_1 & Q_2). The general rule (R8) for conjunctions tells us that Pr(K_1 & Q_2) = Pr(K_1) x Pr($Q_2|K_1$), which is 4/52 x 4/51.

    7. Second disjunct is: Pr(Q_1 & K_2). It works the same way: Pr(Q_1 & K_2) = Pr(Q_1) x Pr($K_2|Q_1$), which is also 4/52 x 4/51.

    8. Now add the probabilities for each disjunct: (4/52 x 4/51) + (4/52 x 4/51).

14.3.2 More Complex Problems

In the next module, we will look at a number of real-life applications of probability. We conclude this module with several problems that are more complex than the ones we've dealt with thus far.

Probability theory was formalized in the 1650s. The Chevalier de Méré's was a wealthy Parisian gambler. He had devised a dice game that was making him money. He would bet even money (betting odds of 1:1) that he could roll at least one six in four throws of a die. Eventually people got wise to this game and quit playing it, so he devised a new game in which he bet even money that he could roll at least one double six (a six on each die) in twenty fours rolls of a pair of dice. But over time he lost money with this bet.

Finally, he asked his friend, the philosopher and mathematician Blaise Pascal (1623-1662), why this was so. Pascal (and Pierre de Fermat, with whom he corresponded) worked out the theory of probability and used it to explain why the first game was profitable while the second one was not. Let's see how to solve the first problem (the second is left as an exercise).

- What is the probability of rolling at least one six in four throws of a die?

Rolling at least one six means rolling a six on the first roll, or the second, or the third, or the fourth. But it is difficult to work the problem in this way because one must subtract out all the relevant overlaps.

> It is easiest to approach this by way of its negation. The negation of the statement that you roll at least one six is the statement that you do not roll any sixes. This negation is equivalent to a conjunction: you do not roll a six on the first throw and you do not roll a six on the second throw *and* you do no roll a six on the third throw and you do not roll a six on the fourth throw. This conjunction has four conjuncts, but that doesn't really change anything that affects the probabilities. Each conjunct says that you get something other than a six, and so each has a probability of 5/6.
>
> Furthermore, each conjunct is independent of the other three (the die doesn't remember earlier outcomes). So, we just multiply the probabilities of the four conjuncts to get the probability that the conjunction itself is true: the probability that you don't get a six on any of the four rolls is 5/6 x 5/6 x 5/6 x 5/6 (= $(5/6)^4$), which turns out to be 625/1296.
>
> This is the probability that you don't get any sixes. So the probability we originally asked about (getting at least one six) is just one minus this: the probability of getting at least one six is 1 - (625/1296) (which is approximately 671/1296). This is just a bit more than 1/2. This means that the odds of getting at least one six are 671 to 625, so over the long run the house will come out ahead, and you will lose if you keep playing their game.

14.4 Chapter Exercises

Exercises are included in most of the sections. Here we present some more difficult problems, extras for experts, although you now know enough to work at least some of the problems here. Answers to some of them are given below but think about the problems before looking (you will need a pretty good calculator to get the exact numbers; if you don't have one, just work out the formulas).

1. The probability that you will get a car for graduation is 1/3, and the probability that you will get a new computer is 1/5, but you certainly won't get both. What is the probability that you will get one or the other?

2. You have a 35% chance of getting an A in Critical Reasoning and a 40% chance of getting an A in Sociology. Does it matter whether the two outcomes are independent when you want to calculate the probability of at least one A? Does it matter whether the two outcomes are independent when you want to calculate the probability getting an A in both courses? Are they likely to be independent? Why?

3. Five of the 20 apples in the crate are rotten. If you pull out two at random, not replacing them as you pull them out, what's the probability that both will be rotten?

The remaining problems are harder.

4. Now solve The Chevalier de Méré's second problem. What is the probability of rolling at least one double six in twenty-four rolls of a pair of dice? Use the same strategy that was used above to solve his first problem.

5. *Aces and Kings*. Remove all the cards except the aces and kings from a deck. This leaves you with an eight-card deck: four aces and four kings. From this deck, deal two cards to a friend.

    1. If they look at their cards and tell you (truthfully) that their hand contains as ace, what is the probability that both of their cards are aces?

    2. If they instead tell you (truthfully) that one of their cards is the ace of spades, what is the probability that both of their cards are aces? The probabilities in the two cases are not the same.

6. *It's in the Bag*. There are two opaque bags in front of you. One contains two twenty-dollar bills and the other contains one twenty-dollar bill and one five-dollar bill. You reach into one of the bags and pull out a twenty. What is the probability that the other bill in that bag is also a twenty?

7. *The Monty Hall Problem*. There are three doors in front of you. There is nothing worth having behind two of them, but there is a suitcase containing $50,000 behind the third. If you pick the right door, the money is yours. Pick a door: 1, 2, or 3. You choose door number 1. But before

Monty Hall shows you what is behind that door, he opens one of the other two doors, picking one he knows has nothing behind it. Suppose he opens door number 2. This takes 2 out of the running, so the only question now is about door 1 and door 3. You may now reconsider your earlier choice: you can either stick with door 1 or switch to door 3.

1. What is the probability that the money is behind door 1?

2. What is the probability that the money is behind door 3?

3. Do your chances of winning improve if you switch?

8. *The Birthday Problem*. How many people would need to be in a room for there to be a probability of 5 that two of them have a common birthday (born on the same day of the month, but not necessarily of the same year)? Assume that a person is just as likely to be born on any one day as another and ignore leap years.

Hint: Much as in the previous problem, it is easiest to use the rule for negations in answering this.

Answers to Selected Problems

7. *The Monty Hall Problem*. We will work the answer out in a later chapter using the rules for calculating probabilities. For now, here are three hints (don't look at the third until you have tried working the problem). First, you do improve your chances by switching to door 3. Second, think about what would happen if you repeated this process a hundred times. Third, draw a diagram representing all the things that could happen and not how often switching pays off compared to the total number of outcomes.

8. *The Birthday Problem*. The negation of the claim that at least two people in the room share a birthday is the claim that none of them share a birthday. If we can calculate the latter, we can subtract it from 1 to get the former.

Order the people by age. The youngest person was born on one of the 365 days of the year. Now go to the next person. They could have been born on any of the 365 days of the year, so the probability that their birthday differs from that of the first person is 364/365. Now move on to the next person. The probability that their birthday differs from those of the first and the second is 363/365. For the next person, the relevant probability is 362/365, and so on.

The birthdays are independent of one another, so the probability that the first four people have different birthdays is 365/365 x 364/365 x 363/365 x 362/365. There is a pattern here that we can generalize. The probability that the first N people have different birthdays is 365 x 364 x….x (365 - (N+1))/365^N. And so, the probability that at least two out of N people have a common birthday is one minus all of this, i.e., (1 - (365 x 364 x….x (365-(N+1)))/365^N. Now that we have this formula, we can see what values it gives for different numbers of people (and so for different values of N). When there are twenty-two people in the room N is 22, and the formula tells us that the probability that at least two of them have a common birthday is about .47. For twenty-three people, it is slightly more than a half (.507). For thirty-two people, the probability of a common birthday is over .75, and for fifty people it is .97. And with one hundred people there is only about one chance in three million that none share a common birthday.

14.5 Summary of Rules for Calculating Probabilities

1. **Events that are Certain to Occur:** If A is certain to be true, Pr(A) = 1.

2. **Events that are Certain not to Occur:** If A is certain to be false, Pr(A) = 0.

3. **Negations:** Pr(~A) = 1 - Pr(A).

4. **Disjunctions with Incompatible Disjuncts:** If A and B and incompatible, Pr(A or B) = Pr(A) + Pr(B).

5. **Conjunctions with Independent Conjuncts:** If A and B are independent, Pr(A & B) = Pr(A) + Pr(B).

6. **Disjunctions:** Pr(A or B) = Pr(A) + Pr(B) - Pr(A & B).

7. **Definition of Conditional Probability:** Pr($A|B$) = Pr(A & B)/Pr(B).

8. **Conjunctions:** Pr(A & B) = Pr(A) x Pr($B|A$).

Part VI

Induction in the Real World

Part VI. Induction in the Real World

In this part, we will examine several ways that induction works in the real world. In Chapter 15, we learn about a few notions from descriptive statistics; you need to understand them to interpret many of the things you will read outside of class. We will then look at samples and populations and some of the ways in which we draw conclusions about populations from premises about samples. We will conclude with a look at correlations.

In Chapter 16, we turn to various applications of probabilistic notions. We will examine the notion of expected value and several other applications of probability. We will then examine several ways in which our probabilistic reasoning often goes wrong in daily life; here we will examine the gambler's fallacy, the conjunction fallacy, regression to the mean, and some common mistakes about coincidence.

Chapter 15

Samples and Correlations

Overview: We begin this chapter with a few basic notions from descriptive statistics; you need to understand them to interpret many of the things you will read outside of class. We will then look at samples and populations and some of the ways in which we draw conclusions about populations from premises based on samples. We then consider correlations. These involve the degree to which various things are related. Correlations underwrite many of our predictions, but we are often mistaken about the degree to which things are correlated.

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In New York City each summer, some number of cats fall from open windows in high-rise apartment buildings. On August 22, 1989, *The New York Times* reported the startling fact that cats that fell further seemed to have a better chance of survival. When they checked with the Animal Medical Center, the paper found that 129 cats that had fallen were brought in for treatment. Seventeen of these were put to sleep by their owners (in most cases because they could not afford treatment, rather than because the cat was likely to die). Eight of the remaining 115 cats died. But the surprising thing is that the cats that fell the furthest seemed to have the highest probability of living. Only one of the 22 cats that fell from above 7 stories died, and there was but a single fracture among the 13 that fell more than 9 stories. What could account for this?

15.1 Descriptive Statistics

We will begin with several basic concepts from **descriptive statistics** that are important for reasoning. We won't be concerned with formulas for calculating them, but you will encounter these concepts outside of this class, so you need to learn what they mean.

Sample: subgroup of a population

A **population** is a group of things (e.g., Florida voters, households, married couples, fruit flies). And a **sample** is a subgroup of the population. For example, we might conduct a poll of 1,000 college graduates and ask them to report their income. These 1,000 people would constitute our sample; the parent population would be all college graduates. In the next section, we will see that information about samples can be used to draw inferences about entire populations, but in this section, we will be concerned with description rather than inference.

Parameter: a feature of a population

A **parameter** is some numerical characteristic of an entire population (e.g., average GPA of all freshmen, average income of all college graduates; as we will see in a moment, it could also be a measure of dispersion or a measure of correlation. For example, an average income in the population of adult U. S. citizens of $18,525 is a parameter.

Statistic: a feature of a sample

By contrast, a **statistic** is a corresponding numerical characteristic of a sample (e.g., the average GPA of college students contacted in a recent survey). One way to remember what goes with what is that the two p-words—population and parameter—go together, and the two s-words—sample and statistic—go together.

15.1.1 Features of Samples

Variables: properties or features that come in degrees

Properties or characteristics that come in degrees are called **variables**. For example, the age, weight, and income of people in the United States are variables. Each of them can take on many different values: Wilbur weights 165 pounds, Martha 103, and Sam 321. We can also think of more abstract things as variables; for example, probability is a variable that can take any of the infinitely many values from 0 to 1. In the simplest case, a variable might only have two values; for example, if you are taking a class pass/fail (such variables are important; they are called *dichotomous variables*).

When the members of a population or sample are measured with respect to some variable like their score on the ACT test, the resulting set of all the numerical scores is a **distribution** of values for that variable. Thus, the set of all the ACTs scores from a given year is a distribution of values for the variable of that year's ACT scores. Similarly, the set of all the scores on the first exam in this class is a distribution of the variable of scores on the first exam.

It can be difficult to see what a large distribution of values really amounts to; we get lost in a sea of numbers. So, it is often useful to *condense* the information in the distribution into simpler numbers. The most basic ways of doing this is to calculate measures of central tendency. There are three common measures of this sort.

Measures of Central Tendency

The **mean** is what you already know under the name average. To find the mean of a distribution, you add all the numbers in the distribution together and divide by the number of items in the distribution. When the class gets an exam back, the first thing many people want to know is the average (i.e., mean) score on the test; this tells them how well the class did collectively. The mean is the most important measure of central tendency, but it has the weakness that it is affected by just a few extreme values.

Mean: the average

The **median** of a distribution is the number such that half the numbers in the distribution are less than it and half are greater. The median of the numbers 1, 2, 3, 4, 5 is 3, because two numbers are less than it and two are greater. What if no single number splits a distribution into two equal parts, as occurs in the distribution 1, 2, 3, 4? Here we will take the number halfway between 2 and 3, i.e., 2.5 as the median; clearly half the cases fall below it and half fall above.

Median: splits the group into halves

The **mode** of a distribution is the value that occurs most frequently in it. The mode of 1, 2, 3, 2, 4 is 2, because 2 occurs twice and all on the other numbers occur only once. A distribution may have more than one mode. For example, the distribution 1, 2, 3, 2, 4, 4, 2, 4 has two modes: 2 and 4.

Mode: most frequent value(s)

What are the mean, median, and mode of the following set of numbers: 179, 193, 99, 311, 194, 194, 179?

1. **Mean:** Add the seven numbers together, which yields 1349. Then divide this by 7, which (rounding off) comes to 192.7.

2. **Median:** The median is easiest to see if we list these numbers in order of magnitude, as 99, 179, 179, 193, 194, 194, 311. Here we

find that 193 splits the distribution into two equal parts, so it is the median.

3. **Mode:** This distribution has two numbers which occur twice, 179 and 194. So, it has two modes, 179 and 194.

Measures of Dispersal

Measures of central tendency are often useful. For example, it will help you understand how you did on an exam to know the class average (the mean). And it will be easier to choose a major if you know the average number of people with that major who found jobs soon after they graduated. But measures of central tendency don't tell us much about the relative position of any given item or about the extent to which values are spread out around a mean.

For example, the distributions

- 7, 8, 8, 9 and
- 1, 3, 11, 17

have the same mean, namely 8. But the items in the first distribution are clustered much more tightly around the mean than those of the second. If the values in a distribution are quite spread out, then the mean may not be very informative. **Measures of dispersal** provide additional information; they tell us how spread out ("dispersed") the values in a distribution are.

The **range** is the distance between the largest and the smallest value in the distribution. In the distribution: 179, 193, 99, 311, 193, 194, 179, the range is the distance between 311 and 99, i.e., 311- 99 = 212.

Percentiles

Often a numerical value or score doesn't tell you much in and of itself. If you learn that you scored a 685 on the math component of the ACT or that you got an 86 on the first exam in this course, that doesn't really tell you how well you did. What you want to know is how well you did in comparison with those who took the same exam. Percentiles provide information about such relative positions. The **percentile rank** of a value or score is the percentage of values that fall below it. For example, if Sandra got an 86% on the first exam and 75% of the class got lower grades, than Sandra's score has a percentile rank of 75%. And her score, 86, falls at, or is, the *75th percentile*.

Percentiles provide relative positions in percentage terms. For example, suppose that 100 people take the first exam and that Wilbur gets a 79%. If

60 (= 60%) students scored lower than 79, then Wilbur's score of 79 falls at the 60th percentile.

Quartiles work like the median. The first quartile is the value such that 1/4 of the values are less than it, the second quartile the value such that half of the values are less than it (this number is also the median), the third quartile the value such that 3/4 of the values are less than it. The first quartile falls at the 25th percentile. The **standard deviation** is a very important measure of dispersal. We can't calculate it without a formula (which we won't worry about here), but the intuitive idea is that the standard deviation measures the *average distance of all the values from the mean*. It tells us how far, on average, the values deviate from the mean or average value in the distribution. The greater the standard deviation, the more spread out the values are. Hence, although the distributions 7, 8, 8, 9 and 1, 3, 11, 17 have the same mean, namely 8, the first will have a lower standard deviation than the second.

Exercises

1. Find the mean, median, mode, and range of each of the following distributions (which we may think of as measurements of people's weight in pounds):

    1. 176, 132, 221, 187, 132, 194, 190

    2. 176, 193, 99.5, 321, 112, 200, 120

Here is a list of people in a class, their score on their final, and the percentage of people who scored below them. In each case, give the percentile where their grade falls.

1. Olivia got a 97%, 95% scored lower.

2. Erik got a 46%, 5% scored lower.

3. Wilbur got an 85%, 80% scored lower.

3. Which distribution will have the greater standard deviation?

- 10, 11, 14, 9

- 6, 9.5, 10, 18.67

15.2 Inferences from Samples to Populations

We frequently use sample statistics to draw *inductive inferences* about population parameters. When a newspaper conducts a poll to see how many people think President Trump should be impeached, they check with a sample, say 2,000 adults across the U. S. and draw a *conclusion* about what American adults in general think. Their results would be more accurate if they checked with everyone, but when a population is large, it simply isn't practical to examine all its members. We have no choice but to rely on a *sample* from the population and make an inference based
on it. When scientists engage in such inferences, they are said to be using *inferential statistics*. But all of us draw inferences from samples to populations many times every day.

15.2.1 Sampling in Everyday Life

Inferences based on samples are common in medical research, the social sciences, and polling. In these settings, scientists use what are called *inferential statistics* to move from claims about samples *to* conclusions about populations.

But we all draw similar inferences many times each day. You are driving through Belleville, KS for the first time and trying to decide where to eat. You have had good experiences at McDonalds restaurants in the past (the set of McDonald's restaurants where you have eaten in the past at constitutes your sample). So, you might conclude that all McDonald's restaurants (the population) are likely to be good and decide to sample the culinary delights of the one in Belleville. Or suppose you know six people (this is your sample) who have dated Wilbur, and all of them found him boring. You may well conclude that almost everyone (this is the population) would find him boring.

Whenever you make a generalization based on several (but not all) of the cases, you used sampling. You are drawing a conclusion about some larger group based on what you've observed about one of its subgroups.

Learning

Most *learning from experience* involves drawing inferences about unobserved cases (populations) from information about a limited number of cases that we have observed (our samples). You know what strategies worked in the cases you have experienced (your sample) for getting a date, quitting smoking, getting your car running when the battery seems dead, or doing well on an exam. And you then draw conclusions about the relevant populations based on this knowledge.

An examination is really a sampling procedure to determine how much you have learned. When your calculus professor makes up an examination, they hope to sample items from the population of things you have learned in the course and to use your grade as an indicator of how much information you have acquired.

15.2.2 Samples and Inference

We often infer a conclusion about a population from a description of a sample that was drawn from it. When we do:

1. Our **premises** are claims about the **sample**.
2. Our **conclusion** is a claim about the **population**.

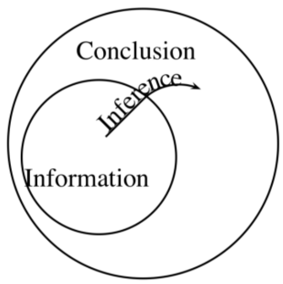

Figure 15.1: Inference from Sample to Population

For example, we might draw a conclusion about the divorce rate of people living in Florida from premises describing the divorce rates among 800 couples that our school's Human Relations Department sampled.

In such a case, our inference is *not* deductively valid. It involves an inductive leap. The conclusion goes beyond the information in the argument's premises, because it contains information about the *entire population*, while the premises only contain information about the sample. But if we are careful, our inference can still be inductively strong. This means that if we begin with true premises (which in this case means a correct description of the sample), we are likely to arrive at a true conclusion (about the entire population).

15.2.3 Good Samples

A good inductive inference from a sample to a population requires:

1. A **large** enough sample.
2. A **representative** (unbiased) sample.

We would need to delve more deeply into probability to say exactly how large is large enough, but we won't worry about that here. The important point is that in everyday life we very often rely on samples that are clearly too small.

We also need a sample that is as representative of *the entire population* as possible. A sample that is not representative is said to be biased. An unbiased sample is typical of the population. By contrast, in a biased sample, some portions of the population are *overrepresented* and others are *underrepresented*.

Good samples:
1. Big enough
2. Representative

The problem with a very small sample is that it is not likely to be representative. Other things being equal, a bigger sample will be more representative. But there are costs to gathering information—a price in time, dollars, and energy—so it is rarely feasible to get huge samples.

We can never be certain that a sample is unbiased, but we can strive to avoid any non-trivial biases we can discover. With some thought, the worst biases are often obvious. Suppose, for example, that we want to know what the U.S. adult public (our population) thinks about the consumption of alcohol. We would clearly get a biased sample if we distributed questionnaires only at a pool hall (we would have an overrepresentation of drinkers and an underrepresentation of those favoring temperance), or only at the local meetings of MADD (here, the biases would be reversed).

A classic example of a biased sample occurred in 1936, when a magazine, *The Literary Digest*, conducted a poll using names in telephone directories and on car registration lists. Most of the people they sampled favored Alf Landon over Franklin Roosevelt in that year's Presidential election, but when election day rolled around, Roosevelt won in a landslide. What went wrong? News organizations now use telephone polling routinely, but in 1936, a relatively small percentage of people had telephones and cars, and most of them were affluent. These were the people most likely to vote for the Republican candidate, Landon, and so the sample was not representative of all voters.

There are other cases where bias is likely, even though it won't be this blatant. For example, any time members of the sample volunteer, e.g., by returning a questionnaire in the mail, we are likely to have a biased sample. People willing to return a questionnaire are likely to differ in various ways from people who are not. Or, to take an example closer to home, tests that focus on only some of the material covered in class are likely to elicit a biased, unrepresentative sample of what you have learned. They aren't a fair sample of what you know. Unfortunately, in some cases biases may be difficult to detect, and it may require a good deal of expertise to find it at all.

Random Sampling

The best way to obtain an unbiased sample is to use random sampling. A **random sample** is a method of sampling in which each member of the population has an equally good chance of being chosen for the sample. Random sampling does not guarantee a representative sample—nothing short of checking the entire population can guarantee that—but it does make it more likely. Random sampling avoids the biases involved with many other methods of sampling.

Random sample: each member of population has equal chance of being sampled

We can rarely get a truly random sample, but under some conditions, typically in carefully conducted studies and surveys, we can come reasonably close. But even in daily life we can use samples that are much less biased than those we often rely on.

Random Digit Dialing (RDD)

Modern technology now allows national polling organizations with large resources to approach the ideal of random sampling. Polls like the *New York Times*/*CBS News* poll use what is called **Random Digit Dialing** (RDD). The goal here is to give every residential phone number an equal chance of being called for an interview. Nowadays, almost all major polls use some form of RDD. For example, the *New York Times/CBS News* poll uses the GENESYS system, which employs a database of over 42,000 residential telephone numbers throughout the U.S. that is updated every few months. The system also employs software that draws a random sample of phone numbers from this database and then randomly makes up the last four digits of the number to be called. Of course, some sorts of people are harder to reach on the phone than others, and some sorts are more willing to volunteer information over the phone (the elderly tend to be more available, more willing to share, and more likely to answer an unknown number, for instance). But RDD constitutes an impressive step in the direction of randomization.

Stratified Random Sampling

Scientists sometimes go a step further and use a **stratified random sample**. Here, the aim is to ensure that there is a certain percentage of members of various subpopulations in our sample (e.g., an equal number of men and of women). They separate the population into relevant categories or “strata” before sampling (e.g., into the categories or subpopulations of men and of women). Then they sample randomly within each category. The thinking here is that results will be more accurate than mere random sampling because random sampling might accidentally over-weigh some group (because they were sampled at a higher rate through variance). So, rather than doing a random statewide poll about who is favored in the gubernatorial election, a poll using stratified random polling would make sure to poll all counties in proportion to turnout expectations (they might also stratify further based on gender, race, education, etc.).

Polls

A growing practical problem in recent years has been the decline in the public's participation in polls. Pollsters are getting more and more "nonresponses." Some of these result from the difficulty in contacting people by phone (people are at work, unwillingness to answer unknown numbers, etc.). But those contacted are also less willing to participate than they were in the past. The reasons for this aren't completely clear, but growing disillusionment with politics and lack of patience for unsolicited calls resulting from the increase in telemarketing may be part of the reason.

The use of *push polling* also leads to a wariness about polls. Push polling is not really polling at all. Instead, an organization, e.g., the campaign organization of a candidate running for Senate, calls thousands of homes. The caller says they are conducting a poll, but in fact no results are collected and instead a damaging— and often false—claim about the other side is implanted in what is presented as a neutral question. For example, the caller might ask, "Do you agree with Candidate X's goal to cut social security payments over the next six years?" Such deceptive uses of polling are likely to make the public more cynical about polls.

Sampling Variability

It is unlikely that any sample that is substantially smaller than the parent population will be *perfectly* representative of the population. Suppose that we drew many samples of the same size from the same population. For example, if we drew many samples of 1,000 each from the entire population of Oklahoma voters. The set of all these samples in called a *sampling distribution*.

The samples in our sampling distribution will vary from one to another. This just means that if we draw many samples from the same population, we are likely to get somewhat different results each time. For example, if we examine twenty samples, each with 1,000 Oklahoma voters, we are likely to find different percentages of Republicans in each of our samples.

This variation among samples is called **sampling variability** or **sampling error** (though it is not really an error or mistake). Suppose that we just take one sample of 1,000 Oklahoma voters and discover that 60% of them prefer the Republican candidate for Governor. Because of sampling variability, we know that if we had drawn a different sample of the same size, we would probably have gotten a somewhat different percentage of people favoring the Republican. So, we won't be able to conclude that exactly 60% of all

Oklahoma voters favor the Republican from the fact that 60% of the voters in our single sample do.

As our samples become larger, it becomes less likely that the sample mean will be the same as the mean of the parent population. But it becomes more likely that the mean of the sample will be close to the mean of the population. Thus, if 60% of the voters in a sample of 10 favor the Republican candidate, we can't be very confident in predicting that about 60% of voters in general do. If 60% of a sample of 100 do, we can be more confident, and if 60% of a sample of 1,000 do, we can be more confident still.

Statisticians overcome the problem of sampling variability by calculating a **margin of error**. This is a number that tells us how close the result of a poll should usually be to the population parameter in question. For example, our claim might be that 60% of the population, *plus or minus three percent*, will vote Republican this coming year. The smaller the sample, the larger the margin of error.

But there are often large costs in obtaining a large sample, so we must compromise between what's feasible and the margin of error. Here you do get what you pay for. It is surprising, but the size of the sample does not need to be a large percentage of the population for a poll or survey to be a good one. What is important is that the sample not be biased, and that it be large enough; once this is achieved, it is the absolute number of things in the sample (rather than the proportion of the population that the sample makes up) that is relevant for taking a reliable poll. In our daily life, we can't hope for random samples, but with a little care we can avoid flagrant biases in our samples, and this can improve our reasoning dramatically.

15.2.4 Bad Sampling and Bad Reasoning

Many of the reasoning errors we will study in later chapters result from the use of small or biased samples. Drawing conclusions about a general population based on a sample from it is often called generalization. And drawing such a conclusion from a sample that is too small is sometimes called the *fallacy of hasty generalization* or, in everyday language, *jumping to a conclusion*.

Our samples are also often biased. For example, a person in a job interview may do unusually well (they are striving to create a good first impression) or unusually poorly (they may be very nervous). If so, their actions constitute a biased sample, and they will not be an accurate predictor of the candidate's future job performance. In coming chapters, we will find many examples of bad reasoning that result from the use of samples that are too small, highly biased, or both.

Example: The Two Hospitals

There are two hospitals in Smudsville. About 50 babies are born every day in the larger one, and about 14 babies are born every day in the smaller one down the street. On average, 50% of the births in both hospitals are girls and 50% are boys, but the number bounces around some from one day to the next in both hospitals.

- Why would the percentage of boys vary from day to day?
- Which hospital, if either, is more likely to have more days per year when over 65% of the babies born are boys?

We all know that bigger samples are likely to be more representative of their parent populations. But we often fail to realize that we are dealing with a problem that involves this principle; we don't "code" it as a problem involving sample size. Since about half of all births are boys and about half are girls, the true percentages in the general population are about half and half. Since a smaller sample will be less likely to reflect these true proportions, the smaller hospital is more likely to have more days per year when over 65% of the births are boys. The births at the smaller hospital constitutes a smaller sample.

This will seem more intuitive if you think about the following example. If you flipped a fair coin four times, you wouldn't be all that surprised if you got four heads. The sample (four flips) is small, so this wouldn't be too surprising; the probability is 116. But if you flipped the same coin one hundred times, you would be very surprised to get all heads. A sample this large is very unlikely to deviate so much from the population of all possible flips of the coin.

Exercises

1. What is the probability of getting all heads when you flip a fair coin (a) four times, (b) ten times, (c) twenty times, (d) one hundred times?

In 2–7 say (a) what the relevant population is, (b) what the sample is (i.e., what is in the sample), (c) whether the sample seems to be biased; then (d) evaluate the inference.

2. We can't afford to carefully check all the computer chips that come off the assembly line in our factory. But we check one out of every 300, using a randomizing device to pick the ones we examine. If we find a couple of bad ones, we check out the whole bunch.

3. We can't afford to carefully check all the computer chips coming off the assembly line. But we check the first few from the beginning of each day's run. If we find a couple of bad ones, we check out the whole bunch.

4. There are more than a hundred nuclear power plants operating in the United States and Western Europe today. Each of them has operated for years without killing anybody. So, nuclear power plants don’t seem to pose much of a danger to human life.

5. Joining the Weight Away program is a good way to lose weight. Your friend Millie and uncle Wilbur both lost all the weight they wanted to lose, and they’ve kept if off for six months now.

6. Joining the Weight Away program is a good way to lose weight. *Consumer Reports* did a pretty exhaustive study, surveying hundreds of people, and found that it worked better than any alternative method for losing weight. [This is a fictitious example; I don’t know the success rates of various weight-reduction programs.]

7. Alfred has a good track record as a source of information about the social lives of people you know, so you conclude that he’s a reliable source of gossip in general.

8. Pollsters are getting more and more “nonresponses.” Some of these result from the difficulty in contacting people by phone (people are at work, screening unknown numbers, etc.). But those contacted are also less willing to participate than they were in the past. Does this automatically mean that recent polls are more likely to be biased? How could we determine whether there are? In which ways might they be biased (defend your answer)?

9. We began the chapter with the story of cats that had fallen from windows. What could account for these finding?

10. Several groups of studies have shown that the survival rates of patients after surgery is actually lower in better hospitals than in hospitals that aren’t as good. More people die in the better hospitals. What might account for this?

11. The psychologist Robyn Dawes recounts a story about his involvement with a committee that was trying to set guidelines for professional psychologists. They were trying to decide what the rules should be for reporting a client (and thus breaching confidentiality) who admitted having sexually abused children, when the abuse occurred in the distant past. Several people on the committee said that they should be required to report it, even when it occurred in the distant past, because the one sure thing about child abusers is that they never stop on their own without professional help. Dawes asked the others how they knew this. They replied, quite sincerely, that as counselors they had extensive

contact with child abusers. Does this give us good reason to think that child abusers rarely stop on their own? What problems, if any, are involved in the group's reasoning?

12. A poll with a 4% margin of error finds that 47% of voters surveyed plan to vote for Smith for Sheriff and 51% plan to vote for her opponent, Jones. What information would you like to know in evaluating these results? Assuming sound polling procedures were used, what can we conclude about who will win the election?

13. Suppose that a polling organization was worried that a telephone poll would result in a biased sample. So instead, they pick addresses randomly and visit the residences in person. They have limited resources, however, and so they can only make one visit to each residence, and if no one is home they just go on to the next place on their list. How representative is this sample likely to be? What are its flaws? Could they be corrected? At what cost?

14. Suppose that you are an excellent chess player and that Wilbur is good, but not as good as you. Would you be more likely to beat him in a best of three series or in a best of seven series (or would the number of games make any difference)? Defend your answer.

15. A study was conducted by the Centers for Disease Control and Prevention was reported in the *Journal of the American Medical Association* (JAMA). The study was based on a survey of 9,215 adult patients who were members of Kaiser Permanente health maintenance organization (an HMO). The study focused on eight childhood traumas, including psychological, physical and sexual abuse, having a mother who was abused, parents who are separated or divorced, and living with those were substance abusers, mentally ill, or who had been imprisoned. It was found that more instances of trauma seemed to increase the probability of smoking. For example, people who experienced five or more instances of trauma were 5.4 times more likely to start smoking by the age of 14 than were people who reported no childhood trauma. Analyze this study. What was the sample and the population? What are possible strong points and weak points?

In 16 and 17 explain what (if anything) is wrong in each of the following examples. When reasoning goes wrong, it often goes very wrong, so it's quite possible for even a short argument to be flawed in more than one way.

16. Suppose that the NRA (National Rifle Association) recently conducted a poll of its members and found that they were overwhelmingly opposed to any further gun control measures.

17. Suppose that a random sample of 500 students at our college showed that an overwhelming majority do not think that the school needs to budget more money for making the campus more accessible to people with disabilities.

18. A TV psychologist recently noted that the average marriage lasts 7 years, a fact that she sought to explain by pointing to evidence that life goes in 7 year cycles (so that it was not surprising that marriages should last 7 years). How may she have misunderstood the fact that she was explaining?

Answers to Selected Exercises

10. The actual cause, though you could only hypothesize it based on the information in this problem, turns out to be that high-risk patients, those needing the most dangerous types of surgery, often go to better hospitals (which are more likely to provide such surgery, or at least more likely to provide it at a lower risk).

14. Hint: think about the hospital example above.

15.3 Correlation

Some variables tend to be related. Taller people tend to weigh more than shorter people. People with more education tend to earn more than people with less. Smokers tend to have more heart attacks than non-smokers. There are exceptions, but "on average" these claims are true.

There are many cases where we want to know the *extent* to which two variables are related. What is the relationship between the number of cigarettes someone smokes and their chances of getting lung cancer? Is there some relationship between years of schooling and average adult income? What is the connection between class attendance and grades in this course? Learning the answers to such questions is important for discovering how to achieve our goals ("Since the chances of getting cancer go up a lot, I'll try to quit smoking even though I really enjoy it.").

Correlation: the degree to which two variables are related

Correlation is a measure of the degree to which two variables are related—the degree to which they vary together ("covary"). If two things tend to go together, then there is a *positive correlation* between them. For example, the height and weight of people are positively correlated; in general, greater height means greater weight. On the other hand, if two things tend to vary inversely there is a *negative correlation* between them. For example, years of schooling and days spent in prison are negatively correlated; in general, more years of schooling means less time in jail. And if two things are completely unrelated, they are not correlated at all.

Correlations underwrite prediction

Correlations between variables are extremely important in *prediction*. If you knew the heights of all the students in your critical reasoning class, you would be able to make more accurate predictions about each student's weight than if you didn't know their heights. You would still make some mistakes, but on average your predictions would be more accurate.

There is a formula for calculating correlations, and the resulting values are numbers between +1.0 (for complete positive correlation) and 10 (for a complete negative correlation); a correlation of 0 means that there is no pattern of relationship between the two variables. This allows for very precise talk about correlations. We won't worry about such precision here, however, but will simply focus on the basic ideas.

Correlation and Probability

We could apply the things we learned about probability to cover all cases of correlation, but here we will just get the general idea by considering the case of two dichotomous variables (variables that only have two values).

Consider the smoking variable and its two values, smoker and non-smoker, and the heart-attack variable and it's two values, having a heart attack and not having a heart attack. The two variables are not independent. Smokers are more likely than non-smokers to have heart attacks, so there is a positive correlation between smoking and heart attacks. This means that $\Pr(H|S) > \Pr(H) > \Pr(H|{\sim}S)$. Or in words, the property of having a heart occurs at a higher rate in one group (smokers) than in another group (people in general, as well as the group of people who don't smoke). So, correlation compares the rate at which a property (like having a heart attack) occurs in two different groups.

If the correlation were negative, we would instead have $\Pr(H|S) < \Pr(H)$. And if there were no correlation at all, the two variables would be independent of each other, i.e., $\Pr(H|S) = \Pr(H)$. Correlation is symmetrical. That means that it is a two-way street. If S is positively correlated with H, then H is positively correlated with S, and similarly for negative correlations and for non-correlations. In terms of probabilities this means that if $\Pr(A|B) > \Pr(A)$, then $\Pr(B|A) > \Pr(B)$ (exercise for experts: prove this).

15.3.1 Correlation is Comparative

The claim that there is a positive correlation between smoking and having a heart attack does *not* mean that a smoker is highly likely to have a heart attack. It does not *even* mean that a smoker is more likely than not to have a heart attack. Most people won't have heart attacks even if they do smoke.

The claim that there is a positive correlation between smoking and having a heart attack simply means that there are more heart attack victims among smokers than among non-smokers.

		Heart Attack	
		+	−
Smoke	+	12	80
	−	7	90

Figure 15.2: Thinking about Correlations

A good way to get a rough idea about the correlation between two variables is to fill in some numbers in the table in Figure 15.2. It has four cells. The + means the presence of a feature (smoking, having a heart attack) and the - means not having that feature (being a non-smoker, not having a heart attack). So, the cell at the upper left represents people who are both smokers and suffer heart attacks, the cell at the lower left represents people who are non-smokers but get heart attacks anyway, and so on. We could then do a survey and fill in numbers in each of the four cells.

Correlation is comparative

The key point to remember is that smoking and heart attacks are correlated just in case $\Pr(S|H) > \Pr(S|{\sim}H)$. So, you cannot determine whether they are correlated merely by looking at $\Pr(S|H)$. This number might be high simply because the probability of suffering a heart attack is high for everyone, smokers and nonsmokers alike. Correlation is comparative: you must compare $\Pr(S|H)$ to $\Pr(S|{\sim}H)$ to determine whether smoking and heart attacks are correlated or not.

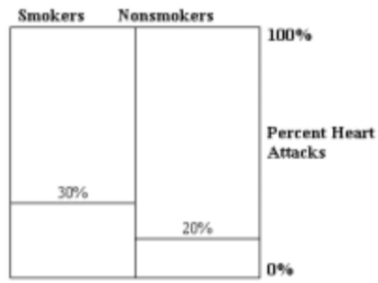

Figure 15.3: Correlation between Smoking and Heart Attacks

Comparative Diagrams to Illustrate Correlation

One of the easiest ways to understand the basics of correlation is to use a diagram like that in Figure 15.3. Diagrams like this are more rough and ready than the diagram above, but they are easier to draw. The percentages are hypothetical and are simply used for purposes of illustration. Here we suppose that the percentage of smokers who suffer heart attacks is 30%, and that the percentage of nonsmokers who suffer heart attacks is 20% (these round numbers are chosen to make the example easier; they are not the actual percentages).

In this *comparative diagram*, the horizontal line in the smokers column indicates that 30% of all smokers suffer heart attacks, and the lower horizontal line in the nonsmokers column indicates that 20% of nonsmokers suffer heart attacks.

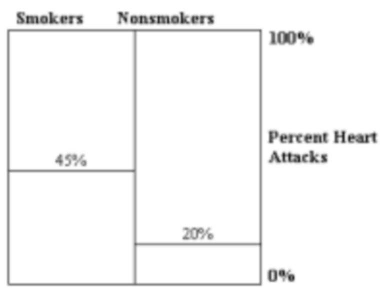

Figure 15.4: A Stronger Positive Correlation

The fact that the percentage line is *higher* in the smokers column than it is in the nonsmokers column indicates a positive correlation between being a smoker and having a heart attack. It is the *relationship* between these two horizontal lines that signifies a positive correlation. Similarly, the fact that the percentage line is *lower* in the nonsmokers column indicates that there is a negative correlation between being a nonsmoker and having a heart attack. The further apart the lines are in a diagram like this, the stronger the correlation. So, Figure 15.4 illustrates an even stronger positive correlation between smoking and heart attacks.

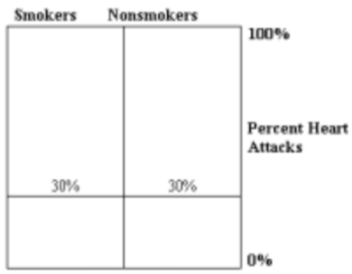

Figure 15.5: Independence between Smoking and Heart Attacks

Finally, if the lines were instead the same height, say at 30% (as in Figure 15.5), smoking and having a heart attack would be independent of one another: they would not be correlated, either positively or negatively.

Notice that to draw such diagrams you do not need to know exact percentages. You only need to know which column should have the higher percentage, i.e., the higher horizontal line.

Correlation and Causation

Correlation ≠ Causation

Correlations often point to causes; they are *evidence* for claims about what causes what. When two variables, like smoking and having a heart attack, covary we suspect that there must be some reason for their correlation—surely *something* must cause them to go together. But correlation is not the same thing as causation. For one thing, correlation is symmetrical (smoking and heart attacks are correlated with each other), but causation is a one-way street (smoking causes heart attacks, but heart attacks rarely cause people to smoke). So, just finding a positive correlation doesn't tell us what causes what.

When your child's pediatrician says, "Spots like this usually mean measles," they are relying on a positive correlation between the presence of spots and having measles. We know the spots don't cause the measles, and commonsense suggests that measles causes the spots. But sometimes variables are correlated with each other even when neither has any causal influence on the other. For example, every spring my eyes start to itch and a day or two later I have bouts of sneezing. But the itchy eyes don't cause the sneezing; these two symptoms are joint effect of a third factor, allergies to pollen, that causes them both (Figure 15.6).

Similarly, there is a positive correlation between a falling barometer and a rainstorm, but neither causes the other. They are both caused by an approaching cold front. So, sometimes variables are correlated because they have a common cause, rather than because either causes the other. There are many examples of correlations between things that are effects of some third, common cause. The scores of identical twins reared in very different environments are correlated on multiple behavioral variables like introversion– extroversion. If the twins were separated at birth and reared apart, one twin's high degree of extroversion cannot be the cause of the other's extroversion. In this case, their high degrees of extroversion are joint effects of a third thing—a **common cause**—namely having the same genotype (genetic makeup).

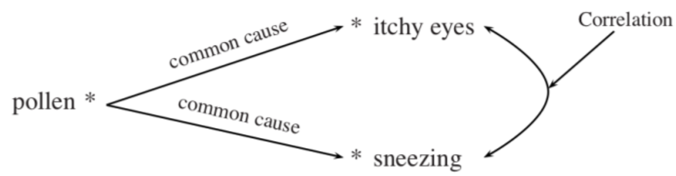

Figure 15.6: Common Causes

Some early spokesmen (they were all men in those days) for the tobacco companies tried to convince the public that something similar was true in the case of smoking. They urged that smoking and heart attacks are correlated because they are *common effects* of some third factor. Some peoples' genetic makeup, the spokesmen suggested, both led them to smoke and made them more susceptible to heart disease. Despite much research, a common genetic cause for smoking and cancer was never found, but the research was necessary to exclude this possibility. We can never rule out the possibility of common causes without empirical observations.

In many cases, it is difficult to determine what causes what, even when we know a lot about correlations. For example, in the late 1990s, the rate of violent crime in many U. S. cities dropped. The drop was accompanied by several factors, e.g., more police on the beat, tougher sentencing laws, various educational programs. Thus, there is a (negative) correlation between number of police and number of crimes, between tougher sentences and number of crimes (more police, less crime), and so on. But there is a great deal of debate about just what *caused* the crime drop (naturally, everyone involved wants to take credit for it). Of course, it may be that each of these factors, e.g., more police, increased education, played some causal role. It is very difficult to determine just how much difference each of the factors makes, but we need to do so, if we are going to implement effective measures to reduce crime.

It is also known that self-esteem and depression are negatively correlated. Lower self-esteem tends to go with depression. But what causes what? Lower self-esteem might well lead to depression, but depression might also lower self-esteem. Of course, there could be a vicious circle here, where each condition worsens the other. But it is also possible that there is some third cause, e.g., a low level of neurotransmitters in the brain, or negative events in one's life.

As these examples show, finding causes is often important for addressing serious problems like crime and depression. But while correlations can frequently be detected by careful observation, tracking down causes is often much more difficult. It is best done in an experimental setting, where we can control for the influence of the relevant variables.

Correlation and Inferential Statistics

Once we determine whether two variables are correlated in a sample, we may want to draw inferences about whether they are correlated in the population. Here, the material earlier in this chapter on inferential statistics is relevant.

Exercises

1. Identify whether the correlation between the following pairs of variables is strong, moderate, or weak, and in those cases that do not involve dichotomous variables, identify whether the correlation is positive or negative. Defend your answer (if you aren't sure about the answer, explain what additional information you would need to discover it); in each case, think of the numbers as measuring features of adults in the United States:

    1. height and weight
    2. weight and height
    3. weight and caloric intake
    4. weight and income
    5. weight and score on the ACT
    6. weight and amount of exercise
    7. weight and gender
    8. years of schooling and income

2. Having schizophrenia and being from a dysfunctional family are positively correlated. List several possible causes for this correlation. What tests might determine which possible causes are really at play?

3. How might you determine whether watching television shows depicting violence and committing violent acts are correlated in children under ten? Suppose that they were: what possible causes might explain this correlation?

4. Many criminals come from single parent homes. Explain in detail what you would need to know to determine whether there really is a correlation between being a criminal and coming from a single parent home. Then explain what more you would need to know to have any sound opinion on whether coming from a single parent home causes people to become criminals.

5. How would you go about assessing the claim that there is a strong positive correlation between smoking marijuana and getting in trouble with the law?

6. We often hear about the power of positive thinking, and how people who have a good, positive attitude have a better chance of recovering from many serious illnesses. What claim does this make about correlations? How would you go about assessing this claim?

7. Suppose that 30% of those who smoke marijuana get in trouble with the law, and 70% do not. Suppose further that 27% of those who don't smoke marijuana get in trouble with the law and 73% do not. What are the values of $\Pr(T|M)$ and $\Pr(T|\sim M)$. Are smoking marijuana and getting in trouble with the law correlated? If so, is the correlation positive or negative? Does it seem to be large or small?

8. Suppose we obtain the following statistics for Wilbur's high school graduation class: 46 of the students (this is the actual number of students, not a percentage) who smoked marijuana got in trouble with the law, and 98 did not. And 112 of those who didn't smoke marijuana got in trouble with the law and 199 did not. What are the values of $\Pr(T|M)$ and $\Pr(T|\sim M)$? Are smoking marijuana and getting in trouble with the law correlated? If so, is the correlation positive or negative? Does it seem to be large or small?

9. Suppose that last year the highway patrol in a nearby state reported the following: 10 people who died in automobile accidents were wearing seatbelts and 37 were not wearing seatbelts. Furthermore, 209 people who did not die (but were involved) in accidents were wearing their seatbelts, while 143 were not wearing them. Does this give some evidence that seatbelts prevent death in the case of an accident? Is there a non-zero correlation between wearing seat belts and being killed in an accident? If so, is it positive or negative, and what is the relative size (large, moderate, small)? Be sure to justify your answers.

Extras for Experts. Prove that positive correlation is symmetrical. That is, prove that $\Pr(A|B) > \Pr(A)$ just in case $\Pr(B|A) > \Pr(B)$.

15.4 Real vs. Illusory Correlations

A pitfall that is especially relevant to this chapter is belief in illusory correlations. We believe in an **illusory correlation** when we think we perceive a correlation where one doesn't really exist. More generally, we believe in an illusory correlation when we think that things go together *substantially* more (or less) often than they do.

A recurrent theme in this course is that human beings are constantly seeking to explain the world around them. We look for order and patterns, and we tend to "see" them even when they don't exist. For example, most of us will think we detect patterns in the random outcomes of flips of a fair coin. So, it is not surprising that we tend to see strong relationships—correlations—among variables even when the actual correlation between them is minimal or nonexistent. This can be a serious error, because once we think we have found a correlation we typically use it to make predictions, and we frequently develop a causal explanation for it. If the correlation is illusory, the predictions will be unwarranted and our explanation of it will be false.

Illusory correlation: something that looks like a correlation, but isn't

If Wilbur, for example, believes that women tend to be bad drivers—i.e., if he thinks there is a correlation between gender and driving ability—then it will be natural for him to predict that he will encounter more bad drivers among women than among men. He may even go so far as to predict that Sue, whose driving he has never observed, will be a bad driver. Finally, he may look around for some explanation of why women don't drive well, one that may suggest they don't do other things well either. So, beliefs in illusory correlations have consequences, and they are typically bad.

Our tendency to believe in illusory correlations has been verified repeatedly in lab studies. In a series of studies in the 1960s, Loren and Jean Chapman gave subjects information that was supposedly about a group of patients at a mental health facility. The subjects were given a clinical diagnosis of each patient and a drawing of a figure attributed to the patient. The diagnoses and drawings, which were all fictitious, were constructed so that there would be no correlation between salient pairs of features; for example, the figure was just as likely to have unfocused eyes when the diagnosis was paranoia as when it wasn't.

Subjects were then asked to judge how frequently a given diagnosis, e.g., paranoia, went along with a feature of the drawing, e.g., unfocused eyes. Subjects greatly overestimated the extent to which such things went together, i.e., they overestimated the correlation between them, even when there was data that contradicted their conclusions. And they also had trouble detecting correlations that really *were* present.

Various things lead us to think we detect correlations when none exist. As we would by now expect, context and expectations often play a major role. We have some tendency to see what we expect, and even hope, to see. And we have a similar tendency to find the patterns we expect, and even hope, to find. For example, in word association experiments, subjects were presented with pairs of words (‘tiger - bacon’, ‘lion - tiger’).

They later judged that words like ‘tiger’ and ‘lion’, or ‘bacon’ and ‘eggs’, which they would expect to go together, had been paired much more frequently than they had been. Similarly, if you expect to encounter women who are bad drivers, you are more likely to notice those who do drive badly, forget about those who don’t, and interpret the behavior of some good women drivers as bad driving.

Illusory correlations often result from overemphasis on positive cases

Many beliefs in illusory correlation amount to superstitions. If you believe that your psychic friend can accurately predict the future, then you believe that there is a positive correlation between what they say and what turns out to be true (i.e., you believe that the probability that a prediction will be true, given that they say it will, is high). Again, we may remember cases where someone wore their lucky sweater and did well on the big exam, which leads them to see an (illusory) correlation between wearing the sweater and success.

Illusory correlations often arise in our reasoning about other people. Many of us tend to think that certain good qualities (like honesty and kindness) are correlated, so, when we learn that a person has one good feature, we think it more likely that they have others. They might in some cases, but it’s not reasonable to draw this conclusion without further evidence. This pattern of thinking occurs so frequently that it has a name—the *halo effect*—and we return to it in more detail near the end of this chapter.

Illusory correlations also make it easier for people to cling to stereotypes. A **stereotype** is an oversimplified generalization about the traits or behavior of the members of some group. It attributes the same features to all members of the group, whatever their differences. There are many reasons why people hold stereotypes, but belief in illusory correlations often reinforces them. Thus, people may believe that members of some race or ethnic group tend to have some characteristic— usually some negative characteristic, like being lazy or dishonest—which is just to say that they believe that there is a correlation between race and personality traits.

But even when our expectations and biases don't color our thinking, we often judge that two factors go together more often than they really do simply because we ignore evidence to the contrary. It is often easier to think of positive cases in which two factors go together than to think of negative cases in which they don't.

Suppose we learn about several people who have the same illness and some of them got better after they started taking Vitamin E. It can be very tempting to conclude that people who take Vitamin E are more apt to recover than those who do not. But this may be an illusory correlation. Perhaps they would have gotten better anyway—people often do. To know whether there is a genuine correlation here, we need to compare the recovery rate among those who took Vitamin E and those who did not.

15.4.1 Ferreting out Illusory Correlations

In later chapters, we will learn to guard against many of the factors that encourage belief in illusory correlations, but we are already able to note one very important remedy. In this example, we were inclined to see a correlation between taking Vitamin E and recovering from an illness because we focused on just one sort of case, that in which people took Vitamin E and got better. But many people who don't take Vitamin E may also recover, and perhaps many other people who do take it don't recover. In fact, it might even turn out that a higher percentage of people who don't take Vitamin E get better. *Correlation is comparative*.

One way to begin to see the importance of other cases is to note that the case of people who don't take Vitamin E but recover anyway provides a *baseline* against which we can assess the effectiveness of the vitamin. If 87% of those who don't take the vitamin recover quickly, then the fact that 87% of those who *do* take it recover quickly doesn't constitute a positive correlation between taking Vitamin E and recovery. If 87% of those who don't take it recover quickly, and if 86% (which sounds like a pretty impressive percentage, if we neglect the contrast cases) of those who do recover, taking the vitamin instead *lowers* the chances of recovery.

A more realistic example illustrates the same point. We may easily remember students who smoked marijuana and got into non-drug-related trouble with the law. They may stand out in our mind for various reasons, perhaps because they are frequently cited as bad examples. This can lead to belief in an illusory correlation between smoking dope and getting into trouble. It may well be that such a correlation exists, but to determine whether it does, we also must consider the contrast groups. In other words, we must consider not just group 1, but also groups 2, 3, and 4:

Group 1: People who smoked marijuana and did get in trouble.
Group 2: People who smoked marijuana but did not get in trouble.

Group 3: People who didn't smoked marijuana and did get into trouble.

Group 4: People who did not smoked marijuana and did not get into trouble.

The relevant question here is whether the probability of getting in trouble is higher if you smoke marijuana than if you don't. In other words, is it true that $\Pr(T|M) > \Pr(T|{\sim}M)$?

And it is impossible to answer this question without considering all four groups. To estimate a person's probability of getting in trouble given that they smoked marijuana ($\Pr(T|M)$), we must first estimate the proportion of marijuana users who did get in trouble, which requires some idea about users who got in trouble (Group 1) and users who did not (Group 2). And then to estimate the probability of a person's getting in trouble given that they did not smoke marijuana ($\Pr(T|{\sim}M)$), we need to estimate proportion of non-users who got in trouble, which requires some idea about non-users who got in trouble (Group 3) and those who did not (Group 4).

But we tend to focus on cases where both variables, here smoking marijuana and getting in trouble with the law, are present. This is an example of our common tendency to look for evidence that confirms our hypotheses and or beliefs, and to overlook evidence that tells against them. This is called **confirmation bias**, and we will examine it in detail in a later chapter on testing and prediction. But for now, the important point is that we can only make sensible judgments about correlations if we consider all four of the groups in the above list.

In real life, we are unlikely to know exact percentages, and we won't usually bother to write out tables like the ones above. But if we have reasonable, ballpark estimates of the actual percentages, quickly constructing a comparative table in our heads will vastly improve our thinking about correlations. If we just pause to ask ourselves about the three cells we commonly overlook, we will avoid many illusory correlations. We will get some practice at this in the following exercises.

15.4.2 The Halo Effect: A Case Study in Illusory Correlation

Seeing More Connections Than Are There

When we give a person a strong positive evaluation on one important trait (like intelligence), we often assume that they should also receive positive evaluations on other traits (like leadership potential). This is called the **halo effect**. The one positive trait sets up a positive aura, or halo, around the person that leads us to expect other positive traits.

The reverse also holds; when a person seems to have one important negative trait, we tend to think that they will have other negative traits as well. The halo effect is a common example of our vulnerability to illusory correlations. We tend to think that one trait (e.g., honesty) is highly correlated with another (e.g., courage), when it fact it may not be. We don't do this consciously, but it shows up in our actions.

Halo effect: if someone has one good trait we tend to jump to the conclusion that they have many others

In one real-world study, flight commanders tended to see a strong relationship between the intelligence of a flight cadet and his physique, between his intelligence and his leadership potential, and between his intelligence and his character. These traits are not completely unrelated, but the commanders greatly overestimated the strength of their connections. In another study, students who were told that their instructor would be warm were more likely to see them as considerate, good-natured, sociable, humorous, and humane. Being warm set up a halo that they thought extended to these other traits.

If two traits really do tend to go together, then we can draw a reasonable (but fallible) inference from one to the other. But such inferences are only legitimate if there truly is a strong objective connection—a high correlation— between the two traits. In many cases there is not, so the halo effect leads us to "see" more correlations or connections than there really are. We tend to see sets of traits as package deals, when in fact they are quite separate.

What is Beautiful is Good

Physical attractiveness provides one of the most striking examples of the halo effect. Different cultures perceive different attributes as attractive, but within most cultures (or subcultures), there is a good deal of agreement on what is viewed as attractive and what is not. Many people act as though they believe that there is a strong positive correlation between physical attractiveness (as rated by members of their culture) and other positive characteristics. For example, physically attractive people are viewed as happier, stronger, kinder, and more sensitive than less attractive people.

Of course, there may be some connection between being attractive and being happy, or between being attractive and having good social skills (why might this be so?). But attractiveness creates a halo that extends to completely unrelated characteristics. For example, experimenters had subjects read a set of essays. Each essay had a picture attached to it that the experimenter said was a picture of the author (although this was just a ruse). The quality of an essay was judged to be better when it was attributed to an attractive author.

Illusory correlations based on attractiveness occur in many settings in the real world. Attractive job candidates are more likely to be hired than less attractive ones. In one real-world study, physically attractive men earned a higher starting salary, and they continued to earn more over a ten-year period, than less attractive men. And although physically attractive women did not have higher starting salaries, they soon earned more than their less attractive counterparts.

The phenomenon even affects basic issues involving justice and fairness. The transgressions of attractive children are judged less severely by adults than similar actions by less attractive children. A mock jury sentenced an unattractive defendant to more years in prison than an attractive defendant, even though the crime was described in the same words in each case. And killing an attractive victim gained a stiffer sentence than killing an unattractive one.

Perhaps these findings should not be surprising. Beauty is held up as an ideal in commercials, movies, and TV, and on-screen heroes and heroines are almost always attractive. In fact, there is a *physical attractiveness stereotype*, and this is probably what sets up the halo. Once we classify someone as attractive, the attractiveness stereotype or schema is activated, and we find it natural to suppose that a person has other components of the stereotype.

There are a few exceptions to the attractiveness halo. Physically attractive women are more likely to be judged vain and egotistical, although people tend to think better of beautiful women, unless they are viewed as misusing their beauty. Physically attractive men are more likely to be judged less intelligent. But in general, physical attractiveness establishes a strong, positive halo.

As in most cases of the halo effect, the physical attractiveness stereotype is based on bad reasoning (although it does have some features of a *self-fulfilling prophecy*: if attractive people are treated better, they may do better in various ways). It is also unfair. But if we know about the phenomenon, we can more easily guard against it in our own judgments and try to protect ourselves against other people's tendencies to fall victim to it in their own reasoning.

15.5 Chapter Exercises

1. There are people who think that there is a strong positive correlation between having the astrological sign Libra and being indecisive. Why might they have come to think this? What claim does this make about correlations? How would you go about assessing this claim?

2. The following passages are from a column in *The Oklahoma Daily* (April 13, 1998) in which Rep. Bill Graves argues that people who are gay should not be employed as support personnel at public schools. For each of the following, (1) explain Graves' point in citing the statistics, and (2) critically evaluate his use of the statistics.

- "The 1948 Kinsey survey . . . found that 37 percent of homosexual men and 2 percent of lesbians admitted sexual relations with children under 17 years old. Twenty-eight percent of homosexual men and 1 percent of lesbians admitted sexual relations with children under 16 years old while they were age 18 or older."

- "The average age of homosexual men is 39 years, and 45 years for lesbians. Thus, that lifestyle is actually a death style from which children should be protected."

3. Evaluate the following interchange:

Wilma: I've just graduate from law school and now I must take the bar exam. I'm sort of nervous about passing.

Wilbur: Don't about 90% of those who take it pass?

Wilma: It's given twice a year. In the summer about 90% pass it; in the winter, it's about 70%.

Wilbur: I'd take it in the summer if I were you.

4. Political consultants increasingly use focus groups to determine which themes, even which words, their candidate should use to get more votes. What is a focus group and how do they work (check the internet if you aren't sure)? Then explain the ways in which the concepts introduced in this chapter, e.g., sample and population, bear on the use of such groups and the evaluation of their responses.

5. Personnel Director for a large company: We are very careful in our job interviews. We see some very good people, and the decisions are often tough. But looking back, we have almost always made the best decisions. The people we have hired have worked out very well.

6. When a teacher gives you an examination, they are taking a sample of the things you have learned in the course. Explain, in more detail, what the sample and the population are in this case. What does it mean for a sample to be biased in this case? In what ways are good tests unbiased?

Answers to Selected Exercises

5. There is a problem with this sample. To see whether the hiring decisions were the best, the Personnel Director would need to know how the people she didn't hired would have worked out. This is nearly impossible to know, but failing this, it would be useful to know how the people who weren't hired ending up doing at the job they eventually got.

Chapter 16

Applications and Pitfalls

Overview: In this chapter, we consider the notion of expected value and several other applications of probability. We then examine several ways in which our probabilistic reasoning often goes wrong in daily life; here we will examine the gambler's fallacy, the conjunction fallacy, regression to the mean, and some common mistakes about coincidence.

Contents

16.1 What do the Numbers Mean?

You can now calculate the probabilities of various things happening. But what do the numbers you get tell you—*what* do they *mean*? The answer is that they mean different things in different cases. We will note three important cases, and the answer is different for each of them.

16.1.1 Ratios of Successes to Failures

With common games of chance, we can determine the probabilities of simpler outcomes intuitively; indeed, it is much easier to do this than it is to calculate them with the relevant rule. Let's analyze what we do when we make these intuitive determinations. You are going to draw one card from a full deck. What is the probability that you'll draw a king? You didn't need any complicated rules to answer this. Instead, you reason that: there are four kings out of 52 cards, and we are equally likely to draw any one of them, so the probability of getting a king is 4/52.

In such cases, where each of the outcomes is equally likely to occur, we take the number of outcomes of interest to us, divide it by the total of possible outcomes, and interpret this ratio as a probability.

$$\text{Number of outcomes of interest} = \frac{\text{number of outcomes of interest}}{\text{number of all possible outcomes}}$$

For example, in the case of drawing a king from a deck, the outcomes of interest are getting a king, and there are four of these. And the set of all possible outcomes consists of drawing any of the 52 cards in the deck. If we call the outcomes of interest a *success* (terminology that goes back to the gambling roots of probability), we can say that the probability of a success is:

$$\frac{\#\ \text{Sucesses}}{\#\ \text{Possible cases}}$$

A similar approach works for outcomes of drawing jellybeans from a jar, throwing dice, spinning a roulette wheel, and the like.

But this approach only works when the basic cases of interest are *equally likely*. It works when we flip a *fair* coin; the probability of heads is the numbers of cases of interest, or the number of cases of interest, successes as they are often called, over the number of possible cases. There is one way to flip a head and two possible outcomes. So, the probability is 1/2. But this doesn't work if we flip a biased coin, say one that is twice as likely to come up heads as tails. There is still just one way to have a success (i.e., to flip a heads) and just two possible outcomes (heads and tails), but the probability of a head will no longer be 1/2. To handle cases like this, and many other real life cases as well, we need to turn to frequencies.

16.1.2 Frequencies

In many cases, probabilities are empirically determined frequencies or proportions. For example, the probability that a teenage male driver will have an accident is the percentage or frequency of teenage male drivers who have accidents. This approach applies, though sometimes less clearly, to the price of insurance premiums, weather forecasting, medical diagnosis, medical treatment, divorce, and many other cases.

For example, a health insurance company records the frequency with which males over 50 have heart attacks. The company then translates this into a probability that a male over 50 will have a heart attack, and charges accordingly for the policy. Again, when your doctor tells you that there is a 5% chance that a back operation will worsen your condition, they are basing their claim on the fact that about 5% of the people who get such operations get worse. The outcomes of interest (getting worse) divided by the total number of cases (all those having this kind of surgery) is 5/100.

In many cases, some of the possible outcomes are more likely to occur than others, but we can adapt the basic approach by viewing the probability of a given sort of event as the relative frequency with which it occurs (or would occur) in the set of possible outcomes.

16.1.3 Degrees of Belief

Often, we do not have access to solid information about frequencies, and sometimes it isn't even clear which frequencies are relevant. But even in these cases, we often have beliefs that involve something very like probabilities. For example, we don't have solid information about frequencies that would let me assess the probability that aliens from outer space have infiltrated the college's golf team. Nevertheless, we believe that probability to be very low. Or, to take a more serious example, if you serve on a jury, you may have to form a judgment about the likelihood that the defendant is guilty.

It may be unclear how we can assign a probability to the statement, "Aliens from outer space have infiltrated the golf team" (let's abbreviate this as *A*). But whatever rough probability value we assign it, our beliefs will only cohere with each other if we assign further rough probabilities in accordance with the rules of probability.

For example, since we think that the probability of *A* is very low, we believe that 1- Pr(*A*) of its negation is very high. And we believe that Pr(*A* or ~*A*) = 1 and that Pr(*A* & ~*A*) = 0.

In short, probabilities sometimes represent ratios involving equally likely cases, they sometimes represent frequencies, and they sometimes represent our degrees of belief. The former is much easier to work with, but many things that matter in life involve the second or third. Fortunately for us, these issues don't matter a lot in the sorts of cases we are likely to encounter.

16.1.4 How Can We Comprehend Such Tiny Numbers?

We can develop some feel for the meaning of frequency probabilities when they aren't too small. For example, the probability that you will roll a two with a fair die is 1/6. This means that on average, over the long run, you will roll a two one-sixth of the time.

But many probabilities are much smaller numbers. For example, the probability of getting kings on two successive draws from a full deck when we replace the first card is 4/52 x 4/52 (approximately .0059), whereas the probability of getting two kings when we don't replace the first card is 4/52 x 3/51 (approximately .0045). We aren't used to thinking about such tiny numbers, and it is difficult to get a grip on what they mean. In a highly technological world, the differences between numbers like this are sometimes important, and they also matter to casinos that want to stay in business. But such differences don't matter much to us in our daily life, and we won't agonize over them. The important point for us is that most of us have a poor feel for very large and very small numbers, even in cases where their relative sizes are very different.

We have considered the probabilities of outcomes when we draw cards or roll dice, but people also consider the probabilities of outcomes in cases that matter a lot more, including matters of life and death. What is the likelihood of dying in a plane crash? Of getting cancer if you smoke? Of contracting HIV if you don't use a condom?

Terrorism is frightening and continued to occupy a relatively large portion of American news and public discourse over a decade after 9/11. In fact, however, far fewer than one in a million Americans are killed by terrorists in any given year, whereas over one in 5,000 are killed in automobile accidents. The differences between the probabilities of these two occurrences is enormous, and any rational assessment of how we live our lives should take this into account.

If we had a good feel for large numbers, we could apply this to probability; for example, it would give us a better feel for the magnitude of the difference between 1/5000 and 1/1,000,000. But most of us are no better with big numbers than with small ones. When we hear about the size of the national debt, which is measured in trillions of dollars, the numbers are so enormous that our minds just go numb. A good way to develop some feel for the meanings of very large and very small numbers is to translate them into concrete terms, ideally into terms that we can visualize. What does one thousand really mean? What about ten thousand? Well, the Straz Center for the Performing Arts seats less than five thousand (4,327), the Amalie Arena seats just over twenty thousand (20,500) and the Raymond James Stadium seats around sixty-five thousand (65,890).

With larger numbers, visualization becomes difficult, but analogies can still be useful. Consider the difference between one million (1,000,000) and one billion (1,000,000,000). It takes eleven and a half days for one million seconds to elapse, whereas it takes thirty-two years for one billion seconds to tick away (how long does it take for one trillion—1,000,000,000,000—seconds to elapse?). And the relative difference in probabilities of one in a million and one in a billion is equally immense.

Exercises

1. If it takes about 32 years for a billion seconds to elapse, how long does it take for a trillion seconds to elapse? Explain how you arrived at your answer.

2. How can we apply the points we have learned about the differences between a million and a billion to the claims that one alternative has a chance of one in a million of occurring and a second alternative has a chance of one in a billion of occurring?

3. Can you think of any concrete image that could help you get an intuitive handle on the number 1,000,000? Give it your best shot.

16.1.5 Probabilistic Reasoning without Numbers

In our daily lives, we rarely worry about *precise* probability values; indeed, such numbers are often unattainable or even meaningless. But in the next few sections, we will see that the concepts we acquired in mastering the rules of probability will help us understand many things that happen in real life. We will see how probabilistic concepts are relevant, even in the absence of precise numerical values for probabilities.

16.2 Expected Value

Most things in life are uncertain, so we don't have any choice but to base our decisions on our views about probabilities. But the costs and benefits, and the value and disvalue of outcomes, also play a role in our decisions. For example, imagine you are thinking about going to see a movie, but the weather report said that there was a 40% chance of rain tonight, and you don't like driving on slick roads. Should you go? If you don't want to see the show very badly you may stay home, but if this is your only chance to see something you've really been wanting to see, the trip may be worth the risk.

Odds of 2 to 1 may be enough for someone to bet a few dollars, but not to bet your life (as you would in a case of risky surgery). Both the probabilities and the values (and disvalues) of outcomes play quite a role in our decisions. The following examples should help us see how this should work if we are reasoning well.

Example 1: Three Point Shots

Wilma, one of the guards on the UCLA basketball team, hits 40% of her shots from less than three-point range and 30% of her shots from three-point range. It may be best for Wilma to take certain shots in certain cases (e.g., if two points will win the game, then she should go for two).

Expected value of shooting threes

But in general, is it better for her to take two-point shots or three-point shots? The probability of hitting a three pointer is lower, but the payoff is higher. How do we weigh these two considerations?

The following table gives us the answer:

	Probability	×	**Payoff**	**= Expected Value**
Two pointer:	.40	×	2 points	= .8 points
Three pointer:	.30	×	3 points	= .9 points

Over the long-haul Wilma will, *on average*, get 0.8 points for each two-point shot she takes and 0.9 points for each three-point shot. We say that .8 is the *expected* value of Wilma's two point shot and 9 is the expected value of her three-point shots. Over the course of a season this difference can matter, and other things being equal it is better for Wilma to attempt three pointers.

Example 2: Rolling Dice

Your friend asks you to play the following game. You roll a die. If you get a six, they pay you six dollars. If you don't get a six, you pay them one dollar. Would this be a profitable game for you to play? To answer this question, we need to determine the expected value of this game.

The formula for this when two outcomes are possible is this:

	Probability of success	×	Payoff (positive)
Plus	Probability of failure	×	Payoff (negative)

In the case of two pointers and three pointers, we could leave out probability of failure since the payoff in such cases is zero points. When we multiply this by the probability of failure, the result is still zero, so it drops out of the picture. But in the present case there is a "negative payoff" for failure.

Plugging the numbers in for the game proposed by your friend, your expected value is determined by the following rule:

$$
\begin{array}{llcll}
 & \text{Probability of success } (= 1/6) & \times & \text{Payoff } (= \$6) & = 1 \text{ dollar} \\
\text{Plus} & \text{Probability of failure } (= 5/6) & \times & \text{Payoff } (= - \$1) & = -5/6 \text{ dollar} \\
\hline
 & & & & = 1/6 \text{ dollars.}
\end{array}
$$

The expected value of this game for you is 1/6 of a dollar. Over the long run, your average winnings per roll will be 1/6 of a dollar, or about sixteen and a half cents. Over the short run this isn't much, but it could add up over time. So, it's a good game for you (though not for your friend—unless they enjoy losing).

Exercise: What payoffs should your friend propose if they want the game to be fair for both of you?

The treatment of expected values can be extended in a natural way to cover more than two alternatives at a time. Just list all the possible outcomes, and record the probability and the payoff for each (listing losses as negative payoffs). Multiply the probability for each outcome by the payoff for that outcome. Then add up all these numbers.

You should think a bit about expected value before you play the slot machines, buy tickets for a lottery, or the like. In all these cases, there is a positive expected value for those running the game, a "house advantage," and a negative expected value for those playing it. A similar point holds for insurance premiums. The insurance company calculates the probabilities of various outcomes and then determines prices of policies and amounts of payoffs so that the company will have a sufficiently high expected value for each policy.

There is a subjective side to payoffs. Even in games of chance, dollars aren't the only things that matter. Some people like gambling, and so even if they lose a little money over the long run, their enjoyment compensates for this loss. Other people dislike risk, so even if they win a bit over the long run, the overall value of the game is negative for them.

There are many other cases where payoffs involve a person's own feelings about matters. Wilbur has a heart condition that severely limits the things he can do. The probability that a new form of surgery will improve his condition dramatically is about 50%, the chances he'll die in surgery are 7%, and the chances the surgery will leave him about the same are 43%. Should he get the surgery?

The answer depends on how much various things matter to Wilbur. If being alive, even in a very unpleasant physical condition, is important to him, then his assessment of the payoffs probably means that he shouldn't elect surgery. But if he can't stand being bed-ridden, he may assess the payoffs differently.

16.2.1 Pascal's Wager

Blaise Pascal (1623–1662) was one of the founders of probability theory. He was also a devout Catholic in seventeenth century France. He argued that we should believe in God for the following reasons. While we are on this earth, we can never really settle the matter of whether God exists or not. But either He does, or he doesn't.

Case one: *God exists*

1. If God exists and I believe that He exists, then I get a very high payoff (eternal bliss).

2. If God exists and I do not believe in Him I get a very negative payoff (fire and brimstone for all eternity).

Case two: *God does not exist*

3. If God does not exist and I believe that He does, I made a mistake, but its consequences aren't very serious.

4. If He doesn't exist and I don't believe in Him, I am right, but being right about this doesn't gain me a lot.

Pascal uses these claims to argue that we should believe in God. What are the relevant probabilities, payoffs, and expected values in each case? Fill in the details of his argument. What are the strengths and the weaknesses of the argument?

Exercises

1. Edna hits 45% of her three-point shots and 55% of her two-point shots. Which shot should she be trying for?

2. Suppose your friend Wilma offers to play the following game with you. You are going to roll a pair of dice. If you get a 7 or 11 (a natural) she pays you $3. If you roll anything else, you pay her $15. What is the expected value of the game for you? What is it for her?

3. Wilbur and Wilma are on their first date and have gone to the carnival. Wilma is trying to impress Wilbur by winning a stuffed toy for him. Wilma is trying to decide between two games: the duck shoot and the ring toss. She can shoot 55% of the ducks, which are worth two tickets each, and she can make about 35% of the ring tosses, which are worth

four tickets each. Assuming Wilma needs to accumulate 15 tickets to win the toy, which game should she play?

4. In an earlier chapter, we learned about roulette. Calculate the expected value for betting on the number 13 (recall that the true odds against this are 37 to 1, but the house odds are 35 to 1).

16.3 The Gambler's Fallacy

We commit the **gambler's fallacy** when we treat things that are independent as though they were not independent. In other words, when we (mistakenly) think that one of two independent things influence the other. For example, the outcomes of successive flips of a fair coin are independent of each other, so the outcome of the second flip does not depend in the least on the outcome of previous flips. If you flip a *fair* coin ten times and it comes up heads each time, the probability of it coming up heads on the eleventh flip is still 1/2.

Gambler's fallacy: treating independent events as if they were not independent

Of course, if you get enough heads in a row you may begin (quite reasonably) to suspect that the coin really isn't fair. But even if it is biased, so that it is likely to come up heads twice as often as tails, the point remains: the outcomes of the two successive flips are independent of each other, so what happens on the next flip isn't affected by earlier outcomes.

In such situations, we tend to think that the coin is more likely to come up tails in order to "even things out," to satisfy the "law of averages." But the coin doesn't "remember" what it did on earlier flips, and people who reason this way commit the gambler's fallacy. Similarly, defective thinking is common with other games of chance like roulette, and it is a danger in any reasoning involving probabilities.

The gambler's fallacy is not restricted to games of chance. Suppose that Wilbur and Wilma have four children, all boys. They would like to have a girl, and they reason as follows. Very nearly half of the children born in the world are girls. We have had four boys in a row, so it's got to be time that we get a girl. It is an empirical question whether having a child of one sex affects the probability of the sex of subsequent children. The evidence strongly suggests that it does not; the sex of one child is independent of the sex of its siblings. So, assuming that the gender of a couple's children are independent of one another, Wilbur and Wilma commit the gambler's fallacy.

There is a saying that lightning never strikes in the same place twice, and some people will even seek refuge in spot where lightning struck before in hopes of being safe. It may be true that lightning rarely strikes in the same place twice, but that is simply because the probability of it striking *in any specific spot* is reasonably low. But the lightning now doesn't know where lightning has struck before, and this general slogan "never in the same place twice" rests on the gambler's fallacy.

Nothing in these cases requires us to have any precise ideas about probability values. If we have good reason to think that two things are independent, we shouldn't act as though one could influence another. For example, we may have reason to think that Wilbur's die is loaded so that sixes are more likely to come up than any other number. We may not know how much more likely sixes are, but if the outcomes of separate throws are independent, only bad reasoning can lead us to suppose that since a six hasn't come up the last ten throws, a six must be due on the next throw.

16.4 The Conjunction Fallacy

We begin this section with two puzzles.

1. Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice and participated in antinuclear demonstrations. Which is more likely:

    - Linda is a bank teller.

    - Linda is a bank teller who is active in the feminist movement.

2. Which alternative seems more likely to occur within the next ten years?

    - An all-out nuclear war between the United States and Russia.

    - An all-out nuclear war between the United States and Russia in which neither country intends to use nuclear weapons, but both sides are drawn into the conflict by the actions of a conflict that spirals out of control in the Middle East.

In both cases, the second alternative is a conjunction that includes the first alternative as one of its conjuncts. So, for the second option to be right (in either case), it must be possible for a conjunction to be more probable than one of its conjuncts. But this can never happen. But these examples attest to our tendency to judge some conjunctions more probable than their conjuncts. Since this involves bad reasoning, we will call it **conjunction fallacy**.

There are three ways to see that such reasoning is fallacious. First, we can think about what would have to be the case if it were right. How could the probability of two things happening together be greater than the probability of either one happening by itself? After all, for both to occur together, each of the two must occur.

Second, the point is a consequence of the rule for probabilities of conjunctions. This is easiest to see in the case where the conjuncts are independent, though the same idea applies in cases where they are not. Unless one of the conjuncts has a probability of 1, we will be multiplying a number less or equal to 1 by a number less than 1, and the result will have to be smaller than either of the two original numbers.

Conjunction fallacy: thinking a conjunction is more probable than either of its conjuncts

When *A* and *B* are independent, Pr(*A* & *B*) = Pr(*A*) x Pr(*B*). If the probability of each conjunct is 1, then the probability of the conjunction itself will be 1. But in most real-life situations, the probabilities of the two conjuncts is less than 1. In that case, the conjunction will be less probable than either conjunct. For example, if Pr(*A*) = .9 and Pr(*B*) = .9, the probability of the entire conjunction is only .81. If Pr(*A*) = .7 and Pr(*B*) = .6, the probability of the conjunction is .42. Third, and best, we can draw a diagram to represent the situation.

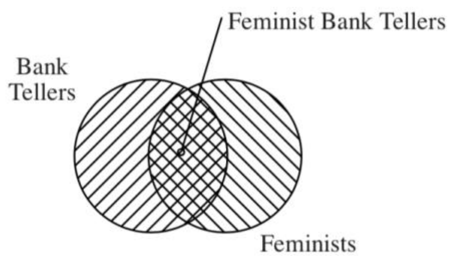

Figure 16.1: Feminist Bank Tellers

The crosshatched area where the circles overlap represents the set of bank tellers who are also feminists. Clearly, this area cannot be larger than the entire circle on the left which represents bank tellers.

Specificity and Probability

As we add detail to a description, it often becomes more *specific*. And as it becomes more detailed and specific, it becomes less probable. For example, suppose that you are going to toss a quarter once. The probability of it landing heads is 1/2. But the probability it will land heads with Washington looking generally north is less, and the probability he'll be looking due north is very small. Indeed, the probability he'll be looking in *any* direction that you specify precisely before the flip is minuscule.

This relates directly to the conjunction fallacy, because adding more detail is just a matter of adding more conjuncts, and adding more conjuncts typically adds more detail. To say that the quarter will land heads with Washington looking north is to say that it will land heads *and* Washington will be looking north. And as always, a conjunction cannot be more probable than either of its conjuncts. Finally, note that we don't need to know precise probability numbers to appreciate the fundamental point that the probability of the conjunction can *never* be greater than the probability of its least probable conjunct, whatever its probability might turn out to be.

More detail means lower probability

16.5 Doing Better by Using Frequencies

A good deal of research has shown that we reason more accurately about many probabilities, including the probabilities of conjunctions, if we think in terms of *frequencies or proportions or percentages*, rather than simply in terms of probabilities. Recall Linda, the single, outspoken, bright, philosophy major. When people are asked whether it is more probable (or more likely) that she is (1) a bank teller, or (2) a bank teller who is active in the feminist movement, well over half of them usually (incorrectly) select (2).

Think Frequencies!

But when people approach the same problem in terms of percentages or frequencies, they do better. If we keep the same profile, but rephrase the two questions to ask: what proportion or percentage of a group of one hundred randomly selected women who fit this profile are (1) bank tellers, and what proportion or percentage of a group of one hundred randomly selected women who fit this profile are bank tellers who are active in the feminist movement, more people avoid the conjunction fallacy. More people (correctly) select (1)—although there is still a strong tendency to commit the conjunction fallacy.

This tendency also shows up in frequency versions of the conjunction fallacy. The question, "Are there more six letter words ending in 'ing' than having 'n' as their fifth letter?" is a question about relative frequencies. Many still say that there are more 'ing' words, even though every six letter word ending in 'ing' has an 'n' as its fifth letter, and there are also non-'ing' words with 'n' in fifth place (e.g., 'barons'). Still, many of us do better here if we think in terms of percentages, proportions, or frequencies than if we simply think in terms of probabilities, or if we simply think in terms of probabilities.

In short, one of the best ways to improve your accuracy in estimating probabilities is to rephrase things in terms of frequencies whenever you can. Instead of asking how probable it is that a person with a given set of symptoms has a disease, ask, "*what proportion* of people in a randomly selected group of 100 who have these symptoms have this disease?" What is the *frequency* of this disease in a group of 100 people who have these symptoms. In fact, you don't even need words like 'frequency' or 'percentage.' Just ask: about how many people out of a hundred (or a thousand) who have these symptoms also have the disease. You can then translate your answer into percentages or probabilities very easily.

It may also help to use percentages instead of probability numbers. Rather than saying the probability of having the disease is .2, you can say that the probability is 20%. When you ask how many things out of a hundred have a certain property and use percentages, then the percentages translate directly into number of things; 90% is just 90 of the items out of 100.

Thinking in terms of percentages or frequencies also makes it easier to think about cumulative risk. If the probability of a certain brand of condom failing is 0.01, ask: how many times out of 100, or 1000, would it fail. The respective answers are 1 every 100 times, and 10 every thousand times. So, over the longer run, there is a substantial chance of failure.

16.6 Why Things Go Wrong

For a spacecraft to make it to the surface of Mars, many different subsystems must function properly. The computer, the radio, the rocket engines, and more must all work. If any of them fail, the entire mission could be ruined. In the case of the Space Shuttle Challenger, a problem with the O-rings was enough for catastrophic results.

Success often requires a Conjunction

Similar points apply to many other cases. For a computer or a car to work, all the parts must work. For the human body to remain healthy, all the various "systems" need to work; the cardiovascular system, the immune system, the nervous system, and many other things must each function well. In general, a complicated system will only function properly if its parts each function properly.

To say that all the subsystems of something must work is to say that subsystem one must work, *and* subsystem two must work, and subsystem three must work, and so on. Your computer's central processor, and its hard drive, and its monitor, and . . . all must work for the computer to work. This means that a conjunction must be true. And as we saw in the previous section, the probability of a conjunction is usually lower than the probabilities of its conjuncts.

Imagine a spacecraft consisting of five subsystems. If any one of them fails, the entire mission will fail. Suppose that the probability that each subsystem will work is 9, and that the performance of each is independent of the performance of the others (this simplifying assumption won’t really be the case, but it doesn’t affect the present point in any relevant way). Then the probability that all five of the subsystems will work is .9 x .9 x .9 x .9 x .9 (= $.9^5$), which is a bit less than 6. If there were seven subsystems (all with a 9 probability of working), the probability that all seven would function properly is less than .5.

Even if the probability that each part of a complex system will function correctly is .99, if there are enough systems, failure somewhere along the line is likely; the more components there are, the more the odds against success mount up (this explains why spacecraft typically include backup systems).

Failure often only requires a disjunction

We can make the same point in terms of disjunctions. A chain is no stronger than its weakest link; if any of them break, the entire chain gives way. If the first one breaks, *or* the second, *or* the third, . . . , the chain is broken. Many things are like chains; they can break down in several different ways. In many cases, the failure of one part will lead to the failure of the whole.

In our imaginary spacecraft, the failure of subsystem one *or* of subsystem two *or* of subsystem three *or* . . . can undermine the entire system. This is a disjunction, and the probabilities of disjunctions are often larger than the probabilities of any of their disjuncts (this is so because we *add* probabilities in the case of disjunctions).

The lessons in this section also apply to things that occur repeatedly over time. Even if the probability of something’s malfunctioning on any occasion is low, the cumulative probability of failure over a long stretch of time can be moderate or even high.

Contraceptives are an example of this. On any given occasion, a contraceptive device may be very likely to work. But suppose that it fails (on average) one time out of every 250. If you use it long enough, there is a good chance that it will eventually let you down. To take another example, the chances of being killed in an automobile accident on any trip are low, but with countless trips over the years, the odds of a wreck mount up.

There is considerable evidence that people tend to overestimate the probabilities of conjunctions (thinking them more likely than they really are) whereas they underestimate the probabilities of disjunctions (thinking them less likely than they really are). As a result, we tend to overestimate the likelihood of various successes while we underestimate the likelihood of various failures.

As before, you don’t need to know precise probability values to appreciate these points. You may know that a contraceptive is likely to work, but that there is a non-negligible chance it will fail. This tells you that, over time, there is a very real chance of its failing.

16.7 Regression to the Mean

The grade school in Belleville, KS administers an achievement test to all the children who enter fifth grade. At the end of the school year, they give the same test again. The average score both times is 100, but something odd seems to have happened. Children who scored below average on the test the first time tend to improve (by about five points), and children who scored above average tend to do worse (by about five points).

What's going on? Might it be that when the two groups of children interact extensively, as they did over the school year, the higher group pulls the other group up, while the lower group pulls the higher group down?

Here is another example. Instructors in an Israeli flight school arrived at the conclusion that praising students for doing unusually well often led to a decline in their performance, while expressing unhappiness when they did poorly often lead to improvement. This group just happened to be studied, but many other instructors and teachers come to similar conclusions. Are they right?

The more likely explanation in both cases is that they involve regression to the mean. **Regression to the mean** is a phenomenon where more extreme scores or performances tend to be followed by more average ones. It's also called **mean reversion**.

The basic idea is that extreme performances tend to revert, regress, or move back toward the mean (i.e., toward the average). So unusually low scores tend to be followed by higher ones (since low scores are below the mean). And unusually high scores tend to be followed by lower ones (since high scores are above the mean). Regression to the mean can occur with anything that involves chance, it occurs frequently, and it is very easy to overlook it.

Regression to the mean: more extreme performances tend to be followed by more average ones

Suppose that you did unusually well (or unusually badly) when you took the ACT. There is a reasonable probability that if you took them again, your second score would be closer to the average. In sports, someone who has an unusually good or unusually bad game is likely to turn in a more average performance the next time around. Indeed, people often remark on the sophomore slump, in which athletes who did exceptionally well as freshmen fall off a bit as sophomores, and the *Sports Illustrated* jinx, in which people who do very well and make it to the cover of *Sports Illustrated* play worse in subsequent weeks. Many cases of this sort simply involve regression to the mean.

Since regression to the mean can occur with anything that involves chance, it affects more than just performances on the basketball court or in the concert hall. For example, there is a lot of randomness in which genes parents pass on to their offspring, and parents who are extreme along some dimension (unusually tall or short, unusually susceptible to disease, etc.) will tend to produce children whose height or susceptibility to disease are nearer the average. Two very tall parents are likely to have tall offspring, but the children are not likely to be as tall as the parents.

Why do things tend to “regress” to the average value? Why not to some other point? Performances involve a “true level of ability” plus chance variation (“error”). The chance variation can involve many different things that lead to better or worse scores than we would otherwise have.

Suppose that you take the ACT several times. Some days you may be very tired, other days well rested; some days nervous, other days more focused and confident; some days you may make a lot of lucky guesses, other days mostly unlucky ones. Often the good and bad conditions will pretty much cancel out, but sometimes you will have mostly the good conditions (in which case you will score very well), and sometimes mostly the bad ones (in which case you will score poorly). If you score extremely well, the chances are that this is a combination of a high ability plus auspicious background conditions, and so your score is likely to be lower the next time around.

Because of the chance error, the distribution of your performances fits a pattern that resembles the standard bell curve. In this distribution of scores, the average value is the value closest to the largest number of cases (we will return to this point when we consider descriptive statistics). So unusually good or unusually bad performances are likely to be followed by the more probable performances, which are just those nearer the average.

The idea may be clearer if we consider a concrete example. Suppose that you shoot thirty free throws each day. Over the course of a month the percentage of shots that you hit will vary. There is some statistical variation, “good days” and “bad days”.

Many things may improve or weaken your performance: how sore your muscles are, how much sleep you got, how focused you are. Sometimes all the things come together in the right way and you do unusually well; other times everything seems to go wrong. But on most days these factors tend to cancel each other out, and your performance is nearer your average. Since your performance is more often near the mean, extreme performances are likely to be followed by more average ones.

16.7.1 Regression and Reasoning

Regression to the mean is very common but frequently overlooked, and failure to appreciate the phenomenon leads to a lot of bad reasoning.

Regression and Prediction

Suppose that Wilbur has an exceptionally good or an exceptionally poor performance shooting free throws in a game. It is natural to base our prediction about how he will do next time on his free throw percentage in the game we saw; we just project the same percentage. But if his shooting was way above (or way below) the average for players in general, his percentage in subsequent games is likely to regress toward this average.

Again, a company may detect falling profits over the previous three months. The manager gets worried, thinks about a way to change marketing tactics, and predicts that this will turn things around. The new tactics are adopted and profits go back up to their previous level. But this may result simply from regression to the mean. If so, the new marketing techniques will (incorrectly) be given credit for the turnaround.

There are various cases where our failure to take regression into account leads to bad predictions; for example, if someone does unusually well (or unusually poorly) in a job interview, we are likely to have a skewed impression of how well they will do on the job.

Explanation and Superstition

Suppose that you've had a couple of poor performances of late. Things went badly on some exams or in the last two recitals you gave. Then you have an unusually good performance the day you wear your green sweater, the ugly one your aunt gave you, and it may become your lucky sweater. Superstitions are often based on something (e.g., wearing the lucky sweater) just happened to coincide with a shift toward a better performance that is simply due to regression to the mean.

Of course, most of us don't really believe in lucky sweaters (though we might still wear one, on the theory that "it can't really hurt"). But lack of awareness of regression to the mean is responsible for a lot of bad reasoning. Whenever an element of chance is involved, regression to the mean comes into play. Nisbett and Ross note that if there is a sudden increase in something bad (e.g., an increase in crime, divorce rates, bankruptcies) or sudden decrease in something good (e.g., a decline in high school graduation rates, or in the amount given to charity) some measure is likely to be taken. For example, if there is a sudden increase in crime, the police chief may increase the number of police officers walking the beat.

If the implementation of a new policy is followed by a decrease in something undesirable or an increase in something desirable, we are likely to conclude that the measure is responsible for the shift. But in many cases, such a shift would have occurred without the measure, simply due to regression to the mean. In such cases, we are likely to *explain* the reduction in crime by the increased number of police on the beat. The measure will be given too much credit.

As a final example, let's return to the question of rewards and punishments. Parents and teachers often must decide whether rewards or punishments are more likely to be effective. Unusually good behavior is likely to be followed by less good behavior simply because of regression, and unusually bad behavior is likely to be followed by better behavior for the same reason.

Hence, when we reward someone for doing extremely well, they are likely to do less well next time (simply because of regression to the mean). Similarly, if we punish them for doing badly, they are likely to do better next time (for the same reason). In each case the change in performance may simply be due to regression to the mean, and the reward and punishment may have little to do with it. It will be natural to assume, though, that punishments are more effective than rewards.

When something like punishment or an increase in police on the beat accompanies regression to the mean, we can easily conclude that society in general, or that we specifically, have found a method to solve certain sorts of problems when in fact, we have little power to solve them. Obviously, this doesn't lead to good decision making at either the public or the personal level.

16.8 Coincidence

Some things strike us a very unusual and unlikely. This often leads us to think that there "must be something special going on" when they do occur—surely, they couldn't "just happen by chance." Wilbur survives a disease that is fatal to 99.8% of the people who contract it, so something special must be going on. In fact, though, there will be two people out of every thousand who do survive. When Wilbur's doctor first saw the test results, he thought it very unlikely that Wilbur would make it, and when Wilbur does the doctor is amazed. But there must be two people who are the lucky pair in a thousand, and it may just have happened to be Wilbur.

As we saw earlier, if we describe an event in enough detail, it will seem very unlikely (before the fact) that it will occur. Suppose you toss a quarter ten times. The probability of any sequence of outcomes is $(1/2)^{10}$, which means that each possible set of outcomes is extremely unlikely. But when you do the tossing, one of these very unlikely sequences will be the one that you get.

There are countless examples of this. Before you tee off, the probability of the ball landing in any spot is close to zero. But if you hit it, it will land some place or another, even though it was very unlikely that it would alight precisely where it eventually does. So, things that seem unlikely can, and do, happen just by chance. Indeed, if we describe things in enough detail, almost everything that happens would have seemed unlikely before it occurred. Still, one of these unlikely things will occur.

16.9 Chapter Exercises

1. Evaluate the following argument, considering concepts recently covered in class.

   > The burglary rate in Belleville, Kansas has always been very close to 1 robbery per 400 homes. But last year it ballooned up to 3.9 per 400. However, the Chief of Police quickly hired three additional policemen, and this year the burglary rate is back down to where it had been before last year's increase. So, hiring more police is a good way to lower the burglary rate.

2. Children doing below average work in school who suddenly do well on an achievement test are often labeled underachievers. Sometimes they are, but what else might be going on?

3. Phil often find that he is disappointed when he returns to a restaurant that seemed outstanding on the first visit. He's often tempted to conclude that the chefs got lazy over time or that the management quit working as hard as they had at the beginning. What do you think about his reasoning? What other explanations might there be for this result?

4. Wilbur reasons in the following way: If a method of contraception has a 6% failure rate, then we should expect the same probability of getting pregnant in 1 year of use as we would in 10 years of use. The chances are that 6% of the people using it will create a pregnancy.

5. If a student gets the highest grade in her class on the first examination in Critical Reasoning, what grade would you predict that she will get on the midterm? Justify your answer.

6. Most of you had to take the ACT or the SAT test; if you apply to graduate school you will have to take the GRE, and if you apply to Law School

you will have to take the LSAT. These exams involve multiple choice questions. To discourage random guessing, many tests of this sort subtract points for wrong answers. Suppose that a correct answer is worth +1 point and that an incorrect answer on a question with 5 listed answers (a through e) is worth -1/4 point.

1. Find the expected value of a random guess.

2. Find the expected value of eliminating one answer and guessing between the remaining 4 possible answers.

3. Using your answers to (a) and (b), when would it be advisable to guess and why?

7. Suppose that you take a multiple-choice exam consisting of ten questions. Each question has four possible answers. The topic is one you know nothing about, and you are reduced to guessing. What is the probability that you will guess right on the first question? What is the probability that all ten of your guesses will be right (you know nothing about the subject matter, so you guess at random and so you can assume independence)? If one million people took the exam, how good are the chances that at least one person would get all the answers right simply by random guessing (don't worry about assigning a number to this, but be as precise as you can, and justify your answer).

8. From a lecture on fire safety in the home: "One in ten Americans will experience some type of destructive fire this year. Now, I know that some of you can say that you have lived in your home for 25 years and never had any type of fire. To that, I would respond that you have been lucky…. But that only means that you are not moving farther away from a fire, but closer to one." Evaluate the reasoning in this passage.

9. Diego makes an average of 35% of his basketball shots. After playing in a pick-up game in which he misses all six of the shots he takes, he argues that in the next game he will be hot because, having missed six already, he has the odds in his favor. Evaluate Diego's reasoning.

10. Suppose that you built a computer that had 500 independent parts. And suppose that each part was 99% reliable when used the very first time. What are the chances that such a computer would work the very first time it was turned on?

11. In the previous chapter, we noted Laurie Anderson's quip: "The chances of there being two bombs on a plane are very small. So, when I fly, I always take along a bomb." We are now in a better position to analyze the bad reasoning involved. Do so.

Answers to Selected Exercises

11. "The chances of there being two bombs on a plane are very small, So, when I fly I always take along a bomb." Assuming I am not in league with any terrorists, whether I bring a bomb has no effect on whether someone else also brings a bomb along on the flight. The two events are independent. But the joke treats them as though they were dependent (my bringing a bomb makes it less likely that others will). Hence it involves a subtle instance of the gambler's fallacy.

Part VII

Systematic Biases and Distortions in Reasoning

Part VII. Systematic Biases and Distortions in Reasoning

In this part, we will examine several common errors and biases in our everyday reasoning.

In Chapter 17, we will see how we often rely on rough-and-ready strategies called *heuristics* in our reasoning. In many cases, heuristics allow us to draw reliable inferences quickly. But if we rely on them too heavily, or in the wrong situations, they can lead to bad reasoning.

In Chapter 18, we will study several further biases in our thinking.

In Chapter 19, we will study peoples' perceptions of their own inconsistencies, and the ways these perceptions influence their attitudes, action, and thought.

Chapter 17

Heuristics and Biases

Overview: We often rely on rough-and-ready strategies called *heuristics* in our reasoning. In many cases these heuristics allow us to draw reliable inferences quickly. But if we rely on them too heavily, or in the wrong situations, they lead to bad reasoning. In this chapter, we will study several inferential heuristics, examine the ways they promote faulty reasoning, and devise safeguards against such errors.

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17.1 Inferential Heuristics

Human beings have many limitations. We have limited memories, attention spans, and computational abilities. We also have better things to do than to spend our time trying to reason precisely about everything that we ever think about. So, we use shortcuts. These shortcuts are called inferential (or judgmental) heuristics.

An inferential (or judgmental) **heuristic** is a general strategy that we use for drawing inferences. It is a rough-and-ready device, a cognitive shortcut, a rule of thumb for reasoning. We use inferential heuristics frequently, usually without being aware of it. Heuristics are usefully contrasted with definite and specific rules for reasoning (like our earlier rules for calculating probabilities).

Like many of the cognitive mechanisms studied in earlier chapters, inferential heuristics are often quite useful. They allow us to draw rapid inferences without having to gather data or compute probabilities. This is valuable, because we rarely have the time, energy, know-how, or interest to go to such trouble. Indeed, to survive, organisms must be able to process information and draw conclusions quickly, and handy, habitual rules of thumb—heuristics—are often better suited for this than more reliable, but time-consuming, rules for reasoning. The drawback is that overreliance on inferential heuristics can lead to serious biases or errors in reasoning.

17.1.1 Sampling Revisited

Remember how inferences from samples to populations work. When we infer a conclusion about a population from a description of a sample from it:

1. The *premises* are claims about the sample.

2. The *conclusion* is a claim about the population.

Good sample:
1. big enough
2. representative

For example, we might draw a conclusion about the average income of Oklahomans based on the results of a sample of 2,000 Oklahomans.

Our conclusion involves an inductive leap. It goes beyond the information in its premises, because it contains information about the *entire population*, while the premises only contain information about the *sample*. But if we satisfy two conditions involving the sample, our inference can still be inductively strong. We must have:

1. A large enough sample.

2. A representative (unbiased) sample.

An unbiased sample is typical of the population. By contrast, in a biased sample, some portions of the population are overrepresented and others are underrepresented. The problem with a very small sample is that it unlikely to be representative. Other things being equal, a bigger sample will be more representative. But there are costs to gathering information, costs in time, dollars, and energy, so it is rarely feasible or desirable to get samples that are huge.

17.2 The Availability Heuristic

- Do more people in the U.S. die from murder or suicide?
- Are there more English words that begin with the letter ‘r’ or words that have ‘r’ as their third letter?
- Are there more famous people from Oklahoma, or from Kansas (a state with roughly the same population)?

Many of our inferences lead to conclusions about the relative frequency or proportion of some feature in a population. Are there more *B*s than *C*s; e.g., are there more Jeeps (*B*s) or Fords (*C*s)? Is an *A* more likely to be a *B* or a *C*; e.g., is an OU student (an *A*) more likely to be male (*B*) or female (*C*)? Since we can rarely check the entire population, we must base our inference on a sample. In everyday life, we rarely have the time or resources to gather a sample in the way scientists do, so we often “do the sampling in our heads.” We try to remember cases that we know about, or to imagine cases that seem relevant.

Suppose that you want to know whether there are more Fords or Jeeps in use today. You will probably rely on the sample of vehicles you can recall. You try to think about the various makes of vehicles you have observed. Obviously, this method is somewhat vague and impressionistic, since you probably don’t remember more than a handful of specific Fords (like Wilbur’s Fiesta) or Jeeps (like Aunt Ethel’s). But at least you do know that you have seen a lot more Fords than Jeeps. You have a generalized memory about this, even though you don’t recall many specific vehicles of either kind.

In many cases, including this one, this method works. You remember seeing a lot of Fords, and you remember that you haven’t seen many Jeeps. The reason why you remember more Fords is that there are more Fords. Fords are easily available to recall largely because there are so many of them. Fords are more **available** in your memory precisely because you have seen a lot more Fords.

Availability heuristic: basing judgments of frequency on ease with which examples can be recalled

When we need to judge the relative frequency or probability of something, we are often influenced by the **availability** or accessibility of those kinds of things in thought. The “sample in our heads” consists of the cases we remember and, to some extent, the cases we can easily imagine. We use the **availability heuristic** when we base our estimates of frequencies or probabilities on those cases that most readily come to mind, on those that are most available in memory and imagination. This heuristic inclines us to assume that things that are easier to remember or imagine are more likely to occur.

17.2.1 Why Things Are Available

Often, we remember certain things because they really do occur frequently, and when this is the case the available sample in our head will often be a good one (or at least good enough for the rough-and-ready inferences of everyday life). When availability is highly correlated with objective frequencies or probabilities, as it often is, it is a useful guide. Are there more words beginning with the letter ‘r’ or with the letter ‘z’? Words beginning with ‘r’ are more available than those beginning with ‘z’ precisely because they are much more common. Here the heuristic works very well, leading us to the correct conclusion.

But the *judged frequency* and the *true frequency* of something may be very different. Things may be available in memory or imagination for reasons having little to do with their frequency or probability. In these cases, the availability heuristic leads us to rely on a small sample (the cases we easily remember) and one that may be biased in various ways (the cases we happen to have encountered and manage to recall). For example, things we are familiar with will be available. And since memory generally becomes less vivid and accessible over time, more recent experiences and events are more likely to be available than those that occurred longer ago.

We begin this section by asking whether there are more English words that begin with the letter ‘r’ or words that have ‘r’ as their third letter. Many of us think (at least when we aren’t primed to think there is a trick involved) that more words begin with ‘r’, though in fact this is false. So why do we think this? But it is much easier to think of, to generate, letters that begin with ‘r’ than to think of words in which ‘r’ comes third. Words beginning with ‘r’ are more available to our minds, and this greater availability leads many of us to infer that more words begin with ‘r’.

Examples of Availability

Around 1 in 30 million Americans are killed by terrorists in a year; significantly more – around 12 in 10,000 – are killed in automobile accidents. But the cases where Americans *are* killed by terrorists are likely to make the news, and for obvious reasons, they stand out in memory. Now suppose we are asked to estimate the number of people killed by terrorists. The sample that is readily available, the one that comes naturally to mind, can easily lead us to overestimate the threat of terrorism today. People also overestimate the rate of homicides and other stories that make the news. This is one reason why most of us suppose that there are more murders than suicides, though statistics show that there are many more suicides than murders. By contrast, the frequency of things that are not so well-publicized, like death from diabetes, is usually radically underestimated.

On the other hand, unless we know of several people who have been killed in accidents, examples of such deaths may not be so salient in memory. Such deaths are common enough that they aren't likely to be reported by the media unless the person killed is well-known. Examples of such deaths are not particularly available, so we may radically underestimate their frequency. To take a related example, fires make the news more often than drownings, and they may be more dramatic in various ways. So, it is not surprising that many people think that death by fire is more likely than drowning, even though the reverse is the case. The good news here is that we may underestimate the amount of helping and kindness there is, since such reports rarely make the news.

Things that occur reasonably often (e.g., fatal automobile accidents) are rarely reported and are easily forgotten, whereas events that are rare but dramatic (e.g., terrorism) make for good news, and stand out in memory. In such cases, frequency is not closely related to availability in memory, and the use of the availability heuristic will lead us astray. For example, 100 times as many people die from disease as are victims of homicide, but newspapers carry three times as many articles about murders.

Media Effects

Here are some further examples. The media and advertisers often tell us about people who strike it rich by winning a state lottery. This can make such cases more available to us in thought, leading us to overestimate the probability of winning a lottery (we all know the probability of winning is low, but it is *much* lower than many people suppose). Again, many more people die of diabetes each year than in accidents involving fireworks. The latter get more press, however, and many people think more deaths really are caused by such accidents.

Partly because they are reported and partly because of the success of the movie *Jaws*, shark attacks seem vivid, easy to imagine, and easy to remember. In fact, they are extremely rare, and you are much more likely to be killed in many other (less dramatic) ways. This is a fine opportunity to put to work the research skills you learned in past chapters. How common are shark attacks? How often are those fatal? Compare those results to human deaths caused by a much more mundane animal, like a pig or a horse.

Surprising Events are Memorable

There are many other cases in which unlikely events may be particularly available. A few people are very likely to recover from an illness that is fatal to most people who contract it. Since the tiny minority who recover will probably be under some sort of treatment (call it treatment X), and since miracle recoveries make for good news, we may hear about the miracle cure due to treatment X. This will be available to memory, and so we overestimate the probability that X can be effective in curing the disease.

Indeed, in all but the most extreme conditions, *almost any* miracle cure or quick fix (for losing weight, kicking cigarettes, quitting gambling, etc.) will seem to work for some people (perhaps because of a placebo effect, perhaps thorough sheer coincidence). In such cases, we may hear an endorsement, perhaps in an infomercial, from people who sincerely believe that they have benefited from the treatment. Such testimony can be very compelling, and it is often easily available in memory. In such cases, the availability heuristic can lead us to spend a lot of money on quick fixes that don't fix anything at all (except the financial condition of the person selling them).

Salience

One or two examples may be so vivid or salient that they lead us to discount much better evidence. Cases "close to home" can be especially compelling. Your Aunt Ethel had a Toyota Prius that was a real piece of junk (though 'junk' wasn't exactly the word she used). This single case is likely to loom very large in your memory. Then you learn that some consumer group you trust (e.g., *Consumer Reports*) did a survey of thousands of car owners and found the Prius to be more reliable than most other makes. If you are like most people, the one case close to home will stand out more (be more salient); it will be more memorable. Hence, it will have a much great influence on what you buy than the careful and detailed study by the consumer group.

Our Everyday Samples are Often Biased

Many of the samples we encounter as we go about our lives are biased. Our age, gender, race, job, friends, interests, and where we live all mean that we will be exposed more to some things than others. If you live in Boston, Massachusetts you will be exposed to a different range of things than if you live in Belleville, Kansas. In many cases this is obvious, and it's relatively easy to discount for it. You realize that it's not safe to predict the general public's tastes in music based on the musical tastes of the people you know; they don't provide a representative sample. But in other cases, the biased nature of the samples we normally encounter may be less obvious. It can be tempting, for example, to form beliefs about the general public's political views on various issues based on the views we hear expressed most often. But these may not be representative of people's views in general.

Problems with Availability

In earlier chapters, we encountered several phenomena which suggest that the availability of things in memory is not always a good guide to how things really are. Perceptual set will incline us to notice certain things while overlooking others, thus, influencing what makes it into memory in the first place. Then elaboration in memory can affect what we remember, as can the context in which we remember it. Further biases may enter because of primacy, recency, or halo effects. In short, the sample in our heads is often based on limited experience, and it can then be further distorted in a variety of ways.

Prejudices and stereotypes are an especially insidious example of this. If you have a negative stereotype of members of a certain group, you are likely to notice some things (e.g., cases where a member of the group fails) than others (e.g., cases where a member succeeds). You will also be more likely to remember such cases and find it easier to imagine them. When you then must predict how typical members of that group will do, the negative cases will be more available than the positive ones, and you are likely to conclude that they will probably do poorly. We will return to this topic in a later chapter.

We can't abandon the availability heuristic. It is deeply ingrained in the way we reason, and it often works very well. But we need to be aware of the ways it can lead to fallacious reasoning. We need to realize that the samples in our heads (and in the heads of others, often even those in the heads of experts) are biased in one way or another.

17.3 The Representativeness Heuristic

Mike is 6'2", weighs over 200 lbs., (most of it muscle), lettered in two sports in college, and is highly aggressive. Which is more likely?

1. Mike is a pro football player.

2. Mike works in a bank.

Here, we are given several details about Mike; the profile includes his size, build, record as an athlete, and aggressiveness. We are then asked about the *relative frequency* of people with this profile that are pro football players, compared to those with the profile who are bankers.

What was your answer? There are almost certainly more bankers who fit the profile for the simple reason that there are so many more bankers than professional football players. We will return to this matter later in this chapter; the relevant point here is that Mike *seems* a lot more like our picture of a typical pro football player than like our typical picture of a banker. And this can lead us to conclude that he is more likely to be a pro football player.

Many of us made just this sort of error with Linda. Linda, you may recall, is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and she participated in antinuclear demonstrations. Based on this description, you were asked whether it is more likely that Linda is (i) a bank teller or (ii) a bank teller who is active in the feminist movement. Although the former is more likely, many people commit the conjunction fallacy and conclude that the latter is more probable.

Representativeness heuristic: claiming something must be a member of category given how typical of the category it seems to be

What could lead to this mistake? Various factors probably play some role, but a major part of the story seems to be this. The description of Linda fits our profile (or stereotype) of someone active in today's feminist movement. Linda strongly resembles (what we think of as) a *typical* or *representative* member of the movement. And because she resembles the typical or representative feminist, we think that she is very likely to be a feminist. Indeed, we may think this is so likely that we commit the conjunction fallacy.

We use the **representativeness heuristic** when we conclude that the more like a representative or typical member of a category something is, the more likely it is to be a member of that category. Put in slightly different words, the likelihood that x is an A depends on the degree to which x resembles your typical A. We reason like this: x seems a lot like your typical A; therefore, x probably is an A.

Sometimes this pattern of inference works, but it can also lead to very bad reasoning. For example, Linda resembles your typical feminist (or at least a *stereotype* of a typical feminist), so many of us conclude that she is likely to be a feminist. Mike resembles our picture of a pro football player, so many of us conclude that he probably is one. The cases differ because with Linda we go on to make a judgment about the probability of a conjunction, but with both Linda and Mike, we are misusing the representativeness heuristic.

Overreliance on the representativeness heuristic may be one of the reasons why we are tempted to commit the gambler's fallacy. You may believe that the outcomes of flips of a given coin are random; the outcomes of later flips aren't influenced by those of earlier flips. Then you are asked whether sequence HTHHTHTT is more likely than HHHHTTTT. The first sequence may seem much more like our conception of a typical random outcome (one without any clear pattern), and so, we conclude that it is more likely. Here the representative heuristic leads us to judge things that strike us as representative or normal to be more likely than things that seem unusual.

17.3.1 Specificity Revisited

We have seen that the more detailed and specific a description of something is, the less likely that thing is to occur. The probability of a quarter's landing heads is 1/2, the probability of its landing heads with Washington looking north is considerably less. But as a description becomes more specific, the thing described often becomes more concrete and easier to picture, and the added detail can make something seem more like our picture of a typical member of a given group.

Higher specificity means
Lower probability

In Linda's case, we add the claim that she is active in the feminist movement to the simple claim that she is a bank teller. The resulting profile resembles our conception of a typical feminist activist, and this can lead us to assume that she probably is a feminist activist. This may make it seem likely that she is a feminist activist. And this in turn makes it seem more likely that she is a bank teller *and* a feminist activist than that she is just a bank teller. But the very detail we add makes our claim, the conjunction, less probable than the simple claim that Linda is a bank teller.

In short, if someone fits our profile (which may be just a crude stereotype) of the average, typical, or representative kidnapper, scrap-booker, or computer nerd, we are likely to weigh this fact more heavily than we should in estimating the probability that they are a kidnapper, scrap-booker, or computer nerd. This is fallacious, because in many cases there will be many people who fit the relevant profile who are not members of the group.

17.4 Base-Rates

A group of men in Belleville, Kansas consists of 70 engineers and 30 lawyers. Suppose that we select Dick at random from the group. The following is true of Dick:

> Marcos is a 30-year-old man, married, no children. He has high ability and high motivation and promises to be quite successful in his field. He is well liked by his colleagues.

Based on this: Is Marcos is more likely to be an engineer, a lawyer, or are these equally likely? What's relevant to deciding?

Researchers Kahneman and Tversky told subjects that they were dealing with a pool of a hundred people, 70 of whom were engineers and 30 of whom were lawyers. If they were simply asked to estimate the likelihood that some person, Marcos, selected at random from this group was an engineer, most said 70%. Another group was given the above description of Marcos. The important thing about this description is that it is an equally accurate description of a lawyer or an engineer (and most subjects in pretests thought so).

The information in the description could be of no help in estimating whether someone is a lawyer or engineer, so we should ignore it and (in the absence of any other relevant information) simply go by the base rates. This means that we should conclude that the probability that Marcos is a lawyer is .7. In the absence of the irrelevant description, people did just this. But when they were given the irrelevant description, they concluded that the probability that Marcos was a lawyer was .5 (fifty/fifty). The *irrelevant* information led them to disregard base rates; they simply threw away information that is clearly relevant.

This is an instance of the so-called **dilution effect**, the capacity of irrelevant information to dilute or weaken relevant information. Sometimes relevant information is called diagnostic, because it can help us make accurate predictions or diagnoses, and irrelevant information is said to be non-diagnostic. Using these terms, the dilution effect is the tendency for *non-diagnostic* information (like the description of Marcos) to dilute diagnostic information (like the percentage of engineers vs. that of lawyers).

Dilution effect: tendency for irrelevant (nondiagnostic) information to dilute or weaken relevant (diagnostic) information

In this case, the base rate of engineers is 70% and the base rate of lawyers is 30%. This information is highly relevant to the questions here. But descriptive information of marginal relevance can lead us to completely ignore highly relevant information about base rates. Remember Mike (7.3), the six two, muscular, aggressive college athlete? Why is it more likely that Mike is a banker than a pro football player? Because there are many more bankers than pro football players. The *base rate* for bankers is higher.

The **base rate** for a characteristic (like being a banker, or being killed by a pig) is the frequency or proportion of things in the general population which have that characteristic. It is sometimes called the initial or prior probability of that trait. For example, if one out of every twelve hundred people are bankers, the base rate for bankers is 1/1,200. Often, we don't know the exact base rate for something, but we still know that the base rate for one group is higher, or lower, than the base rate for another. We don't know the base rate for farmers or for chimney sweeps in the United States, but there are clearly far more of the former than the latter.

When we acquire information about someone or something (like our description of Mike) we need to *integrate* it with the old, prior information about base rates (many more people are bankers than pro football players). In the next section, we will see that in many cases this can be done quite precisely. But the important point now is that although both pieces of information are important, in cases where the size of the relevant group (or the difference in size between two relevant groups, e.g., bankers and pro football players) is large, the old, base-rate information can be much more important. Unfortunately, we often let the new information completely overshadow the prior information about base rates.

The **base-rate fallacy** occurs when we neglect base-rates in forming our judgments about the probabilities of things. We commit this fallacy if we judge it more likely that Mike is a pro football player than a banker (thus ignoring the fact that there are far more bankers than pro football players). Overreliance on the representativeness heuristic often leads us to underestimate the importance of base rate information. In the present case, Mike resembles our picture of the typical pro football player, so we forget what we know about base rates and conclude that he probably is one.

Base rate fallacy: ignoring or underutilizing base rates when estimating probabilities and making predictions

Pigs vs. Sharks

We conclude this section with a quick examination of your chances of being killed by a shark and a pig, discussed earlier. The implication of the passage was that live pigs, not infected pork that people eat, kill substantially more people than sharks do. The only way to know for sure whether this is true is to check the statistics (if anyone keeps statistics on death by pig). That said, it seems probable that you are more likely to die from a pig than a shark, because the base rate for contact with pigs is much higher than the base rate for contact with sharks. (Of course, individual risks may vary. If you're a shark hunter, who comes into contacts with sharks far more often than you do pigs, your individual risk of death by shark would be higher). Most contacts are uneventful, but once in every several thousand, or hundred thousand, contacts commonsense tells us that something will go wrong. So, you probably are more likely to be killed by a pig, and it is much more likely that you will be injured by one. But a movie named *Snout* just wouldn't have the cachet of a movie named *Jaws*.

Confusions about Inverse Probabilities

We know that a conditional probability like Pr(red| heart) may be quite different from its inverse, here Pr(heart|red). The first probability is 1 whereas the second is 1/2. But in many cases, it is easy to confuse a probability and its inverse. It is true that the probability of someone fitting Mike's profile if they are a professional football player is reasonably high. By contrast, the probability of being a professional football player if they fit the profile is low (because the base rate of pro footballers is low, lower than the base rate of non-pros who fit the profile). Here it is easy to confuse a probability with its inverse. We will return to this problem in more detail in a later chapter.

Safeguards

1. Don't be misled by highly detailed descriptions, profiles, or scenarios. The specificity makes them easier to imagine, but it also makes them less likely.

2. Use base-rate information whenever possible. You often do not need any precise knowledge of base rates. Just knowing that there are a lot more of one sort of thing (e.g., bankers) than another (e.g., professional football players) is often enough.

3. Be careful to distinguish conditional probabilities from their inverses.

17.5 Anchoring and Adjustment

- Estimate the percentage of African countries in the United Nations (how much is it above, or below, 10%)?

The average response here is about 25% (the correct answer is 35%). But if you ask another group of people to:

- Estimate the percentage of African countries in the United Nations (how much is it above, or below, 65%)?

the average response is about 45%. Why?

We often fail to adjust enough to reference points or anchors.

In the first case, most people think that 10% is too low, but they still begin with that figure and adjust up (to 25%) from it. In the second case people feel that 65% is too high, but they still begin with that figure and adjust downward (to 45%) from it. In each case their original starting point—10% or 65%—provides a reference point or *anchor*. We begin with this anchor and adjust up or down, but frequently we don't adjust enough. When we don't, the anchor has a strong effect on the judgment that they make. An anchoring and adjustment bias occurs when we don't adjust (up or down) enough from an original starting value or "anchor".

The anchor we use might be determined by the wording of questions or instructions, as it was above. But in different cases there will be different natural anchors that we'll tend to use.

Estimate, within 5 seconds, the product of:

8 x 7 x 6 x 5 x 4 x 3 x 2 x 1.

In experiments, the median response is about 2,250. But if you instead ask people to quickly estimate the product of:

1 x 2 x 3 x 4 x 5 x 6 x 7 x 8,

the median response is about 512. It appears that people perform just a few of the multiplications, *anchor* on the result, and *adjust* upward from there. In the first case the product of the first two or three digits is larger, so we adjust upward from a larger anchor and arrive at a larger number than we do in the second case. In this case, neither anchor leads to a very accurate answer (the correct answer is 40,320).

17.5.1 Anchoring Effects can be Very Strong

Anchoring effects can occur even when anchoring values are known to be entirely arbitrary, when they are ridiculously extreme, and when people are paid money for making correct estimates and predictions.

In the study that used our first example (involving the percentage of African nations in the United Nations), the anchor values were set by having each subject spin a wheel much like the one on *Wheel of Fortune* (it was rigged to stop at either 10% or 65%). So, 10% or 65% served as anchors for the subjects, even though they believed these numbers were completely arbitrary. But these anchors still had a strong impact on their estimates (in the 10% group the estimate was 25% and in the 65% group it was 45%).

Anchoring effects also occur when anchoring values are outlandishly high or low. When a group of psychologists asked subjects to estimate the number of Beatles records that made the Top Ten after first asking them if the number was less than 100,025, they found that this ridiculously high number served as an anchor and led subjects to give a high estimate (though not, of course, one anywhere near as high as the anchor itself). Even when people are offered money for doing well, they remain susceptible to anchoring biases, and even the predictions of many expert forecasters will be influenced by arbitrary anchor values.

17.5.2 Anchoring and Adjustment in the Real World

In many cases, the current situation—the way things presently are, the status quo—provides an anchor. In other cases, first impressions provide an anchor. This may help explain the strength of the primacy effect. And some people think that anchoring helps explain hindsight bias (the tendency after the fact to think that we knew it all along). In hindsight, we are anchored to what we know about how things turned out, and it’s hard to think back and accurately reconstruct how we thoughts about things before we learned what the outcome was.

We can fall prey to an anchoring bias any time examples or numbers are used to provide a frame of reference ("Estimate the number of people who live in Oklahoma; for example, is it between three million and four million?"). Often this happens without anyone intending to bias our judgments.

But whenever people are susceptible to a bias, there will be people who have learned to exploit that susceptibility. For example, experienced negotiators or people collecting for charities will often begin with extreme demands or requests in hopes of setting extreme anchors. Everyone knows that adjustments will be made in the direction of less extreme demands, but the more extreme the anchor, the greater its capacity to lead to an outcome closer to the one the negotiator wants. Similar points apply when two people are haggling over a price. Other people in the persuasion professions, e.g., auctioneers and advertisers, can also exploit our susceptibility to anchoring effects by staking out extreme positions.

17.5.3 Safeguards

The most difficult thing is realizing that we are being influenced by an anchor at all. So, the first step is to get in the habit of thinking about predictions and negotiations in terms of anchoring and adjustment. Once we do, we can look out for anchor values that seem too high or too low. We can also escape the power of anchors to color our thinking by considering several rather different anchor values. And if someone proposes an extreme anchor, counter with another anchor at the opposite extreme.

17.6 Chapter Exercises

1. Linda is thirty-two years old, outspoken, single, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and she has also participated in antinuclear demonstrations. Rank the probabilities of each of the following:

    1. Linda is a bank teller.
    2. Linda is either a bank teller *or* a leader in the feminist movement.
    3. Linda is a bank teller *and* a leader in the feminist movement.
    4. Linda is a bank teller, a leader in the feminist movement, and she plays the guitar.

2. Suppose that you don't know anything about Sue except that she is a woman. Rank the following from most probable to least probable:

1. Isabella is a student.

2. Isabella is a student who wants someday to be the first astronaut from Rhode Island.

3. Isabella is either a student or a professor of English.

4. Isabella is either a student or she isn't.

3. Couples often disagree, even argue, about who has been doing more than their share of the housework lately. Often, each person quite honestly and sincerely thinks that they have done more than the other. This could happen without any self-deception or wishful thinking on the part of either person. How might some of the things we have learned in this chapter help explain it?

4. It is sometimes said that when people give us estimates for repairing our car or our home they are likely to start out by giving us a high estimate, since many people just accept the recommendations. Assuming this is true, imagine a person you know gets a very high estimate of the cost of a new roof, but decides to spend less than recommendation but a good deal more than they had originally planned. Which heuristic may have been involved here, and how did it work?

5. In the pretest, you were asked which alternative seems more likely in the next ten years:

   1. An all-out nuclear war?

   2. An all-out nuclear war that accidently develops out of a confrontation in the Middle East involving Iraq or Iran and some of their neighbors and that then spreads out of the region to other countries? Which answer is right? Why? Which heuristic might aid and abet giving the wrong answer?

6. Do you think that there are more famous people from Oklahoma or from Kansas (a state of roughly the same size)? Don't proceed until you have thought about this question. How do you think people from Kansas would answer this question? What heuristics might be involved here?

7. Wilbur wants to buy a new car. He goes to the bookstore to get a mochaccino and the latest issue of *Consumer Reports*, which contains their most recent safety survey of large-sized sedans. The Chevrolet Impala has the highest safety rating, and Wilbur notes this. His next stop is to see his hairstylist, Wilma. Hearing that Wilbur is interested in

buying an Impala, Wilma shrieks, “Those cars are dangerous! Total death traps. My client Suzy totaled hers when she ran into a utility pole going fifteen miles per hour!” So, Wilbur buys a Honda instead. Why? What should Wilbur have done? What is the relevant heuristic or reasoning fallacy? How would you evaluate the credibility of his two sources of information?

8. We know the following about Wilma: She is 23 years old, athletic, and has taken various forms of dance for 18 years. Is she more likely to be a Dallas Cowboys cheerleader or a sales clerk for Dillard’s? Defend your answer and relate it explicitly to concepts and material studied in this chapter.

9. Which hand is more probable?

    1. Ace of spades, king of spades, queen of spades, jack of spades, ten of spades.

    2. Three of hearts, eight of diamonds, jack of spades, two of spades, nine of clubs. Many people judge the first more likely. How might overreliance on one or more inferential heuristics lead to this error?

10. Wilbur is very shy and withdrawn, helpful, but with little interest in people or in the world of reality. He has a need for order and structure, and a passion for detail. Which is more likely and why: that Wilbur is a farmer or that he is a librarian? If you require more information to answer this question, what information do you need? How could you get it?

11. Suppose that we polled people and found the following (this example is hypothetical). The people polled were asked to estimate the percentage of American adults who were unemployed. Those who were employed underestimated the number, and those were unemployed overestimated it.

12. In experiments, subjects consistently err in judging the relative frequency of two kinds of English words. They estimate that the number of words beginning with a certain letter (for example ‘R’ or ‘K’) is greater than the number of words with those letters appearing third, even in the case of letters where words with the letter in third position are far more numerous than words in which the letter comes first. Explain what might lead subjects to this conclusion.

13. Most automobile accidents occur close to home. Why do you suppose this is true? Should you feel safer as you drive further from home?

14. Airlines sometimes post "full" fares prices that are higher than the fares they typically charge, and automobile dealers often post suggested retail prices on the window sticker that are higher than they will really charge. What is going on here? How effective do you think it is? What would be some good ways to resist these tactics?

15. In December of 1989, Norman, Oklahoma residents were warned about house fires. "On the average, we have two to three house fires with the Christmas season," said Fire Marshal Larry Gardner, "and we haven't had one yet." Gardner appeared to be arguing that since we hadn't had a severe house fire yet, we were very likely to have one soon. Assuming this was his intention, what fallacy was he committing?

16. Earlier, we learned about illusory correlations. Explain what an illusory correlation is, and say how the availability heuristic might encourage us to believe in certain illusory correlations. Give an example to illustrate your points.

Answers to Selected Exercises

9. The two hands are equally probable, but overreliance on the representativeness heuristic may lead us to think that the second hand is more likely, because it more closely resembles our mental picture of a random hand of cards.

11. In our example we imagined that some people were polled and asked to estimate the percentage of American adults who were unemployed. Those who were employed underestimated the number, and those were unemployed overestimated it. Why? One reason is that unemployed people are more likely to live in areas and to go to places where there are other unemployed people, and of course their own situation is highly salient to them. By contrast, people who are employed tend to interact mostly with others who are employed too. Different samples were available to the people in the two groups.

Chapter 18:

More Biases, Pitfalls, and Traps

Overview: In this chapter, we study several more biases and tendencies to flawed thinking and consider ways to avoid them.

Contents

18.1 Framing Effects

18.1.1 Different Presentations of Alternatives

Which of the following two alternatives do you prefer?

- *Alternative A*: A 100% chance of losing $50.

- *Alternative B*: A 25% chance of losing $200, and a 75% chance of losing nothing.

And which of A* and B* do you prefer?

- *Alternative A**: An insurance policy with a $50 premium that protects you against losing $200.

- *Alternative B**: A 25% chance of losing $200, and a 75% chance of losing nothing.

Most people prefer option B over A. And most prefer A* over B*.

But what is the objective difference between the two pairs of alternatives? The money comes out just the same with each pair. The only difference is that with the second pair of alternatives the loss is *described as insurance*. Whether we prefer risk or not is influenced by the way the risk and its alternative are described.

Before asking why this might be so, let's consider two more sets of alternatives. Imagine that the U.S. is preparing for the outbreak of a rare disease that is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

- *Program C*: if C is adopted, 200 people will be saved.

- *Program D*: if D is adopted there is a 13% probability that 600 people will be saved, and a 23% probability that no people will be saved.

And which of the following two would you prefer?

- *Program C**: if C* is adopted, 400 people will die.

- *Program D**: if D* is adopted, there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die.

Most people prefer Program C to Program D. But most people (who have not seen the choices between C and D) prefer D* to C*.

Is this a problem? Yes, because the two pairs of alternatives are the same; they are exactly equivalent in terms of how many people live and how many people die. As before, the only difference is in how the alternatives are described.

Framing Effects

These differences in wording are said to **frame** the issue in different ways. When we frame a choice in terms of a certain loss, we think about it differently than we would if we frame it in terms of insurance. When we frame a choice in terms of people being saved from death, we think about it differently than we would if we frame it in terms of people dying. A small change in wording can have a big impact on our judgments.

Framing effects occur when the way we word or conceptualize alternatives influences which alternative people prefer. Such effects are often quite difficult to avoid; indeed, many people retain the choices they originally made in the above problems, even after the contradiction is pointed out to them and even after they acknowledge it.

18.1.2 Losses vs. Gains

In general, when probabilities of options are judged to be moderate to high, people are *risk averse* when it comes to potential gains. Being **risk averse** means that we avoid risky situations. We prefer a certain gain (say of $10) to a 50/50 chance of getting $20 (even though these alternatives have the same expected value). In fact, many people prefer a certain gain (say of $10) to a 50/50 chance of getting $25 or even more.

By contrast, when probabilities are judged to be moderate to high, people tend to be **risk seekers** when it comes to losses. Most of us prefer the risk of a large loss to a certain loss that is smaller. In our first example, most people prefer B (a 25% chance of losing $200, and a 75% chance of losing nothing) to A (a 100% chance of losing $50). How we think about risks often depends on how the situations are framed. More specifically, it depends on whether they are framed *as gains* (200 people are saved) or *as losses* (400 people die).

Whether we code events as loses or gains strongly influences how we think about them. Our examples so far have been artificial, but framing effects occur in the real world. For example, when several gas stations on the East Coast wanted to charge people more for using a credit card (because this entailed more expense for the gas station), their credit-card-using customers strongly objected to this “credit card surcharge”. The charge was framed as a penalty or a loss. But when the gas stations *reframed* the policy as a discount for using cash—which amounted to exactly the same thing in terms of the overall cost—customers were more willing to accept it.

The study involving the fictitious disease provides an example of a *preference reversal*. It was theorized that it occurred because the first description of the two options presents or *frame* things in terms of a gain (saving lives) in relationship to the reference point (600 are expected to die), so that people are risk averse. But the second pair of descriptions frames the same options in a way that places the reference point at the status quo; here the options involve a loss (people dying), and so respondents are now willing to select what sounds like the riskier alternative. They reverse their preferences, even though their options stay just the same.

In a more realistic study, McNeil and his colleagues gave several hundred radiologists given descriptions of two treatments – surgery and radiation therapy – for lung cancer. In half the cases, the description was framed in terms of the cumulative probability of living longer than a given time frame. In the other half of the cases, it was framed in terms of the probability of dying within that span (e.g., 85% chance of living longer than five years, and 15% chance of dying within the next five years).

Surgery was preferred to radiation therapy 75% of time when it was put in terms of surviving, but only 58% of the time when it was put in terms of mortality (the major downside of surgery is dying soon afterwards, and the dying frame may have emphasized that). Choices depended on whether the treatments were framed in terms of gains (people saved) or losses (deaths).

Lobbyists, trial lawyers, spin doctors, and public relations people are often quite skilled at framing issues in the way that is most favorable to their position. Unless we have strong feelings about the issue we often don't notice this, but when you are listening to such people it is always wise to ask yourself how the points they are making might be reframed.

Preference Reversals and Elicitation

Some preference reversals (like that involving the disease) involve framing effects. In other cases, options are framed in the same way, but people's evaluations are *elicited* in different ways. For example, if subjects are offered one of two options and asked to *choose* one of the pair, they tend to focus on the positive features of the two things. But when they are asked to *reject* one of the two (which leads to the same result, namely getting one of the two things), they focus more on negative features (which is thought to be more compatible with the instruction to reject).

In a range of cases, responses seem tailored to be compatible with the statement of the problem or task, and this can lead to preference reversals. In such cases, seemingly trivial differences in how we get people to express their preferences can lead them to reverse their preferences. But few of us want our preferences to depend on trivial differences between ways of eliciting them.

18.1.3 Loss Aversion

Most people feel a particular aversion to loss. This *loss aversion* means that losses loom larger than corresponding gains. A loss of $100 is more painful than the pleasure derived from a gain of $100. Loss aversion at least partially explains two important phenomena: the *status quo bias* and the *endowment effect*.

Loss aversion: a loss of a given size seems bigger than a gain of the same size

Status quo bias: wanting to keep things the way there are now

The **status quo bias** is a bias in favor of the way things already are. Unless things are going badly, people often prefer to keep things the same, rather than risk trying something new. Loss aversion helps explain this, since the potential disadvantages of change loom larger than the potential advantages. We also value items we already possess (our "endowment") more than we would value them if we didn't have them. This is known as the **endowment effect**. We would typically require more money to sell something we already have than we would pay to buy it. This is clearly relevant to public policies involving regulatory takings (or eminent domain, where the government takes someone's land to build a highway, dam, or the like). Our aversion to loss explains the endowment effect as follows: once we have something, giving it up is viewed as a loss, and so we require more in compensation for it than we would be willing to expend to acquire it.

The upshot of our discussion of framing and loss aversion is that the risks people are willing to take depend on whether they frame something as a potential gain or as a potential loss. Positive and negative frames lead us to think about things differently; different ways of framing the same options often influence peoples' preferences. It makes a difference whether alternatives are framed in terms of employment or unemployment; again, peoples' preferences are affected by whether options are framed in terms of crime rates or law-obedience rates.

Framing effects surely play a large role in politics and policy, where choices between uncertain options are ubiquitous and people with competing interests will represent them in quite different ways. It certainly is not completely true, but there is some truth in the old expression; it's not what you say—it's how you say it.

18.1.4 The Certainty Effect

Would you pay more to reduce the probability of a serious disease from 90% to 85%, or to reduce it from 5% to 0%? If you are like most people, you would pay more for the latter. Although the objective decrease in risk is the same in each case, people have a strong preference for the "sure thing." We prefer certain outcomes over uncertain ones.

In Russian roulette, for example, most people would pay more for a reduction of one bullet in the gun when it involves going from one bullet to none than when it involves going from two bullets to one (though if we were forced to play the game, most of us would spend a lot in either case). Given the option, most of us would choose a certain gain rather than take a chance on a larger gain that is only probable. For example, we would opt for a sure gain of $1,000 over an 80% chance to win $1,500 (or even more).

Equal probabilities are not always treated equally. If someone can frame an option in a way that seems to reduce all uncertainty about it, people will be more likely to accept it. For example, politicians who promise to completely solve a problem will fare better than those who merely offer policies that will probably make it less severe, even though the latter are frequently much more realistic. We don't like uncertainty.

Certainty effect: preference for certain outcomes over equally important uncertain outcomes

18.2 Psychological Accounting

People frame the outcomes of choices as well as the choices themselves. Tversky and Kahneman asked people what they would do in the following situation:

> **Case 1:** You have decided to see a play where admission is $10 per ticket. As you enter the theater, you discover that you have lost a $10 bill. Would you still pay $10 for a ticket to the play?

88% of the respondents said they would still pay the $10 for the ticket. Tversky and Kahneman then asked other people about this situation:

> **Case 2:** You have decided to see a play and paid the admission price of $10 per ticket. As you enter the theater you discover that you have lost the ticket. The seat was not marked and the ticket cannot be recovered. Would you pay $10 for another ticket?

Only 46% would pay another $10 for a ticket. But the two cases are completely equivalent in terms of the total amount a person would be out. Nevertheless, when the case is framed in these two different ways, people make quite different choices.

Tversky and Kahneman hypothesize that people do **psychological accounting**. In effect, we keep different psychological books for different things. In Case 2, the respondents seem to add the second $10 to the overall amount they would be spending on a ticket, and they aren't willing to pay $20 to see the play. In this scenario, people see the entire $20 coming out of their "budget for play." But in the first case, the $10 they lost comes out of a different psychological account—not out of the account set aside for seeing plays—so they see the ticket as costing just $10. When we get windfalls, “easy money,” we tend to think of it as less valuable than money we work hard for. An extreme example of this occurs when people are gambling. They tend to think of their winnings as “house money” which is not quite their own. So, they find it easy to bet with it (and, typically, to lose it).

Many people owe thousands of dollars on their credit cards. The use of credit cards also involves something like mental accounting. It is easy to overspend on a credit card because it doesn’t feel quite like spending. The money isn’t coming out of a psychological account where we have stashed money we are reluctant to part with. In fact, however, money from this account is especially real, because we pay interest on our credit card bills. This is one thing people sometimes mean when they speak of ‘compartmentalization’.

Although one of the best ways to save is to treat all money equally, we can sometimes use mental accounting to our advantage. For example, if you receive an unexpected gift, you can put the money in a bank account set aside to pay for next year’s tuition. This moves it from the “easy-come easy-go” psychological account to another account from which you are more reluctant to draw.

18.3 Magic Numbers

We often judge outcomes and performances relative to some special number or target. Such numbers were originally used to measure something else, but sometimes they acquire a life of their own. They take on a significance that is disproportionately large compared to their actual value. Such variables are sometimes called **magic numbers**.

Magic numbers: numbers originally used to measure something else can take on a life of their own

In the case of the economy, the cost-of-living index or the GNP may be treated as the measure of economic strength. When evaluating a business with an eye to buying or selling, stock price/earning ratios are sometimes taken as the key. F. DeGeorge and co-workers found three variables of this sort in businesses: positive profit, previous year’s earnings, and the agreement of financial analysts’ earnings estimates. Closer to home, for many of you, ACT or SAT scores and GPA easily become magic numbers for measuring academic promise and success. Furthermore, we often set a somewhat arbitrary *threshold* for this number, with anything below the threshold counting as failure and anything above it counting as success. In public policy, business and other arenas where people want to measure progress or success, precise target numbers, quotas, acceptable level of risk, grade point average, and the like often come to define success and failure.

The Local Charity will count it a failure unless they raise $35,000, the new police chief fails unless she reduces crime by the targeted 2.5%.

Lawyers often speak of certain thresholds as *bright lines*. These are clear boundaries that make it easier to set policies people can understand. You must be over a very clearly defined age to buy beer; a precise level of alcohol in a driver's bloodstream counts as driving under the influence. Bright lines are easy to judge (you aren't 21 until midnight tomorrow), and they create clear expectations. We can generalize this notion to apply to threshold and boundaries in other settings; in the charity example, raising $35,000 is a bright target that tells us whether our fund-raising efforts were a success, or a failure. Target numbers are often ones that are salient and easy to remember; the local charity set a goal this year of raising $35,000, not $33,776. Furthermore, the numbers aren't completely arbitrary; no one would think raising $3.50 was a worthwhile target. Still, within some vague range of sensible targets, the selection of a specific number typically is arbitrary.

Like many of the other points we have studied (e.g., heuristics), magic numbers and bright targets help us simplify very complex situations involving things like the economy and the environment. And frequently the numbers do tell us something about how the economy or a firm or a school is doing. Bright targets can also provide good motivation; if I set a goal of losing twenty pounds over the summer, it gives me something definite to shoot for.

In policy settings, bright lines are sometimes useful because they provide a line that isn't renegotiated by each person on every occasion. In policy matters this is useful, because there is often a very real risk that the people making the decisions will do so in a way that isn't fair, or at least that won't appear fair. If the judge can simply decide if someone drank too much before getting behind the wheel, there would be a great deal of potential for abuse. Having a definite cutoff percentage of blood-alcohol level makes it more likely that everyone will be treated the same, and expectations are clear to everyone.

Problems with Magic Numbers

Although magic numbers and bright targets are frequently useful, even unavoidable, they often take on a life of their own.

Originally, they were a means to an end, e.g., an aid to seeing if the economy is improving, but eventually they become ends in themselves. This can lead to several problems.

1. Simply getting across the threshold is often seen as *the* measure of success, even when progress on either side of the line (getting

closer to the goal by this much, exceeding it by that much) is equally important. Often the difference between almost making it to the target, on the one hand, and exceeding it by just a little, on the other, is insignificant. So, a bright target can promote all-or-none thinking.

2. Target numbers can also be treated as the only relevant measures of success and failure, even though the precise target numbers are somewhat arbitrary and other, perhaps more important variables, are ignored.

3. In the worst case, magic numbers represent variables that are not very important, or their specific target values are not set in any sensible way.

Magic Numbers and Suboptimal Policies

Magic numbers are often introduced in an honest effort to assess performance or progress, but they can have unintended consequences, including counterproductive policies and behavior. For example, policy makers sometimes establish bright lines when dealing with environmental issues.

For example, suppose that an agency sets a precise target for what counts as an acceptable level of arsenic in your community's drinking water. Clearly the arsenic level come in degrees, with less arsenic being better, whatever the target value is. But hard and definite numbers can foster a feeling that either risk is present or else it's been eliminated, when it's more accurate to think in terms of more and less risk, rather than risk or no risk.

It is often felt that anything short of a designated target is failure, and anything over it, even if it only limps over the line by just a bit, is a success. F. DeGeorge and co-workers found that people in charge of large businesses would often manipulate their earnings to get beyond a target value. Often it didn't matter how far from the target they ended up, provided they passed it. Worse, it often didn't matter if the way of getting to the target would lead to problems in the longer run; for example, they would sometimes sell items at a large discount (or even a loss) late in the year, just to meet a target for yearly earnings.

C. Camerer and his colleagues found that New York City cabdrivers would set a target income for a day's work. They would drive until they reached that target, then knock off for the day. They would make more money with less driving if they drove fewer hours on days when business was slow and more hours on days when it was brisk. But the daily-earnings target seemed to be a bright threshold that took on an intrinsic importance.

As a third example of how magic numbers can lead to less than optimal policies, consider recent programs to make schools more accountable. The basic idea is a good one; schools have a very important obligation to their students and to those who pay the bills (in many cases taxpayers like us) to do a good job. Many recent efforts to judge how well schools are doing rely on standardized tests that are administered every few years.

In some cases, this has led teachers to spend a great deal of time teaching the students things that will help them do well on such tests, while short-changing other things. To the extent that the tests measure the things students should be learning, this might be acceptable, but it is by no means clear that the tests do that. Indeed, we will see in the final chapter that if one goal is to foster critical reasoning, then training people to do well on standardized tests is not the best thing to focus on.

Magic Numbers Can Become Ends in Themselves

Instead of being treated as indicators or indices of how well (or badly) things are going, magic numbers often displace what we originally cared about and become ends in themselves. We slip from thinking that GPA tells us something about how much a student is learning to thinking that GPA really is how well a student is doing. Furthermore, such numbers can distort our picture of the situation. For example, Wilbur may have a higher GPA than Wilma because Wilber's courses are much easier. There is also a political dimension to the selection of many magic numbers and targets. Someone in charge of a business or governmental agency will find it tempting to propose those measures of success that will show that they are in fact succeeding, while those who are unhappy with the way things are going may propose rather different magic variables to measure performance.

The allure of bright lines and magic numbers is one of several things that can lead us to focus on factors that are easy to measure or quantify, while paying less attention to things that are harder to measure, even when they are more important. This in turn can lead to the view that what can't be quantified or measured is unimportant, or even not real (we will return to this in Chapter 20). Magic numbers and bright lines are often useful and even unavoidable, but they can lead to genuine problems. The key questions to ask when you hear some number cited as a sign of success or failure are:

1. Is it really a good measure, an accurate indicator, of the thing that it's supposed to be measuring, and

2. Does the specific target number associated with it really have any special significance?

Exercises

1. One of the middle schools in your city has been doing very badly by almost everyone's standards; students, parents, teachers, and neutral observers are all upset. Last week the school district allocated almost two million dollars to improve the school, and you are put in charge of a task force to assess how much (if any) the school really does improve. You will consult experts, but the experts you consult may disagree, and then your task force will have to draw a conclusion of its own. Think about the ways you would try to assess whether the tax dollars really translated into helping the students. Focus on some of the reasons why this would be difficult. How might people with different vested interests propose different measures of success? What might they be?

2. Management and workers at a large grocery chain are locked in a bitter negotiation over salary increases. What sorts of measures of how well the business is doing and how well the workers are doing might the workers focus on? What sorts of measures of how well the business is doing and how well the workers are doing might management focus on?

3. You are appointed as a student representative to a group asked to ascertain whether classes that feature a lot of group work provide a better educational experience than classes that don't. Your committee will consult experts, but the experts you consult may disagree, and then the committee will have to reach a conclusion of its own. How could you assess whether, on average, classes with a lot of group work did a better job of teaching people the things they should be learning than classes without group work do. Focus on the reasons why this would probably be difficult. How might people with different vested interests (e.g., those who spent a lot of time developing group projects vs. those who spent a lot of time developing lectures and individual projects) propose different measures of success? (We will return to some of the issues about group learning in Chapter 24.)

4. Give a real-life example of a bright line. Why is it supposed to be important? Who decided what it would be? How arbitrary do you think it is?

5. What connections might there be between magic numbers, on the one hand, and issues involving framing and psychological accounting, on the other?

6. Think of some variable that is important but hard to quantify. How might it be overlooked if we focus too much on how it can be measured?

7. In arguing for the need for a bright line for what counts are a reduced risk pesticide, the Consumers Union and its Consumer Policy Institute (CPI), a nonprofit product testing organization in Yonkers, New York, argued:

> The purpose of these bright lines is to limit the pool of candidates for reduced risk status, and to provide EPA [Environmental Protection Agency] some easily applied criteria for saying "no" to requests for reduced risk status. Bright lines are also needed to reduce the time and agency resources required to evaluate requests for consideration for reduced risk status. If EPA opens itself up to a significant number of such requests, the time and resources entailed in reviewing and deciding upon such requests will end up diverting significant agency resources, and would hence defeat the purpose of the policy. Restate the basic points in clear, non-technical English in a more general way that could apply to other issues in addition to pesticide labeling. How strong are such arguments for having bright lines in cases like this? What might be said in defense of the other side?

18.4 Sunk Costs

At the beginning of September, you were really excited about OU's prospects in football, and when Wilbur suggested that you should each spend $100 for good seats at the OU-Texas game in Dallas, you enthusiastically agreed. But now it's October, the team hasn't done very well, and you aren't very interested in football anymore. Besides, it's still very hot, you've had a cold, and you'd really prefer to stay in Norman this weekend and relax. But then you remember that $100. It's too late in the day to sell the ticket to someone else, so if you don't go to the game you'll have wasted it. Better get on the road.

We often reason this way, but is it rational? Your $100 is *already gone*. Your overall financial situation is *just the same* as it would have been if someone had stolen that $100 right before you bought the ticket. If *that* had happened, it wouldn't justify going to the game. So how can the fact that you have sunk $100 justify going now? It won't bring your original $100 back. So how can it justify spending more money (for gas and food in Dallas) to do something you won't enjoy?

Sunk costs: basing a decision on past investments (that are already gone) rather than on current prospects

The $100 Wilbur paid is known as a **sunk cost**. A sunk cost is money that has already gone down the drain. Since it is gone, it doesn't make sense to continue with a plan you no longer believe in simply because you sunk money in it. Following through on the plan won't bring that money back; it will only lead you to incur further costs (e.g., paying for gas and food on the trip to Dallas and having a miserable time doing it). Instead, we feel like we must carry on to justify our initial expense.

Even people with a lot at stake often honor sunk costs. Wilma is the CEO of a large company that designs and manufacturers attack helicopters. Her company has spent $700,000 designing a new helicopter when it learns that a competing company has already designed a helicopter with the same features and has just landed a contract with the Pentagon. There won't be any other market for her company's helicopter. Should Wilma authorize another $200,000 to finish the design project? If she does, she is honoring a sunk cost.

Sunk costs also operate at the national level. When a country is involved in a war that they aren't winning, one of the justifications typically offered to keep fighting, even when it can only lead to further disaster, is that "if we don't, all those soldiers who died will have died in vain."

Honoring sunk costs isn't always a bad thing to do. Sometimes it is important to us to follow through on a plan or commitment because we want to be the sort of person who finishes the things they start. And in other cases, we can turn our tendency to honor sunk costs to our advantage. Many people reply on the power of sunk costs as a means of self-control, paying a good deal of money to join a health club or buy a home treadmill. Their hope is that the thought "all that money will go to waste if I don't go work out" will make them more likely to get to the gym.

18.5 Confirmation Bias

Many studies (as well as a bit of careful observation) document our tendency to look for, remember, and acknowledge the value of positive evidence that supports our beliefs, while overlooking or undervaluing negative evidence that tells against them. The distinction between positive and negative evidence may be clearer if we consider a couple of examples.

- Suppose that you believe (or hypothesize) that all swans are white.

Then a white swan is *positive evidence* for your view; it confirms or supports (though it doesn't conclusively establish) your belief. By contrast, swans that are not white are *negative evidence* against your view; they disconfirm your belief. In fact, even one non-white swan shows that your belief is false. One black swan falsifies your hypothesis right then and there.

Confirmation bias: tendency to look for confirming evidence while ignoring disconfirming evidence

In many cases, though, negative evidence disconfirms a hypothesis without utterly refuting it. For example, Wilbur might wonder whether Wilma has a crush on him. The fact that she goes out of her way to chat with him is confirming, though by no means conclusive, evidence that she does. And the fact that she sometimes seems to avoid him is disconfirming evidence, though it doesn't prove that she doesn't.

Confirmation bias is our common tendency to look for, notice, and remember confirming or positive evidence (that supports what we think) while overlooking or downplaying disconfirming or negative evidence (which suggests that what we think is wrong). For example, if Wilbur is already convinced that women are bad drivers, he may be more likely to notice or remember cases where women drove badly and to overlook or forget cases where they drove well.

The *selective thinking* exhibited in this bias makes for bad reasoning, because it allows us to support our views without running the risk of finding out that they are wrong. It really boils down to considering only those points that support our own views, which is about as far from being open minded as possible. Careful reasoning requires testing our views to see if they fit the facts. The confirmation bias also encourages beliefs in illusory correlations (Chapter 15), since it encourages us to look for cases where two variables do go together without looking for cases where they may not.

Since the confirmation bias often leads to bad reasoning (that's why it's called a *bias*), it is important to avoid it. It should help to convince yourself of the value of negative evidence and to make a practice of looking for it, but this bias is difficult to eliminate.

In a series of experiments, Mynatt, Doherty, and Tweney had subjects attempt to determine whether various laws or generalizations about the movement of a spot on a computer screen were true or not. They asked some people to *confirm* various generalizations about the dot's movement, others to *disconfirm* them, and still others just to test them. The instructions to disconfirm were not effective; about 70% of the time people in each group looked for confirming evidence. And the ineffectiveness of asking people to look for disconfirming evidence persisted even when the value and importance of searching for such evidence were explained to them before they began their task.

18.6 Self-Fulfilling Prophecies

A **self-fulfilling prophecy** is the tendency for a person's expectations about the future to influence that future in a way that makes the expectations come true. Sometimes we have expectations, most often about other people, that lead us, unwittingly, to treat them in a certain way. And treating them in this way may in fact lead them to behave in the way that we thought they would.

For example, if you hear that Wilbur is hostile before you ever meet him, you may be more likely to be hostile when you do meet him ("He's hostile, so I'd better beat him to the punch"). And this may lead *him* to react with hostility, even though he would have been friendly if you'd been friendly yourself. Your prediction leads you to act in a way that makes the prediction come true.

The psychologist Robert Rosenthal and his coworkers have studied self-fulfilling prophecies extensively. In a famous study in 1968, Rosenthal and Lenore Jacobson told grade schoolteachers at the beginning of the school year that their incoming students had just been given a battery of tests. Twenty percent of these students, it was explained, had great potential and should be expected to blossom academically in the coming year. In fact, the students in this group were selected randomly. Nevertheless, these twenty percent ended up improving more than the other students. What happened?

Self-fulfilling prophecy: tendency for a person's expectations about the future to influence the future in a way that makes the expectations come true

The chances of randomly picking the twenty percent that would improve are extremely small. Hence, the explanation is that teachers' expectations influenced their students' performances. Teachers expected the students in the targeted group to blossom, which led them to act in ways that encouraged the students to do so. For example, teachers gave the students in the high-potential group more time, more and better feedback, and more encouragement.

In short, the teachers' expectations led them to behave in ways that made their expectations come true. This sort of self-fulfilling prophecy is sometimes called the Pygmalion effect, after the play *Pygmalion*, in which a professor of linguistics transforms a young woman with little education and bad grammar into a sophisticated, well-spoken person. Countless studies since have shown that this effect is very real (though often it is of modest size), both in the classroom and in other settings.

Pygmalion effect: people often perform better because we expect them to

Stereotypes can also serve as self-fulfilling prophecies. If teachers expect students from some groups to perform better than others, this may lead them to treat their students in ways that will make these expectations come true. In a society where people think that women are incapable of performing a demanding job like being a doctor, young girls are likely to be treated in a way that suggests they can't do such work. Furthermore, any interest they may display in medicine will be discouraged, and they will be encouraged to adopt quite different roles, like being a housewife. Years of such treatment will make it much more difficult for a woman to become a doctor. So, the prediction that they can't be doctors can lead people to treat them in ways that will make the prediction come true.

18.7 The Validity Effect and Mere Exposure

Validity Effect

Researchers have found that the mere repetition of a claim will lead many of the people who hear it to think that it is more likely to be true (than they would have if they hadn't heard it before). This is called the **validity effect**: mere repetition makes the claim seem more likely to be true or more "valid." This effect occurs with true statements, false statements, and statements that involve expressions of attitudes.

In experiments on the validity effect, subjects are often asked to rate the likelihood that a series of sentences (e.g., "Over 22% of the countries in the United Nations are in Africa") are true. In a later session, they are asked to perform the same task, but with a partially overlapping set of sentences. On average, sentences encountered in the first session receive higher rankings; subjects are more inclined to think they are true, simply because they have encountered them before. We seem to tend to believe what we hear.

Validity effect: mere repetition of a claim increases people's tendency to believe it

Since the validity effect can lead people to believe certain things without giving them any thought whatsoever, it is not surprising that it is exploited in propaganda, advertising, and related endeavors. If a company has enough money to run ads over and over, we will hear their claims about their product over and over. In many cases, this will strengthen our tendency to believe those claims. The validity effect may also account for some of the biases and stereotypes people have. If you hear over and over how redheads are hot tempered, this will increase your tendency to believe it (especially if you don't interact much with redheads).

Mere Exposure

There is an old saying that familiarity breeds contempt. The more you see of someone, the more flaws you notice, and you wind up thinking less of them. But in many cases, this old saying is wrong. The more people are exposed to something (that they don't already dislike), the more they tend to like it. They don't need to interact with it, or hear it discussed. The mere exposure to the stimulus, without anything else happening at all, is enough to make them like it more.

In a standard experiment people (who don't know Chinese) were exposed to several Chinese characters. Later they were shown a larger set of characters that included the ones they saw earlier, as well as some new ones. The more previous exposures subjects had to one of the characters, the more they liked it the second time around. Similar results have been obtained for many other sorts of stimuli. For example, in one study, subjects were first shown pictures of men's faces. The more times subjects saw a picture, the more they thought they would like the person. Advertisers know about this.

Mere exposure: tendency to like things more simply because we've been exposed to them

Not only can repeating their claims make them seem more valid (the validity effect), simply exposing us to the name or a picture of their product can give us a comfortable sense of familiarity that translates into a purchase when we go to the store.

Subliminal Mere Exposure

The mere exposure effect also occurs when people don't remember that they had previously encountered the stimulus. It even works, up to a point, when they were previously presented with a stimulus but weren't aware of it. Even when figures are flashed on a computer screen for a very brief time, too fast for subjects to be aware of them, the subjects will later show a preference for these figures over ones they haven't been exposed to previously.

In these cases, the exposure is said to be *subliminal*; 'sub' means under and 'liminal' means consciously detectable, so something subliminal is something that can't be detected consciously (something supraliminal is something that can be). Are we susceptible to the subliminal influences of others? Can people manipulate our thoughts and actions by sending subtle, subliminal messages? In 1957, it was widely reported that a marketing group had conducted an experiment in a New Jersey movie theater. According to the story, messages like "Eat popcorn" and "Buy a soda" had been flashed on the screen, but so briefly that people in the audience weren't aware of them. And, the story continued, sales of popcorn rose by 58% and those of soda by over 15%.

No one wants to have their thoughts and actions manipulated by other people in this way, but fortunately there is no evidence that this story is true, or that others can manipulate our thoughts and actions in such dramatic ways. We certainly are influenced by people's body language and tone of voice in ways we may not realize. But there is no evidence that advertisers or the manufacturers of "subliminal self-help" tapes can manipulate our thoughts and actions in any major ways.

18.8 The Just World Hypothesis

We tend to think that the world is fair and just, that people usually get pretty much what they deserve, and they deserve pretty much what they get. The psychologist Melvin Lerner called this phenomenon the **just world hypothesis**: we think that things turn out, by and large, the way that they should. Life is basically fair. There is a good deal of evidence that many of us tend to think this way. There are, of course, exceptions. Bad things (e.g., some terrible disease from out of the blue) do sometimes happen to good people. But when this occurs, it often seems almost puzzling, unexpected. Typically, we tend to think, we reap pretty much what we sow.

Lerner has shown that when people learn about an unfair outcome that is otherwise difficult to explain, they look for a way to blame the victim ("they must have done something to deserve this misfortune"). In an experiment by Ronnie Janoff-Bulman and her coworkers, subjects heard a description of a young woman's friendly behavior to a man she had met. They thought that her behavior was entirely normal and appropriate.

But other subjects, who heard the same description but were also told that she was then raped by the man, thought that her behavior was more than friendly, and that it encouraged the rape ("She was asking for it"). They blamed *the victim* (this is still not uncommon in cases of rape). Hindsight bias may also be involved here, since once an outcome (the rape) is known, people often think they could have seen it coming.

Just-world hypothesis: Tendency to think world is fair and that people get what they deserve

We may want to believe in a just world to make ourselves feel safer and more secure. We assure ourselves that, if we do the right things, disaster probably won't strike us (that wouldn't be fair). But when we look at actual cases, we see that bad things can easily happen to good people, and that people who aren't so good can do quite well. Good luck or bad luck can strongly affect things.

To the extent that we think this way, we will tend to think that most people who aren't doing well are getting what they have coming. So, if a group is treated badly, we may feel, they must have some defects that explain the bad treatment.

18.9 Effect Sizes

You hear on the news that a famous and trustworthy medical journal has recently published a study showing that a large daily dose of a moderately expensive dietary supplement, vitamin Q, will cut your risks of developing XYZ syndrome *in half*. In other words, people who do not take the vitamin will be twice as likely to develop this syndrome. The syndrome is painful but not life threatening, and the vitamin costs $20 a day. Should you start taking the vitamin?

The answer depends on a variety of things (e.g., whether you can afford the vitamin). But the first question you should always ask about such reports is:

- What is the base rate of XYZ syndrome?

Suppose that only 1% of the population (who don't take vitamin Q) ever develops XYZ syndrome. Then if you take the vitamin, you cut your chances in half, down to 0.5%. In other words, you go from a 1 in 100 chance of developing the syndrome to a 1 in 200 chance. These numbers are so small that taking the vitamin may not be worth your time. By contrast, suppose that the base rate was 20%. If you could cut that in half, down to 10%, you would go from a 1 in 5 risk to a 1 in 10. The numbers here are big enough that you might want to give the vitamin some serious thought.

This is a fictitious example, but there are many real-life cases that illustrate the same point. Suppose that you learn that people who don't get enough vitamin C are ten times more likely to get botulism (which results from a deadly poison) or rabies. What are the first questions you should ask? What is the base rate for botulism? What is the base rate for rabies? It turns out that no more than three or four Americans die of either botulism or rabies each year. So, even if some factor made rabies ten times as likely to kill you, your chances would still be about 30 out of 250 million.

But what if you learned of some precaution that could decrease your chances of having a heart attack by 20%? Again, the relevant question is: what is the base rate? It turns out that about 1 in 3 Americans die from a heart attack, so if you could decrease your chances of heart disease by 20% it would be worth doing (we will return to this issue in more detail in the chapter on risks).

In these examples, we are at least given percentages that tell us something about the impact of various drugs and the like. But media reports of experimental results often don't tell us about the magnitude of effects. The anchorwoman tells us that the manipulation of a certain experimental variable (e.g., taking vitamin Q) reduced cancer, and that this result is statistically significant. But *statistical significance* does not mean the same thing as practical significance.

To say that a result is statistically significant simply means that it is unlikely that it was due to chance (to sampling variability). But with large samples, small and trivial differences are often statistically significant. For example, a study might find that vitamin R reduces the risks for XYZ syndrome by 0.20% (i.e., it reduces it by 15 of 1%). If our sample is large enough, this result may well be statistically significant. But the effect is so small that it won't be of much practical significance to anyone.

18.10 The Contrast Effect

Consider Figure 18.1. The two inside circles are the same size, but the one on the right looks larger because of the size of the six circles surrounding it. In these two examples, the *context* influences how we perceive things.

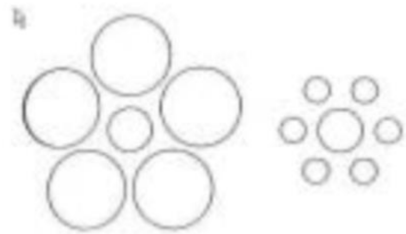

Figure 18.1: Circles in Context

Context can also influence how we think about things. The way that we think about or evaluate something often depends on what's around it. The alternatives, the points of comparisons, can strongly affect our perceptions, memories, judgments, inferences, and decisions.

Contrast effect: evaluations of, or judgments about, something are influenced by the contrast between it and things around it

The **contrast effect** occurs when our evaluations of, or judgments about, a thing are influenced by the contrast between it and the things around it. Many of our everyday judgments and inferences are affected by contrasts. George Bush would look short standing next to Shaquille O'Neal (a tall basketball player), but tall standing next to Shannon Miller (a short gymnast). The contrast effect is typically stronger the more similar the stimuli are to each other. For example, the effect is stronger when we compare Bush to two other people than when we have him stand beside two tractors of different heights.

When one thing is compared to something similar that is not as good as the first, the first thing is judged to be better than it would be without the comparison. In some cases, both things are present at the same time, but the contrast effect also works when temporal contexts are involved. If the job applicant interviewed right before Wilbur does a terrible job, Wilbur is likely to seem better just by comparison. When a professor teaches two section of the same course in the same semester, if one class is a 'dud,' it can make the professor think of the other class as exceptionally strong, even if they are in fact strictly average. The contrast with the first section will made them seem better.

We can exploit the contrast effect to make something look better (than it would have otherwise) by placing it in a context with something that looks worse. For example, a real estate agent might show buyers an overpriced or dilapidated home before showing them the home he wants them to buy. We can also make something look worse (than it would have otherwise) by placing it in a context with something that looks better. For example, the agent might discourage a person from buying a house by showing them a much better house first. And if you are in the market for a house, it is usually unwise to look at houses you know you can't afford. This will set up a contrast effect so that the houses you can afford won't look all that good.

Other Context Effects

The wording of questions can affect our answers in many ways. Earlier we learned about a study where half the people in a group were asked, "How frequently do you have headaches?" and the other half were asked, "If you occasionally have headaches, how often?" The average response of the first group was 2.2 headaches a week, while that of the second group was 0.7 headaches a week. Similarly, if you survey the people coming out of a movie and ask half of them, "How long was the movie?" and the other half, "How short was the movie?" those asked the first question will think the movie was longer.

The way options or possibilities are worded also influences people's responses to polls and public opinion surveys. For example, the results of polls to determine attitudes toward abortion vary depending on how the questions are worded. The questions in polls and surveys also often require you to select from a restricted set of alternatives (e.g., should we increase defense spending or should we lower it?), which again tends to frame things in certain ways.

Surveys are often remarkably reliable, and if several surveys by different organizations converge on the same results, then we have good reason to believe them. But the wording effects we have encountered in this section should lead you to take any single survey with a grain of salt. This is especially true of surveys conducted by groups with a vested interest in the outcome. They can often make it more likely that they will find the response patterns they are looking for by framing their questions in ways that are likely to elicit the response that they want.

The Compromise Effect

A good deal of research shows that many of us are reluctant to buy either the highest or the lowest priced item. We prefer to "compromise" on a price somewhere in between. Businesses sometimes exploit this effect to sell more of one of their products.

For example, if Wilbur's factory has been selling two models of car stereos, one for $200 and one for $300, they may be able to increase the sales of the $300 model by bringing out a $400 model. The point isn't merely hypothetical. Researchers have argued, for example, that Williams-Sonoma was able to sell more of their $275 bread machines when they began producing a $400 bread machine.

18.11 How Good—or Bad—are We?

In this chapter and the one before it, we encountered several biases that can lead to bad reasoning. There is some debate about just *how* bad people are at reasoning. The heuristics and biases approach that figured prominently in the previous chapter was developed by Amos Tversky and Daniel Kahneman in a series of papers beginning in the early 1970s, and many people have found this approach very promising. But in the last few years, some psychologists have argued that we are better at reasoning than some of this literature suggests.

Our performance depends, in part, on how we frame things. If we ask whether it is more probable that Linda is a bank teller or a bank teller and a leader in the feminist movement, we don't do very well. If we rephrase the question in terms of frequencies, rather than probabilities, we do better. If we ask: are there more people fitting Linda's profile who are bank tellers or who are bank tellers and leaders in the feminist movement, we give better answers. But while we may not be as bad at reasoning as some psychologists have suggested, it is clear that there is a lot of room for improvement.

18.12 Chapter Exercises

1. Investors are often less willing to sell assets at a loss than they are to sell assets that have gained in value. Indeed, many of us are very reluctant to see a falling stock. Is this sensible? What things should you consider in trying to decide whether to sell a stock or other asset that is losing in value.

2. People often go to investment counselors for help in investing their money. Should they put their money in stocks (with chances of a higher return, but riskier) or in bonds (less chance of high payoff, but less risk). So almost the first question an investment counselor asks a new client is how much risk they can live with. How might subtle differences in the way the counselor words this question affect the answers she'll receive (and, hence, the advice that she will give)?

3. Although you can't arrange such things, do you think you might do better in a job interview if the person right before you turned in a terrible performance? Why? How would you test a hypothesis about this?

4. Most of us have heard that taking an aspirin a day decreases our chances of getting a heart attack. This result is statistically significant. But is it of any practical significance? What would it mean to say that it is? What information would you need to answer this question? How would you get it? Get it.

5. What role might the endowment effect play in insurance fraud? Explain. Given an example or two, and be sure to defend your answer.

6. The following was a question on the pretest: Which do you prefer?

   a. A 100% chance of losing $50.

   b. A 25% chance of losing $200 and a 75% chance of losing nothing?

About 25% of you, on average, chose (a), and 75% of you chose (b). Explain why most of you probably picked (b). Be sure to use to relevant concepts that were discussed in class. What type of attitude regarding loss does this reveal about most of us?

7. Countless Americans are currently battling a credit crisis. Indeed, many people owe thousands of dollars in credit card bills. Explain what psychological accounting is and how it could contribute to this crisis. What remedies does psychological accounting suggest?

8. Give an example, preferably one from your own experience, of the compromise effect. How susceptible to it do you think most of us are?

9. Researchers randomly divided a group of Duke undergraduates into two groups. The first group was asked to imagine that they had a ticket to that year's NCAA Final Four tournament (a more important item at Duke than many other universities). They were asked how much money it would take them to sell their ticket, and the median price was about $1,500. The second group was asked how much they would pay for a ticket to the Final Four and their median price was about $150. What could account for this enormous difference? Do you think these figures would hold up if first group of students had the ticket in hand? Can you think of similar examples? What do they tell us about human reasoning?

10. You and your friend both paid $12 to see the movie, but by the time it is half over you both realize that you aren't enjoying it at all, and it only seems likely to get worse. What reasons are there to stay? What reasons are there to leave? What should you do? What would you do? What do you say when Wilbur asks how you can waste your hard-earned money by leaving early.

11. Jodie finds that once she's installed a piece of software on her computer she is very reluctant to remove it, even if she never uses it. After all, she tells herself, "I might need it one of these days". But when she recently reinstalled the operating system, she found it easy not to put the software

back on her computer. What might be going on here? How sensible is it? Can you think of similar examples in your own experience?

12. You have lost weight on your new diet, but a few minutes ago you broke down and got a Big Mac and large order of fries at the McDonalds' drive through window. You haven't eaten them yet. What should you do?

13. "To terminate a project in which $1.1 billion has been invested represents an unconscionable mishandling of taxpayers' dollars." – Senator Jeremiah Denton, 11/4/81. Is this true or not? What more would you need to decide. What problems could be lurking here?

Answers to Selected Exercises

1. Refusal to sell falling stock or other assets like a house that is declining in value is often a futile effort to honor sunk costs. You would be better off deciding which stocks to buy and sell based sensible expectation of their future performance, not on what has happened in the past. If there is good reason to think the stocks or the housing market will rebound, hold on to them. If not, cut your losses.

10. This is a case of sunk costs.

Chapter 19

Cognitive Dissonance:

Psychological Inconsistency

Overview: Earlier, we studied the notion of logical inconsistency. In this chapter, we will study psychological inconsistency, peoples' perceptions of their own inconsistency, and the ways these factors influence their attitudes, beliefs, and thoughts. We will see that, although making our beliefs and attitudes more consistent is typically a good thing to do, one strategy for doing this (dissonance reduction) often results in bad reasoning.

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19.1 Two Striking Examples

Last week you signed up to be a subject in a psychology experiment. Now, you walk into the psychology lab, sit down across the table from the experimenter, then notice a large plate of fried grasshoppers in front of you. After some initial discussion of other matters, the experimenter asks you to *eat* a few of the grasshoppers. What would you do?

The pressure to comply with experimenters in situations like this is much greater than is often supposed, and many of the subjects in this 1965 study by Philip Zimbardo and his coworkers ate several grasshoppers. But the experimenters manipulated what turned out to be a very interesting variable; they randomly assigned each of the subjects to one of two groups.

> **Nice-experimenter Group:** In this condition, a warm, friendly experimenter nicely asked subjects to eat grasshoppers as a favor.
>
> **Cold-experimenter Group:** In this condition, a cold, aloof experimenter pressured subjects to eat grasshoppers.

The subjects were later asked (by a third person) how much they liked the grasshoppers. No one was wild about them, but which group do you think disliked them the least? It turned out that the group that had been asked by the aloof experimenter had a more positive attitude toward eating the grasshoppers than the group that had been asked by the friendly experimenter.

A 1959 study by Leon Festinger and James Carlsmith sheds some light on this puzzling outcome. They asked each of their subjects to perform a boring, repetitive, meaningless series of manual tasks—arranging and rearranging rings on spools—for an hour. They then asked each subject to go outside to the waiting room to tell the next subject how interesting and enjoyable the experiment was, and to remain on call to talk to other subjects about it, in case the experimenter's assistant would be unable to do so. In other words, they asked the subjects to lie.

The subjects were randomly assigned to two conditions:

> **High-Reward Group:** Subjects in this condition were paid $20 to lie to the person waiting outside.
>
> **Low-Reward Group:** Subjects in this condition were paid $1 to lie to the person waiting outside.

Subjects were later asked how much they had enjoyed the hour-long task. Now that you know the outcome of the grasshopper experiment, you may be able to predict what they said. The high-reward ($20) group said that the activity was very dull. It was dull, so no surprise there. But the low-reward ($1) group said that the task had been more interesting. What's going on?

In each case, the group that had a *strong external inducement* to do something they didn't want to do (eat grasshoppers, lie to the waiting subjects) didn't change their original attitude (about eating grasshoppers or about how boring the task was). But the group that had a *weak external inducement* did change their attitude (the grasshoppers weren't so bad; the task really wasn't all that boring).

19.2 Cognitive Dissonance

Leon Festinger devised the theory of cognitive dissonance to explain such phenomena. This theory was very popular in the 1950s and 1960s, was studied less in the next two decades, and made a comeback in the 1990s. Festinger argued that when a person perceives *inconsistencies* among her actions, attitudes, and beliefs, she will experience an unpleasant motivational state that he called 'cognitive dissonance' ('cognitive' means 'psychological' and 'dissonance' means 'disharmony', so the idea is that the person feels a disharmony or conflict among their beliefs, attitudes, and the like). Dissonance is psychologically uncomfortable.

Cognitive dissonance: a state of tension when one sees their actions, beliefs or attitudes as inconsistent

The notion of dissonance will be clearer if we contrast it with two other notions. Some of our actions and attitudes *reinforce* one another: you oppose gun control, and you belong to the NRA; you support campaign finance reform, and you voted for the candidate who supports it. Others are *irrelevant* to one another: you oppose gun control, and you brush my teeth. But some of our actions and attitudes are *psychologically inconsistent*: you believe smoking can kill you, but you smoke two packs a day; you think lying is wrong, but you lied through your teeth to get this job. Such inconsistency will often produce cognitive dissonance.

Cognitive dissonance is an emotionally unpleasant state of tension that results from such perceived inconsistencies. For example, telling a lie to the waiting subjects (action) seems inconsistent with your view that you're not the sort of person who would tell a lie unless there was a good reason to do so (belief).

Cognitive dissonance involves tension and discomfort, so people will try to *eliminate*, or at least *reduce* it. The way to reduce it is typically to modify some of one's actions, beliefs, or attitudes. Since past actions have already occurred, and a person cannot change what has already been done, dissonance reduction will typically involve a change in attitude or beliefs. This will be easier to see if we consider how dissonance theory explains the two experiments described above.

19.2.1 How Dissonance Theory Explains the Experiments

In both experiments, subjects are induced to do something they don't want to do. Eating grasshoppers is disgusting and lying to the person outside is wrong. To explain such phenomena, dissonance theory requires one additional assumption:

- When we have strong external reasons or justification for doing something that we don't approve of, we can explain why we did that thing by noting this justification.

Subjects in the high-reward condition of the second (boring task) experiment could reason this way (though they didn't do so consciously): I told a lie. I think lying is wrong and I'm not the sort of person who lies without good reason. But *sometimes* there *are* good reasons. For example, it is acceptable to tell a little white lie to avoid hurting someone's feelings ("How do you like my new haircut?"). That wouldn't really show that I'm deceitful. Similarly, in this case, I had a good external reason to tell a lie (the $20). In short, subjects in this condition could conclude that the lie didn't really reflect badly on them, because they had a strong external justification ($20) to tell it.

But subjects in the low-reward condition didn't have this out. They could only reason this way: I told a lie. I think lying is wrong and I'm not the sort of person who would tell a lie unless there was a good reason to do so. But I didn't have a good reason ($1 isn't enough to justify it). So, these subjects feel an inconsistency among their beliefs and actions: I lied; I wouldn't lie without a good reason; I didn't have a good reason. The result: cognitive dissonance.

Festinger reasoned that subjects who lied for $1 couldn't really justify doing it for so little money. So, to avoid seeing themselves as deceitful—to make their action *consistent* with their attitudes—they (subconsciously) modified their attitude toward the experiment. It really wasn't as boring as they originally thought.

The pattern of explanation of the second experiment is the same. Subjects who encountered the friendly experimenter had a good external justification for eating the grasshoppers. They were doing something to help a nice person that they liked. But subjects who had the unfriendly experimenter couldn't justify their actions in this way. They were stuck with some dissonant views about themselves: I just ate those disgusting grasshoppers; I don't do things like that without a good reason; I had no good reason to eat them. To reduce this inconsistency, they modified their attitude. The grasshoppers weren't really *that* disgusting after all.

In this chapter, we will examine four types of situations where cognitive dissonance plays a role in our actions and thought. The first, which we have focused on thus far, involves induced compliance.

19.3 Insufficient Justification and Induced Compliance

19.3.1 Induced Compliance and Counter-Attitudinal Behavior

These experiments illustrate the first of three types of insufficient justification effects that we will consider in this chapter. It is sometimes known as the **insufficient justification through induced compliance paradigm** of dissonance reduction.

When we think we lack sufficient justification for doing something that runs counter to our attitudes we may modify our attitudes

In both studies, subjects were induced to do things that they didn't really want to do. The experimenter got them to engage in "counter-attitudinal" behavior (i.e., to do things that ran counter to their attitudes—like telling a lie). But in each study, half of the subjects were induced to do so with what seemed to them like very weak justification. These subjects could not find a good external justification for doing what they did, and this produced cognitive dissonance between the counter-attitudinal behavior and the attitude itself. Since the subject could not go back in time and undo the behavior, the only way to reduce this dissonance was to modify their attitudes so that they become more consistent with telling the people outside that the experiment was interesting (the task wasn't really that boring).

Such shifts in attitude are known as *insufficient justification effects*, because they arise when justification or coercion is so small that it seems to the subject insufficient to justify their behavior. Thus, subjects seemed to find $1 an insufficient justification to lie, and to find eating grasshoppers at the behest of someone they didn't like an insufficient justification for eating them.

Note that the justification is in fact sufficient to get the subject to do something they don't want to do (since most of them did eat grasshoppers or lie). But later it seemed so mild that it was difficult for the subject to realize that this was what had led them to do what they did. They saw the justification as insufficient. They were subtly pushed to do something, but it felt to them like they freely chose to do it.

Not all examples of attitude change in response to induced compliance are trivial. For example, European-American students were asked to write essays in support of large scholarships for minority students (which many of them opposed). Half of the subjects were told that the exercise was voluntary (low external incentive). The other half were told that it was required (high external incentive). The subjects with the high external incentive didn't change their attitudes about affirmative action, but the subjects with a low external incentive developed more positive attitudes to minority students. Similar results have been found for attitudes toward many other topics, including police brutality and the legalization of marijuana.

When people experience cognitive dissonance, they will typically try to modify the inconsistent element that is least resistant to change. So, although one of Zimbardo's subjects could theoretically reduce dissonance by denying that she ate the grasshoppers, it is obvious that she just did, and so it is easier to change her attitude about eating grasshoppers. Again, deeply held views that enhance one's self-esteem will be more resistant to change than many of our more peripheral, less deeply held attitudes.

Insufficient justification effects leading to attitude change have been found in a very wide range of conditions. They are especially strong when the following conditions are met (but there is good evidence that dissonance and attempts to reduce it can arise even when they are not met).

1. The person sees the counter-attitudinal behavior as freely chosen (if it was coerced, then the coercion would explain the behavior).

2. The behavior could be foreseen to have some bad consequence.

3. The person sees themselves as responsible for these consequences.

An Alternative Explanation: Self-perception Theory

Daryl Bem proposed an alternative account of such phenomena. He argued that people discover their own attitudes and emotions partly by observing how they themselves behave. When internal cues are ambiguous or hard to interpret, we are in much the same position as an outside observer who is trying to interpret us.

According to Bem, subjects in the two experiments inferred their attitudes by observing their own behavior. Thus, subjects paid $20 inferred that they lied because they were well paid. But subjects paid $1 inferred that they said what they did because they believed it (since there being no strong external reasons to justify it). It remains a matter of controversy whether Bem's account or dissonance theory's account provides a better explanation of these two experiments (there is some evidence that Bem's theory is right about certain types of cases and dissonance theory is right about others).

If I'm doing X, I must not think X is so bad

We won't worry about this issue here, however, since the phenomena themselves are what matter for our study of reasoning. We will speak of these sorts of results as *dissonance results*, and we will see that in many cases it is quite plausible to suppose that peoples' aversion to perceived inconsistency plays an important role in their thought and behavior.

19.3.2 Prohibition

A related type of insufficient justification involves prohibition. In a 1963 study, Aronson and Carlsmith told nursery-school children that they could not play with an attractive toy. Half the children were threatened with a mild punishment if they played with the toy; the other half were threatened with a more severe punishment. Later the children in the mild threat condition valued the toy less than the children in the severe threat condition.

Dissonance theory's explanation is that the children in the severe threat condition had a very good external justification not to play with the toy. They could have said to themselves: I like the toy, but I don't want to be punished and that is why I'm not playing with it. But the children in the low threat condition couldn't reason this way. The threat was very mild, and so it provided insufficient justification for avoiding the toy. This led to dissonance: I like the toy; I play with toys that I like; but I'm not playing with this one. They reduced this dissonance by devaluing the toy. ("It's really not that attractive after all.") What implications might this have for getting children—or adults—to change their attitudes?

19.4 Effort Justification and Dissonance

The second sort of dissonance phenomena involves our need to justify the effort that we put into something. For example, numerous studies show that when people undergo a severe or difficult initiation to join a group, they value membership in the group more than people who don't have to go through so much to get in.

People who undergo a severe initiation seem to reason as follows: I am a sensible person who would not put myself through this difficult initiation if it were not worth doing; I am putting myself through all this difficulty. Now if the group isn't worth belonging to, this package of thoughts is inconsistent and that will create dissonance. But if the group is worth the effort, that could justify what I've been going through. More generally (just as your grandmother always said), people tend to value things more when they must work hard to get them.

19.5 Post-Decisional Dissonance

The third sort of dissonance phenomena involves decision making. We often must make difficult choices between alternatives: Where should I go to college? What should I major in? Which job offer should I accept? Should

I marry Wanda? Should we put off having children until we are more settled?

In a difficult decision, each alternative has some pluses and some minuses, and we aren’t sure how to balance them out in a way that will lead to the best choice. You are trying to decide whether to bring the collie or the terrier home from the animal shelter. Both dogs have pluses and minuses. The collie seems smarter, but she may be too big for your little apartment; the terrier is cute but seems a little dumb and you’ve heard terriers are difficult to house train.

Whichever dog you choose, you will give up some positive features (of the dog you don’t take) and accept some negative features (of the dog that you do take). Your awareness of these positive and negative features will be dissonant with the choice that you eventually make. This is known as **post-decisional dissonance:** after a difficult choice, we are likely to experience dissonance.

Post-decisional dissonance is greater when the choice is hard to undo, because we can’t reduce the dissonance by changing our decision. In such cases, how could we reduce it? Once people commit themselves to a choice, they often exaggerate both the positive aspects the thing they chose and the negative aspects of the thing they rejected. Once you chose the terrier, you may conclude that a collie would have been too much trouble, probably wouldn’t have been affectionate, and that terriers are much smarter than you had supposed.

This strategy for reducing post-decisional dissonance shows up in many studies. Jack Brehm posed as a representative of a company that was doing consumer research on household products. He asked people to rate the desirability of various household appliances, like coffee makers and toasters. As a reward for participating in the study, each woman was offered a choice between two of the items that she had rated. Later, the women were asked to re-rate the desirability of the products. Brehm found that the appliance the woman had chosen was rated higher than it originally had been, while the appliance she could have chosen, but didn’t, was ranked much lower. This is known as the *spreading effect*; we often feel like there is a greater difference between the desirability of things after we choose between them than we did beforehand.

Although the evidence is less clear cut, some of it suggests that after a difficult decision people also often become selective in the information they seek about the things they chose between. They seek out and attend to information that supports their decision (after bringing home his terrier, Wilbur, reads about the virtues of terriers) and avoid or discount information that doesn't support it (he quits reading about the strong points of collies).

19.6 Belief Disconfirmation and Dissonance

The fourth dissonance phenomenon, and the last one we will study, involves the disconfirmation of someone's belief (a belief is *disconfirmed* when there is clear evidence that it is false). Information that is inconsistent with our beliefs can produce dissonance. This can lead us to avoid the information, or to ignore it, or to dismiss, or to attack the people who convey it to us (we have encountered all these strategies before).

Sometimes, however, it becomes so obvious that the belief is false that tactics like these simply will not work. The disconfirmation of a belief can produce dissonance, since we felt like it was true, and if we acted on the basis of the non-disconfirmed belief, the possibilities for dissonance are especially strong. We will now consider a very interesting, real-life example of this.

19.6.1 When Prophecy Fails

In 1954, Leon Festinger came across a newspaper account of a small "doomsday" cult who believed that the world would end on December 21. His coworkers infiltrated the group and observed the members' behavior. The group members were very committed to their beliefs. They had gotten rid of all their possessions (who needs a toaster when the world is about to end?) and were genuinely preparing for the world to end.

December 21 came and went, and the world didn't end. This dramatically disconfirmed the group leader's prediction, and we might expect that the members of the group would have lost their faith and left. Members of the group who were alone on December 21 did lose their faith, but those who were with the rest of the group did just the opposite. They concluded that their own actions had postponed the end—though it would arrive soon—and this seemed to strengthen their faith. Before their belief had been disconfirmed, members of the group hadn't done much to convince others to join them, but after the disconfirmation, they worked hard to convert others to their own position. Their new belief, that their actions had delayed the end of the world, restored the consistency between their belief in the head of the group and the fact that they had given away everything they owned, on the one hand, and the fact that her prophecy failed, on the other.

19.7 Dissonance Reduction and Bad Reasoning

Over the short run, dissonance reduction often allows us to see our views as well-founded and our actions as compatible with our ideals, but it doesn't make for good and independent reasoning. Indeed, some of the ways dissonance reduction works will be familiar to students of fallacies. When someone offers arguments for views we don't like or evidence suggesting that we are wrong or that our actions are harmful, there are several common ways of reacting. All these can help us reduce dissonance.

1. Distort the person's position or argument or evidence so that we don't have to take it seriously (e.g., the straw man and either/or fallacies).

2. Shift the focus away from the person's position, argument, or evidence so that we don't have to think about it (e.g., ad hominem and red herring).

3. Overestimate the quality of the arguments or evidence supporting one's own position (e.g., appeal to a suspect authority and appeal to ignorance).

4. Rationalize that "everybody does it," so we might as well too.

While such strategies may protect our attitudes and self-image, being unwilling to confront the facts does not promote clear and independent thinking. In the following exercises, we will encounter examples of the importance of cognitive dissonance and dissonance reduction in the real world.

19.8 Chapter Exercises

What role do you think that cognitive dissonance and attempts to reduce it play in the following cases?

1. Many Jews in Germany and other European countries saw signs of terrible danger as the Nazis came to power. But many of them made little effort to leave.

2. Many of the people who worked in the concentration camps saw themselves as good, decent human beings, even after the war was over. How could this be?

3. Suppose you were a heavy smoker when the Surgeon General's report about the dangers of cigarettes came out in 1964. How would you react?

List several ways that a smoker might try to reduce dissonance when learning about the report.

4. Recall the different perceptions students had of the Princeton-Dartmouth football game. How might dissonance reduction be involved in the very different interpretations they had of this game?

5. The more difficult it is to become a member of a group (e.g., because it costs a lot of money, because of harsh hazing practices), the more people who do become members tend to value it. Give an example of this. How does dissonance enter the picture?

6. Suppose you are strongly tempted to cheat on the final for this course. Once you have decided what to do, you will probably experience some dissonance. Why? How might you reduce it?

7. If people change their attitudes more when they do things for small rewards, what effects might punishment have on attitude change?

8. Suppose that some person or group has already invested a lot in something (money to keep an aging car running, lives lost in a war). There is some tendency to think that justifies further investment. Could dissonance theory be relevant here?

9. In his excellent discussion of dissonance theory, Elliot Aronson says that a modern Machiavelli might well advise a ruler:

    1. If you want someone to form more positive attitudes toward an object, get them to commit themselves to owning that object.

    2. If you want someone to soften their moral attitude toward some misdeed, tempt them so that they perform that deed. Conversely, if you want someone to harden their moral attitudes toward a misdeed, tempt them—but not enough to induce them to commit the deed.

What do you think about this advice?

10. Wilbur is struggling to decide between buying a house and renewing the lease on his apartment. There are positive and negative factors on each side. If he buys the house, he will have a tax deduction on his mortgage, and he will be building up equity in something that he owns. But he will have to care for the lawn, and he is financially responsible for things that break. On the other hand, if he renews his apartment lease, someone else cares for the lawn and fixes things when they break. But he won’t be getting a tax write-off or building up any equity. After considerable

agonizing, Wilbur decides to buy the house. How is Wilbur likely to reason, and feel, after he makes his decision?

11. We've examined the role that cognitive dissonance might play in leading us to ignore disconfirming evidence or to attack those who present it. First explain how this works. Then explain how the reduction of such dissonance is related to the straw man fallacy, the ad hominem fallacy, and confirmation bias.

Answers to Selected Exercises

1. Many Jews in Germany and other European countries saw signs of terrible danger as the Nazis came to power. But many of them made little effort to leave. It would be very hard to get out of the country, and it is difficult to reconcile your worst fears with many other beliefs you have. And once you have decided to stay, post-decision dissonance reduction is likely.

2. Many of the people who worked in the concentration camps saw themselves as good, decent human beings, even after the war was over. How could this be? One common finding is that those who worked in the camps came to see their victims as less than human. When you treat someone badly, there is a tendency to derogate them, to think "well, they deserved it." How could this reduce dissonance?

3. Suppose you were a heavy smoker when the Surgeon General's report about the dangers of cigarettes came out in 1964. How would you react? The report was careful and thorough, a good authority. But you might be inclined to disbelieve it (otherwise you would face the dissonant thoughts: I care about my health; smoking is bad for me; I smoke.) A study done at the time showed that only 10% of nonsmokers doubted the report. 40% of heavy smokers did.

4. Recall the different perceptions students had of the Princeton-Dartmouth football game. How might dissonance reduction be involved in the very different interpretations they had of this game? Our beliefs and values influence what we focus on and how we interpret it. Seeing things in ways that fit with our views is one way to reduce (or prevent) dissonance.

5. The more difficult it is to become a member of a group (e.g., because it costs a lot of money, because of harsh hazing practices), the more people who do become members tend to value it. "I went through hell to get into this group. It must be worth belonging to."

6. Suppose you are strongly tempted to cheat on the final for this course. Once you have decided what to do, you will probably experience some

dissonance. Why? How might you reduce it? Judson Mills did a study of cheating with sixth graders that helps answer this question.

1. Those students who had succumbed to the temptation developed a more lenient attitude toward cheating.
2. Those students who had resisted the temptation developed a more negative view about cheating. (Why?)

7. If people change their attitudes more when they do things for small rewards, what effects might punishment have on attitude change? Aronson and his coworkers found that mild threats of punishment were more effective in changing attitudes than harsh threats.

    1. They hypothesize that if a person does something solely because they fear a severe punishment, they don't come to change their attitudes about it. They do it because the punishment would be severe, not because of the attitudes that they happened to have.
    2. If they do something when there is only a mild threat of punishment, they can't so easily explain their behavior by the present of a strong external inducement.

Part VIII

Evaluating Hypotheses and Assessing Risks

Part VIII. Evaluating Hypotheses and Assessing Risks

In Chapter 20, we examine the scientific investigation and how it helps us move from claims of correlation to those of causation.

In Chapter 21, we study risks, the misperception of risks, and ways to more accurately assess the riskiness of various actions and projects.

Chapter 20

Critical Reasoning and the Scientific Method

Overview: Science is a complicated human practice, and there are many different sciences. No simple account can do justice to all aspects of every scientific field, but we will examine the main features that are present in most. We will also see that many of the tasks that confront scientists also confront ordinary people when they attempt to understand the world around them, including other people and even themselves. In doing this we will take a closer look at how we move from claims of correlation to those of causation.

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20.1 Science

The key feature of *genuine science* it that its claims are testable, in one way or another, but various other factors also play a central role. No simple account can do justice to every aspect of every scientific field, but we will examine several features that are central to most of them. These include:

1. Formulating theories or hypotheses (often about causation)
2. Making predictions
3. Testing
4. Getting data (sampling)
5. Drawing inferences from sample to population
6. Assessing covariation (correlation)
7. Explanation

Some items on this list are more important in some sciences than in others, but much science involves some version of most of them.

We have studied several of these topics in earlier chapters, but it is worth revisiting them in the context of *scientific investigation*. It might be helpful to think of the above list as something of a flowchart, in which one moves through the steps numerically, but you should also keep in mind that in the things can be trickier in the real world. While the best place to start is by formulating a hypothesis, we sometimes just don't know enough about an issue to do this, and instead we must start with data collection. In the context of medical research, we call this a *study in nature*. Researchers who are not yet at a point where they are prepared to test a product or procedure will observe subjects suffering from a disease or condition to try to infer causes or potential solutions (so skipping to steps 4 & 5 above). Only then are they able to develop a hypothesis, make a prediction, etc.

20.2 Formulating Hypotheses

The first thing we need to do when engaging in scientific investigation is formulate a hypothesis. A hypothesis is an idea or claim that we think might be true and we want to investigate further. Philosophers of science refer to the forming of that first idea or hypothesis as the *context of discovery*. Ideas can come from anywhere, and as a result there is no methodology for developing a hypothesis. Why you developed a hypothesis will be a function of your psychology, your interests, the regional and historical context you are in, and so forth. In the (fictional) account you probably remember from grade school, Isaac Newton was said to have been struck on a head with an apple. For whatever reason, this made him wonder if there might be fundamental forces at work that control motion. Why? Who knows? This event was the context of discovery for Newton's theory of gravity.

With that initial idea in place, we move to the *context of justification*. It isn't enough that we have an idea that we think might be true, we need that idea to be one that we can test in order to justify it. Phrasing the hypothesis as a claim that can be determined to be false through testing is important. Smoking causes cancer, an object in motion remains in motion unless an outside force acts upon it, and social distancing reduces Covid-19 transmission are all examples of testable hypotheses.

20.3 Making Predictions

Before we can move on to data collection, we need to know what data we are looking for. To do this, we take our hypothesis and ask ourselves, "if this is true, what should we expect to see?" These expectations about what the world should look like if our hypothesis is true are our predictions. A prediction typically takes the form: if such and such test conditions are realized, then such and such should result. The more precise our predictions are, the easier it will be for us to collect and evaluate our data, but this may not always be possible. If we are making predictions about something we already know a lot about, we are often able to be relatively precise, "we expect to see this drug reduce HIV transmission rates by x" is a prediction, but so is, "we expect to see lower cholesterol among vegans compared to non-vegans".

20.4 Testing Hypotheses

Ok, so we have a hypothesis, and it has yielded some predictions. Now they need to be tested. But what does it mean to test a hypothesis? A theory or hypothesis is testable just in case some sort of objective, empirical test could provide evidence that it is either true or false.

When we formulate tests, we are figuring out the best way to check if the predictions we made are true. In an experimental test, we can bring about the test condition in a laboratory or some other controlled setting. Experimental sciences employ many experimental tests, but in some sciences (e.g., astronomy, meteorology) such tests are difficult to devise. We can obviously still test hypotheses in these areas, as we have made scientific advances in these fields, but we must bend our tests around observing naturally occurring phenomena instead.

Whenever possible, the way we want to test is with a **controlled experiment**. This involves collecting data on two representative groups – one group, which serves as a baseline, is the *control group*, and the other, that is affected in some way that lets us test our hypothesis, is the *experimental group*. The end result is we can compare the data collected from the control group to that of the experimental group and measure the impact the change in treatment had. For example, in a clinical drug trial, researchers will give one group a new drug, give the other group no drug (or the same drug they've already been taking), and see if those who get the new drug have improved health outcomes.

Not all tests are equally good at evaluating hypotheses. In general, a difficult or severe test of a theory is much better than a weak or easy test. The more unlikely a prediction seems to be before we check it, the better the test it provides of a theory. For example, if your local meteorologist has a theory that predicts it will rain in Seattle sometime this coming April, we won't be bowled over if this comes true (we all knew that it would rain at least a little sometime during April, long before we ever the meteorologist's theory). But suppose their theory predicts that it will rain between nine and nine and a half inches in Seattle between noon and 1 pm on April 7. If this happens, we are surprised, and take it to provide strong—though not conclusive—support for the theory: it must have something going for it, to get something like this right. Other things being equal, predictions that are extremely definite and precise provide a better test of a theory than predictions that are indefinite or vague.

What we really want, though, is a *falsifiable* hypothesis. A theory or hypothesis if falsifiable just in case some sort of objective, empirical test could show that it is false. The reason this is preferable is because, if we can run a test that may show our view is false, but the test *doesn't* show that it is false, then we have good reason for thinking this view is true. The same isn't the case for tests that only yield positive evidence for a view. Positive evidence is pretty easy to come by. No matter how much positive evidence we have, we need to keep in mind that there always might be negative or disconfirming evidence out there. We can even find positive evidence for hypothesis we know are false. There is positive evidence that Santa Claus is real, for instance (there he is, at the mall).

A hypothesis is *falsifiable* if it is possible to prove it false

An additional kind of falsifiable test is a *critical test*. A critical test is one where two theories are pitted against each other. Critical tests are not particularly common, but what is great about them is that at the end of the process we have strong reason to support a hypothesis and strong reason to reject another.

It is important to keep in mind that theories can't be conclusively falsified because when predictions don't turn out to be correct, the result can be pinned on one of the *auxiliary hypotheses*. An auxiliary hypothesis is a background assumption used in testing a theory or hypothesis of interest. Every test of any interesting scientific theory involves auxiliary hypotheses (e.g., about the workings of the measuring devices one employs, the presence or absence of various disturbing influences, and so on). This is not to say that we should never set aside a hypothesis or conclude that it is false. After a failed test, we should go back and check all auxiliary hypotheses. If they seem to be reasonably supported (the equipment is in good working order, etc.) we will have reason to discard the hypothesis.

20.5 Getting Data & Drawing Inferences

We studied samples and populations in Chapter 15, and we can quickly recall the basic points here. We often infer a conclusion about a population from a description of a sample that was drawn from it. When we do:

1. Our *premises* are claims about the *sample.*

2. Our *conclusion* is a claim about the *population.*

For example, we might draw a conclusion about the percentage of people who favor sending troops to a certain region from premises describing the responses of 700 people to a poll on the subject. In such a case, our inference is not deductively valid. It involves an inductive leap.

But if we are careful in our polling, our inference can still be inductively strong. This means that if we begin with true premises (which here means a correct description of the sample), we are likely to arrive at a true conclusion (about the entire population).

A *good inductive inference* from a sample to a population requires:

1. A large enough sample.

2. A representative (unbiased) sample.

These same principles apply when we are sampling as a part of scientific investigation. All things considered, we want larger samples, keeping in mind that there are information costs the larger a study gets. The larger a sample we test on, the longer the study will take. So, when testing time-sensitive treatments (like vaccines for Covid-19) we might decide to test a smaller sample in the interest of getting a drug to market faster. We also need to keep in mind that if a sample is restricted to a certain group (age, gender, socio-economic status, etc.) the results will only be understood as applying to that population. More diverse populations will give us more universal conclusions.

20.6 Assessing Correlation and Claiming Causation

As we discussed in Chapter 15, it is a common mistake to confuse correlation with causation. In analyzing the data, we get from testing our hypotheses, we are looking to move from mere observation of correlation to understanding causation. How we do that is tricky, though. In this section, we will first look at some complicating factors and outright mistakes people make when looking to claim causation and then we will turn our attention to some methods that work well.

correlation ≠causation

20.6.1 Bad Causal Reasoning

As with other sorts of reasoning, causal reasoning can go awry in many different ways, but there are several patterns of defective causal reasoning that are common enough that we should discuss them here.

Post Hoc, Ergo Propter Hoc

This Latin phrase (usually shortened to 'post hoc,' still turns up often enough that it's worth learning it. It means: after this, therefore because of this. We commit this fallacy when we conclude that *A* caused *B* simply because *B* followed *A*.

When we put it this way, it is likely to seem like such hopeless reasoning that it isn't really worth warning about it. Day follows night, but few of us think that day causes night. There are many cases, however, where it really is tempting to reason in this way. For example, we sometimes take some action, discover the outcome, and conclude that our action led to the outcome. We encountered numerous cases of this sort when we learned about regression to the mean in 16.7.1).

Post Hoc fallacy: assuming a causal relation because one thing follows another

For example, if the institution of a new policy is followed by a decrease in something undesirable or an increase in something desirable, it may be tempting to conclude that the measure caused for the shift. The crime rate went up last year, we added more cops or passed tougher sentencing laws, and this year it came back down to its normal level. In many cases this return to normal might have occurred without the measure, simply as a consequence of regression to the mean. In such cases, we are likely to *explain* the reduction in crime by the increased number of police or the new laws, but we will be wrong, and the new measure will be given credit it doesn't deserve.

As a final example, when some people recover from a given illness after taking a certain drug, it is tempting to conclude that the drug caused their recovery. But might they have recovered anyway, without the drug? In many cases, people do. Here we need to compare the rate of recovery among those who take the drug with the rate among those who do not. In many cases, the best way to do this is with a controlled experiment. The connection here may just be an illusory correlation (Chapter 15), and if it is, there is no interesting causal connection here at all.

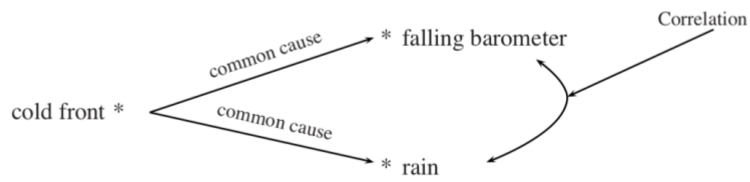

Figure 20.1 Common Causes

Common Causes

When two sorts of things are positively correlated, it is sometimes the case that one causes the other. But we reason badly when we take a correlation between two things to show that one causes the other. When we studied samples and correlations (Chapter 15) we noted that correlations between two things are often based on some third, common cause. For example, there is a *positive correlation* between a falling barometer and a rainstorm, but neither causes the other. They are the joint effects of a common cause: an approaching cold front.

Separating Cause from Effect

Sometimes the problem here is described as *confusing cause and effect*. How could anyone have a problem with this? Isn't it usually obvious? Yes, very often it is. But in complex systems it is often difficult to determine what causes what.

Families with a member who is schizophrenic tend to be dysfunctional in various ways. But does the schizophrenia lead to familial problems or do the problems lead to the schizophrenia? The answer needn't be simple. In addition to these two possibilities, it may be that there is some third, common, cause. Or it may be that each thing makes the other worse. There may be a sort of vicious circle with a *feedback loop*.

Feedback Loops

Feedback loops occur when the output of a system is then used as input for the same system. These loops make it tricky to engage in causal reasoning because they entangle cause and effect. Take for example temperature change and melting snow and ice. As temperatures increase snow and ice melt, which reveals more earth. The exposed ground is less reflective and absorbs more heat, causing temperatures to rise, which itself causes more snow to melt. We end up with a system where rising temperatures melts snow and ice, but melting snow and ice cause temperatures to rise. So, which is the cause, and which is the effect? That way of thinking is wrongheaded because of the feedback loop. The only correct way to understand causation in this case is by looking at the system as a whole and seeing them as entangled.

Confounding Variables

In other cases, a number of things go together in ways that may make it difficult to determine exactly what causes what. For example, people of color receive worse health care, as a group, than white people. But it is sometimes argued that this isn't a direct result of racial discrimination but of economic differences (which often are a result of discrimination), lack of good health insurance, or yet other factors. The more involved a system is, the more complicated things are, and the less likely it is that any single cause can be identified (although in the above example, it is going to be the case that addressing discrimination and systemic injustice would address much of the problem).

Causal Schemas

One final aspect of bad causal reasoning to keep in mind is the existence of causal schemas. A **Causal schema** is a cognitive short cut that we have developed to help us explain commonplace cause and effect. If your mom always cooks you breakfast in the morning, and you wake up and see breakfast on the table, you will immediately conclude that your mother was the cause of breakfast. We rely on causal schemas all the time. If we didn't, we would constantly be starting from scratch trying to figure out how we find ourselves in the situations we are in. Taking into account the *information cost* of reinvestigating everything all of the time causal schemas are necessary in everyday life.

When we really need to understand cause and effect, though, casual schemas can get in the way of the truth. This is because the whole purpose of causal schemas is to allow us to skip investigation, but the only way we can know is if we investigate. Consider the breakfast example above. While your mother is the person who has always prepared breakfast in the past, it is possible that your father, sibling, or a bizarre home invader made the meal. It is also important to keep in mind that our causal schemas are only as good as the investigation that went into forming them in the first place. Inaccurate beliefs lead to inaccurate schemas.

20.6.2 Mill's Methods

Mill's methods are techniques designed to help us isolate the genuine causes from a list of potential causes. They are often called *eliminative* because they pinpoint the true cause (when they do) by eliminating potential causes that aren't genuine. These techniques get their name from John Stuart Mill (1806–1874), the British philosopher who systematized them. They weren't invented by Mill, though, since people who engaged in careful causal reasoning always employed similar strategies.

Mill's methods: five strategies for establishing causation

Mill's methods are not magical. They cannot pinpoint causes in a vacuum. They require us to make substantive assumptions about the sorts of things that might have caused a given event or type of event. In many situations we can do this with a reasonable degree of confidence, so the methods are often useful. But they are not foolproof; causal reasoning is inductive reasoning, and so it is subject to standard inductive uncertainty. To that end we need to remember, as always, to remain fallible about the conclusions that we draw using these methods.

Method of Agreement

Basic Idea: We need to focus on things that are the same, that agree between cases. If a potential cause *A* is present when an effect *E* is absent, then *A* isn't the cause of *E*. If we can *eliminate all but one* of the potential causes in cases where *E* occurs, then the remaining potential cause is the actual or genuine cause.

A B C→E
A D C→E
A B D→E
A

Examples

> *Bad Oysters:* You and several friends get sick after going out to eat together. You each had different entrées and cocktails, but you shared the raw oyster appetizer. You can eliminate all food and drinks you didn't all have as causes for the food poisoning.
>
> *Toxic Relationships:* Every relationship Steve has been in is unhealthy. Steve and his various partners fight until eventually they break up. The thing common in all of the toxic relationships is Steve. We are left to conclude Steve is the cause of the relationship problems.

Method of Difference

Basic Idea: We need to focus on what is different between cases. If an *effect of interest* occurs in one case but not in a second, look for a potential cause that is present in the first case but not in the second. If you find one, it is likely to be the cause (or at least part of the cause).

A B C→E
A B C→E
A

Examples

> *Getting your car to start:* If your car started yesterday but won't start today, we need to think about what might have changed. If it was 50 degrees yesterday and today it is 20 degrees, it might be that the colder temperature is preventing your car from starting.

Allergic reaction: You go into your backyard to enjoy the beautiful flowers that your partner has planted. Before long, your eyes begin to water, and your nose starts to run. You go back inside. Soon, the symptoms subside. It is likely that the difference in your environment – flowers versus no flowers – were causing your symptoms.

Baking a Cake: If the first time you made a cake it was pretty good, and the second time not so much, you should think about what you did different. If you decided to substitute salt for sugar the second time, that difference is likely to be the cause of it tasting less good.

Joint Method of Agreement and Difference

Basic Idea: We are *combining the previous two methods*. So, we are looking to see what is different between cases with different outcomes and what is the same about the ones that have the same outcome. If *A* is always present when, but only when, *E* is present, then *A* caused *E*. When agreement and difference were considered apart, we could conclude likelihood of causation in each case. Now that we have combined them, it seems even more likely we can conclude causation because *A* looks to be necessary and sufficient for *E*.

Examples

Test Prep: All the people who took the Wilburton Prep course for the LSAT (a test used in making decisions about admissions to law schools) were accepted by the law school they wanted to attend. But none of the people who applied to the same law school but didn't take the course were accepted.

Bad Oysters Part II: This time everyone decides to order the same entrées and cocktails, but after the bad experience last time only half of you ate the raw oyster appetizer. Again, some of you get sick. It turns out only the people who ate the appetizer got sick. Now you can see that everyone who ate the raw oysters got sick and nobody who didn't got sick.

Toxic Relationships Part II: Every relationship Steve has been in is unhealthy. Steve and his various partners fight until eventually they break up. After moving on from Steve, all his partners find themselves in loving healthy relationships. The thing common in all the toxic relationships is Steve, and once Steve is absent the toxicity does not manifest. We now have more evidence that Steve is the cause of the relationship problems.

Method of Residues

Basic Idea: Sometimes we have a complicated situation with several causes and outcomes. If a number of factors are thought to cause a number of outcomes and all of the factors have been matched to outcomes except one, then the remaining factor can be understood as the cause of the last outcome. Basically, we can *disentangle things by narrowing* our focus to the things left in the group that have not been matched.

Example

> *Sick at the Fair:* You notice that every year after attending the State Fair you have a stomachache, you're woozy and light-headed, and your skin feels very hot. You think about what a day at the Fair is normally like for you. It seems that your day at the fair invariably falls on a hot, sunny day which is too bad, since there's very little shade and you never remember to wear sunscreen. The bathroom situation is always disgusting, so you avoid drinking as much as possible, to avoid having to use it, but you do spend the day stuffing yourself with deep-fried everything.
>
> So, you have three symptoms, a stomachache, light-headedness and a sunburn and three causes, long hours in the sun, gorging on greasy food and not drinking water. You quickly piece together that the greasy food caused the stomachache and the hot sun lead to the sunburn. As they are the only things left, the failure to drink water must have caused the light-headedness (although you might notice that there is also a *feedback loop* at play, here, as the hot sun that lead to the sunburn also accelerated the dehydration when you didn't drink).

Method of Concomitant Variation

Basic Idea: This method is related to our earlier discussion of correlation (Chapter 15). It is relevant when different amounts or rates of something are involved. The word 'concomitant' is not as common as it was in Mill's day, but it simply means accompanying. This method applies when an increase in one variable is accompanied by an increase in the other. If the amount of outcome *E* increases as the amount of event *A* increases, then *A* likely causes *E*.

Examples

> *Cigarettes:* Aiko has recently started smoking. She has found that the more cigarettes she smokes, the more headaches she has. The method of concomitant variation tells us the cigarettes are the likely cause of the headaches.

> *Podcast:* A few months ago, Aadesh found a new podcast he likes. He has gone from listening occasionally to consuming the hundreds of past episodes and new ones as soon as they come out. Over this same time, people close to Aadesh observe that he has begun to make misogynistic comments with increasing frequency, proportional to the amount of time he spends listening to the podcast. The method of concomitant variation tells us that the podcast is amping up Aadesh's misogynistic rhetoric.

20.7 Giving Explanations

The last step of our scientific process is incorporating what we have learned into what we already know in order to better understand the world around us. In many ways, this is the easiest part. We thought something might be true, and now we either know it isn't or we have stronger reasons for believing that it is. Our new understanding in turn lets us interact with the world in new ways that can have a profound and positive impact.

Learning about things and understanding how they work can often be rewarding in and of itself, but it is vital if we are to deal successfully with the world around us. If we understand how things work, we will be able to make more accurate predictions about their behavior, and this will make it easier for us to influence how things will turn out. If you understand how your computer works, you will be in a much better position to fix it the next time it breaks down.

On a more global scale, we have seen time and time again that the results of the process outlined in this chapter can have a profound impact on life as we know it. In ancient times, diseases were often attributed to supernatural causes, e.g., demons, but such theories did not provide very effective ways to treat or prevent disease. The work of Louis Pasteur and others toward the end of the nineteenth century led to the germ theory of disease. This theory allows us to understand the causes of many diseases and to explain why they spread in the ways they do. And this understanding in turn led to vaccines and other measures that allowed us to eliminate some diseases and curtail the spread of others.
The stakes for successful understanding can be very high. That is why we need to be careful to not overstate what we know.

The Explanation Reflex: Telling More Than We Can Know

The benefits of understanding create a strong desire in us to be able to explain things. Way back in Chapter 1, we learned that this desire is called the *explanation reflex*. It can be very hard to accept that we don't understand something, or that we don't understand it well enough to be able to make informed decisions. This is why we often prefer a bad explanation to no explanation at all. The willingness to accept any explanation over no explanation is what leads us to accept illusory correlations and the illegitimate causal arguments discussed in section 20.6.1. The explanation reflex is good, as it is what drives us to investigate in the first place. We just need to be careful that we don't let it lead us to overstate what we know.

The Illusion of Explanatory Depth

The pull to understand is often so strong, it can lead us to believe that we understand far more than we do, and to believe we understand those things in far greater detail than we do. Researchers Leonid Rozenblit and Frank Keil have labeled these interrelated beliefs the **illusion of explanatory depth**. We've all had the experience of listening to a parent, uncle or some other blowhard talk about a complex issue (single payer healthcare, the electoral college, or car repair), only to be left feeling like they don't quite understand what they're talking about – and it's likely that they don't. They have a superficial understanding of the subject that they have rounded up in their minds to a much deeper level of knowledge. What is important to remember is that we are all doing this to some extent – certainly more than we realize.

Illusion of explanatory depth: The belief that we understand things far better than we actually do

Rozenblit and Keil first demonstrated the illusion of explanatory depth not by asking people to explain complex systems, but by focusing on everyday objects. Subjects were asked to rate the extent to which they understood how zippers, toilets, and ballpoint pens worked. Then they asked the subjects to explain in as much detail as they could how those objects worked. It turned out that virtually nobody could explain these objects in much detail (which led them to revise their beliefs about how well they understood them). This might seem funny (and it kinda is), but you should stop reading for a second and see how well *you* can explain how these things work.

The illusion of explanatory depth should be setting off alarm bells for you by now. If you've spent most of your life mistaken about how well you understood how zippers worked, what makes you think you understand far more complicated systems about which you have strong beliefs.

We can take a key lesson away from this discussion. When someone has a strong opinion about something, we should always ask for an explanation of the matter (this goes for our own beliefs, as well as other people). The next time your uncle is pontificating about why a single payer healthcare system won't work, don't argue with him. Instead, ask him to explain how such a system works, what exactly the problems are with it, how his preferred system works, and how it addresses the problems with single payer.

Be Mindful of Bias

Lastly, it is important to keep in mind all the ways we are susceptible to error when integrating new information into our past understanding. In past chapters, we have discussed the various ways that we have trouble processing criticism and accurately assessing information that runs counter to our current views. Remember also that we are susceptible to confirmation bias, belief perseveration and all the other biases and pitfalls discussed in sections IV, VI and VII.

The key to success on the explanatory level is to remember to be fallible. Investigation might reveal our current beliefs to be flawed. That's ok. Every time we're confronted by disconfirming information, we have an opportunity to refine our views and come to a more accurate understanding. This is a good thing.

20.8 Chapter Exercises

1. Thinking back over sections IV, VI, VII, and VIII, what are some biases and pitfalls that can impede our ability to successfully integrate new integration into our belief systems?

2. How would you go about testing the following hypotheses?

    1. Your mother loves you.

    2. The stove is hot.

    3. That fungus will go away if you use this foot cream.

    4. That fungus is caused by walking around in wet socks.

    5. This vaccine prevents Covid-19.

    6. I will like my favorite band's upcoming album.

    7. My favorite band's upcoming album will be a commercial success.

3. Explain which versions of Mill's methods are involved in the following cases, and assess the plausibility of the arguments that make use of them.

    1. Wilbur: In recent years, several states have enacted right-to-work laws (laws that make it illegal for workers to have to join a union). Each of those states soon began collecting more tax dollars. Our state budget is about to be cut, and tuition fees at state schools are

about to go up yet again. So, we need to pass a right-to-work law here.

2. Wilma: That's not right. In some states where a right-to-work law was passed, state tax revenues increased, but in other states that passed such laws, tax revenues decreased. We do need a better budget, but this shows that passing a right-to-work law isn't the answer.

3. On Thursday, Wilbur drank many rum and cokes, and woke up the next day feeling dreadful. On Friday, Wilbur pounded several bourbon and sevens, and woke up the next morning feeling awful. On Saturday, Wilbur switched to gin and tonics (and had quite a few) and felt like death the next morning. Sunday afternoon, Wilbur reflected on the past few days and drew the following conclusion – he must have some sort of carbonation allergy.

4. In the following exercises, list some potential causes of the effect that is singled out, and explain how you might use one or more of Mill's methods to try to pinpoint the actual cause.

   1. You have successfully raised tomatoes each of the last four years, but this year almost all your crop is going bad, with tomatoes dying before it's time to pick them.

   2. Your four-year-old twins, Wilma and Wilbur, go to the same day care center and spend much of the rest of their time together. But Wilma has come down with measles while Wilbur has not. Why? How might Wilma have gotten it? How did Wilbur escape?

   3. Wanting to use up some milk and eggs that are nearing their expiration date, you serve your family a brunch of quiche, blueberry muffins, and eggs benedict. Everyone gets sick. Using the following data, which ingredient was the most likely culprit?

      - Quiche: 2 eggs and ½ c. milk per serving
      - Muffins: 1/6 egg and 1/6 c. milk per serving
      - Eggs benedict: 1 egg per serving; 1 T. milk

      - Your partner ate a slice of quiche and two eggs benedict and got very sick.
      - You had eggs benedict and a muffin and got moderately sick.
      - Your son had several muffins and drank a tall glass of milk and was mildly sick.

Chapter 21

Risk

Overview: In this chapter, we study risks, the misperception of risks, and ways to more accurately assess the riskiness of various actions and projects.

Contents

21.1 Life is Full of Risks

Nothing will be quite the same after September 11, 2001, and that certainly includes how we think about risk. One moment things were fine, the next moment disaster struck. Indeed, the bulk of the revisions to this edition of the text were completed during the Covid-19 pandemic. More than 16 and a half million had people contracted the virus and more than 650,000 of them died by the time we finished editing, at the end of July 2020 (who knows what the final numbers will be, as the numbers shows no sign of slowing). People lost their jobs, and as a result, their homes and cars. People already living on the margins became homeless.

There is no way to avoid all risks

It was a sobering reminder of how risky life can be and of how little, sometimes, we can do to avoid those risks. But these tragic consequences also emphasize the importance of doing what we can to avoid life's dangers and mitigate harm when risk is unavoidable. In this chapter, we will learn how to distinguish the big risks from the small ones, and we will develop some tools for thinking about risks.

Everything involves some risk. Even if you stay home in bed with the covers pulled up tight, accidents can still befall you. Every year, thousands of people are taken to emergency rooms after falling out of bed. Some risks are serious, and we should take precautions to avoid them. Other risks are overblown, and we just make ourselves miserable if we dwell on them. The trick is to learn how to tell the difference.

Before proceeding, take the following pretest. Indicate which of the two items on each row you think causes more deaths in America each year; you might also indicate how much more likely you think one is than another (answers are given at the end of the chapter).

Pretest

1. Diabetes	vs.	homicide
2. Suicide	vs.	homicide
3. Asthma	vs.	tornado
4. Lightning	vs.	flood
5. Lung cancer	vs.	heart disease
6. Stomach cancer	vs.	rabies
7. Homicide	vs.	stomach cancer
8. Suicide	vs.	syphilis

There are many sorts of risks: health risks ("Is rabies really a danger?"), physical risks ("Is skydiving more dangerous than rock climbing?") job risks ("What are the chances that a new restaurant will go under within the first year?"), financial risks ("What if I buy stock in a company that goes bankrupt?), crime risks ("What are the chances my car will be stolen?"), social risks ("Will I be a social outcast if I tell people what I really think about gun control?"), sexual risks ("How reliable are condoms?"), environmental risks ("How real is the threat of global warming?"). You name it, and there's a risk involved.

We will touch on various sorts of risks, but to keep things manageable we will focus on causes of death and types of crime, with a bit on some other risks you encounter frequently. But the tools we develop for thinking about these types of risks apply equally to all the other types of risk.

21.2 Describing Risks

We understand risks better when we can describe them in rough numerical terms (e.g., about one person out of every forty-two is killed in an automobile accident). Precise numbers don't really matter; ballpark figures are enough. It won't matter to most people whether 37,000 people out of a hundred million or 43,000 people out of a hundred million die each year from lung cancer. But it does make a difference when its 37,000 people out of a hundred million or 370 out of a hundred million.

It will make things more realistic if we work with some actual numbers, so we will use Figure 21.1 below, which gives the leading causes of death among all Americans in 2015 (the most up to date data available at the time of this writing). These figures are based on a report released by the National Center for Health Statistics (the number after each cause of death is the actual number who died; data are based on a review of death certificates).

21.2.1 Risk Ratios

Risks are reported by fractions. They are numbers from 0 to 1, and they can be interpreted as *probabilities*. We will call these risk ratios. In the case of death rates, the risk ratio is given by a fraction:

$$\frac{\text{Number of Deaths}}{\text{Number in Target Population}}$$

In the case of deaths, the numerator is clear cut; it is simply the number of people who died from a given cause. But the denominator is less clear cut, and in many cases, there will be different ways to express it. For example, in assessing the risk of hang gliding, would we want to express the number of deaths per (over) people who went hang gliding, or the number of hours spent hang gliding? We will return to this important point below. But in the present case we are dealing with conditions that could strike almost anyone, so to keep things simple, we will use the total number of Americans as our denominator.

In the 2010 census the number of Americans tallied just under 309 million. This figure is low, since several million people weren't counted, and the population has risen since then. If we were aiming to do perfectly accurate risk assessment it would be important to be as precise as possible. Since we

1. Heart disease: 633,842
2. Cancer: 595,930
3. Lung disease: 155,041
4. Accidents: 146,571
5. Strokes: 140,323
6. Alzheimer's disease: 110,561
7. Diabetes: 79,535
8. Influenza and pneumonia: 57,062
9. Kidney disease: 49,959
10. Suicide: 44,193
11. Blood poisoning: 40,773
12. Chronic liver disease: 40,326
13. High blood pressure: 32,300
14. Parkinson's disease: 27,972
15. Lung damage from inhalation of foreign substance: 19,803
16. All other causes: 538,539

Figure 21.1: Causes of Death in America in 2015

are just learning how to do these things we'll round the population to 300 million to make the math easier. So, we express the death rate for a given medical condition as:

$$\frac{\text{Number of Deaths from Condition}}{\text{Total Number of Americans}}$$

Which is:

$$\frac{\text{Number of Deaths from Condition}}{300{,}000{,}000}$$

So, for example in 2015 633,842 people died from heart disease, so the death rate for heart disease is:

$$\frac{633{,}842}{300{,}000{,}000}$$

Numbers with such large denominators are hard to comprehend. It is possible to round such fractions off and reduce them down to more meaningful numbers, but this can take time. We can also use a calculator to divide the numerator by the denominator. This gives a decimal value which is in fact the probability or frequency of a heart attack death. In 2015, this probability number was 0.0021. But this number is so small that it's hard to comprehend. We need a more user-friendly way to express these numbers.

Deaths per Million

It is often clearest to express risk statistics in terms of number of deaths per million, per hundred thousand or the like. This also makes it easier to compare risks. The general formula for this is just:

$$\frac{\text{Number of Deaths}}{\text{Number in Target Population}} \times c$$

where *c* is the common denominator, we use for all of the risks. For example, if we want to express the risk ratio as number of deaths per million, then *c* is one million (1,000,000). If we want to express them as number of deaths per hundred thousand, then *c* is one hundred thousand (100,000).

The choice of *c* is a matter of convenience: select a number that will make the resulting figures as easy to understand as possible. When we are talking about the entire United States, thinking in terms of deaths per one million or even per hundred million makes sense. But if we were thinking about death rates in Norman, OK, a smaller number, like deaths per one thousand, would be easier to understand. The number of heart disease deaths per million people is:

$$\frac{633{,}842}{300{,}000{,}000} \times 1{,}000{,}000$$

which is approximately 2,113 per one million people. In 2015, 2,113 people out of every one million died from heart disease.

Exercises

1. Express the death rates for cancer, stroke, diabetes, and suicide:

    1. as a fraction

    2. as a probability

    3. in terms of number of deaths per million people

    4. in terms of number of deaths per hundred million people

Finding a Useful Denominator

Since you probably won't be compiling risk tables anytime soon, you won't have to make decisions about the best denominator to use. But you do need to think about the issue, so that you can more easily interpret figures that you read.

If we are thinking about the relative risks of rock climbing and driving a car, it won't be very useful to express them in terms of the number of deaths (or injuries) out of all 300 million people living in the United States. If we do this, driving a car will look much riskier, since so many more people drive. Instead, we want a denominator that reflects just the actual number of people involved in each activity. We could use the number of people who go rock climbing each year, so that our ratio is number of injuries, say, per number of rock climbers. We could also express the ratio in terms of the number of hours spent rock climbing each year, so that the figure is number of injuries over the total number of hours people spent rock climbing in a given year.

For example, if 700,000 people went rock climbing last year and 150 of them were killed, the relevant ratio would be 150/700,000 = 15\70,000. Alternatively, we could use the number of hours that people spent rock climbing in 2015. Suppose that it is 900,000. If we do this, we would end up with a figure that told us about the number of deaths per 900,000 hours. We could also use a common denominator figure like we did above, to the number of deaths per 100,000 hours (or 1,000 hours, or whatever makes the most sense). It's useful to try to understand these general ideas, but you won't need to worry about the details of all of this.

When we think about the riskiness of an occupation (e.g., coal mining), we will probably begin with number of deaths per year over the number of people who were coal miners in that year. But these yearly risks are cumulative. So, if we want to know the risk confronting someone who spends their entire working life as a coal miner, we need to multiply this figure by the number of years the average person works (about 40). This gives the risk that a coal miner will die in the mines at some point in their career.

Choosing an informative denominator is largely a matter of commonsense. For example, suppose we are planning a trip to Anchorage, Alaska and are wondering about the relative risk of driving or taking an airline. We could look at the number of deaths per hour for driving and for flying. But since we are interested in the relative risk of driving or flying for the entire trip, it makes more sense to look at the numbers of deaths per mile. After all, we must travel about the same number of miles with either mode of transportation.

21.2.2 Finding Information about Risks

The United States Census Bureau (https://www.census.gov) has an extensive web site with a huge collection of data (so much that it can be difficult to find what you want). For more data concerning the united states another useful source is the National Safety Council's Injury Facts page (https://injuryfacts.nsc.org). Internationally the Global Health Observatory out of the World Health Organization (https://www.who.int/data/gho) is an excellent resource. But for specific topics, it is often easiest to do an internet search for the specific information you want. Some of it is reliable, some of it isn't; as always, the guidelines for evaluating information on the web in 6.3 is relevant here.

21.3 Health Risks

In general, people tend to *underestimate high* probabilities and *overestimate low* probabilities, and this holds in risk assessment. You hear about rabies shots and cholera shots. These are both serious diseases, and it makes sense to get a rabies shot for your dog, or a cholera shot for yourself if you are traveling to countries where it is a danger. But only 1-3 cases of rabies are reported in the United States each year, and on average there are only 6 reported cholera cases in the U.S. per year. So, it isn't the best use of your time to think about ways to avoid rabies or cholera (not to mention the plague, which sounds terrible, but afflicts only an average of 7 Americans each year and is rarely fatal if treated).

It is true that anyone can be stricken by a rare disease, and it won't be much comfort for that person to hear that their probability of getting it was low. But *everything* we do carries some risk, and we simply can't plan to deal with every risk life offers. The best approach involves two steps, both of which involve probabilities.

1. Identify the large risks in your (or your family's) life.

2. Adopt measures that have the highest probability of helping you avoid those risks.

We have considered the factors that bear on the second issue in earlier chapters, so here we will focus on the first. But one general point is worth emphasizing before turning to details. Whenever people are worried about a risk, someone will come along with a way for you to avoid or reduce it—for a price. If their remedy sounds too good to be true, it probably is. On the other hand, we do know a good deal about how to reduce many of life's most serious risks, and often the ways to do it don't require you to spend any money at all.

21.3.1 The Big Three

Figure 21.1 on death rates in 2015 gives a good indication of the causes of death in America over the recent past (although deaths from COIVD 19 are obviously going to be among the top three for this year). As the table shows, there are three big killers: heart disease, cancer, and stroke. Your chances of being killed by one of these is much, much greater than your chances of dying in any sort of accident, or from anything else. Fortunately, there are also reasonably simple steps you can take to greatly lower your risk from the Big Three.

Heart Disease

When we think of heart-related deaths, most people think immediately of cardiac arrest, or heart attack. But heart disease-which can lead to heart attack-is a much bigger animal. Coronary artery disease occurs when the arterial walls) which carry blood to the heart) become lined with a buildup of cholesterol, causing the pathways to narrow. This means less blood gets to the heart, which means the heart must work harder, and may develop an irregular beating rhythm, which, over time can lead to heart failure. If an already narrowed path becomes blocked by a blood clot, heart attack occurs. And if those clots make their way to the brain, stoke occurs. While even the best-kept heart will eventually wear out, it is well known that certain behaviors increase the risk of heart disease, and lead to it developing earlier in one's life. Smoking, poor diet, and lack of exercise greatly increase one's risk of death from heart disease.

Cancer

Cancer is a blanket term that covers several diseases that involve unregulated growth of cells. The probability that an American male will develop cancer at some point is 1/2, and the probability that an American woman will is 1/3. The causes of cancer aren't fully understood, though there are clearly different risk factors for different types of cancer, so there are no universal precautions. There are however, relatively easy ways to decrease your risk of some kinds of cancer (smoking is a very large risk factor for lung cancer and several other cancers; and spending ling hours in the sun is a risk factor for skin cancer). There are also easy preventative measures against some forms of cancer, For instance, getting your tweens vaccinated against HPV greatly reduces their (or their future partners') risk of getting cervical cancer as adults.

Lung Disease

Like cancer, there are several forms of lung disease, all characterized by breathing difficulties. Although it can be hereditary, it is most often caused by environmental exposures. Smoking is the highest risk factor, but exposure to dust, pollen, and chemicals cause it to develop as well. The harm to the lungs caused by these irritants accrues over many years, and by the time its effects are noticeable, the damage is often irreversible. Wearing face coverings to protect against inhalants might seem like overkill when you're young, but it could ad years to the end of your life. When we're young, we don't worry too much about catching infections that we're confident we'll recover from. But the bronchitis you bounced back from when 20 left you just that much more vulnerable to more serious problems later in life.

Other Causes of Death

Some of the other leading causes of death will probably surprise you. For example, pneumonia and influenza are eight on the list, diabetes is seventh, and blood poisoning isn't all that far behind.

Risk Factors

It is always possible to get more informative risk ratios by making the target group more precise. Instead of looking at the rate of strokes in the entire population, we could look at the rate of strokes by age group, e.g., from 20-30, 21-40, etc. There is a tradeoff here between more precision and more complicated statistics. But the general idea here is important. Almost one in four Americans will die of heart disease, but the risk is much higher in some groups than in others. If several members of your family had heart disease, your risk is higher; if you are over fifty or overweight, the risk goes up. Again, strokes are the third leading cause of deaths among Americans, but over two thirds of stroke victims are 65 or older.

Just as we can consider smaller subgroups, rather than looking at all Americans, we can consider larger groups by looking at a number of countries, or even at the entire world. This will often change risk factors, since the risks facing people in developing countries are often quite different from those facing Americans. For example, the fifth highest cause of death world-wide in 2016 was diarrheal diseases. They killed 1.4 million people worldwide, but since about 99% of the deaths occurred in developing countries, they don't show up as risk factors for Americans.

If you are really concerned about a given risk factor, you can usually find statistics that break the risk down by groups, and you can see what the risk is for the group you are in (e.g., males between 18 and 28 years of age). But even a simple break down like the one in Figure 21.1 gives us a pretty good idea about risks that can lead to death.

Smoking

Smoking is the single greatest preventable risk factor in America. About 480,000 people die each year from smoking related deaths (this isn't reflected directly in our table, but smoking leads to items, like heart attacks and cancers, that are on the list). Males smokers reduce their life expectancy by over eight and a half years, and female smokers reduce theirs by over four and a half years. Being overweight is also a major risk factor for several of the leading killers (not just heart attacks, but also cancer).

21.4 Crime Risks

In 2018, Bessemer, AL was ranked the most dangerous city in America, with a violent crime rate of 29.8, and a one in thirty-four chance of being a victim.

What are your chances of being the victim of a crime? It depends on many factors: how old you are, where you live, what risks you take. It is possible to break the statistics down for each of these categories, but we won't go into that level of detail here. Two general types of statistics are relevant in thinking about crime: crime rate and victimization rate. Crime rate tracks number of crimes reported relative to a population, while victimization rates track victims of crimes relative to a population. The figures aren't extremely precise, because many crimes go unreported, but they are in the ballpark. Criminologists prefer to focus on victimization rates, because in focusing on victims, we can get more nuanced and precise data, but also, as you likely expect given what you have learned in past chapters, it focuses our attention on people, as opposed to more abstract concepts.

It is important to be clear about the difference between a crime rate and a victimization rate. A crime rate tells us what percentage of people commit a given type of crime, e.g., how many people commit assault. A victimization rate tells us what percentage of people are victims of a given type of crime, e.g., how many are assaulted.

Violent crimes have been decreasing over the past several decades, but they are still a very real risk in many parts of America. In 2018, there were just over 16,000 homicides (considerably less than the number of suicides), about 735,000 rapes, and over half a million robberies. But when you think about risks from crime, you will be more interested in victimization rates. The following table gives the victimization rates in 2018 for several violent crimes; the figures report the number of victimizations per 1,000 persons.

1. Simple assault: 14.6
2. Aggravated assault: 3.8
3. Robbery: 2.1
4. Rape and sexual assault: 2.7
5. Domestic violence: 4.8
6. Auto theft: 4.3

Figure 21.2: Victimization Rates for 2018

But these statistics vary a great deal for different groups. Your chances of being robbed if you work the night shift at the 7-11 are much higher than the national average. Your chances of being murdered if you live in the inner city are much higher than average. The victims of most crimes are most likely to be black, female, poor, young, (12-24), and urban.

Exercises

1. Express the figures in the table of victimization rates (Figure 21.2 on the preceding page) in terms of probabilities.

2. Find the victimization rates for homicide and arson (use the internet).

21.5 Other Risks

21.5.1 Sex

Most of the risks here are well-known and easily avoidable. But lots of people don't manage to avoid them. The two major sexual risks are various diseases, especially HIV, and unwanted pregnancies. At a very base level you can help mitigate these risks by using birth control and protection. Moving past the obvious though, you can work to reduce risks on a societal level. Supporting legislation and college policies that make access to protection and birth control cheap or free would go a long way to lowering your risks, as would providing better reproductive health options to women.

21.5.2 Love and Marriage

There is a very real risk that if you get married you will end up getting divorced. According to the US Census Bureau, the national marriage rate for 2018 was 16.6 and the divorce rate was 7.7. So, for every 1,000 people 16.6 of them were married and 7.7 divorced. Keeping in mind this counts people 15-year-old and over, and there aren't a lot of 15-year olds getting married or divorced. It also is comparing divorces to total population, so a lot of those people not getting divorced were also not married. When looking at marriage data alone, we can see that the average length of a marriage is 8 years. The likelihood of a first marriage ending within 5 years is 20% and within ten years is 33%. Despite these figures, few people think that they will be among the casualties. This isn't a reason to stay single, but it reminds us that nothing is without its risks.

21.5.3 Jobs and Businesses

You are *much* more likely to be injured working in a meat packing plant or on an oil rig than working in a shoe store or an insurance office, but in the modern Western world, most jobs are relatively safe. There isn't a lot of physical risk. Financial risk is a different story, particularly if you are thinking of starting a new business. This isn't to say that you shouldn't start a new business; many prosper and thrive. But one out of five businesses go bankrupt each year, and one out of two new businesses go under within a decade.

21.6 Cognitive Biases and the Misperception of Risk

Many fallacies and cognitive biases lead us to misperceive risks

All sorts of factors make it easy to misperceive risk. The media report certain types of calamities (e.g., people killed in fires) more often than others that are in fact, more common (e.g., drownings). Then too, the grislier cases stick in our minds. And as if that weren't enough, there are people who have a vested interest in exaggerating certain risks (you need more insurance; you must take this special dietary supplement to avoid liver cancer). Finally, risks that are serious (like heart disease) may require big changes in our lives, so it is often tempting to downplay them.

Many of the biases and fallacies we have studied lead us to overestimate the risk of some things and to underestimate the risk of others.

Sample Size and Bias

Whenever we draw inferences from small or biased samples, our conclusions will be unreliable. This is as true when the conclusions are about risks and remedies as it is about anything else.

Neglecting Base Rates

If we neglect base rate information, our estimates of various outcomes can be highly distorted. Often, we hear figures that sound very dramatic, but they sometimes become trivial when we learn about the relevant base rates. A new drug cuts the death rate from the bubonic plague in half. But the base rate of plague is very low (less than four Americans got it last year). Whenever we hear about risks, our first question should always be: *What is the base rate*? Typically, we don't need a very precise answer; a ballpark figure is usually enough.

Availability

If we don't appreciate how large the difference between the probabilities of having a heart attack and the probability of dying at the hands of a terrorist are, even after September 11, it will be difficult to make rational plans about diet and travel. Several thousand Americans will die from heart disease in a year, whereas in every year but 2001, about one in a million Americans die at the hands of terrorists.

Risk information can be available for many different reasons. The media report some things more than others (e.g., fires more than drownings; plane crashes more than car wrecks). Moreover, people you know tend to talk more about some risks than others (if your uncle was recently mugged, you will hear a lot about muggings). Sometimes a particularly vivid and horrifying sort of accident comes to mind more easily simply because it is more frightening. For example, being electrocuted by wiring in your home sounds very gruesome. But only 200 Americans (less than one in a million) a year die from electrocution. By contrast, over 7,000 die from falls in the home. And of course, no one can forget the sight of the twin towers at the World Trade Center collapsing.

Probabilities of Conjunctions and Disjunctions

We tend to overestimate the probabilities of conjunctions and underestimate the probabilities of disjunctions. This means that we underestimate likelihood of failure and overestimate the likelihood of success. This can lead us to underestimate the likelihood of certain risks.

Cumulative Effects

We are prone to underestimate the power of cumulative effects. For example, a contraceptive device may work 99% of the time, but if we rely on it frequently over the years, there is a good chance that it will eventually let us down. Suppose, for example, that you use a brand of condom that breaks 1% of the time. Each time you use one, the chances are low that it will break. But if you use that brand of condom a couple of hundred times, the chances of a failure start to mount up. Similarly, the chances of being killed in an automobile accident each time we drive are low, but with countless trips over the years, the odds mount up.

Coincidence

Wilbur survives a disease that is fatal to 98% of the people who contract it. Wilbur's case is rare, and so people will talk about it, it may make the papers or TV, and so we are likely to hear about it. If we focus too much on the lucky few who survive a disease despite doing everything their doctor warned them not to, we may conclude that the risk of the disease is much lower than it is.

Regression to the Mean

If we overlook regression to the mean, we may think that certain measures will decrease targeted risks, even when they are ineffective and only seem useful because they happened to coincide with regression to the mean. For example, we may overestimate the power of a given policy (like increasing the number of police or enacting tougher sentencing laws) to cut down on crime. This will mean that we have an inaccurate perception of the risks of various crimes and the best ways to combat them.

Illusory Correlation

When we believe in an illusory correlation, we think that changes in one thing tend to accompany changes in another. For example, we may think that certain jobs or occupations have a higher (or lower) correlation with various diseases than they really do. This will lead us to overestimate (or underestimate) the risks of various undertakings.

Anchoring and Adjustment

It is possible to set anchors at unreasonably high, or unreasonably low, probabilities for a given type of risk. Even though we frequently adjust for these anchors, we often don't adjust enough. So, a high anchor can lead us to overestimate the likelihood of a risk and a low anchor can lead us to underestimate it.

Wishful Thinking and Dissonance Reduction

It is often easier to deal with a risk by convincing ourselves that it's not as serious as other people say. When the Surgeon General's first report on the dangers of smoking came out in 1964, only 10% of nonsmokers doubted the report. 40% of heavy smokers did.

It's easy to dismiss a report of a recent study suggesting that one of our favorite foods causes cancer by saying that everything causes cancer and the experts keep changing their minds anyway. This is not an unreasonable reaction to a single study. But many of the greatest health risks, e.g., smoking and heart attacks, are established beyond all reasonable doubt. Unfortunately, the remedies, while having little financial cost, can exact a huge cost in the changes of lifestyle they require. Many people who would pay a lot of money to avoid these risks won't pay the price of lifestyle change. It is easier to downplay the risk.

Framing Effects Revisited

Earlier we learned that people are typically *risk averse* when it comes to possible gains. We prefer a certain gain (say of $10) to a 50/50 chance of getting $20 (even though these alternatives have the same expected value). In fact, many people prefer a certain gain (say of $10) to a 50/50 chance of getting $25 or even more. By contrast, people tend to be *risk seekers* when it comes to losses. Most of us prefer the risk of a large loss to a certain loss that is smaller. For example, most people prefer B (a 25% chance of losing $200, and a 75% chance of losing nothing) to A (a 100% chance of losing $50). How we think about risks often depends on how things are framed.

More specifically, it depends on whether they are framed as gains (200 people are saved) or as losses (400 people die).

When we frame a choice in terms of a certain loss we think about it differently than we would if we frame it in terms of insurance. When we frame a choice in terms of people being saved we think about it differently than we would if we frame it in terms of people dying.

21.6.1 Tradeoffs

Often the only way to decrease one risk is to increase another one. To take a whimsical example first, you will decrease your risks of being hit by a car or falling under a train if you stay home all day in bed. But in the process, you will have increased the risks of injury from falling out of bed, the risk of countless health problems due to lack of exercise, and the risk of being poor since you'll probably lose your job.

The same point holds for risks that are a serious worry. Many illnesses are best treated with medication, and if they are serious you may be better off in a hospital. But hospitals are run by people and people in all areas are prone to error. Research out of John Hopkins University shows that medical error is the third leading cause of death in the US, causing around 250,000 deaths nationwide each year. Further endangering you is the possibility of adverse reactions to prescribed medications. At the end of the day, if you're sick enough, you are better off in a hospital, but it isn't without risk.

The U.S. respond to the Covid-19 pandemic focused on tradeoffs. The safest thing in terms of preventing the spread of the virus and saving lives was for everyone to shelter in place. If everyone did this, though, it would mean that we would not have access to food and cleaning supplies. We needed to balance the harms that came from exposure with the harms of not having access to basic supplies. Evaluating how badly we handled negotiating these tradeoffs is a job best left for an ethics or public policy class, but the argument about how we ought to behave was really an argument about tradeoffs.

21.7 Psychological Influences on Risk Assessment

21.7.1 Individuals Differences

People differ greatly in their attitudes toward risk. Some people enjoy taking risks, and other people will go to great lengths to avoid risks. In general people are more willing to put up with voluntary risks than with risks that are imposed on them. For example, many people are willing to take a fairly large risk when they go rock climbing (since they chose to do it), but they would be very upset by the (probably much lower) risk brought on when the government decides to put a toxic waste dump near their town.

There isn't anything irrational about this; it probably reflects important facts about personal autonomy. But people also tend to perceive something as less risky when it is voluntarily incurred, which is simply a misperception. People are also more tolerant of risks that they have some power to deal with than with risks over which they have no control. Many people feel safer driving a car (control condition) than riding in the passenger's seat (less control). They also perceive such activities to be less risky. People also perceive natural risks to be less severe than human-made risks, and they think of risks involving novel technology or especially dreaded outcomes (like nuclear power facilities) as especially great.

21.7.2 Groups

Later in the book, we will read about the risky shift. The risky shift occurs when people who take part in a group discussion are willing to support riskier decisions than they would individually, before the group discussion.

21.8 Chapter Exercises

1. Here are answers to some of the pretest at the beginning of the chapter. The + indicates that the cause is the more likely of the pair and the - that it is the less likely. Use the information in the Table of causes of death (Figure 21.1) to fill in the number of deaths per hundred million people. The figures for the causes not listed in that table are given below.

    1. 1. Diabetes + 2. Homicide -
    2. 1. Suicide + 2. Homicide -
    3. 1. Asthma + 2. Tornado -
    4. 1. Lightning - 2. Flood +
    5. 1. Lung Cancer - 2. Heart Disease +
    6. 1. Stomach Cancer + 2. Rabies -
    7. 1. Homicide - 2. Stomach Cancer +
    8. 1. Suicide + 2. Syphilis -

The numbers after each cause of death give the approximate number it kills a year per one hundred million Americans.

1. Asthma: 920

2. Tornado: 44

3. Lightning: 52

4. Flood: 100

5. Lung Cancer: 37,000

6. Stomach Cancer: 46,600

7. Rabies: < 1

8. Syphilis: 200

2. How likely would you think it is for someone in the U.S. to die from anthrax in a year? How likely is it for them to drown? You don't need exact numbers, just good ballpark figures. Why are most of us so much more frightened of the use of anthrax by terrorists?

3. First, give your best estimate of each of the following:

    1. Being killed in a car wreck in a one-year period.

    2. Being killed in a boating accident in a one-year period.

    3. Being killed while riding a bicycle in a one-year period.

    4. Being killed in a plane crash in a one-year period.

    5. Being killed in a fire in a one-year period.

    6. Being murdered in a one-year period.

Then go online and find out the actual probabilities. How close were you? Try to explain why you were wrong, in any cases where you were way of the mark.

Part IX

The Social Dimension

Part IX. The Social Dimension

Human beings are social animals, and the thoughts and actions of others have an enormous impact on our own actions and thoughts. In this module, we will examine several aspects of the social dimension of reasoning.

In Chapter 22, we examine the most central, non-rational ways in which other people influence our attitudes and thoughts. We acquire many of our most deeply rooted attitudes and beliefs in the process of growing up in the family and society that we do. As we mature, the pressures of peer groups, professional persuaders (like advertising agents), and authority figures influence our attitudes and thoughts, often without our even realizing it. Social influences often have good consequences, but as cases like the Holocaust show, they can also lead to terrible results. The goal in this chapter is to become more aware of these social forces and to devise safeguards to diminish their power over us.

In Chapter 23, we turn to our attempts to understand and explain human behavior. We will find that people often greatly underestimate the power of the context or situation in which other people act; we attribute their actions to their traits, desires, or abilities, when in fact the situation in which they act plays a bigger role in explaining their behavior. We will also examine the differences between the causes people find for their own actions and the causes they find for the actions of others. The goal in this chapter is to do a better job at explaining why people do the things they do.

In today's world, many people's jobs require them to work as a part of a group; projects are carried out by teams, and numerous decisions are made by committees. Juries, legislative bodies and, most importantly families, are groups that must think about goals and make collective decisions. There is great variability among groups, so we can't expect any simple, blanket conclusions that apply to all of them, but we will see that groups are susceptible to several sorts of biases. In Chapter 24, we learn more about these biases and shortcomings in group thinking and develop ways to avoid them.

The harmful effects of biases and prejudices in our society are all too obvious. There are many reasons why people are biased against members of certain groups, but one important cause of prejudices and stereotypes is *faulty reasoning*. The goal of Chapter 25 is to see how the biases and fallacies that we studied in earlier chapters foster (and help maintain) prejudices and stereotypes. It would be too much to hope that clearer thinking would eliminate such problems, but it would be a step in the right direction.

Social dilemmas are situations in which actions that seem to be in each person's own self-interest lead to outcomes that are worse for everyone. Such situations occur in international relations, countries and cities, families, and two-person interactions. The goal in Chapter 26 is to learn about the causes of such dilemmas and to examine strategies for extricating ourselves from them.

Chapter 22

Social Influences on Thinking

Overview: Human beings are social animals. The thoughts and actions of others have an enormous impact on our own actions and thoughts. Social influences often lead to good reasoning, but when we rely on them too much, or in the wrong context, their influence can be disastrous. They can be the worst impediment there is to clear and independent thinking. In this chapter, we will examine several ways that other people can influence our actions and thoughts and discuss some remedies for the problems that these pose.

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22.1 The Social World

We can't help but rely on other people. Most of the knowledge we have was acquired from others. Most of the goods we own were made by others. In a diverse, highly technological society like ours, we continually must rely on the expert opinions of others. And the most important parts of life for most of us are our relationships with other people. Given the importance of the social world for almost all aspects of our lives, it is not surprising that social factors influence our thinking in profound ways. These influences often promote good critical reasoning. But they also have their dark sides, often leading to poor reasoning; indeed, as Nazi Germany shows, they can lead to beliefs and actions with terrible consequences.

It isn't possible to completely escape such influences but understanding how they work can help us guard against their undue influence. Moreover, to the extent that we are aware of them, we are less vulnerable to those who are willing to use this knowledge for their own ends.

22.2 Persuasion: Rational Argument vs. Manipulation

We often find ourselves trying to convince other people of one thing or another. People in some jobs do this for a living, but no matter what our vocation, we are likely to do it. You might want to convince your teacher that you deserve a second chance on the big exam, or to convince your students that they should care about critical reasoning. You might want to convince someone to go out on a date with you, or marry you, or divorce you. You will almost certainly want to convince your children, once they are old enough to understand, that hurting other people for no good reason is a bad thing to do. In fact, we spend a lot of time and energy trying to convince other people.

There are many different (and often subtle) techniques for persuading people of things. One of the main points in this course is that the best way to do this is by giving them a good argument that employs premises they accept. Why does this matter? If we do this, we treat other people as autonomous adults who we think can make up their own minds. We give them what we think are good reasons, and then let them decide for themselves. But if we try to persuade them in other, non-rational ways, we treat them as objects to be manipulated (I'll say whatever he wants to hear, if it will get him to buy this car) or as children who aren't capable of thinking for themselves ("After all, I know what's best for him").

The latter approach is called *paternalism*. It assumes that other people are not capable of thinking for themselves. This is a very sensible view to take regarding young children, and we often must extend it to adults who suffer from severe mental disturbances or who act in ways that harm others (though there is much debate about just who falls into this category). But it's a very dangerous view to take about adults in general.

Just a little thought about the history of the twentieth century should convince us of the dangers of deciding that others don't know how to reason correctly, or how to decide what is best for them. An easy way to see why this is objectionable is to think about how we would feel if other people treated us as an object to be manipulated or a child to be cajoled and tricked into acting and thinking in the ways others want us to.

Life is too short for us to devote hours thinking about each decision we make. But when the decisions are important, we should think about them for ourselves. Even in these cases, rationality is an *ideal*. In this respect, it is like a good marriage: it's a goal well worth striving for, even though there will be lots of lapses and backsliding, and even on our best days we won't fully achieve it.

Of course, there are many other ways to persuade people. Indeed, we have encountered a variety of techniques that can be quite effective for doing this. One of the most effective ways to do so is to provide what *seems* like a good argument on the surface, but which persuades (if it does) because it takes advantage of various cognitive biases (e.g. our tendency to ignore base rates) or because it appeals to our emotions or self-interest. This is one reason why the study of fallacies and cognitive biases is worthwhile. Our earlier modules cover many of the ways in which bad arguments can persuade us when we aren't careful. We will now turn more directly to the social aspects of persuasion.

22.3 Social Influences on Cognition

There are many ways in which other people influence our own behavior and attitudes. Many of them involve one or more of the following:

Socialization

We acquire many of our most fundamental beliefs, attitudes, and values in the very process of growing up.

Experts

We constantly rely on the views and advice of experts, including teachers, textbooks, and much of the mass media. We have examined the role of experts in detail in an earlier chapter, so we won’t discuss it here.

Mere Presence

Our performance on cognitive tasks is affected by the mere presence of others; even as a passive audience can influence how well we do.

Persuasion Professions

We are targets of people in the “persuasion professions” (advertising agents, lobbyists, politicians, social reformers), who are constantly trying to influence how we think.

Conformity

We are very strongly influenced by the views and actions of our peers (or members of groups we admire).

Obedience

We are all more susceptible to the views and commands of those in authority than we would suppose.

Most of these influences can be useful, and none of them are intrinsically bad. We often must rely on the views of experts; our society wouldn’t do well without rules and authorities with the power to enforce them (though perhaps some of the specific rules are flawed). Sometimes these things only influence our actions, but often they influence our thoughts, attitudes and beliefs (frequently without our even realizing it). In the rest of this chapter, we will examine some of the ways in which these influences operate, and we will devise some safeguards to diminish their power over us.

22.4 Socialization

Most people’s basic picture of the world is largely determined by what they were taught as they grew up. Young and helpless infants don’t have the tools to question the things their parents teach them; until master a certain amount of language, they don’t possess the words or concepts required to frame challenges or doubts. As we acquire language, we get a set of categories and principles for thinking about the world. As we are rewarded and chastised, we acquire a sense of what is right and what is wrong.

In our early years, we absorb many of the beliefs of the people raising us, entirely unaware we are doing so. As we grow older, additional social forces come into play: teachers, peers, the mass media, and so on.

Think of the beliefs that are most important to you. They are likely to include beliefs about things like religion, morality, patriotism, and love. Can you recall a time when someone reasoned with you and got you to change your mind about these matters? Did you ever seriously entertain the thought that some religious or moral views quite different from your own might be true and that yours might be false? If you had grown up in a culture with a very different religion or morality, what do you suppose you would now think about these matters?

Certainly, people sometimes change their views about such matters; some are converted to religion or come to see it as much more important than they had in the past (they are "born again"), while others lose their faith. But many people acquire such beliefs when they are very young, and they retain them with little alteration for the rest of their lives. The fact that you acquired a belief simply because your parents held it doesn't mean that it's false.

But if you continue to hold it solely because other people taught you to do so, you are handing control of your mind over to others. Of course, no one has time to constantly examine all their fundamental beliefs. But it is healthy to examine some of them now and again, and the years you spend in college are a particularly good time to do it. You may finish the process with the same views you have now. But if you have thought about them critically, they will then be your views.

Exercises

1. Can you remember a time when you didn't hold pretty much the beliefs that you have now about religion? About morality?

2. If you had grown up in a very different culture, one with a quite different religion or morality, what do you suppose you would now think about these matters?

22.5 The Mere Presence of Others

The mere presence of others can affect our performance on many sorts of tasks. **Social facilitation** occurs when their presence enhances performance. For example, many people do better in athletic events if an audience is present. The same holds true for cognitive tasks; we often do a better job at solving verbal or mathematical problems and puzzles if others are watching.

In some cases, however, the presence of others detracts from our performance. This is known as **social impairment**. Research suggests that an audience enhances someone's performance on a task if they are accomplished at it, but it detracts from their performance if they are not. Although these findings are of interest, we will focus more on longer term social influences on thought.

22.6 Professional Persuaders

Many people work in the *persuasion professions*. The success of professional advocates like advertising agents, lobbyists, social media influencers, trial lawyers, and politicians, as well as the success of social reformers and charity workers, depends on their ability to persuade others to do something. Their goal is to convince us to buy a new car, vote for Donald Trump or visit Key West.

Often, people in the persuasion professions have a bad reputation: the stereotypical used-car salesman would run over his own mother to clinch a deal. But in many cases, professional persuaders are admirable: the world is a better place because of those who try to convince us to give some of our time or money to those in need, or to stay indoors during a pandemic.

Often, the goal of professional persuaders is to manipulate our beliefs or attitudes in a way that will benefit them. For example, political life is increasingly a matter of advertising and image manipulation. Nowadays many candidates are marketed like consumer products, their message fine-tuned to reflect the latest poll results, their every word explained by spin doctors.

22.6.1 Professional Persuaders: Tricks of the Trade

There are many techniques for persuading people. Some involve pressuring them, but the most effective devices are the ones that people don't even notice. For example, a real estate agent might exploit the contrast effect by first showing a prospective buyer a run-down, over-priced house right before showing the house they are really trying to sell. In this section, we will learn about three of the most effective techniques for getting people to do things without their even realizing that they are being manipulated.

The Foot-in-the-Door Technique

One very effective device is the **foot-in-the-door technique**. The foot-in-the-door technique involves getting someone to do or believe something that is reasonably small. After they do agree to the small request, the person is more likely to comply with a larger request or suggestion. Professional fund raisers are well-aware of this technique. Often, they first ask for a small donation, then come back later to ask for a larger one.

In a study, homemakers were asked a few questions about which soaps they used. A few days later, both the group who had answered these questions and another group who had not been previously contacted were asked if a survey team could come to their home and spend two hours recording every product that they owned. Homemakers who had agreed to the small requests (to answer a few questions about soap) were over twice as likely to accede to the much larger request.

Foot-in-the-door technique: first get someone agree to something small

An even more dramatic illustration of the foot-in-the-door technique comes from a 1966 study of a group of Palo Alto residents. Psychologists going door-to-door asked residents to display a modest three-inch sign saying BE A SAFE DRIVER. Two weeks later, another person was sent around, both to the people contacted earlier and to another group of people who hadn't been previously contacted. He asked for permission to erect an enormous billboard on the resident's front lawn that proclaimed DRIVE CAREFULLY and showed them a picture clearly depicting the billboard as an enormous monstrosity. Only 17% of the people who had not been contacted before agreed to the request. But 55% who had been contacted earlier and displayed the small, three-inch sign agreed. In other words, over half of those who had acceded to the earlier, smaller request, agreed to the bigger one.

The foot-in-the-door technique is commonly used by people in the persuasion professions. A salesperson at the door often asks for something small like a glass of water. Once the resident agrees to that request, the salesperson has a better chance of getting them to buy something. There aren't many door-to-door salespeople nowadays, but telemarketers have adopted this technique too. It was also used, less innocently, by the Chinese during the Korean War. They made small, innocent sounding requests of their prisoners of war, and then moved very gradually on to larger requests.

Lowballing

There is a related phenomenon known as **lowballing**. This occurs when a person is asked to agree to something with incomplete or inaccurate information about its costs. Later, they learn that the true cost is higher. But having made the original commitment, they are more likely to accept the new cost than they would have been had they known about it up front.

Lowballing: getting a person to agree to something based on inaccurate information

For example, car dealers sometimes clinch a sale, go off to verify it with their boss, then return with the news that it's going to cost just a little more than they'd thought. Someone might ask you for a ride home and when they get in your car announce that they live twenty miles away. In both cases, the person who made the original commitment is more likely to follow through on it than they would have been had they known about its cost at the time that they made their decision. The subjects made an initial commitment to be in the experiment and only later discovered what they had gotten themselves into.

The Door-in-the-Face Technique

The **door-in-the-face technique** is another device for eliciting compliance. The strategy here is to lead someone to believe or do something by first asking them to do something bigger (or to believe something less probable), which you know they will refuse. After the larger request is refused, the person is often more likely to do or believe the second, smaller, thing.

Door-in-the-face technique: first get someone to refuse a large request

Robert Cialdini and his coworkers asked one group of people to volunteer to work as a counselor for two hours a week in a juvenile center for at least two years. Not surprisingly, no one agreed to this. Later, the people in this group and an equal number of people who had not been contacted before were asked to chaperone a group of juvenile delinquents on a trip to the zoo. People who had first been asked the much larger request (to become a counselor for two years) were over three times as likely to take the delinquents to the zoo as those who had not been asked. In another study, subjects were asked to contribute time to a good cause. Some of them were asked to contribute a lot of time. Most refused, but they were later asked to commit less time. Only 17% of those who were only asked for a small amount agreed, but 50% of those who were first asked for a large amount agreed to a smaller amount. This technique is common in bargaining and negotiating at all levels, from negotiations between nations to negotiations between parents and children.

Safeguards

People can resist these pressures, but it requires some thought. We often go along because we act without paying much attention to the situation. The following study illustrates the point. There was a line to use the only nearby photocopier at a library. A group of psychologists had a person ask to cut in front of others in the line. If the person simply asked to cut in without giving any reason, most of the people in the line refused. And if they gave a good reason like, “Could I cut in because I’m running late to pick up my child from school?” most people let them cut in. No surprises thus far.

What is surprising is that if the people conducting the study gave anything that had the format of a reason, most people let them cut in. For example, if they asked, “Could I cut in because I need to make some copies?” many people granted their request. These people’s minds weren’t really in gear, and the mere fact that it sounded vaguely like a reason, though it wouldn’t have seemed a good reason if they had thought about it, was all it took for them to allow someone to cut in front of them.

22.7 Conformity

We comply with someone's wishes if we do what they ask us to do. Conformity involves a subtler pressure, and we are often unaware of its influence. Conformity may result either from a desire to be right (this is sometimes called *informational influence*) or from a desire to be liked, to belong, or to seem normal (*normative influence*).

Informational influence leads to what is sometimes called **social proof**. We use social proof when we attempt to determine what is correct by seeing what other people think is correct. This is often a good way to proceed. If we aren't sure which fork to use for the salad at a fancy party, it is natural to see which fork others are using. If we aren't sure what the speed limit is, it makes sense to match our speed to the average speed of other drivers. And in ambiguous situations, we often think that other people have a better idea of what is going on than we do (while they may be thinking the same thing about us).

Social proof: using what others think to try to determine what we should think

But social proof isn't always good. When people are about to vote on some important issue in a meeting, some of them first look around to see how others are voting, and then try to go with the majority. And under the wrong conditions, social proof can lead to disaster. One of the reasons many Germans went along with the Nazis was that many other Germans did so too.

In the case of normative influence, we go along to get along, to be liked, accepted, or at least not despised. Normative influence can lead people to conform publicly, but they may not privately accept the views they act like they have accepted. Sometimes normative influence only involves an isolated action, but it can involve norms that affect us on many occasions.

Norms are explicit or implicit rules that tell us what sorts of behavior, attitudes, beliefs and even emotions are appropriate in situations. For example, in our society it is appropriate to be angry under some circumstances (e.g., when we see an injustice committed) but not others (e.g., if someone unintentionally mispronounces our name).

22.7.1 The Autokinetic Effect

Muzafer Sherif (1906-1988) was one of the pioneers of experimental social psychology. He was born in Turkey but came to the United States and did much of his work at the University of Oklahoma. One of his most famous studies involved a perceptual illusion known as the autokinetic effect, but the experiment was really about group norms and conformity.

You are blindfolded and led into in a dark room; you aren't sure where the walls are, or the size of the room. If someone shines a tiny spot of light on a fixed spot on the wall in front of you, it will appear to move, even though it is completely stationary. This is the *autokinetic effect*; it is a standard perceptual illusion. Of course, if people don't know about this illusion, they will think the spot of light really does move, and then disappear. But people differ a good deal in how much they think it moves. Some think it's just a few inches; others think its several feet.

Sherif told his subjects that they were participating in an experiment on perception and that their task was to estimate how far the light moved on each of a several trials. When subjects performed the task by themselves, each developed a characteristic response (it moved two inches; it moved a foot and a half).

In another condition subjects worked in groups of two or three. In these conditions, the subjects' estimates of the distance the light moved would converge until they were in very good agreement. *Group norms* emerged. Different groups would settle in on different norms, but the norms within each group were quite stable. In another condition, Sherif introduced a confederate into some of the groups who was forceful enough to get the rest of the members to adopt his norms.

The norms established by a person's group persisted for at least a year (when the subjects were brought in and retested), and as members gradually left the group and were replaced by new members, the norms were passed down to later generations. Although the group members did not realize it, there were powerful pressures in the situation that led them to conform.

22.7.2 Ash's Conformity Studies

Solomon Ash thought that Sherif had exaggerated the degree to which people conform, and in a famous series of studies conducted in the early 1950s, he set out to show the limits to conformity. To his surprise, he found something very different. In a typical Ash experiment, a group of experimental subjects were seated in a semicircle around a table. All but one of the people were confederates, accomplices who were in on the experiment. But the lone subject was led to believe that these other people were subjects too.

The people around the table were shown a series of cards, two at a time. The card on the left had a single vertical line, the standard. The card on the right had three vertical lines; one line was the same height as the standard line (the one on the first card), and both the other lines clearly were not (as in Figure 22.1). The difference was completely obvious to anyone with normal vision, and when subjects in a control condition were shown the cards, only

5% of them made a mistake about which line on the second card matched the line on the first.

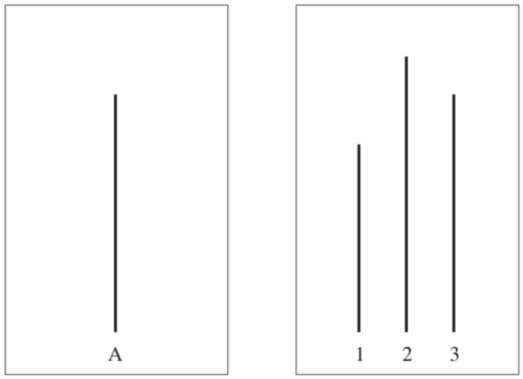

Figure 22.1: Which Line Matches A?

The experimenter then asked the people in the group to say which line on the second card was the same height as the line on the first. One by one they gave their verdicts, working their way around the table to the lone subject. Sometimes the confederates gave the correct answer, but sometimes they didn't. When they all agreed in the wrong response, there was pressure on the subject to conform. On 37% of the trials, subjects went along with an (obviously) incorrect response, with about three-quarters of the subjects going along at least once.

It would not be surprising if the rate of conformity differed from one culture to another, and this has been found to be the case. In countries that stress the importance of the group, there is more conformity. A striking thing about Ash's studies is that he found so much conformity in the United States, where the value of individualism is so strongly stressed. Many similar experiments have been conducted in this country over the years. Most find slightly lower rates of conformity, perhaps because many people have become more willing to challenge authority, but Ash's basic results have held up.

Ash found that if there was only one confederate, the subject wouldn't conform. But perhaps the most important finding was that if even one of the confederates gave the correct response, the subject almost always gave the correct response too. The presence of even one dissenter among a group of conformists was usually enough to undermine the group's influence.

Pressures to conform can be nearly irresistible, and often we go along without giving it any thought, by habit. The dark side to Ash's studies is that even when the correct answer was very clear and the subject didn't know any of the people in the group around the table, conformity was common. What would happen if the issue was murky, or if the group included one's friends and people she admired?

Exercises

1. What would you have predicted would have happened in Ash's study if you heard it described but weren't told the results?

2. What would you have predicted that you would have done in Ash's study if you heard it described but weren't told the results?

3. What do you think that you would have done if you had been in Ash's study?

4. Why do you think the presence of a single dissenter could radically decrease the amount of conformity?

22.8 Obedience

22.8.1 The Milgram Experiments

Obedience to authority is a kind of compliance. It occurs when someone can punish us for disobeying, but it also occurs when the person making the request seems to have a *legitimate right* to do so. The notions of conformity, compliance, and obedience shade off into each other, and we won't be concerned with drawing precise boundaries among them. The important point is that there are many clear cases of each, and in all of them the actions of others can influence us. We are trained to obey. But not all obedience involves a blind, cringing willingness to do whatever we are told; there are often good reasons for obeying. It would be impossible to raise children if they never did what they were told. And in many cases, there are good reasons for adults to comply with the directives of legitimate authorities. If a police officer directs our car down another street, it is usually reasonable to do as they ask.

But sometimes people fulfill requests or follow orders that harm others, or that violate their own views about right and wrong. *Excessive deference to authority* occurs when people give in too much to authority and quit thinking for themselves. This is what happened in one of the most famous experiments ever conducted.

These experiments were conducted by the psychologist Stanley Milgram and his coworkers at Yale University from 1960 to 1963. In each session, two people entered the waiting room of a psychology laboratory. One was a subject. The second person also said that they were a subject, but they were really a confederate (an accomplice who works with the experimenter).

The experimenter would tell the pair that they are going to participate in an experiment on learning. One of them would play the role of the teacher and the other would play the role of the learner. The two were asked to draw straws to determine who would get which role, but in fact the drawing was rigged so that the real subject was always the teacher and the confederate was always the learner. The learners were supposed to learn certain word pairs (e.g., boy-sky, fat-neck), which they were then expected to repeat in an oral test given by the teacher. The teacher was asked to administer an electric shock to the learner every time the learner made a wrong response (with no response in a brief period counted as a wrong response). The voltage of the shock increased each time in intervals of 15 volts, with the shocks ranging from 15 volts to 450 volts. The shock generator has labels over the various switches ranging from "Slight Shock" up to "Extreme Intensity Shock," "Danger: Severe Shock," and "XXX" (Figure 22.2). The learners were strapped down so that they could not get up or move so as to avoid the shocks. They were at the mercy of the teacher.

Volts	15-60	75-120	135-180	195-240
Label	Slight Shock	Moderate Shock	Strong Shock	Very Strong Shock

255-300	315-360	375-420	435-450
Intense Shock	Extreme Intensity Shock	Danger: Severe Shock	XXX

Figure 22.2: Labels on the Shock Generator

The teacher and learner were put in different rooms so that they could not see one another, and they communicated over an intercom. After the first few shocks (at 150 volts), the learner protested and cried out in pain. After a few more shocks, the learner protested that they had a weak heart. And eventually the learner quit responding entirely. But since no response is counted as a wrong response, the subject is expected to continue administering the shocks.

The teachers typically showed signs of nervousness, but when they were on the verge of quitting the experimenter ordered them to continue. The experimenter in fact had a fixed set of responses; they began with the first, then continued down the list until the subject was induced to continue. The list is:

1. Please continue (or please go on).

2. The experiment requires that you continue.

3. It is absolutely essential that you continue.

4. You have no other choice, you *must* go on.

If the subject still refused after getting all four responses, they were excused from the rest of the teaching phase of the experiment.

How many people do you think would continue giving shocks all the way up to 450 volts? The experimental setup was described to many people, including students, laypeople, psychologists, and psychiatrists. All of them thought that most of the subjects would defy the experimenter and abandon the experiment when the learner first asked to be released (at 150 volts). The experts predicted that fewer than 4 percent would go to 300 volts, and that only one in a thousand would go all the way to 450 volts. Indeed, Milgram himself thought that relatively few people would go very far. But the results were very different. In this condition of the experiment, 65% of the people went all the way, administering shocks of 450 volts, and all of them went to at least 300 volts before breaking off. (Figure 22.3).

Milgram and his colleagues varied the conditions of the experiment, but in all cases, they found much higher rates of obedience than anyone would ever have predicted. For example, nearly as many female subjects continued to the end, where they administered 450-volt shocks to the subject. And when the experiment was conducted in a seedy room in downtown Bridgeport, Connecticut, instead of the prestigious environment of Yale University, obedience was nearly as great.

Condition	Men	Women	Bridgeport
Average voltage	405	370	325
Percent who continued to end	65%	65%	47.5%

Figure 22.3: Results of Milgram Experiments

The more directly involved the subject was with the victim, the less the compliance. And, in a result that fits nicely with Ash's data, if several subjects were involved and one refused to obey, the others found it easier to refuse. On the other hand, many people went along with an authority, even though they didn't understand what was going on. In short, many of Milgram's subjects went all the way, delivering what they thought was a very painful shock to someone who seemed to be in great discomfort and to be suffering from heart trouble. A compilation of the results of several studies is given in Figure 22.3; the number of subjects in each condition is 40.

In another condition, a team of people (all but one of whom were confederates) had to work together to administer the shocks. One read the word pairs, another pulled the switch, and so on. In this condition if one of the confederates defied the experimenter and refused to continue, only ten percent of the subjects went all the way to 450 volts. As in the Ash studies, one dissenter—one person who refused to go along—made it much easier for other people to refuse as well.

Ethical standards no longer allow studies like Milgram's, but in the years after his work, over a hundred other studies on obedience were run. They were conducted in various countries and involved numerous variations. Most of them supported Milgram's results. In an even more real-life context, a doctor called a hospital and asked that an obviously incorrect prescription be administered to a patient. Although ten out of twelve nurses said they wouldn't dispense such a prescription, twenty-one of the twenty-two nurses that were called did comply.

22.8.2 Changing Behavior vs. Changing Beliefs

In some cases, we do things that we don't think we should to win the approval of others. For example, many of the subjects in Ash's conformity studies knew that they were giving a wrong answer, and only did so because of the social pressure they felt. But in many cases, we can only get someone to behave in a certain way (e.g., to shock unwilling victims) if we change the way they think.

22.9 What Could Explain Such Behavior?

22.9.1 Obedience Training

Children are taught to obey. This is unavoidable. Eight-month-old infants don't have the language or concepts to understand our reasons for forbidding them to do certain things like pulling the dog's tail. As children mature, we can give some explanations ("How would you like it if someone did that to you?"), but it isn't possible to engage in a subtle and detailed argument with a four-year-old. Someone at this age can, of course, generate an endless series of "why questions," but at some point, the exasperated reply will be, "Because I said so."

If people, with their diverse beliefs and goals, are to live together in anything approaching harmony, society must have certain rules, and we are trained to obey them. In some cases, the need for rules is dramatic; in war time, for example, it is necessary for people to work together in a coordinated way, and this requires authorities who others will obey. But society also requires such things as laws and taxes to function smoothly. Of course, many parents, and many societies, greatly overdo things, but the basic point here is that authority has its place, and we have been trained to recognize that. The key is for us to think about whether we should obey an authority in a given situation.

22.10 Responsibility

22.10.1 I Was Just Following Orders

Many subjects in the Milgram experiment felt great discomfort as they delivered what they thought were increasingly powerful shocks to the learner. They would stop and convey their misgiving to the experimenter. One of the most effective ways of getting them to continue was to assure them that they were *not responsible* for the learner or his health.

When people don't feel responsible for their actions, they can bring themselves to do quite terrible things. After World War II, many Germans who had worked at the death camps defended themselves with the refrain, "I was just following orders." They were just soldiers doing what soldiers were being ordered to do; the responsibility for their actions lay elsewhere.

22.10.2 Asleep at the Wheel

Many of our actions result from habit. Often this is good; we can't stop to think about everything that we do. But the habits to conform and obey make it easy to go along with things we shouldn't, *without really thinking about them*. This is illustrated in a small way in the study where people asked to cut into a line to use a copying machine; it is illustrated in a much more frightening way in the Milgram experiments. One reason subjects went as far as they did in these experiments was because of a habit to obey those who seem to be legitimate authorities. We often do this almost automatically, without thinking about what we are doing. In fact, habit is one of the greatest enemies of clear and critical thinking.

22.11 Safeguards

It should go without saying that there are no foolproof ways to avoid the disastrous consequences of conformity and obedience. These have always been with us, and probably always will be. But it doesn't follow that we should just shrug our shoulders and say, "That's life." If we can find ways to diminish these catastrophic consequences, that would be very good. There are many things that might help. Here we will consider several that involve reasoning and inquiry.

22.11.1 The Open Society and the Importance of Dissent

In the Ash studies, the study involving nurses and improper prescriptions, and Milgram's studies of obedience, the most effective way of reducing conformity or obedience was to have at least one other person present who refused to go along. Often even one dissenter was enough to eliminate conformity or mindless obedience. This strongly suggests the importance of

fostering an atmosphere in which dissent is possible. In a group, including an entire society, where open discussion is allowed, a variety of viewpoints can be aired, abuses by authorities can be exposed,
and reasons for resisting them can receive a hearing.

A free and open society, one open to ideas and disagreements, makes critical reasoning much easier. In a society where open discussion is allowed, a variety of viewpoints can be aired. Without free expression, the scope of our thoughts will be limited; we will be exposed to fewer novel ideas, and our sense of the range of possibilities will be constricted.

Since no one has cornered the market on truth, we should beware of those who would set themselves up as censors to decide what the rest of us can say and hear. But one price of free and open discussion is having to hear things we may not like. This can be unpleasant, but it can still be a good thing. A view or position may be: (1) true, (2) false, or (3) some mixture of the two. In each case, we will be better off if a view we find offensive is allowed a hearing.

1. **The view is true**: If the view I dislike is true, it should be allowed a hearing. The truth doesn't necessarily set us free, but it does put us in a better position to solve the problems that beset us. Actions and policies based on mistaken views are much less likely to succeed than those based on true views.

2. **A mixture of truth and falsity**: Complex views or positions usually contain some mixture of truth and falsity. In such cases, we can learn something from the part that is right, and we can strengthen our own views by seeing why parts of it are in error.

3. **The view is false**: What if the view I find offensive is false? It might even seem too dangerous for the masses to hear about it—they might be taken in or led to do things they shouldn't. In addition to the problem of who is to decide which views should be banned (there will always be volunteers for this job), this assumes that most people are so bad at reasoning that they can't be trusted to think about things for ourselves. The claim that others just aren't smart enough to be exposed to certain ideas is both insulting (to them) and arrogant.

It can be valuable to think about views we don't like. One of the best ways to truly understand our own beliefs is to see how they compare to the alternatives. In trying to meet the challenge of an alternative view, we must think seriously about what our own beliefs really mean, and why we hold them. This is healthy, because it is very easy for us to hold beliefs that we don't really understand, mouthing slogans and repeating formulas without much comprehension (remember the *illusion of explanatory depth*). And if, after careful consideration, we can't give good reasons why our views are better than the alternative, it might be time to modify them.

Appropriate context matters a great deal when we think about these issues. Politically complex and sensitive issues make a lot of sense to discuss on Sunday morning talk shows and at town board meetings, and should be encouraged. There isn't anything wrong with shutting the door on a Jehovah's Wittiness who has come to spread the good word when you're just trying to make dinner, though, and your pediatrician doesn't have to invite Jenny McCarthy to the office to spread conspiracy theories about vaccines. Allowing a free exchange of ideas does not require that we give over our lives to this pursuit in all cases and at all times.

With all of this, we need to be mindful of a distinction between allowing the free expression of ideas with allowing hate speech. We want to see a true exchange of ideas that allows for truth to come to the surface. This will mean we encounter views that we dislike, and that are wrong or harmful, but we have a chance to prevent the spread of those views by arguing against them. The concern with hate speech (racist, misogynistic, homophobic, transphobic, etc.) is such speech fights against the goal of open discourse. First, people using speech of this kind are not looking to engage in the free exchange of ideas – they are looking to harm people. Critical thinking requires that we start from an understanding that we might be wrong, and a hope that discourse will reveal the answer. There is no opening for a true dialogue when what you are saying is that certain people who could be engaging with you in honest discourse don't have equal worth (because then, there is no reason to listen to them).

Second, allowing this type of speech silences people in the group at which the speech is being directed. Charles Lawrence refers to hate speech as 'fighting words,' because the impact they have on the person being targeted is more akin to an assault than a conversation. There is very little that can be said in response to dehumanizing language, and so it is often silences its victims. The impact of this is that we lose access to the voices and views of people who are not male, cisgender, straight and white. Lastly, the hate speech itself cases harm. Free speech advocates like to focus on the benefits of an open discussion (and those benefits are outlined above), but there is no true distinction between words and actions. Speaking is an action. If the result of your speech is unjustified harm to another, then restricting your speech is on the table, in the same way that restricting your actions is warranted any time you cause unjustified harm through that action.

One final point to keep in mind is that the dominant culture influences the views that are even considered a part of an open discourse. It isn't like all views have equal access to be heard. Newspapers, colleges, and other gatekeepers have a large influence on which voices get amplified and which don't. The result is, some views understood as common place and others are seldom, if ever, heard. You have likely heard countless times throughout your life that law enforcement is very important, but few of you had heard of the police and prison abolition movements until the murder of George Floyd by the Minneapolis Police Department, even though these movements have been around longer than the authors of this text have been alive (and polling suggest most people still don't know what the abolition means in these contexts). Many free speech defenders confuse an inclusion of more diverse views as them being silenced. Instead, we should see the inclusion of more female, people of color, trans and non-binary voices as a course correction – genuinely increasing the views and perspectives we encounter. Remember, if traditional views are correct, then they will withstand the criticism coming from the people who were formerly excluded from the public discourse.

22.12 Chapter Exercises

1. Explain why you think the subjects in the Milgram experiments on obedience did things they would not have done on their own. To what extent did the experimenter simply get them to do things (even though they knew they shouldn't) and to what extent did they change the way that they *thought* or *reasoned* about things?

2. Could low-balling have played a role in the Milgram studies? Explain.

3. What lessons can be learned from the Milgram experiments? What could be done to make people less likely to do what the subjects in these experiments did? Defend your answers in a brief paragraph.

4. In what ways might learning about the Milgram experiments change how you think? In what ways might learning about the experiments change how you act?

5. If you ended up in a position where you administered shocks to a series of "learners" day after day, what sort of attitude do you think you would develop towards them? How would you think about your own actions and the way that they reflected on you?

6. What light do these experiments shed on the following cases?

    1. The massacre at My Lai, in which American soldiers killed unarmed Vietnamese old men, women, and children, not because it was militarily necessary, but because they were ordered to do so.

2. The Nazi holocaust, and the Nazi trials after the war, where Nazi officers gave as their excuse—or justification—that they were just following orders.

7. What implications does the behavior exhibited in Milgram's experiments have for issues involving clear, independent reasoning?

8. What might help one become the sort of person who would resist the experimenter's orders? (This is a question for each of us, but also a question about how you would want to raise your children).

9. In Milgram's study, subjects would often continue when told, "the experiment requires that you continue," or "you have no choice." Why do you think this was effective? How do you think the subjects thought about such remarks?

10. When subjects in the Milgram experiment began to have doubts, the experimenter said that he would, "take the responsibility." What role did this play in their actions? How do issues about responsibility affect our own actions?

11. Canned laughter is commonly used on TV sitcoms and other shows. Experiments have found that when the material is even a little funny, the use of a laugh track leads an audience to laugh longer and more often and to rate the material as funnier. Why could explain why people—most of whom profess to dislike canned laughter—laugh more when there is a laugh track? Do you think that they really perceive the material funnier?

12 Bartenders often "salt" their tip jars with a few dollar bills at the beginning of their shift to simulate tips left by previous customers. Why do you think they do this? Would you be more likely to leave a tip if they had? Give some other examples of this sort of phenomenon.

13. Wilbur and Wilma, both seventeen years old, are trying to negotiate a curfew with their parents.

Wilbur's scenario: Wilbur asks his dad if he can stay out until 10 pm on a Tuesday night to go to a basketball game. His dad agrees. Wilbur comes home on time, and later that week he asks his dad if he can stay out until 1:00 am on Saturday night to go to a concert. His dad agrees.

Wilma's scenario: Wilma asks her mom is she can stay out until 2:00 am on a Tuesday night to go to a basketball game. Her mom says, “No way!” Later that week, she asks her mom if she can stay out until 1:00 am on Saturday night to go to a concert. Her mom agrees.

What is going on in each scenario (the answers may be different in the two cases)?

14. In obedience and conformity experiments, it has been found repeatedly that the presence of even one dissenter (a person who refuses to comply) makes it easier for others to refuse compliance as well. Why is that? Defend your answer. You may find it useful to relate your answer to one or more of the experiments discussed in this chapter.

15. The habitual use of the device of social proof is not conducive to good reasoning. But can you think of some ways in which it might be used to promote good or healthy behavior? Explain your answer.

16. Do you think that the subjects who played the role of the teacher in the Milgram experiments were unusually sadistic or somehow worse than people in general? If not, why did they do what they did?

17. Give an example, either imaginary or from your own experience, of the door-in-the-face technique. Then give an example of the foot-in-the-door technique. In each case, explain why you think the technique worked (if it did) or failed to work (if it failed).

18. Give an example, imaginary or real (it could be from your own life, but you don’t need to attribute it to yourself) where a person’s ways of thinking and reasoning (as opposed to just their behavior) are changed in the name of conformity.

19. Give an example, imaginary or real (it could be from your own life, but you don’t need to attribute it to yourself) where a person has inconsistent beliefs and engages in dissonance reduction to try to eliminate the dissonance or tension generated by the inconsistency.

20. Give three examples of legitimate authorities and cases where it would be reasonable to comply with their requests. Defend your answers in a brief paragraph.

21. Give an example where there would be pressure to comply with the request of an authority, but where it would not be a good thing to do so. Defend your answer in a brief paragraph.

Chapter 23

The Power of the Situation

Overview: We have seen repeatedly that context strongly influences reasoning. Since we spend much of our time in social contexts, it is not surprising that many features of social situations exert a strong influence on our thought and behavior. In this chapter, we will see how most of us frequently underestimate the power of situations—typically social situations—to influence our actions and thoughts. We will also learn about some common biases in our reasoning about people, including ourselves.

Contents

23.1 Case Studies

Riots and Mobs

When a crowd gets completely out of control, as it does in a violent riot or mob, it can do terrible damage. One of the most frightening things about mobs is that quite normal people can be swept up in them. How can people act in ways that are so out of character? We will see in this chapter that such situations can be very powerful. Somehow the situation leads many people to do things they wouldn't have thought possible.

Helping: The Good Samaritan

The book of Luke in the New Testament of the Christian Bible relates the parable of the Good Samaritan. A man traveling the road from Jerusalem to Jericho is robbed, beaten and left by the side of the road to die. Several people see him but pass on by. Then a Samaritan (a member of a group that was poorly regarded by the target audience of the story) comes upon him, helps, and saves the victim's life.

In 1973, John Darley and Daniel Batson conducted a famous study at the Theological Seminary at Princeton University. The subjects were students at the Seminary, and when each arrived, they were told that they would be giving a lecture in another building on campus. Half were told that their talk should be about career alternatives for priests (this was meant to be a neutral topic); the other half were told that their talk should be about the parable of the Good Samaritan. Each group was then divided into three further subgroups that differed only in the instructions they received about how soon the talk was to be.

1. You are already late (high-hurry condition).

2. You should leave now (intermediate-hurry condition).

3. There is no rush (non-hurry condition).

So, we have *six groups* in all: two different topics for the talk, and three different hurry conditions.

Condition	Low Hurry	Intermediate Hurry	High Hurry
Percent who Helped	63%	45%	10%

Figure 23.1: Results of the Good-Samaritan Study

As the subjects made their way to the building where they were to give their talk, each of them passed a man slumped in a doorway. He was coughing, groaning and clearly in need of help. Which groups helped the most?

The topic of the talk didn't make much difference. Furthermore, subjects who scored high on religiosity measures weren't any more likely to help than those who scored low. In fact, the only factor that had much impact on whether a person helped or not was whether they were in a *hurry*: 63% of the subjects in the no hurry condition helped, 45% in the-intermediate hurry condition helped, and only 10% of those in the high-hurry condition helped (Figure 23.1). The personality or character traits of the subjects surely weren't irrelevant to whether they stopped to give aid. But it was a *feature of the situation*—how rushed the people were—that played the greater role.

Helping: Kitty Genovese

At 3:20 A.M. on March 13, 1964, it was reported that Kitty Genovese arrived back at her apartment in Queens after a long night's work. As she walked from her car to her building, she was accosted by a stranger who stabbed her repeatedly. Over and over she fell, was stabbed, struggled up, tried to crawl to her doorway, and was stabbed yet again. People in nearby apartments heard her screams, turned on their lights, and watched as the horrifying scene dragged on for almost thirty minutes. But what shocked the nation was that, according to the news report, at least 38 people watched the brutal murder and none of them called the police. Not one.

We now know that much of what we thought about the above story actually comes from profoundly bad reporting (several of the neighbors did call the police for instance), but at the time it led psychologists John Darley and Bibb Latané to wonder about the conditions that would inhibit helping, and in 1969, they conducted an experiment to try to find out. There were three conditions in their experiment. In one condition, the subject was alone in the room, in the second, the subject was in a group with two other real subjects, and in the third, the subject was in a group with two other "subjects" who were actually confederates.

The experiment began normally enough. One or more subjects entered the room and began filling out a questionnaire. But suddenly smoke began coming out of a vent in the room; it certainly looked like something that could be dangerous. When the subjects were alone in the room, 78% of them reported the smoke. When there were three genuine subjects, 38% of the subjects reported it. And when there was one subject together with two confederates who did nothing, only 10% of the subjects reported it.

These results are typical. In 90% of the studies on the matter, a lone bystander is more likely to help than a person in a group. And many studies indicate that your chances of getting help may be best if only one other person around. Why is this—why don't people help when we would expect them to?

Why Don't People Help?

Why didn't someone call the police as they watched Kitty Genovese's brutal murder? Our first thought might be that they actually enjoyed watching her suffer. But surely all the people in her neighborhood couldn't have been sadists. In fact, it turns out that when *other people* are present, people in general are more likely to stand by and do nothing. The *situation* inhibits helping. Psychologists often refer to the phenomena as the bystander effect.

Bystander Effect: We are less likely to help victims when other people are present

In the previous chapter, we encountered the concept of social proof: people often wait to see what others do to determine the appropriate response. If everyone is waiting to see what behavior is appropriate, there may be no response at all. Put yourself in the position of a subject in the smoke study: Maybe the smoke pouring out of the vent is harmless; the other people in this room seem to think so, maybe they know more about such things than I do, and if I go for help I might end up looking like an idiot.

The lessons learned from the research that followed the Kitty Genovese murder is also a dramatic illustration of something else that is quite common: diffusion of responsibility. If you are the only one present and something needs to be done, you must do it if it is to be done at all. But if there are several people around, maybe someone else will act, and you'll be off the hook. **Diffusion of responsibility** occurs when multiple people are present, and the responsibility diffuses or radiates throughout the group, so that no one feels particularly accountable. In situations like this, people are less likely to help. If you are willing to engage in some self-reflection you can probably remember countless times where you watched quietly while an injustice happened hoping someone else would speak up.

Prisoners and Guards

On Sunday morning, August 17, 1971, nine young men were picked up without warning at their homes by the Palo Alto police. They had been drawn from a group of about seventy men who had answered an advertisement in the local paper offering $15 to participants in a two-week study on prisons. After interviews and psychological screening, the group was narrowed to about twenty-five, and these people were randomly assigned to play the role of prisoner or guard.

The nine men arrested that Sunday morning were those who had been randomly assigned the role of prisoner. They were driven to the local Police Station, booked, fingerprinted, blindfolded, and taken to a simulated prison in the basement of the psychology building at Stanford University. Meanwhile, those assigned the role of guards were given uniforms and instructed that their task was to maintain order (without using violence).

The subjects were part of a study on roles and behavior conducted by the Stanford psychologist Philip Zimbardo and his coworkers. After an initial rebellion by the prisoners, the guards quickly gained control, and soon stepped completely into their role as guards. They taunted, humiliated, and degraded the prisoners, making them do pushups or clean out toilet bowls with their bare hands when they didn't obey. They began treating the prisoners like they weren't real human beings. The prisoners also got into their role as prisoners, becoming listless, subservient, and suffering from stress (some had to be released early because they were cracking under the pressure). In fact, their reaction was so severe that the experiment had to be called off before the end of the first week.

The subjects were assigned *randomly* to play the role of prisoner or guard. But the situation felt so real, with uniforms, bars on the cells, and the other props of a real prison, that the subjects quickly adopted their roles all too well. In a very short time, normal people were transformed into sadistic guards or passive victims. Zimbardo and his coworkers had created a very powerful situation in which people fell into predetermined roles despite themselves. If six days in a setting that everyone knew was "just an experiment" had this effect, what effects might an even more powerful situation (like a real prison) have?

Brown Eyes vs. Blue Eyes

Even young children are not immune. Jane Elliott was a third-grade teacher in the small Iowa town of Riceville. Her students had little exposure to minority groups, so she decided to let them learn first-hand. One day, in the late 1960s, when her students arrived for class, Elliott informed them that brown-eyed children were smarter and better than blue-eyed children and so they should be treated better. The brown-eyed students were then given various privileges, while the blue-eyed students were subjected to demeaning rules that underscored their inferior, lowly status.

Well before the end of the day, the brown-eyed students were discriminating against their blue-eyed former friends: they fought with them, ostracized them, and suspected them of underhanded behavior. Meanwhile the blue-eyed students became angry, demoralized, and withdrawn.

The next day Elliott told the students that she had made a mistake; it was in fact the blue-eyed children who were superior. The situation then replayed itself with the blue-eyed children engaging in ready and often hostile discrimination. The third day, the class discussed the implications of what they had been through. In 1992, before a huge television audience on the Oprah Winfrey Show, Elliott carried out the experiment, with similar results, using adults as subjects.

23.2 The Fundamental Attribution Error

23.2.1 Explaining Why People Do What They Do

We are often more interested in other people and what makes them tick than in anything else. Why do they do the things that they do? What led several hundred people at Jonestown to die by suicide? Why did so many of the subjects in Stanley Milgram's famous experiments on obedience administer (what they thought were) severe shocks to the learner? Why is it so believable that people did nothing while Kitty Genovese was murdered? Such questions also arise closer to home. Why did Sally give Wilbur that weird look when he said that they should go out again soon? In fact, we often have occasion to wonder why we do some of the things that we do: why in the world did I say that?

Patty Hearst

On Friday, February 4, 1974 Patty Hearst, the eighteen-year-old daughter of a wealthy San Francisco publishing family, was kidnapped by a terrorist group calling themselves the Symbionese Liberation Army (the SLA). She was abused and tortured and kept—bound and blindfolded—in a closet for 57 days. It is not surprising that she was terrified.

What is surprising is what happened next. Hearst began to identify with her captors. She renamed herself ‘Tania’, and carried a machine gun into a San Francisco bank and held it on the customers while other members of the SLA robbed the place. Even twenty months after her rescue, she continued to defend the views of the group. Why did she do this? There was nothing in her past to indicate that she would have any sympathy with a radical group like the SLA, and even the people who knew her best couldn’t understand it.

There probably isn’t any simple explanation for her actions, but there are two general types of answers. First, perhaps she was one of those rare people who gets swept up in such things; she had a weak character and wasn’t strong enough to resist.

This may well be part of the story, but a very different *sort* of answer is possible. It may be that many kidnapping victims begin to identify with their kidnappers after a time. In fact, there is a name for this phenomenon: it is called the ‘Stockholm Syndrome’ (after a 1973 incident in Stockholm in which robbers held four people captive in a bank vault for six days; after several days, the victims began to establish a bond with their captors). Some psychologists claim that such behavior is a not uncommon attempt to cope with the uncertainty and terror in the situation. But we won’t be concerned here with which explanation of Hearst’s behavior is correct (quite possibly both get at part of the truth). Our interest is in the two, quite different types of explanations illustrated in this paragraph.

Internal vs. External Causes

We can try to explain Hearst’s behavior by citing “internal” causes (her character traits, e.g., being weak and impressionable) or by citing “external” causes (the fact that many people in a terrifying situation like hers start to identify with their captors to cope with their terror). More generally, we can divide the causes of peoples’ actions into two sorts:

Internal Causes: Causes “inside” the person: their personality traits or dispositions, attitudes, values, desires.

1. Rashad returned the lost billfold because he is *honest* and *helpful*.

2. Penelope yelled at Carl because she was *angry*.

3. Hai gave me that weird look because he’s an extremely *creepy* individual.

External Causes: Causes “outside” the person: features of the situation in which the person acts.

1. Rashad said that line 2 matched line A because of the strong *social pressure* exerted by the other people in the experiment.

2. Penelope didn’t help the victim because the *situation* was one in which it was unclear whether the victim needed help and no one else at the scene seemed to think that he did.

3. Hai followed the leader’s orders, but anyone else would have done the same thing in those *circumstances*.

All actions take place in some context or situation, and both a person’s internal states (dispositions, attitudes, etc.) *and* features of the situation (e.g., the presence of others, the commands of an authority figure) play a role in determining what he does in that situation. It is *never* the case that internal causes aren’t important. But as we will see, people strongly overestimate the strength of internal causes while underestimating the strength of external ones.

The Fundamental Attribution Error

All these cases—mobs, helping, conformity, obedience, the prison study—illustrate the power of the situation. But we tend to underestimate this power. This is such a large and common bias in our reasoning about other people that it has been given a name: the fundamental attribution error. **The fundamental attribution error** occurs because of our strong tendency to overestimate the significance of internal causes and to underestimate the power of external (situational) causes. The fundamental attribution error gets its name from the fact that we often make this mistake when we are trying to *attribute* a person’s actions to causes of one kind or another. For example, we commit this error if we focus too much on whether a would-be helper is a helpful sort of person (thus attributing their behavior to an internal cause) while overlooking features of the situation like the fact that other people are present (thus ignoring external causes).

The Fundamental Attribution Error in the Laboratory

People commit the fundamental attribution error in the real world and in the psychological laboratory. In various studies, subjects listen to someone give a speech in which they read an essay that was written by the experimenter. The speech defends some cause, like the legalization of marijuana. Even when subjects were *told* that the person was required to give the speech and that it may not reflect their true view, they are strongly inclined to believe that it really does reflect the speaker’s views. In this case, the subjects do not take the situation adequately into account (the other person was *required* to give this speech, and almost anyone would do the same thing in such circumstances).

In another experiment, Lee Ross and his collaborators had subjects play a quiz game. It was clear to everyone involved that subjects were *randomly* assigned to be either the questioner or the contestant. The questioner was instructed to devise ten difficult factual questions based on their own knowledge which they were then to ask the contestant. The questioners were at a very great advantage, since they picked the questions based on their own background and expertise (which the contestants were unlikely to share).

Fundamental attribution error: underestimating the power of the situation to influence behavior

But despite this clear situational advantage, observers, questioners, and even the contestant themselves rated the questioners as more knowledgeable and intelligent than the contestants. People underestimated the power of this situation—the advantage of those who got to make up the questions—and overestimated the extent to which the contestants' behavior reflected their traits or characteristics (like being intelligent or knowledgeable).

Another way to see the point is that the results would have been quite different if the questioner and the contestant had exchanged roles; then the people who seemed smarter would have seemed less intelligent, and vice versa. The situation is such that the questioner—whoever it is—will look better, but people tend to overlook this fact. When they do, they commit the fundamental attribution error.

The Fundamental Attribution Error in the Real World

When we first hear about bystanders who witness harm, but don't help or the people in the Milgram study who administered ever-greater shocks, we are first inclined to think they are uncaring, cruel or sadistic. When we do so, we attribute their behavior to *internal causes* (their uncaringness, cruelty or sadism). We overlook the fact that the situations are very powerful and that many people—perhaps even us—would act the same way in those situations. When we do this, we commit the fundamental attribution error.

The fundamental attribution error is also encouraged by the belief that people have relatively stable traits that strongly influence how they will behave in a wide range of settings: Wilbur is honest, and he would behave in an honest way in almost any circumstances. But it turns out that people's traits aren't as robust as we usually assume. There is not as much consistency in people's behavior from one type of situation to another as we commonly suppose. The moral psychologist John Doris has dubbed this view, "situationism."

What the Fundamental Attribution Error Does Not Mean

Before proceeding, it is important to note two things that do not follow from the fundamental attribution error. First, the claim is not that everyone is the same. People *do* differ, and these differences help account for why they do the things that they do. If virtually everyone in a situation would do the same thing, e.g., eat grasshoppers when an experimenter pressures them to, then the fact that a person ate some grasshoppers doesn't tell us much about them.

On the other hand, if somebody does something that most people would not do in that same situation, their action does tell us something about them. For example, most people in Ben Affleck's position would not have gotten that back tattoo, so the fact that he did tells us something about him. The point is not that we should never attribute behavior to internal causes, but that we tend to overattribute it to internal causes.

Second, the fact that situations are more powerful than we often suppose does not mean that people are not responsible for what we do ("It's not my fault: the situation made me do it"). Some people help even when others are present. Some people refuse to go on shocking an innocent victim. Some Europeans hid Jews during World War II in the face of strong social pressures and grave physical dangers. Indeed, the hope is that by learning about the power of the situation, we will be better at resisting that power. Learning about the frequent failure of people in groups to help someone in need should make it easier for us to realize the importance of stopping to help. And learning about the Milgram experiment should make it easier for us to stop and ask, when someone in authority tells us to do something that seems questionable, whether we should comply.

Consequences of the Fundamental Attribution Error

The fundamental attribution error is a very common bias in our reasoning about other people, and it can lead us astray in several ways.

1. It leads us to think that they are *more consistent* than they are.

2. It leads us to think that we can do a better job of *predicting* their behavior based on their traits than we can.

    - We would often do better basing our prediction on our knowledge of the situation.

3. It leads us to think that we have a *better understanding* of human behavior than we do.

But the fundamental attribution error also suggests some more positive lessons. It is important to raise people with good characters. But since behavior is more strongly influenced by situations than we often suppose, it is also important to design social settings and situations in a way that is likely to bring out the best in people, rather than the worst.

23.3 Actor-Observer Differences

We often explain other people's behavior by citing internal causes, like their beliefs and attitudes and traits. John helped his elderly neighbor carry her groceries because he's a caring and helpful person. But how often do we explain our own actions this way? How natural would you find it to say: "I helped Agnes carry her groceries because I'm caring and helpful person."

Of course, we might not *say* this because it sounds immodest. But how often do we even think of our own actions in this way? We are much more likely to say (and think) that we helped Agnes because she looked frail and in need of help. In doing so, we cite features of the situation (a frail older person needing help) rather than internal causes (I'm such a helpful person).

Actor-observer asymmetry: we tend to see others behavior as internally caused, but to see our own as externally caused

This asymmetry in how we think about the actions of others and our own actions is known as the **actor-observer difference** (or the **self-other difference**). We tend to see other peoples' actions as having internal causes (John is helpful) but we see our own actions as having external (situational) causes (Agnes needed help). This phenomenon gets its name because the agent or *actor* (in this case John) sees his actions are largely influenced by the situation. But when John *observes* others, he sees *their* actions as largely influenced by their traits and other internal states.

The actor-observer difference amounts to a bias in our reasoning about people's actions, both our own and those of others we observe. But it does mean that we are less susceptible to the fundamental attribution error when we try to explain our own actions than when we try to explain the actions of others.

23.4 Special Cases

There are certain special cases where we tend to give situational explanations sorts of behavior, and other cases where we tend to give dispositional explanations. We conclude with three important examples.

Blaming the Victim

Earlier we discussed the just world hypothesis. We tend to see people as getting pretty much what they deserve, and when someone suffers in a way that is not the result of obviously bad luck, we tend to think they must have brought it on themselves. They suffer their misfortune because of the *sorts* of people they are. When we reason in this way, we are giving a *situational explanation* of their behavior.

Ultimate Attribution Error

Many people tend to give *dispositional explanations* of the failures or the negative behavior of members of groups they don't like: "It's no wonder Wilbur did poorly on the exam; he's an Okie, and Okies are dumb." By contrast, we tend to explain their successes and positive behavior in situational terms: "He was just lucky," "She must have gotten some special break". We will return to this matter in more detail in Chapter 26.

Self-Serving Biases

We are more likely to attribute our own good or successful actions to internal causes and our bad or unsuccessful ones to external causes. There are two biases here. The **self-enhancing bias** is the tendency to attribute successful outcomes to our own abilities, and the **self-protective bias** is the tendency to attribute unsuccessful outcomes to the situation. There appears to be a stronger tendency to take credit for our good actions than to blame our failures on the situation, although the issue is a difficult one to study because people may not report their true feelings when discussing themselves and their own actions.

Biases in how we think about ourselves are related to the Lake Wobegon Effect. There we learned that a large majority of people think that they are above average in a variety of ways, and only a very small percentage think that they are below average.

For example, a survey of a million high school seniors found that 70% rated themselves above average in leadership skills, while only 2% felt they were below average. And *all* of them thought that they were above average in their ability to get along with others. Most people also think of themselves as above average in intelligence, fairness, job performance, and so on. They also think they have a better than average chance of having a good job or a marriage that doesn't end in divorce.

Conclusion

A great deal of our thinking in daily life involves thinking about people, others and ourselves, trying to understand, explain, and predict their actions. Two of the more robust findings in recent psychology concern such social cognition or reasoning. First, we tend to commit the fundamental attribution error and, second, actors and observers view the causes of behavior differently. In this chapter, we have seen the various ways in which we are susceptible to these biases and a number of the ways they lead to suboptimal reasoning.

23.5 Chapter Exercises

1. Several studies suggest that people in Asian societies like Taiwan are less likely to commit the fundamental attribution error than people in the U.S. or Western Europe. What does this claim mean? What might explain this?

2. Even when people are expressly told that an essay's author was forced to defend a position, they tend to attribute that position to the author. Why?

3. Wilbur arrives thirty minutes late to pick up Wilma for their first date. He tells her that he was detained on the phone with his mother, and then he had to stop and get money, then he had a flat.

    1. How does Wilbur probably view this situation?

    2. How does Wilma probably view this situation?

4. How could Wilma's view, in conjunction with the primacy effect, affect her later views about Wilbur?

5. Describe a real-life situation (one not mentioned above) that involves actor-observer differences. Explain what is going on with our reasoning when such differences occur.

6. What implications do the themes of this chapter have for self-knowledge, for the degree to which we can understand who we are and why we do the things we do?

Chapter 24

Reasoning in Groups

Overview: Being able to work in groups is important in today's world. Many projects are carried out by teams, numerous decisions are made by committees, and most people's jobs require them to work as a part of a group. Juries, parole boards, city councils, and corporate boards all reason together and make decisions. And families are groups, ones whose decisions affect us quite directly. In this module, we will consider several features of group reasoning and decision making. There is great variability among groups, so we can't expect simple, blanket conclusions. But we will see that although groups have their virtues, they are susceptible to several sorts of biases, and we need to guard against them.

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24.1 Group Reasoning

Many policies are fashioned or overseen by legislative bodies, advisory panels, committees, coalitions, boards, or other groups. Under some conditions, the cognitive shortcomings of group members can be attenuated by the group, but under some conditions they are accentuated. Groups are also susceptible to biases of their own, including polarization (making a more extreme decision than group members would make individually), out-group homogeneity (seeing other groups as more homogeneous than they really are), and such nebulous but real afflictions as Janis' "groupthink" (which occurs when a group feels that it must be right and fails to perform a reality check).

We often *feel* that groups are more likely to arrive at balanced, reasonable conclusions and decisions than individuals working alone. Other things being equal, we tend to suppose that groups have the following advantages:

1. They typically have more information than single individuals.

2. More viewpoints are likely to be represented.

3. Problems that one person might overlook are more likely to be noticed.

4. They are likely to take fewer risks and make fewer extreme recommendations.

And indeed, groups often do a better job than individuals working alone. But not all the above points are true of all groups, and groups also exhibit various biases and weaknesses.

24.2 Social Loafing

Members of a group often do less work, and do it less well, than they would if they were working alone. This phenomenon is called **social loafing**. One reason for social loafing seems to be a *diffusion of responsibility*. Each member of a group feels less responsibility and accountability for the work than they would if they had the sole responsibility. This is confirmed by the fact that social loafing can be reduced if each member of a group has a specific task or if each member is accountable for the work that they do.

Social loafing: members of a group often do less than when working alone

Many college classes feature group projects. Most students are not enthralled with group work, and the most common objection is precisely that it promotes social loafing, so that some people do more than their share of the work. One way to reduce social loafing is to assign each member of the group a specific role, and to grade them on their contribution to the group. Social loafing is relevant in understanding the dynamics of groups and in explaining the behavior of their members. Both are related to reasoning, but in this chapter, we will focus on several topics that involve reasoning even more directly.

24.3 Group Dynamics and Setting the Agenda

Many group deliberations exhibit a similar structure. A range of options are proposed and discussed. At some point, an option arises that no one strongly objects to (even if they don't like it very much). At this point further options are not well received, and some version of this proposal has a good chance of being accepted. In other words, a group tends to focus on ideas that happen to be brought up early in the discussion and to give most of their weight to preferences that are expressed relatively early.

This means that the order in which options are introduced can affect a group's decision (later we will see that the order in which things are voted on can determine which one will win). This is so, because groups often have a bias to minimally acceptable solutions that come up relatively early in discussion.

24.3.1 Heuristics and Biases in Groups

Throughout this course, we have seen that individuals are susceptible to various fallacies and biases. Groups can commit the conjunction fallacy, rely too heavily on inferential heuristics, and ignore information about base rates. Moreover, just as individuals are often guilty of self-serving biases, groups are often guilty of group-serving biases.

24.3.2 Out-group Homogeneity Bias

But new sorts of biases enter the picture when we turn to groups. Perhaps the most important is the tendency to see other groups (especially "out-groups"; e.g., people of other races, religions, countries, sexual orientation) as *more homogeneous* than they really are. In other words, groups tend to see themselves as quite varied, whereas members of other groups are thought have much in common. Not only are the members of out-groups seen as more similar than they really are, they are often thought to share stereotypical attributes.

Out-group homogeneity bias: tendency to see out-groups as more homogeneous than they really are

There are probably various reasons for this. Often, in-group members have limited interaction with those in the out-group, and so they don't see the wide variations among members of that group. In this case, people rely on a small and biased sample of the out-group based on limited interactions, news reports, or conventional "wisdom" about members of the out-group.

As we will see in a later chapter, this bias about other groups can promote stereotypes, which in turn lead to prejudices and ethnocentrism. If the members of a group seem reasonably similar, then we will be more inclined to generalize from the behavior of a small sample of them than if we thought of the group as more heterogeneous.

24.4 Group Polarization

Group decisions are often more extreme than the decisions their members would make if they were acting alone. The first example of this that was studied by social scientists was the risky shift.

The **risky shift** occurs when people who take part in a group discussion are willing to support riskier decisions than they would individually, before the group discussion. This has been found in numerous studies. Many of them employ a questionnaire in which a person or group is asked what the probability for success would have to be to recommend the riskier (but more profitable) of two options. For example, how likely does the prospect for success need to be to warrant switching to a job with higher chances of advancement but also higher chances of failure?

Many decisions in the real world are made by groups, so the question naturally arises, whether these are riskier than decisions made by individuals would have been. (Can you think of any examples?)

More recent research has also found evidence of a **conservative shift**. This is just the opposite of a risky shift; it occurs when people in a group decide to support less risky decisions than they would individually. Both shifts are examples of a more general process of **group polarization**, which can lead either to riskier or to more cautious decisions, depending on the initial views of group members. A risky shift tends to occur when the views of group members already incline towards being risky. A conservative shift tends to occur when they already incline towards being conservative.

Group polarization: group decisions are often more extreme than the decisions their members would make acting alone

Group polarization can affect attitudes as well as decisions. For example, it has been found that students with relatively little racial prejudice became less prejudiced after discussing racial issues, whereas students who began with prejudices emerged from the group discussion with even stronger prejudices. Similar results have been found on the issue of women's rights and many other topics.

24.5 Group Accuracy

How accurate are the conclusions groups reach? It depends on the problem and the makeup of the group. But in many cases when a task (like a mathematical problem) has a clear right answer, groups tend to do better than the members do on average, though not as well as the best members of the group.

24.6 Groupthink

Groupthink: tendency for groups to reach uncritical decisions because of group pressures to agree

Groupthink is an impairment in decision making and judgment that can occur in highly cohesive groups with a strong, dynamic leader. Group members isolate themselves from outside information, try to please the group leader, and agree on a decision even if it is irrational. They tend to have feelings of invulnerability, and a strong sense that they are right. Such a group is in strong need of a "reality check." But since there is so much pressure inside the group to agree, it is not likely to come from inside the group. And since the group often feels isolated, sometimes even persecuted, it is not likely to listen to voices from outside the group. History is full of such cases, but you probably see it most clearly with cults. For example, David Koresh and the Branch Davidians in Waco, Texas, Jim Jones and his followers in Jonestown, Guyana, and the members of Heaven's Gate.

More importantly, groupthink can occur on less extreme scales. Often, top governmental decision makers are part of a small, closed team, and they too can fall prey to groupthink. For example, America's attempts to overthrow Castro in Cuba led to the Bay of Pigs fiasco in 1961. In view of the lack of preparation, this was quite predictable, but none of the top officials in Kennedy's government saw the disaster coming. Even after their landslide victory over George McGovern in 1972, the Nixon White House felt under siege, going so far as to construct an official "Enemies List." Their schemes led to Watergate, and Nixon's eventual resignation.

24.7 Successful Groups

Although groups, like people, can be biased, there are several factors that promote good group reasoning. The points here apply to many groups, but since you are probably doing group work in some of your classes, we will focus on that.

24.7.1 Groups in the Classroom

More and more classes include group projects. There is little evidence that this improves learning, although it probably does help students learn to reason in a social context. Some students dislike group work because they feel they end up doing more than their share while others, the social loafers, get a good grade despite doing little work. But even if some students do more of the work, they do gain something from it. In the chapter on memory, we distinguished between recognition and recall. With the former we can recognize something when we see it again, but we couldn't have said much about it if we hadn't. If we can recall something, we have a better grip on it. And, continuing down this path, if we can explain something to others, we have still a better grip. Being in a situation where we must explain things promotes the depth of our own learning and understanding.

If a group project involves a newly formed group that will only be together for one class meeting, the prospects for useful discussion and learning are not great. The group is not likely to be cohesive, and in this setting, people tend to avoid disagreement. Hence, even if someone proposes an idea or solution that many of the group members think is flawed; they are unlikely to say so. Moreover, others may be reluctant to advance their own ideas, because they are worried about the reception they will get. This lack of open discussion makes it much harder to critically evaluate the ideas that are proposed, and it may prevent some good ideas from being proposed at all.

If a group is to make headway with a difficult or controversial issue, an open expression of alternative points of view followed by a frank discussion of them is needed. If the group has met several times before and its members have gotten to know one another, there is likely to be a higher level of trust, and this will make it easier for each member to express their own ideas and to candidly evaluate the ideas of others. Things also work much better when the group has very specific goals. In the absence of highly specific tasks, discussion often becomes somewhat aimless or drifts off into small talk.

Groups also work better when they are given quick feedback. This isn't surprising, because feedback is always important in learning; if you don't know how you are doing, it's difficult to make progress. But it may not be so obvious that groups do better when this feedback includes a comparison of their work with the work of other groups. Such comparisons foster group cohesiveness and effort, because group members then see themselves in competition with other groups. They are then less likely to compete against one another and more likely to work together to compete against other groups.

Finally, groups do better if there are rewards for success. We all are most likely to put our time and energy into projects that have a definite payoff. All these points demonstrate once again the power of the situation. How well people do in groups depends on:

1. Whether it is a cohesive group in which members trust each other.

2. Whether they are given a definite task with a clearly defined goal.

3. Whether they get quick feedback, including feedback on how their work compares with that of other groups.

4. Whether they are rewarded for good work.

Although we have been discussing groups in the classroom, most of these points are quite general. Some groups (e.g., juries) meet only once; others (e.g., a city council) meet repeatedly over time. Some (e.g., juries) have a clearly defined task; others (e.g., a task force to solve some social problem) have a more nebulous task.

24.8 Safeguards

Once again, an atmosphere that fosters dissent is important, and the group leader should encourage people to air objections. Many group biases are less likely if group members are permitted to express disagreement, since the group will be exposed to alternative points of view. It will be easier to break the grip of a singular way of looking at the relevant issues. It can even be useful to have someone play the role of devil’s advocate. Sometimes it is also helpful to first discuss the issues in subgroups (to encourage development of alternate points of view). And seeking the views of people from outside the group also provides another perspective.

24.9 Chapter Exercises

1. You are teaching a class and want to assign group projects. Answer each of the following questions in detail and give examples.

    1. What sort of feedback would you give the groups?

    2. What steps would you take to make sure they knew how well they were doing in comparison to the other groups in the class?

    3. What steps would you take to make sure groups were rewarded for their efforts?

    4. How could you give rewards in a way that didn’t unduly penalize those who did more work or unduly reward those who did less?

    5. More importantly, how would you encourage everyone to do their fair share in the first place?

2. Suppose that you learn that some important policy decision was made by a large group. How might that affect the way you think about it?

3. What do you think explains the risky shift? What role, for example, might diffusion of responsibility play here?

4. Give an example from your own experience of the risky shift (also called the choice shift) and explain the factors that you think brought it about. What problems might a risky shift cause and how might we try to minimize its dangers?

5. Give an example from your own experience of group polarization and explain the factors that you think brought it about. What problems might a group polarization cause and how might we try to minimize its dangers?

6. Give an example, either from your own experience or from your reading, of “groupthink,” and explain the factors that you think brought it about. How might we try to minimize the tendency for people to engage in groupthink?

7. Note some concrete ways in which we might try to reduce the various dangers inherent in group thinking. How practical are they?

Chapter 25

Stereotypes and Prejudices

Overview: The harmful consequences of stereotypes, prejudice, and discrimination are all around us. In this chapter, we focus on the ways fallacies, biases, and other flawed patterns of thinking help foster and maintain prejudices and stereotypes. It would be too much to hope that clearer thinking alone would eliminate such problems, but it would be a step in the right direction.

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25.1 Consequences of Prejudices and Stereotypes

The harmful effects of stereotypes, prejudice, and discrimination are all around us. At their worst, they can lead to institutionalized discrimination, slavery, and even genocide. But milder forms of prejudice have an adverse impact every day on people all around us. They can affect every aspect of a person's life, from their opportunities as a child to their dignity and self-esteem. They also are bad for those who hold them; going through life hating people simply because they are members of some group is not a rewarding way to live.

The catalogue of atrocities resulting from prejudice and discrimination is virtually endless. According to our best scientific estimates, several centuries ago there were ten million Native Americans living in what is now the Continental United States and Canada; by 1900 the number had fallen below 400,000. Over 4,000 African Americans were lynched in the United States from the 1880s to the 1960s. And the list goes on and on. Violent hate crimes still occur, and there are still organized groups like the Klu Klux Klan and The Proud Boys whose chief purpose is to promote prejudice and violence. To a large segment of the U.S., it felt like these groups were on the decline, but we now know they mostly left public spaces to fester on the internet. It is now commonly accepted that white supremacist movements are on rise in the U.S., and once again becoming more public (for many people, they reentered the public discourse with the Unite the Right rally in Charlottesville, VA in 2017). While it can be easy to focus on these major demonstrations of racial discrimination, doing so can also lead many to ignore far more common and subtle forms of discrimination that are all around us.

Implicit Bias

A study originally published in the *New England Journal of Medicine* that has been replicated several times at this point, demonstrates the impact of this subtler discrimination. In the study, actors claimed to have various symptoms in clinical settings with 700 doctors. The results found that black people, particularly black women, were less likely than white people to receive proper testing for serious heart disease—even when doctors believed that the black women had just as high a likelihood of benefiting from the test. We see a similar phenomenon when we look at how doctors assess pain. African Americans and Hispanics are less likely than white patients to receive pain medication, even when they report higher degrees of pain. Few (if any) of the doctors were overtly racist. But the results of their decisions on these matters result in lower quality of life and increased likelihood of death for people of color.

Implicit Bias: unconscious expectations or beliefs pertaining to groups that shape how we treat them

So, what's going on in these cases? These doctors, and everyone else, have implicit biases. For the most part, those of us who are not explicit bigots think that, because we reject discrimination in principle, this it means that we act impartially and in non-biased ways. Unfortunately, this is not the case. The way society is structured, a lot of bias gets engrained in how we think. A little reflection might remind you of a time when you expected a person of color to be more aggressive than they turned out to be, of your surprise that a flamboyant teacher turned out to be straight, or the way you were bothered by the assertiveness of a woman when you would have easily accepted it in a man. All of these are examples of implicit biases manifesting themselves. Most people reject the idea that they have implicit biases, even after they have been pointed out to them. The great news here is, we don't have to fight about it. You can test your implicit biases by taking an implicit bias test. There are several tests on a variety of implicit biases (gender, race, disability, etc., at: https://implicit.harvard.edu/implicit/takeatest.html.

25.1.1 Stereotypes, Prejudice, and Critical Reasoning

Stereotypes and prejudices have many causes and meet many needs. Some of the causes involve emotions and feelings that aren't easily affected by evidence or reasoning, and so attempts to change them will certainly require more than careful and critical thinking.

But faulty reasoning *does* help foster and maintain stereotypes and prejudices. Since our concern in this book is with critical reasoning, we will focus on how the fallacies, biases, uncritical use of various heuristics, and other flawed patterns of thinking studied in earlier chapters help support stereotypes and prejudices. In short, this chapter is an application of our earlier work to a very important—but very difficult—social topic.

Although it would be too much to hope that clearer thinking alone would eliminate prejudice and discrimination, it would be a step in the right direction. Among other things, it would make it more difficult to defend stereotypes with bad reasoning; it would also help us think about these topics in a way that isn't so clouded by emotions that we don't think about them carefully.

25.2 Prejudice

A **prejudice** is an attitude toward a group and its members. The members are targeted simply because they belong to the group. Prejudices typically involve beliefs (stereotypes) about the group *and* emotions or feelings (ranging from mild dislike to extreme hatred). Prejudices are often held for emotional reasons or to help rationalize actions like exploitation of a minority group. But people with prejudices often defend their views—which of course they don't think of as prejudices—with reasons and arguments. And these *can* be rationally evaluated.

25.3 Stereotypes

25.3.1 Schemas

As we saw earlier (7.5.2), there is now considerable evidence that people have well-organized packets of generic knowledge about many things, including librarians, picnics, graduate student offices, visits to restaurants, first dates, and so on. These packages of information are called *schemas*.

For example, the picnic schema includes having a meal outdoors, eating off paper plates, taking a bottle of mustard, sitting at a picnic table, and so on. Not all these things are required for a picnic, but most of them will be true of your typical picnic. So, once we learn that Wilma and Wilbur went on a picnic, we can reasonably infer that most of these things probably occurred; e.g., they probably took a bottle of mustard and ate off paper plates.

Schemas are useful because they help us organize our knowledge; they allow us to automatically fill in many details, and they structure our expectations. A little information may activate it, and we can then use the generic knowledge in the schema to quickly draw further *inferences* about the situation.

For example, when we hear that Wilbur packed a bottle of mustard in a basket, this is likely to activate our picnic schema. And we can then use it to draw inferences about what Wilbur is up to; we would expect him to be eating outdoors, for example. Similarly, your schema for a graduate student office probably includes having books in it, so it is natural to expect that such an office will have books, or to remember it as having books (even if it didn't). We couldn't get along without schemas. They help us categorize events, objects, and people, which makes it easier to explain and predict what they do. Even schemas that are a bit inaccurate are often useful. But some schemas are so inaccurate that they can lead to bad consequences.

25.3.2 Stereotypes as Schemas

A **stereotype** is a schema about the members of a certain group. It includes the character traits, physical traits, and other features commonly associated with the group. When we think of a picnic, we are likely to think that people ate off paper plates, or to remember that they did (even if they didn't), because this is part of our schema for a picnic.

Similarly, research shows that many prejudiced white people have a stereotype of African American males as athletic, hostile, and lazy. So, when someone who has a schema like this learns that Wilbur is an African American, they are likely to infer (virtually automatically) that he is probably hostile. A stereotype needn't involve negative feelings about the stereotyped group, but when it does, it leads to prejudice. Stereotypes are dangerous because they are (i) typically inaccurate, (ii) attribute the same features to virtually all members of a group (even though there are usually large differences among group members), and (iii) are often very resistant to change. We will examine these features below, but first it will be useful to consider some examples of stereotypes.

Examples of Stereotypes

It can be uncomfortable to discuss stereotypes and prejudices in a classroom setting. For one thing, some of the people in the class are likely to be members of groups in question. But open and respectful discussion is necessary if we are to think about these issues in a clear way. If we want to see where a stereotype is *mistaken*, we must acknowledge what that stereotype is. Keeping things at a completely abstract level or, worse, pretending that there aren't any problems, is not an effective way to think about these issues.

It may help if we begin by noting that everyone—even straight, white, cis males—is to varying degrees the victim of stereotyping. In fact, pointing this out is in part a function of stereotyping from your humble authors. There is a kneejerk defensiveness that is common enough we expect some of you reading this to be having it, and we want to cut it off at the pass. So, yes there is stereotyping in regard to all groups. We tend not to linger on the stereotyping of groups that have benefitted most from systemic injustice. It's better to focus on those for whom the stereotyping is the most severe and harmful, because that is where we can affect the most positive change.

Stereotypes seem to be incredibly entrenched. While the world has changed dramatically in the last hundred years, our stereotypes have remained largely the same. Not everyone has the same stereotypes for various groups, but many stereotypes are widely shared. Quickly write down the traits that you think are commonly ascribed to Latino, or Jewish, or gay people. Don't censor what you write (remember, you aren't saying that you feel this way about the group). You will probably come up with some of the following characteristics, which research shows are widespread aspects of common stereotypes: Latinos are stereotyped as aggressive, unintelligent, and lazy. Jews as shrewd, intelligent, and materialistic. Gay men as effeminate; lesbians as masculine.

25.4 Discrimination

When prejudice is widespread, it can lead to pervasive, even institutionalized, discrimination. Just fifty years ago in many parts of the United Sates, African Americans were required by law to sit at the back of the bus, use separate water fountains, and attend separate schools from those used by white students. And they were treated this way simply based on their membership in this group. We teach this in schools as if it were ancient history, but you likely know people who passed on an opportunity to fight in the civil rights movement.

25.4.1 Overt vs. Institutionalized Discrimination

We have already worked our way through a discussion of overt prejudice and discrimination, as well as the subtler phenomena of implicit bias. Even still, we have another significant component of discrimination to address – **institutionalized discrimination**. Remember, with overt discrimination, bigots are intentionally trying to cause harm and injury, and with implicit biases, people have unconscious expectations that result in discriminatory or prejudicial behavior. When we discuss institutionalized discrimination, we move past individuals and look at the way society itself allows for biased and unequal treatment. A helpful way to think about this is as a *feedback loop* – a root cause of implicit bias is institutional discrimination, but implicit biases make institutional discrimination worse.

Institutionalized discrimination: structural features of systems that result in discrimination

While institutional discrimination happens in all sectors of society, it is best seen in law enforcement. Much of modern policing relies on what is known as pretext stops. A pretext stop is when a police officer stops you for a minor violation (tinted windows on your car, cruising, loitering) not because they necessarily want to enforce that particular town/city code, but because they want justification for questioning you further because they suspect something more criminal is going on. If you've heard about policing policies like 'stop and frisk' or 'broken window' they are built on pretext stops. The problem is, we are not all subject of pretext stops equally. Because the process starts with an officer's desire to question someone, any biases they have, implicit or overt, influence the decision. As a result, people of color, especially males, are subject disproportionally to pretext stops. Very few police officers are thinking about harassing people because they are black, but that is often the result. To their eyes, white teens loitering looks like play, and black teens loitering looks like gang activity. A white man driving a BMW looks like normal business and a black man doing the same thing looks like theft. This institutional discrimination explains the data we see when, for instance, we look at drug use vs drug arrest rates. Black people are 2.7 times more likely to be arrested for drug related offenses, yet white people are more likely to use drugs (and both groups are equally likely to sell them). This is where the *feedback loop* comes full circle. Because people of color are arrested at higher rates, they are more likely to be viewed as criminal, and as a result, they continue to be the more likely subject of pretext stops in the first place.

25.4.2 In-groups vs. Out-groups

An *in-group* ("us") is a group that a person belongs to (or wants to belong to), and identifies with. We are all members of a variety of in-groups, from small social clubs or cliques to being citizens of an entire country. *Out-groups* ("them") are groups we don't belong to, and don't identify with. The less we identify and sympathize with a group, or the more we dislike it, the more "out" it is. What's in and out depends on who you are. One person's in-group (e.g., the Ku Klux Klan) will be many others people's out-group.

There are various reasons why people identify with groups, including the fact that it helps foster and maintain self-esteem and a social identity. But whatever the exact causes, people think about their in-groups and out-groups in different ways. Discrimination is often based on long-smoldering resentment that goes back many centuries. Race is the most obvious, though not the only, example in the United States. Elsewhere it is religion: in Northern Ireland, it is Protestants vs. Catholics; in India, Hindus vs. Muslims. In India, there are also divisions between castes. In Africa, there are tribal hatreds like those in Rwanda between the Tutsis and Hutus. And gender and sexual orientation evoke discrimination almost everywhere. In Asia, for example, there are 76 million missing women—76 million fewer women than there should be, given the very nearly equal birth rates of males and females. This results from the fact that women in many societies are valued less than males, and so they receive less food, worse health care, and fewer resources generally.

Discrimination Can Be Easy

Studies show that discrimination against out-groups increases when times are hard, when money, jobs, or food become scarce. But it is also sobering to realize that prejudice and discrimination can spring up quickly, almost spontaneously, in a wide variety of situations.

In Chapter 23, we saw how quickly the guards in the Stanford Prison Study came to see their prisoners as almost subhuman. We also saw that even young children are not immune. Remember Jane Elliott's third-grade class in Riceville, Iowa (23.1)? One day Elliott informed her students that brown-eyed children were smarter and better than blue-eyed children and so they should be treated better. The brown-eyed students were accordingly given various privileges and the blue-eyed students were subjected to rules that called attention to their new, inferior status.

Before the end of the day, the brown-eyed students were banding together and discriminating against their blue-eyed former friends; they fought with them and ostracized them. Meanwhile the blue-eyed students became angry, sullen, and withdrawn. The next day the roles were reversed.

Years later, many of the students felt that the experience had taught them things about discrimination that they would never have learned otherwise. If something like this can happen in a single day among friends, one can only imagine the effects of being treated like the brown-eyed children year after year in a setting that is never—unlike Elliott's experiment—"called off."

The Minimal Intergroup Discrimination Effect

Many studies show that we have a strong tendency to identify with groups, even when they are arbitrarily formed and short-lived. Groups formed based on meaningless or trivial criteria are called *minimal groups*, and this identification is known as the *minimal intergroup discrimination effect*. Once someone becomes a member of a group, they will tend to favor that group, even when the group is formed arbitrarily, as when students are randomly assigned, based on coin flips that they all observe, to one of two groups.

If a group member is then given a chance to divide rewards between members of their own group and the other group, most show marked in-group favoritism. This occurs even when they do not know the other members of their own group, will not get any of the rewards they are distributing to them, and their fellow group members cannot reward them in return. The mere membership in a group is often enough, without any selfish motives or long-term identification, to produce in-group bias. It is enough to make us like members of our group more and to treat them better.

25.5 Features of Stereotypes

We noted three key features of stereotypes above. They are (i) typically inaccurate, (ii) attribute the same features to virtually all members of a group (even though there are enormous differences among the group members), and (iii) are often very resistant to change. Since different stereotypes are inaccurate in different ways, issues of accuracy are best discussed when examining specific stereotypes. But we can say something general about the other two points.

25.5.1 Homogeneity

The Out-Group Homogeneity Bias

The **out-group homogeneity bias** is the common tendency to see other groups (especially "out-groups"; e.g., people of other races, religions, countries, sexual orientation) as *more homogeneous* than they really are.

Group members tend to see their own group as quite varied, whereas members of other groups are thought to be much more alike.

Because the members of out-groups are viewed as more similar than they really are, it is easier to think that most of them fit a simple stereotype that lumps all of them together. We tend to think of this person as "just one more of them"—just another person from India, rather than as the unique individual Rajeev Singh.

Out-group homogeneity bias: tendency to see out-groups as more homogeneous than they really are

Various factors can account for the out-group homogeneity bias. In some cases, people have little interaction with members of the out-group, and so they rely on a common stereotype that presents a simplified picture of the group. People may also be exposed to an unrepresentative sample of group members, perhaps because they only interact with a few people in the group or because they rely on media coverage that tends to focus on a small segment of it (e.g., athletes, executives, criminals).

Strong Identification with One's Group

People's identification with an in-group can be very strong. *Ethnocentrism* is the belief that one's in-group (e.g., the people in one's country, region, religion) are *superior* to members of other groups. It need not involve ill treatment of those in other groups, but it often involves a distrust or wariness of them. *Communalism* is an extreme form of ethnocentrism. It is the tendency for people to divide into groups based on religion, race, language, ethnic identity, or some other common feature. Insofar as it involves a pride in one's heritage and culture, there is nothing wrong with it, but it often spills over into prejudice and even violence against members of other groups. The "ethnic cleansing" in Kosavo, the strife between Tutsis and Hutus in Rwanda, or the closed aspects of various societies in the Middle East involve communalist tendencies. It is an irony of the modern world that increasing globalization and increasing communalism are both on the rise (in some cases, the latter is surely a reaction to the former).

Ethnocentrism: belief that one's in-group is superior to other groups

25.5.2 Resistance to Change

Stereotypes and prejudices are often very difficult to change. It is frequently thought that many prejudiced people harbor prejudices partly because they have never really known members of the target group. Hence, if they can meet such people and interact with them in a positive setting, this will help them to see the group members as unique people, ones with many of the same features they themselves have, rather than simply as members of a group. This is often called the contact hypothesis: contact between individual members of groups in a positive setting where they are treated as equals will help each person become less prejudiced about the other.

Sometimes this works, but it is not as effective as we would hope. One reason for this is that prejudices often have a deeply rooted emotional component, sometimes one going all the way back to a person's socialization as a young child. In watching and talking to our parents and (later) others around us, especially our peer group, we internalize norms for thinking about different groups in different ways. But people also have cognitive (reasoning) biases and employ cognitive heuristics that help them retain prejudices, even when they interact with members of the target group who don't remotely fit their stereotype. We will examine some of these in a moment, but first it will be useful to look at some of the cognitive mechanisms involved with prejudice.

25.6 Cognitive Mechanisms

Different Types of Processing

There is increasing evidence that the human mind consists of several subsystems that work relatively independently of one another. For example, there seems to be a special system for recognizing faces that is largely independent of the perceptual system for recognizing other sorts of objects (one piece of evidence for this is that people with certain kinds of brain damage lose one ability while the other remains intact). Subsystems are not just somewhat independent; they can sometimes even arrive at rather different conclusions about the same thing.

Although the general topic of cognitive (mental) subsystems is fascinating, only a couple of views about alternative types of cognitive processes are relevant here. Patricia Devine has argued that our thinking about other people goes on in two different ways.

First, there is a relatively automatic, habitual mode of thinking that reaches conclusions quickly, involves little or no conscious thought, and over which we have little control. This system is useful, because we often need to draw conclusions fast; we don't have the time or attentional resources to reason in painful detail about everything we encounter, and this system lets us do a lot of social navigation on automatic pilot. But since it lies beyond our control, it can arrive at conclusions we would not endorse if we thought about things carefully; and since it lies outside our conscious thought, it can influence us without our awareness.

Second, there is a more self-conscious mode of thought that is more reflective, and that we can control; it's what we normally think of as careful, conscious thought. It can lead to more well-reasoned conclusions than the automatic system provides.

A Two-Stage Model of Information Processing

Devine puts these ideas together in a two-stage model of our processing of information about people. In the first stage, automatic processing draws quick conclusions. Here, stereotypes can exert a strong influence. In the second stage, conscious processing can tell us that a conclusion we came to automatically is unsupported or even wrong, and we can then modify or ignore it.

Suppose, for example, that Wilma isn't prejudiced against African Americans. Still, she has grown up in a society where the stereotype of black people as hostile is very common, so she has been exposed to it over and over. Under various conditions (e.g., when she sees a black person, or hears about one), this stereotype may be triggered automatically; it influences her thought without her intention. It's automatic. But since Wilma is not prejudiced, her controlled, conscious processing can step in and remind her that the stereotype is unfair and inaccurate, and so she can avoid acting on it. By contrast, if Wilbur is prejudiced, this automatic, stereotypical reaction may be the end of the matter; he won't go on to think about it more carefully. In cases where we don't have much time or motivation to think about something consciously, e.g., because we are busy thinking about something else, we may only go through the first stage of processing. Devine's research suggests that under these conditions, even people who are relatively unprejudiced may still be influenced by common stereotypes. In such situations, a stereotype is activated automatically, and people don't go on to make the corrections they normally would have if they had given the matter conscious thought. Since the automatic processing occurs outside of conscious control, however, they aren't aware of this. This gives us a theoretical framework to understand implicit bias.

Evidence for the Two-Stage Model

In one study, Devine used a test to divide white subjects into a high-prejudiced group and a low-prejudiced group. She then displayed words on a computer screen very quickly so that subjects were not consciously aware of them, but the words were up long enough that they did register unconsciously. One half of each group received words that are commonly associated with stereotypes of black people ('jazz', 'hostile', 'Harlem'); the other half got completely neutral words. She then asked the subjects to read a story about a fictional character named 'Donald'.

The story is designed to be ambiguous enough that it is possible for readers to interpret Donald's actions in various ways. Race is not mentioned in the story. But even low-prejudiced subjects who had seen the words involved in the black stereotype interpreted Donald in a much more negative way than those who saw the neutral words. The words associated with the stereotype somehow activated negative feelings. This automatic processing, completely outside the conscious awareness and control, influenced how they interpreted Donald and his actions. Although the details of Devine's model aren't fully accepted by everyone working in her field, several subsequent studies confirm the basic idea that cultural stereotypes can operate automatically to influence how we think, without our even being aware of it. One moral of this research is the importance of careful, conscious thought, since without it we may arrive at conclusions that are quite different from the ones we would want to draw.

25.6.1 Levels of Generality

There also seem to be differences in processing that are based on the levels of *generality* of the things that we think about. The social psychologists Susan T. Fiske and Steven Neuberg argue that the *attitudes* we have concerning *general categories* or groups may differ a good deal from the attitudes we have toward their individual members. Many people claim to dislike lawyers in general, but they like their own (individual) lawyer just fine. Lots of people express contempt for politicians, but they like those that they know about; for example, most incumbents are popular in their home districts or states and win when they run for reelection. This is relevant here, because prejudices are often *general*, directed against "*them*"—that's just what *they* are like.

The psychologist Robert Abelson suggests that there are two different subsystems here, and that they communicate poorly enough that they often lead us to have inconsistent attitudes (e.g., disliking a group while liking its members). A classic study by Richard LaPiere in 1934 illustrates the idea. LaPiere traveled around the United States with a young Chinese couple. They were accommodated in all but one of the two hundred restaurants and hotels where they stopped.

Later Lapiere wrote these places and asked if they would be willing to accept Chinese guests. Of those who answered, 90% said "No." There are probably many reasons for this, but one may be that the respondents had negative views about the general category of Chinese, but they didn't have any difficulty with these two Chinese *individuals*.

If something like this is right, it helps explain why a positive interaction with individual group members may do little to change a person's general attitude toward the group (we will see additional explanations below). The reason is that the cognitive subsystem that deals with generalities and groups is to some degree unaffected by the subsystem that deals with specific individuals. If so, then it may be more effective to change prejudices against groups by changing how people think about the group's history or achievements, rather than only by getting people to interact with group members; the latter is important, but it may not be enough because it may not affect the cognitive subsystem that is responsible for how we think about groups.

25.7 Flawed Reasoning and Prejudice

Many fallacies and cognitive biases help foster and maintain prejudices

Many of the cognitive biases, fallacies, and other pitfalls in reasoning studied in earlier chapters help foster and maintain stereotypes and prejudices. We will now examine some of them.

Belief Perseveration

Belief perseveration (8.5) is the common tendency to retain a belief even after our original reasons for thinking it true have been undermined. Some beliefs are so thoroughly entrenched that they are impervious to evidence that would discredit them. Once we acquire a belief, it can be very difficult to get rid of it, even when the evidence clearly tells us that we should. The next two cognitive biases help explain why this is so.

Confirmation Bias

Many studies (as well as a bit of careful observation) document our tendency to look for and remember positive evidence that supports our beliefs while not seeking (or even avoiding) negative evidence that could tell against them. Confirmation bias (18.5) is the selective tendency to look for, notice, and remember confirming or positive evidence (that supports what we think) while ignoring or downplaying disconfirming or negative evidence (which suggests that what we think is wrong). For example, if Wilbur already thinks that women are bad drivers, he is more likely to notice or remember cases where women drove badly than cases where they did not.

Confirmation bias leads to bad reasoning, because it means that we never put our views to the test. Hence there will be little chance of finding out that we are wrong, even when we are. This bears on the topics in this chapter because if we have stereotypes, we will tend to look for (or notice) evidence that confirms them, and we won't look for (or notice) evidence that might show they are mistaken. So, even if we encounter group members who don't fit our stereotype (i.e., people who disconfirm it), we may overlook or ignore it.

Subtyping

Sometimes when people interact with members of a stereotyped group it is so obvious that the group member doesn't fit the stereotype that it is impossible for them to ignore it. But even this often fails to lead to any change their stereotype. Instead they maintain their stereotype by appealing to subtypes.

A **subtype** is a stereotype for a small and atypical subset of a group. For example, research shows that prejudiced white people have a stereotype of black people as lazy and hostile. When someone like this meets a black person who obviously doesn't fit the stereotype—say someone who worked their way up from a life of poverty to be CEO of a large, successful corporation—the stereotyper often classifies the other person as a member of a subtype, like Black Businessperson. This allows them to maintain the stereotype in the face of contradictory information ("this person doesn't fit the profile, but they're an exception—most black people do"). There are also gender subtypes, like career woman, feminist, housewife, jock, player, and punk.

Subtype: a stereotype for what is seen as a small and atypical subset of a group

Sample Size

When we draw inferences from small or unrepresentative samples, our conclusions will be unreliable (15.2.3). Some stereotypes no doubt arise from such hasty or unwarranted generalizations. In any large group, there are bound to be some members with negative characteristics. If we happen to interact with just these members of a group, it is easy (though unwarranted) to generalize to the entire group from this faulty sample.

Heuristics

The uses of various cognitive heuristics (like availability and representativeness) (Chapter 17) have associated patterns of faulty reasoning called biases, and these can also lead to bad reasoning about other people.

Two Meanings of 'Bias'

Before seeing how this works, it is important to be clear that we are dealing with two different meanings of the word 'bias'. When we studied heuristics, we also examined their associated biases; for example, the representativeness heuristic often leads to a bias to think that a conjunction can be more probable than either of its conjuncts. In this context, we often speak of a 'cognitive bias', and 'bias' means a systematic tendency to reason badly in a certain way; for example, we have a bias, a tendency, to think conjunctions can be more probable than their conjuncts, and we tend to overlook regression to the mean. By contrast, when we discuss prejudices, we are likely to talk about 'biases' towards groups. Here the word 'bias' means pretty much the same thing as 'prejudice'. Context will make it clear which sense of the word is involved.

Two meanings of 'bias'
1. tendency to employ a certain pattern of bad reasoning
2. prejudice

Availability

We use the availability heuristic (17.2) when we base judgments of frequency on the ease with which examples can be recalled or imagined.

This heuristic makes us inclined to assume that things that are easier to remember or imagine are more likely to occur.

Often, we remember certain things because they really do occur frequently, and when this is the case, the available sample will be a good enough for the rough and ready inferences of everyday life. But things may be available in memory or imagination for reasons having little to do with their true frequency or probability. In such cases, the availability heuristic will lead us to rely on a sample (the cases we easily remember) that is unrepresentative in various ways.

If we expect members of a group to behave in a certain way (as we will if we are strongly influenced by a stereotype of the group), we will be more likely to notice and remember behavior that matches our expectations. If Wilbur thinks that women are bad drivers, he will be more likely to notice when women do drive badly than when they don't (or than when men drive badly), and he is more likely to remember those occasions where they do. Such cases will be more available to Wilbur when he thinks about women drivers, and this will lead him to think that a larger percentage of women are bad drivers than is the case.

Availability may also explain some cases of the out-group homogeneity bias. If we only interact with a small subgroup of a group, or if we rely on media reports that deal only with a small segment of the group, then our sample will be small and unrepresentative. It will easily come to mind, however, and so we may conclude that most members of the group are like the members of the small (and quite possibly atypical) subgroup that we know about.

Representativeness

We use the *representativeness heuristic* (17.3) when we conclude that the more like a representative or typical member of a category something is, the more likely it is to be a member of that category. Put in slightly different words, the likelihood that x is an A depends on the degree to which x resembles your typical A. So here we reason like this: x seems a lot like your typical A; therefore, x probably is an A. For example, Linda resembles your typical feminist (or at least a *stereotype* of a typical feminist), so (many of us conclude) she is likely to *be* a feminist. Sometimes this pattern of inference works, but as we have seen, it can also lead to very bad reasoning.

This can lead us to believe that someone is a member of a group when they are not ("they fit the group stereotype, so they probably belong to the group"). We also frequently make the opposite mistake. Someone is in the group so, we (mistakenly) conclude, they probably fit the stereotype.

Anchoring and Adjustment

An anchor (17.5) is a sort of reference point. Often, we know that an anchor is too high or too low, and we try to adjust for it. But very often we *don't adjust enough*. So, although we don't simply accept the anchor as given, it still skews our final judgment; a high anchor often leads us to overestimate something, and a low anchor leads us to underestimate it.

If we frequently hear that members of a group are unusually dumb or dishonest, we may assume that this claim is too extreme. But it may still provide an anchor, so when we adjust away from it, we don't adjust enough. We don't think the group is as dishonest as we are told, but we may still think that they may be a bit more dishonest than average—even when they aren't. The anchor biases our final judgment.

Memory Effects

Memory is an active, constructive process. We fill in gaps in memory in ways that help us make sense of the world. For example, people heard a fictitious story about a dictator. In one version, he was called 'Gerald Martin'; in another he was called 'Adolph Hitler'. The story didn't mention Jews, but many of the people who heard the Hitler version of the story later thought— "remembered"—that it contained the sentence 'He hated the Jews and persecuted them'. People in the other group did not. People in the first group filled in details based on their knowledge of Hitler. We can also fill in details about a person based on our beliefs about the groups they belong to. Here our stereotypes affect the way we edit memories and fill in details.

Collective Memory

Much as individuals have memories that are stored in their brains, societies have "collective memories" (8.10) that are embodied in their beliefs, legends, and stories about the past. Social scientists have found that collective memories change over time, and that they are often quite different from the original events that gave rise to them.

Sometimes people in power, particularly in totalitarian societies, set out to revise collective memory. There are many techniques for doing this, including rewriting textbooks, constantly repeating the rewritten version of history, and forbidding discussion of what really happened. But it also occurs, in a less conscious way, in more open societies. It often happens that certain groups (e.g., Native Americans) are portrayed in inaccurate ways in a group's collective memory. This can certainly affect how people will think about that group, what images of it will be available, and how they will feel about it.

Illusory Correlation

We believe in an *illusory correlation* (15.4) when we mistakenly think that two things go together when in fact, they are unrelated. For example, Wilbur may think that being a woman and being a bad driver tend to go together, i.e., that these two things are positively correlated. Illusory correlations often result from an overemphasis on positive cases, and Wilbur is likely to notice the cases where the two things go together (cases where woman drive badly) and to ignore cases where they don't (cases where women drive well, or cases involving men's driving). He ignores evidence that tells against our view that the two things are related. It is often easier to think of positive cases where two things go together than to think of negative cases where they don't, especially if we already think that two things typically accompany each other.

There are many reasons why people hold stereotypes, but belief in illusory correlations often reinforces them. Thus, people may believe that members of some race or ethnic group tend to have some characteristic—usually some negative characteristic like being lazy or dishonest—which is just to say that they believe that there is a (positive) correlation between race and that characteristic.

The Validity Effect

Researchers have found that the mere repetition of a claim will lead many who hear it to think that it is more likely to be true than they would have supposed if they hadn't heard it before. This is called the *validity effect* (18.7). The mere repetition makes the claim seem more likely to be true (or "valid"). This effect occurs with true statements, false statements, and statements that involve expressions of attitudes.

Since the validity effect often leads people to believe things without giving them any thought, if we hear a claim over and over, from the time we are small children, we will have some tendency to believe it simply because we have heard it so much. So, if people repeatedly hear that Jews are materialistic, without hearing others say that they aren't, they will tend to believe it.

The Just World Hypothesis

Many people think that the world is basically fair and just. People usually get pretty much what they deserve and deserve what they get. The psychologist Melvin Lerner called this the *just-world hypothesis* (18.8).

Lerner has shown that when people learn about an unfair outcome that is otherwise difficult to explain, they look for a way to blame the person who suffers the misfortune ("they must have done something to bring on their problems"). To the extent that we feel this way, we will tend to think that most people who aren't doing well are getting what they have coming (until recently, many victims of rape were viewed in this way). So, if a group is treated badly, we may feel, they must have some defects that explain this bad treatment ("Where there's smoke there's fire"). In short, we tend to blame the victim, and sometimes this extends to blaming entire groups.

Wishful Thinking

We engage in *wishful thinking* (9.5) when we disregard the evidence and allow our desire that something be true to convince us that it really is true. Our strong human tendency to wishful thinking is one reason why claims by pseudoscientists, advertisers, and others are accepted even when there is little evidence in their favor. When things go badly *for others*, we tend to blame the victim. But when things go badly for us, we often look for *someone else* to blame. We would rather not think that we are at fault, or even that we had a run of plain bad luck. **Scapegoating** is blaming others for problems, especially social or personal problems. Prejudice, stereotypes, and scapegoating reinforce each other. Unflattering stereotypes about a group lead to prejudice against its members, and the need to find scapegoats provides an emotional cause for adopting stereotypes.

Prejudices and scapegoating seem to be more common when times are tough, for example, when the economy is bad. A classic example is the way that Nazis in Germany in the 1930s and 40s blamed the Jews for many of their social problems (which included a devastated economy). Scapegoating is still very common today, and with the rise of communalism, it may increase.

Dissonance Reduction

Most people do not see themselves as evil or sadistic. Consider people who find themselves in a situation where they systematically treat others badly, or even where they simply ignore their plight. It would lead to a good deal of cognitive dissonance (Chapter 19) if they thought to themselves: although I am basically a good person, I am treating these people badly (or ignoring their suffering), and they do not deserve to suffer. One way to reduce this dissonance is to change one's attitude toward the mistreated group: "Maybe they really do deserve to be in their situation after all"; "Maybe (in extreme cases) they aren't even quite human."

This fits with the common finding that most of the people who worked in Nazi concentrations camps came to see their victims as less than human. When you treat someone badly, there is a tendency to derogate them, to think, "well, they deserved it." When we are the victimizers, blaming the victim helps us reduce dissonance.

Inert Knowledge

As with any knowledge, we may know that common stereotypes are inaccurate or oversimplified in various ways, yet fail to keep this in mind outside the setting (e.g., a classroom) where we learned it. When we need it, the knowledge just doesn't come to mind. We aren't aware of our situation as one where our knowledge about the limitations of a stereotype is relevant; we simply don't think about such factors.

Framing Effects

We have seen more than once that the way factors are presented or worded can influence how we think about them. A description of a welfare program as one that helps young children get a hot breakfast will evoke very different images from a description of it as an inducement for Welfare Queens to have more children so they will receive bigger checks. In highly emotional issues of the sort that surround race, sexism, sexual orientation and the like, different people will frame things in vastly different ways.

We have also seen that it is extremely important whether something is framed as a gain (e.g., lives saved) or as a loss (lives lost). Most things can easily be framed either way. For example, a member of a dominant group can frame something as a higher employment rate among a minority group (a gain) or as members of the minority group taking jobs away from members of the dominant group (a loss).

Status Quo Bias

The *status quo* bias is a preference to keep things pretty much the way they are. Unless things are going badly, people often prefer to keep things the same, rather than risk trying something new. So, people in groups that are doing well will have a preference to keep things largely as they are, rather than to risk new policies (e.g., a new affirmative action program) that might make things worse for them.

Contrast Effect

The contrast effect occurs when our evaluations of, or judgments about, something are influenced by the contrast between it and the things around it. If you view another group (and its members) as inferior to your group (and its members, including me), then you look better by comparison. It may increase my sense of self-worth and self-esteem. So, people sometimes derogate other groups so that their own group will, by contrast, look better.

Self-fulfilling Prophecy

A self-fulfilling prophecy is the tendency for a person's expectations about the future to influence that future in a way that makes the expectations come true. Sometimes we have expectations about people that lead us, unwittingly, to treat them in a certain way, and treating them in this way may then lead them to behave in the way that we thought they would.

For example, if you have a stereotype of African Americans as hostile, you may be inclined to be hostile to John, just because he is black. And this may lead him to react with hostility, even though he would have been friendly if you'd been friendly myself. Your prediction leads you to act in a way that makes your prediction come true.

Rosenthal and Jacobson's work (18.6) is relevant here. Recall that they told grade schoolteachers at the beginning of the school year that their incoming students had just been given a battery of tests and that twenty percent of the students should be expected to blossom academically in the coming year. In fact, the students in this group were selected at random. Nevertheless, these twenty percent ended up improving more than the other students. Teachers expected the students in the targeted group to blossom, which led them to act in ways that encouraged the students to do so. This sort of self-fulfilling prophecy is sometimes called the *Pygmalion effect*, and many studies since have documented its existence.

Stereotypes as Self-fulfilling Prophecies

Stereotypes can also serve as self-fulfilling prophecies. If teachers expect students from some groups to perform better than others, this may lead them to treat their students in ways that will make these expectations come true. In a society where people think that women are incapable of careers working with computers, young girls are likely to be treated in a way that suggests they can't do such work. Furthermore, the interest they display in computers may be discouraged, and they will be encouraged to adopt different interests. Years of such treatment *will* make it much more difficult for a woman to have a career working with computers.

In studies by Carl Word, Mark Zanna and Joel Cooper, it was shown that white interviewers conducting mock job interviews were more at ease with white interviewees than with black ones, and this led the white interviewees to be more at ease while the black interviewees were less so. The interviewers' expectations that white interviewees would be easier to talk to led them to behave in ways that tended to make this expectation come true.

Self-fulfilling prophecies can lead us to behave in ways that lead others to confirm a stereotype. Then, because of confirmation bias, we may focus on this evidence, without thinking to look for evidence that would disconfirm our stereotype, and without asking how others might have behaved if we had behaved differently toward them.

The Power of the Situation

We have seen (Chapter 23) the very strong power of social situations to influence how we think about people and how we explain why they do the things they do.

Conformity Pressures

As we grow up, we acquire many beliefs and attitudes and norms without ever thinking about them. This process is called *socialization*. Without it we would never become full members of a culture, which is to say we would never become fully human. But we can be socialized to hold many different beliefs, and if someone grows up always hearing that women are inferior to men (and almost never hearing that they aren't), they must be an exceptional person not to be influenced by this.

Situational vs. Dispositional Explanations

In Chapter 23, we saw the importance of the distinction between internal, dispositional explanations of the causes of someone's actions, on the one hand, and external, situational explanations, on the other. Dispositional explanations cite internal causes like character traits, whereas situational explanations cite features of the circumstances surrounding the actor.

The distinction between internal (dispositional) explanations and external (situational) explanations is also important when we think about members of groups. For example, the average score for various minority groups on certain standardized tests (like the ACT) is lower than the average score for white students. But what does this mean? The issue is one about whether a dispositional explanation (members of the lower-scoring groups just aren't as smart) or a situational explanation (members of the lower-scoring group had to attend much poorer schools) is the right one. More generally, explanations that cite stereotypes cite internal, dispositional causes; a group member does certain things because that it just the sort of person that he (and the others in the group) are. They are just hostile or lazy or materialistic or bigoted: "He did that because he's an Okie, and all Okies are bigoted".

Blaming the victim also involves giving an internal, dispositional explanation of the victim's plight. They suffer their misfortune because of the sorts of people they are ("O.k., she didn't deserve to be raped, but anyone who behaves like she did is asking for trouble"). Whereas in many (though of course not all) cases people suffer misfortunes because of features of their circumstances that are beyond their control, and here external, situational explanations will be more accurate ("She just happened to be there when the prison escapee came along").

The Ultimate Attribution Error

Thomas Pettigrew has called our tendency to give dispositional explanations for the negative or unsuccessful behavior of an entire group of people the ultimate attribution error. By contrast, although we often give dispositional explanations to explain the failures of the members of an out-group, we tend to give external, situational explanations of their positive behavior and successes ("He was just lucky," "She must have gotten some special break because she was a woman").

There is evidence that when a member of a stereotyped group behaves in a way that disconfirms a negative stereotype, we tend to offer a situational explanation of her behavior; we reason: "Almost anyone would do the same thing in that situation, and so, it doesn't really tell us much about the person involved." This is yet another way in which we can retain our stereotype in the face of disconfirming evidence. For example, Wilbur is convinced that women are bad drivers. One day he sees Sue think quickly, then steer out of the way of an on-coming truck. But he reasons (situationally), "anyone in her position would be so frightened that they would be really focused and alert, and so they'd do the same thing."

Ultimate attribution error: giving dispositional explanations for the behavior of an entire group

25.8 Responses

25.8.1 Remedies and Reasoning

Problems stemming from prejudices and discrimination are among the most severe difficulties we face today. There are no easy answers or quick fixes, but it is important to look for strategies that could help reduce these problems.

Although mere contact between members of different groups is not as effective at changing stereotypes or reducing prejudice as we might have thought, there is something to the contact hypothesis. When members of groups that dislike or distrust each other interact in a positive setting; it often does help members of each group see members of the other group in a more positive light. But if people are brought together and the setting isn't positive, things may get worse, and it isn't always easy to ensure a positive setting in the real world.

For example, contact between black and white students increased when schools were desegregated, and this did sometimes lead to less prejudice. The general findings suggest that this contact did not significantly reduce prejudice, however, and in some cases prejudice even increased. One reason for this may be that the contact in such settings is often minimal; there is still a lot of segregation in desegregated schools. Members of ethnic groups often congregate together (a quick look at who sits with whom in most school cafeterias should convince you of this). But even so, contact did increase without any noticeable drop in prejudice. So mere contact is not enough.

Education and the Jigsaw Classroom

Education is probably the best hope for changing stereotypes and prejudices. In general, younger people in our culture have fewer negative stereotypes than older people, and it is probably easier to change their attitudes than it is to change the attitudes of people who are more set in their ways.

One setting that has had a good deal of success is the *jigsaw classroom*. It was developed by Elliot Aronson and his co-workers in the 1970s in Austin, Texas. The idea is to set up a situation where two or more groups of students must work together to achieve a common goal. Students are placed in small groups. Each person in the group must master a given bit of the material and teach it to the other people in the group, so each person and their contribution are like a piece of a jigsaw puzzle that must be worked in to complete the picture.

For example, in a project on the life of George W. Bush, one student might gather information on Bush's childhood, another on his time in college, and so on. So, the success of the group requires the cooperation of all its members. Such approaches are now part of what has become known as the cooperative learning movement.

This interdependence requires working together, and it often does foster mutual interest and respect that are not present in more traditional classrooms. Even approaches like this are not a universal cure, however, since the quicker students in a group may come to resent group members that they see are slowing the group's work down.

Breaking Habits

Stereotypes and prejudices are *habitual*, relatively automatic patterns of thinking and feeling, and Patricia Devine has usefully compared changing a stereotype to breaking a habit. Often stereotypes are very ingrained, and we can't expect to get rid of them easily—any more than a long-time smoker can hope to easily kick the habit. It takes work over time, and even then, the results may be less than perfect. But if one wants to change how they think about another group, conscious effort to do so, including catching oneself when one falls back into stereotypical modes of thought, can help. Of course, none of this works unless a person wants to change.

Conclusion

In this chapter, we have seen that stereotypes (and through them prejudices) are usually based on flawed or fallacious reasoning. Thinking more clearly about them and the evidence on which they rest is the first step in dealing with them.

25.9 Chapter Exercises

1. What is the out-group homogeneity bias? Explain some cognitive (i.e., reasoning) mechanisms that could lead to it. Then explain some ways in which it could contribute to prejudice.

2. Give an example where the use of the availability heuristic helps foster a stereotype and explain how it does so. How could the danger of this be minimized?

3. What is a genuine correlation? What is an illusory correlation (and how does it differ from a genuine one)? Explain how such cognitive illusions could lead to prejudice and give a concrete example.

4. Many inner cities have become so violent that the leading cause of death of young black men there is now murder. Give an example of an internal explanation of this that involves a common stereotype of black males. Then give an external, situational explanation of the same phenomenon. How do the two explanations differ? What is their relationship to the ultimate attribution error?

5. List two stereotypes that are commonly associated with two groups. In what ways are they unfair? Identify faulty types of reasoning that may have led to the formation of each of these stereotypes, or that may have helped keep them in place once they were present.

6. What is the difference between an internal (or dispositional) explanation of an action and a situational explanation of it? What roles do these types of explanation play in the fostering and the maintenance of prejudice?

7. Give an example (real or imaginary) where the use of the representative heuristic helps foster or maintain a prejudice or stereotype and explain how it does so. How could the danger of this happening be minimized?

8. What is the ultimate attribution error? Explain how it resembles (and how it differs from) self-serving biases, on the one hand, and how it is similar to (and also how it differs from) the fundamental attribution error, on the other. How can the ultimate attribution error lead to prejudice?

9. What is modern racism and how does it differ from more the more traditional sorts of racism prevalent in our country several decades ago? Give a concrete example of modern racism.

10. How might dissonance reduction lead to prejudice? Explain the general mechanisms and illustrate your discussion with a concrete example.

11. What is the jigsaw classroom? How might the ideas it embodies be applied in other settings? Explain and give a concrete example.

12. Give an example of scapegoating that has occurred in recent years. What part did stereotypes play in it? In what ways did it involve faulty reasoning?

13. Give an example of communalism and note any harmful aspects of it.

14. Analyze each of the following dialogues.

    1. Edna: I hear you just got hired as the manager of that new pizza place on Lindsey.

    Wilbur: Yeah, and it’s a fantastic job. The only downside is the boss says I must hire some women delivery drivers.

    Edna: So, what’s wrong with that?

    Wilbur: Well, don’t get me wrong. I like women. But you know what kind of drivers they are. And they’ll spend twenty minutes talking to the people at each stop. They’ll be lucky to make two deliveries an hour. I mean, just look at my sister Sue. Four wrecks in just two years. And she can’t stop talking.

    2. Sue: What’s up Edna? You look steamed.

    Edna: Wilbur just drives me up the wall. He’s so prejudiced. He’s just like all men, though, such a sexist.

    3. Professor Smith: Those right-wing fundamentalists are really getting out of hand. I support their right to free speech, but why do they have to use it to say such idiotic things? They must have IQs of about 40.

    Professor Jones: I don’t like their views a lot myself, but some of them are extremely intelligent. That new student from Louisiana is a fundamentalist, and he's the smartest person we've ever had in our graduate program.

Professor Smith: Well, if he's a fundamentalist, maybe you'd better reevaluate him.

4. *Bubba*: Thank God somebody finally stood up for what's right.

Sue: What do you mean?

Bubba: That bar down the street is throwing out the gays and lesbians. They should all be banned.

Sue: What have they ever done to you?

Bubba: Well, I've been lucky enough not to know any, but I know all about them. It's like a disease. It's one of the reasons the economy is going to hell in a hand basket.

Sue: But Tom's gay, and everybody likes him.

Bubba: Well, I don't mean him. He's different. But you know what I mean.

15. Write a dialogue that illustrates the use of a stereotype, a second that illustrates scapegoating, and a third that illustrates a self-fulfilling prophecy.

16. Discuss some ways that more careful attention to evidence and reasoning might help reduce prejudices.

Chapter 26

Social Dilemmas

Overview: Social dilemmas are situations in which actions that seem to be in each person's self-interest lead to outcomes that are worse for everyone. Such situations occur in international relations, countries and cities, families, and two-person interactions. Their common structure is clearly displayed by a game called the *Prisoners' Dilemma*, so we will begin with it. We will then examine social dilemmas in a variety of settings. We conclude with a discussion of strategies for extricating ourselves from such dilemmas.

Contents

26.1 Prisoner's Dilemmas

The notorious felons *A* and *B* rob a bank. A few days later they are apprehended and booked into jail. The District Attorney feels certain that they committed the robbery but doesn't have enough evidence to convict either prisoner unless one of them confesses. The DA puts the two prisoners in separate interrogation rooms and makes the following offer to each:

1. If you confess but the other prisoner does not, you can go free (in return for turning state's evidence). The other prisoner will be sentenced to 10 years.

2. If you both confess, you each get 5 years.

3. If neither of you confess, you will both get 1 year (I can't get a conviction on robbery, but both of you were carrying unlicensed concealed weapons when you were arrested).

The DA informs each prisoner that they both received the same offer, and leaves them both to ponder their options.

Each prisoner may feel some loyalty to the other prisoner, or may consider the possibility that if they squeal the other will seek revenge. But suppose each is so terrified of prison that such considerations play a negligible role in their deliberations.

What would you do?

A two-by-two matrix (Figure 26.1) allows us to visualize the possible outcomes. The rows of the matrix represent *A*'s options (Confess, Don't Confess). The columns represent *B*'s options (the same as *A*'s). Each of the four cells of the matrix specifies one of the four possible outcomes. The first number in each cell represents the number of years *A* gets, and the second number in the cell represents the number of years *B* gets.

Thus, the top left cell of the matrix represents the outcome where *A* and *B* both confess. The numbers in this cell are 5, 5, which indicate that in this situation both prisoners get a 5-year sentence. The top right-hand cell represents the outcome where *A* confesses but *B* does not. The numbers in this cell are 0, 10, which indicates that in this situation *A* gets 0 years and B gets 10. The two bottom cells work the same way.

Now put yourself in *A*'s position. How would you reason? *A* doesn't know whether *B* will confess, but *B* only has two options: confess or not. So, *A* considers each possibility in turn.

1. ***B* confesses** (this means we are considering the first column). In this condition, I get 5 years if I confess and 10 years if I do not. So, if *B* does confess, I'm better off (by five years) if I confess too.

2. ***B* does *not* confess** (we are now in the second column). In this condition, I get 0 years if I confess and 1 year if I do not. So, if *B* doesn't confess, I'm better off (by one year) if I confess.

		B	
		Confess	Not Confess
A	Confess	5,5	0,10
	Not Confess	10,0	1,1

Figure 26.1: Prisoner's Dilemma

Either way, *A* is better off confessing. So, confessing looks like the rational thing to do. *B* will go through the same pattern of reasoning, so it's also rational for him to confess.

The unsettling result is that when each prisoner pursues their own self-interest, the outcome is collectively self-defeating. They both end up with a condition (5 years in prison) that is four year's worse than the fate they would have had (1 year) if they'd cooperated. Each prisoner acts to maximize his own self-interest, so from the point of view of each prisoner it makes good sense to confess. But the result for each is much worse.

Would it make a difference if the prisoners could communicate before making their decisions? It depends. In many cases, people reach an agreement to do something in the future. Suppose that is the case here. *A* and *B* discuss the DA's offer and agree to cooperate.

But when alone, both *A* and *B*'s thoughts return to their earlier line of reasoning. They ask themselves: Is it rational for me to keep my agreement? And the same line of reasoning they went through before convinces them that they are better off breaking their promise and confessing. Since *B*'s reasoning will parallel *A*'s, both confess. The ability to communicate isn't enough to solve the problem; if *A* and *B* do not trust each other, then their most fervent promises of cooperation won't help.

26.2 Real Life Prisoner's Dilemmas

There are many situations like the prisoner's dilemma in the real world, many situations in which the pursuit of narrow self-interest leads to an outcome that is worse for everyone. Since this pattern is so clearly displayed in the Prisoner's Dilemma, such situations are often called Prisoner's Dilemmas as well.

International Relations

For several decades, the United States and the Soviet Union were locked in a nuclear arms race. This cost vast amounts of money and led to a situation where the complete annihilation of the world was a real possibility. Both countries would have preferred mutual disarmament to the spiraling arms race. But like our prisoners, they were trapped in a dilemma.

Each reasoned the same way. Either the other side will keep its nuclear arsenal or it won't. If they keep their weapons, then we must keep ours (so we won't be at their mercy). On the other hand, if the other side disarms, it's still good for us to have nuclear warheads so that they will have to stay in line. A perfectly rational line of thought leads to an outcome that is worse for both parties. The situation is depicted in Figure 26.2; the figure below; here the top entry in each cell indicates the outcome for the U.S., and the bottom entry in the cell indicates the outcome for the U.S.S.R.).

USA \ **USSR**	Build Arms	Disarm
Build Arms	Costly & dangerous, Costly & dangerous	Dominate the world, At the mercy of the other
Disarm	At the mercy of the other, Dominate the world	Cheaper & world safer, Cheaper & world safer

Figure 26.2: The Arms Race

The general pattern in a prisoner's dilemma can arise when more than two parties are involved. The above line of reasoning would be essentially the same if there were more nations, say the United States, Russia, and China, engaged in a nuclear arms race. All three countries would be better off if everyone disarmed, but the situation makes this almost impossible. Indeed, the basic structure of the situation would be the same for any number of parties.

Cartels face a similar problem. The countries in OPEC (an oil cartel) reach an agreement to limit their production of oil to keep the price reasonably high. But it is impossible to determine precisely how much oil any country sells, and so each country will have an incentive to cheat.

Why? Because each country can reason as follows. Either most of the other countries will stick to their production quota, or they will cheat. If most cooperate, the price of oil will remain high, and we are better off producing more to bring in extra money. On the other hand, if most of the other countries cheat, we are suckers if we don't; in this case, we had better get as much oil on the market as fast as possible, before the price drops through the floor.

This leads to a situation where many of the countries are likely to cheat, with the result that the price of oil goes down and they all suffer. Each of the parties would have been better off sticking to their original agreement, but strong pressures to defect are inherent in the situation. Many other international situations, e.g., those involving trade negotiations and world standards for pollution reduction, generate similar difficulties.

26.2.1 Public Goods and Free Riders

Prisoner's Dilemmas are a danger in any situation involving public goods. The following four features are each necessary (and together jointly sufficient) for something to be a public good:

1. Action by many of the members of a group is required to provide that good; the action of just a few members isn't enough.

2. If the good is provided, it will be available to everyone in the group, including those who don't contribute to its production.

3. There is no way (at least no practical way) to prevent noncontributing members from enjoying the benefits of the good.

4. The individual's contribution is a cost (e.g., in time or money or energy or emotional involvement) to that individual.

National defense is a public good. Many people must do their share (either by serving in the armed forces or by paying taxes to fund the defense budget). But once a country has a defense system, everyone will benefit from it, whether they contributed their share or not. And in many cases, it may not be clear whether a person does their share (they may be able to cheat on their taxes, for example). In fact, there are many things that approximate being public goods.

Energy conservation is also a public good. Many people must do their part if a meaningful amount of water, oil, or gas is to be conserved. If enough people cooperate, they all enjoy the benefits of more and cheaper energy sources. This will be so even if a few people don't do their share, however, and in many cases, it isn't possible to determine who does pitch in and who doesn't.

Other examples of public goods include population control, protecting the environment, preventing inflation, public health programs like immunizations, and public education. Not everyone has to contribute for us to have public goods. We all expect there will be some slackers, but problems arise if there are too many. Public goods tend to generate two sorts of difficulties: the problem of free riders and the problem of assurance.

The Problem of Free Riders

In some cities, you pay for public transportation on the honor system. Provided most people pay, the system will work. But since so many people are involved, it will continue to work if a few people take a free ride at the expense of those who do not. This provides a nice metaphor for those who benefit from something without doing their share to produce it; these free loaders are said to be "free riders" on the efforts of those who do.

Rational individuals may easily conclude that they should take a free ride on the contributions of others because of the following (valid) bit of reasoning:

1. Either enough others will contribute for the good to be produced or else not enough will contribute.

2. If enough others do contribute, the good will be produced (my little input won't be missed), and so it is in my interest not to contribute.

3. If not enough people contribute, then the good will not be produced (despite the trouble I go to in doing my share), so it is in my interest not to contribute.

Free riders: people who benefit from a public good without helping to produce or maintain it

Since each person can reason in this way, many are likely to conclude that it is not in their interest to contribute. If so, the good will not be produced (even though it would be to the overall benefit of people to have it). The pattern of reasoning is the same as that in prisoner's dilemma; cooperation is necessary for the best results, but those who do not want to pay the price can enjoy the benefits of public goods by exploiting the cooperativeness of those who produce them (see Figure 26.3).

		Others	
		Cooperate	Ride Free
Me	Cooperate	Enjoy Benefits, Costs of Cooperation	No Benefits, Costs of Cooperation
	Ride Free	Enjoy Benefits, No Personal Cost	No Benefits, No Personal Cost

Figure 26.3: Taking a Free Ride

26.2.2 The Assurance Problem

A person may be quite willing to forego a free ride and contribute if she could be assured that enough others would also contribute for the good to be produced. But since she realizes that many people may fail to do their share (perhaps because they want a free ride), she lacks assurance about their actions. This provides an incentive for her not to contribute either.

The assurance problem becomes especially acute if some people are detected cheating. As distrust sets in, assurance plummets, and more people defect. This can trigger a downward spiral, since it will become more obvious that more people are shirking their responsibilities, and the motivations for others to do their share decreases.

The Tragedy of the Commons

We will now consider four social dilemmas, some of which are all too real.

The Commons Goes Down the Drain

In many nineteenth-century English villages, the families shared a modest parcel of land, the Commons, on which they grazed their cattle. They sold milk and butter and occasionally beef, and everyone made a reasonable living. But the more cattle a family had, the more it prospered, so each family had a motivation to add more.

If only one or two families added a couple of cows, it didn't really damage the Commons. But every family could reason in this way, and they all added more cattle. At some point the Commons reached its carrying capacity; it was overgrazed and much of the grass died. As a result, cattle barely survived, some died, and profits dropped. When each family showed restraint, they all did well. When they each pursued their own interest, the result was worse for all.

Voting

Most of us put a very high value on democracy; the ability to vote in free and open elections is one of the most important features of our country. But democracy only works if a reasonable percentage of eligible voters do so. Turnout is already low, typically less than fifty percent, but if it dropped to ten percent, or three percent, there would be little reason to view elected officials as legitimate representatives of the people.

So, most of us want enough people to vote to maintain our democratic institutions. But it takes time and energy to go to the polls, and in a national election, one person's vote has virtually no chance of making a difference. Of course, as we have seen several times since Bush v Gore, a few voters can sometimes have a very large impact.

Still, it is probably almost as likely that you will be run over by a steam roller on the way to the polls as it is that you will cast the winning ballot in a presidential election. And you are certainly more likely to be killed in a traffic accident than to determine the winner. So why *should* you vote? Why not sit back with a beer and take a free ride on the backs of those who take the trouble to go to the polls?

Campaign Costs

Raising the enormous sums of money needed to run for national office requires a great deal of time, and many people find it distasteful. Most candidates would prefer that everyone spent less on political campaigns. But each candidate also realizes that others are likely to spend more than they agree to spend, so there is pressure on everyone to spend more. This escalates, and we end up with our current situation, where big money plays a major role in who gets elected.

Salary Caps

Most owners of professional football teams would prefer a situation in which no team paid vast, multi-million dollar salaries to their players. But efforts to cooperate often collapse, because sooner or later some team will spend a lot on some player who is just too good to pass up. Because the owners realize that they can't trust themselves, they placed a salary cap on what teams could spend.

The State

Our largest cooperative endeavor is working together to maintain a society and government. Once a state is established, there are various mechanisms that help keep it going. But given our recent examples, we may wonder how a state could be established in the first place, and it is even possible to wonder how it keeps working, once it has been set up.

Of course, some states do break down, but many do not. How is this possible? This was the first collective-action problem to occupy philosophers, and figures like Thomas Hobbes, John Locke, and Jean-Jacques Rousseau used it as a starting point for their important discussions of the justification of the state (Locke's work, for example, was a major influence on the founders of this country).

In a large society like ours, a certain amount of free riding is bound to go undetected. The only way to prevent it would be to set up excessive monitoring and other oppressive measures, and this cure would be worse than the disease. This means that everyone will have numerous opportunities to take a free ride on the efforts of others, and so each person can reason as follows. Either enough people will cooperate to keep the state running (by being good citizens, obeying the laws, paying taxes, etc.), or else not enough will. If enough people do their part, then my little bit won't be missed, so I should take a free ride in any situation where I can get by with it. And if not enough people do their share, my tiny efforts won't keep the state running. Either way, I'm better off cutting corners whenever I can.

Closer to Home

Prisoner's Dilemmas also arise in smaller groups. Consider a commune or large family that shares a big house. All of them would prefer a clean house to a messy one, and if each of them cleaned up the mess they made, the house would be spotless and neat. But the house is large, and if only one person cleans up their mess the house will remain almost as untidy as if they did nothing.

Of course, they could clean up other people's messes too, but then others are free riding and this is likely to lead to resentment and an eventual refusal to do other's work for them. So, there is some pressure for each person to leave the mess they make, with the result that the situation is worse for everyone. Prisoner's dilemmas can occur any time trust is required. If two groups (e.g., Protestants and Catholics in Northern Ireland) are extremely suspicious of one another, they will be motivated to violate ceasefires and other agreements for much the same reasons that our prisoners were motivated to squeal. Trust, of course, is an issue in small groups, including groups of two, so we have worked our way back to the two-person case where we began.

26.3 How is Cooperation Possible?

When we focus on the reasoning in prisoner's dilemmas, it can begin to seem that social cooperation is impossible. Under some conditions, it is very difficult to secure or maintain cooperation, but it clearly is possible in many situations, because cooperative endeavors often do work very well. People do help one another, they do donate money to charities, they do pitch in, in all sorts of ways. Given what we have seen about social dilemmas, how is this possible? If we could understand why it works in some cases, it might be easier to find solutions in cases where it doesn't work so well.

Cooperation is Not Always Good

In this section, we will examine several mechanisms that promote cooperation; but first, a warning is in order. When we focus on energy conservation or pollution control, cooperation looks like a good thing, and in such cases, it is. But cooperation isn't intrinsically good; it all depends on the goals people are working to promote. A great many Germans worked together very efficiently to murder millions of Jews. As always, we have to think critically about each case.

Social dilemmas are a very mixed bag, and we shouldn't expect any single strategy to solve all of them. In some of our examples, defection may be relatively easy to detect; in others, it might be impossible. In some cases, people know each other; in others, they will never see each other again. In some cases, coercion and sanctions are possible; in others, they aren't. Some measures are relatively easy to implement; others would take a profound restructuring of society. But there are several devices that can promote cooperation in various conditions; they are not mutually exclusive, though some of them only make sense in certain settings.

1. **Coercion** We can force people to cooperate by imposing sanctions on those who do not. The state, with its network of laws, police, judicial system, and prisons are well-suited to this task.

2. **Rewarding By-Products of Cooperation** In many cases, working together with others is rewarding in and of itself.

3. **Prudence and Prospect of Future Interaction** In some cases, we will have to interact with people over time. If they have discovered our propensity to take free rides, our reputation will suffer and they will be less likely to share benefits in the future. There may be a short-term gain from cheating, but it is offset by the long-term costs.

4. **Loyalty** If the members of a group know each other and care about one another, cooperation will often be easier to achieve.

5. **Moral Principles and Individual Ideals** Moral principles and individual ideals, like the principle not to lie, or the ideal of being the sort of person who does their share, often prevent people from taking a free ride.

26.3.1 Coercion

Suppose that our prisoners were members of the mob, and knew that a contract would go out on them if they squealed. This alters the incentives or payoffs by raising the cost of defection to a point that the prisoners are likely to cooperate.

Many social dilemmas are solved by the coercive power of the state. Our tendency to obey authority, examined earlier in this module, is sometimes enough to get people to do their share. But self-interest is an extremely powerful force, and can override even the threat of authority. Governments can require cooperation because they can enforce sanctions against those who are caught not cooperating. A major reason why people pay taxes is that they will be penalized if they don't; in effect the state forces us to pay for public goods by taxing us. The goal is to raise the cost of defection so that people will prefer to cooperate. There are many other examples of this sort. One reason why companies don't dump pollution into the river, for instance, is that they will be fined if they are caught doing so.

Coercion can also be effective in some smaller groups. The workers in a factory may prefer the benefits of unionization (higher salaries, more job security) to their present situation. But they may also want to avoid the costs of being in the union themselves; one cost is union dues, but a higher cost is that the union might go out on strike and strikers may lose their jobs. In states that allow "closed shops," ones in which all the workers can be required to belong to the union, workers are coerced into joining and so they can't take a free ride of the backs of those willing to strike.

The threat of coercion is one way of achieving cooperation, but there are many settings in which it won't work. Coercion is possible at the international level (one country can place embargoes on the goods of another country, bomb it, invade it, and so on), but it is rarely effective. The absence of a threat of coercion is of course one reason why it is often difficult to secure cooperation on the international level. In smaller groups, coercion is often more effective, but it can't be the whole story behind cooperation in such settings. It doesn't explain why people often forego a free ride in those cases where they won't be caught (e.g., some kinds of voluntary rationing). Nor does it explain why we often help others in situations where we wouldn't be punished or criticized if we hadn't lent a hand (e.g., giving directions to a stranger; sending money to poor children in another country). Finally, in some groups, for example a married couple, coercion would achieve cooperation only at the cost of undermining the group.

But even when coercion is possible, it is not an attractive way to promote cooperation. Big, coercive government is very dangerous. Furthermore, if people only cooperate because they must, they are much more likely to seek opportunities to cheat. It would be better all the way around if people cooperated because they wanted to.

26.3.2 Positive By-Products of Cooperation

In some cases, cooperative endeavors are rewarding in and of themselves. Many people take pleasure in working alongside others for something they view as a good cause. Striving to promote a common end, like stacking sand bags by a river that's about to flood the town, or banding together to fight for social justice, can generate friendships and feelings of solidarity. Even intrinsically unpleasant acts, like giving blood, can seem rewarding when we do it to help others. In many cases, social by-products do a lot to promote cooperation, but they can't explain all cases. Even people who think we need taxes experience little solidarity with fellow taxpayers as they write out their checks on April 15. Few of us feel warm fellowship with others when we turn our thermostats down to conserve energy or flush our low-flow toilets. Moreover, while the positive side-effects of cooperation often do help maintain cooperative enterprises, they don't explain how those enterprises get off the ground in the first place.

26.3.3 Prudence and the Prospect of Future Interaction

The members of small groups are likely to know each other and to interact over time. Here, pressures of conformity become stronger, and the worry about one's reputation increases. If people come to think of you as a social parasite, your reputation will suffer. Many people find this aversive in itself. But it also means that others will be less willing to trust or help you in the future. So, often it is better to forego a short-run benefit (getting a free ride) in favor of the long-term benefits of cooperation. Free-riding may be in your *short-term* self-interest, but it is often in your *longer-term* self-interest to do your share.

We often do things we don't particularly like doing now to enjoy benefits later. But we are human, and sometimes we go for good old instant gratification. Something *right now* – a cigarette, another piece of pie, a free ride on the efforts of others – often wins out over our long term best interests. So, foresight and prudence have theirs limits in the promotion of cooperation.

Worries about the prospect of future interaction diminish as the size of the group increases. In small rural communities, everybody knows everybody else, but large cities are much more anonymous. In large groups, it is easier to take free rides without detection, and even if others notice, the chances that we'll ever meet again are slim. There is a good deal of evidence that smaller groups cooperate better than huge groups, and this is one reason why.

Iterated Prisoner's Dilemmas

People who will interact with each other over time are not in the same position as our prisoners. With frequent contact, we learn which people can be trusted, and we adjust our behavior accordingly. Some aspects of this setting can be modeled by **iterated prisoner's dilemmas**.

Here 'iterated' means 'repeated', so that two (or more parties) play a series of prisoner's dilemma games. After a few rounds, each party has some idea about how trustworthy the other parties are. Groups of people can do this, and social scientists have studied their behavior when doing so. You can also do a computer simulation to see which strategies work best.

It turns out that the strategy that will win under many conditions is *tit-for-tat*. If the other person cooperates on one trial, you cooperate on the next (thus, rewarding cooperation). And if the other person defects on one trial, you defect on the next (thus, punishing defection). Why do you think this strategy works? The fact that tit-for-tat wins out under certain conditions may help explain why people would cooperate with others when they knew they would be interacting with them in the future. But we often help strangers that we know we'll never see again, so, it can't be the whole story.

26.3.4 Loyalty

Suppose that our prisoners knew each other well and cared about one another's welfare. Perhaps they are brothers, or old friends. Each would then have reason to trust the other and to care about their welfare, and this would make them more likely to cooperate. More generally, groups that have common aims and shared understandings can often foster feelings of trust and solidarity. As groups become larger and more diverse, this becomes more difficult.

26.3.5 Moral Principles and Individual Ideals

What If Everybody Did That?

> *Ann*: I know it's election day, but I'm sort of tired. I'm just not going to vote.
>
> *Betty*: But what if everybody did that?
>
> *Ann*: But everybody doesn't.

> *Betty*: What if everybody reasoned that way? Then nobody would ever do the socially responsible thing.

But Betty's responses simply invite the now-familiar litany. Either (almost) everyone will do the socially responsible thing or they won't. If they do, then your contribution won't be needed; if they don't, your efforts to be a good citizen will be in vain. If we think in terms of short-term payoffs for ourselves, the question, "What if everybody did that?" isn't going to faze us. We need reasons, other than narrow self-interest, to be moved by Betty's line of argument.

Principles and Ideals

In fact, most people *are* motivated by things other than narrow self-interest. In the process of socialization, members of a culture internalize moral principles and individual ideals, and these exert an extremely powerful influence on behavior. For example, codes of honor played a central role in many cultures, particularly strongly hierarchical ones, and many people preferred death to dishonor. Indeed, throughout history, people have been willing to die for a cause.

In our original scenario, the prisoners were chiefly motivated by a desire to spend as little time in prison as possible. But suppose instead that they were political prisoners struggling for a cause they thought extremely valuable. In this case, one or both might be willing to make large sacrifices, even give up their life, to remain loyal to their cause and their comrade.

Altruism also leads many people to help others even when it is not in their narrow self-interest to do so. When the Nazis occupied France during World War II, many French people heroically risked their lives to hide Jewish people that they hadn't even known previously. We do have a capacity to act in accordance with principles and from feelings of altruism, as well as out of narrow self-interest, and these often promote cooperation.

Most of us, for example, believe that lying is wrong. This principle will make us more likely to cooperate in cases when we have promised to do so. Our self-image may also be that of a person who does their share, who keeps their bargains, whether other people do so or not. Even if you could cheat without being detected, you wouldn't do so because you think that it's wrong, or because you don't want to be the sort of person who cuts corners or takes the easy way out.

Suppose that Steve's chief motivation for cooperating is mere prudence; he doesn't want to be caught cheating because people wouldn't treat him very well in the future. Since his motivations are to avoid suffering the consequence of detection, it makes as much sense for him to seek subtle ways of cheating as it does for him to cooperate. But if Steve is motivated by the belief that cheating is wrong, he won't do this. It would be a mistake to underestimate the power of norms and ideals, but as history makes lamentably clear, they are too weak to sustain all cooperative endeavors (including living together in peace) without help from other sources.

26.4 Fundamental Values: Clashes and Tradeoffs

Basic Values

Members of different cultures often have at least somewhat different values. We will consider this below, but let's begin thinking about ourselves. In a large, heterogenous country like the United States, there are many disagreements about values, but there are some basic values that most of us share. Many of the most basic disagreements in our society involve clashes among these values. Often these values reinforce each other, but there can also be tensions among them. In some cases— the hard ones—you can have more of one value only by having less of another.

Consider the following values:

1. Freedom or liberty
2. Majoritarianism (majority rule, i.e., democracy)
3. Equal opportunity
4. The need for security
5. Community moral standards

Basic Tradeoffs

Virtually everyone in our country believes that democracy, the rule of the many, is a good thing. But democracy can be in tension with other values, most obviously individual rights and liberties. A majority can tyrannize a minority just as much as a dictator can. For example, until the 1960s, poll taxes and other public policies made it almost impossible for African Americans in many parts of this country to vote.

A chief purpose of a constitution, a Bill of Rights, and judicial review (review of lower court decisions by higher courts) is to guard against a tyranny of the majority. People have certain fundamental rights that cannot be violated, even if the majority wants to. But where should we allow majority rule, and where do individual rights override it?

Freedoms or liberties or rights are in tension with other values. For example, as we've seen with the anti-vaccination movement, we have all been made less safe because of the freedom that has been offered to parents in many states. Indeed, there are even tensions among liberties themselves. For example, freedom of expression and the press can be argued to trump other freedoms, as without it our other freedoms could be abused without most of us ever hearing about it, and that would make such abuses easier and more frequent.

Still, most of us think that there should be some limits on freedom of the press. In this century, as technologies like wiretapping and videotaping have advanced, we have become increasingly sensitive to people's rights to privacy. For example, reports in the media wreaked havoc on Richard Jewell's life when they reported he was a suspect in the Olympic Park Bombing (it turns out he was a hero who saved countless lives). Many of us also remember the role the paparazzi played in Princess Diana's death. In recent years we have also seen a transition from publishing that names of sexual assault victims to withholding them. The question of how to balance freedom of expression with rights to privacy is consistently in flux as societal values change.

Most of us think there should also be other limits to freedom of expression. People tend to favor laws against libel and slander, child pornography, and publishing manuals explaining how to construct nuclear weapons. Freedom of the press can also conflict with a right to a fair trial. If we are constantly hearing about a terrible crime, it can make it much more difficult for the defendant to receive a fair trial. But as debates over censorship of the internet show, balancing such considerations is never easy. Most of us also think that everyone should have the opportunity at a decent life. But America is built on layers of systemic injustice. We don't start on an equal playing field and as a result, action needs to be taken to balance things out (in the form of school lunches, public education, universal healthcare, etc.). The only way to do this is by the redistribution of money. As noted previously, people don't like to pay taxes, but a dislike of taxes is in tension with the belief that America offers everyone a chance at success.

Finally, community values can conflict with other fundamental values. Laws against sex work and selling drugs place restrictions on the rights of adults to engage in free business transactions, and censorship laws restrict freedom of expression.

Discussion Topic

Tom is trapped in a cave with a very hungry and sick child that will die if she doesn't eat soon. They both know that they will be rescued in a matter of hours, but the child will probably starve to death before that happens. Tom has several egg salad sandwiches that will spoil if they aren't eaten in the next couple of hours. He eats a sandwich and a half then, full, tosses the rest into a deep lake rather than giving one to the hungry child.

1. Is his action wrong?

2. Why or why not (what *principles* might lie behind our judgments about whether it is wrong or not)?

Now suppose that someone proposes the following argument:

> Most of us are in a situation that is very like Tom's. We could, at minimal cost to ourselves, do things that would greatly improve the lot of starving people in various places. Indeed, even just the things we waste, or the money we spend on things we don't need, could do a lot to help people who are really suffering, through no fault of their own. So, we are really no better than Tom.

3. Your task is to evaluate this argument.

    (a) The argument turns on an analogy. Just what is the analogy (what two things are said to be analogous)?

    (b) What relevant *similarities* are there between the two cases?

    (c) What *ir*relevant *similarities* are there between the two cases?

    (d) What relevant *differences* are there between the two cases?

    (e) What *ir*relevant *differences* are there between the two cases?

    (f) What principle (or principles) do you think lie behind this argument?

    (g) Is this a good analogy?

    (h) Could the argument be rephrased without using the analogy? What would be lost if it was?

    (i) Could the story about Tom be revised in any ways that would make the analogy better?

    (j) Should we have a *law* that requires people in Tom's situation to help the child?

26.5 Chapter Exercises

1. Suppose you are working on a group exercise in class, and that your personal grade for the project will be identical with the grade earned by your group. But part of the work for the project requires that each person

spend some time gathering information in the library before the next meeting, when the group will complete its project.

Is there an assurance problem in this setting? Is there a danger of free riders in this setting? To what extent do the features of this situation mirror the problems involving public goods (go through the conditions for a public good one by one)? To what extent are they different? What measures might minimize the problem of free riders?

2. Explain why each of the following is a public good. How might people try to take a free ride, enjoying its benefits without contributing, and how might this be prevented?

   1. population control

   2. protecting the environment against pollution

   3. preventing inflation

   4. various public health programs like immunization

   5. public education

3. In the chapter on groups, we examined social loafing (24.2). How is social loafing related to free-riding? In what ways are they different? In what ways are they the same? What ways of fostering group cohesiveness decrease free-riding?

4. When Chris Swoyer moved to Norman, there was a shortage of apartments, and prices were high (at least they seemed high to him). Many builders noted the shortage and began construction of new apartment complexes. In a few years, there were too many apartments; landlords had to maintain vacant apartments, and many offered to lower rents to entice people to stay. They would have preferred a situation where the apartments were all filled and rents were higher. Why didn't this happen? Is this a Prisoner's Dilemma? If so, why; if not, why not?

5. Owners of professional football teams might impose salary caps because they cannot trust themselves to stick to an agreement to pay lower salaries. Can you think of other situations like this? We sometimes vote to have taxes to support government activities or dues to support an organization. In what ways is this like the owners' use of salary caps.

6. You live in a large house with a group of other people. All of you would prefer a clean house to a messy one, and if each of you cleaned up the

mess you made, the house would be clean. But the house is large, and if only one person cleans up their mess, the house will remain almost as messy as if they did nothing. As a result, no one ever seems to clean up anything. How might you use each of the four measures discussed above (26.3) (coercion, setting things up to yield rewarding social by-products, prudence, and moral principles and ideals) to do this. Which of the four do you think would be most effective? Which least?

7. You have been hired to promote more energy conservation in the state of Oklahoma. How might you use each of the four measures discussed above (coercion, setting things up to yield rewarding social by-products, prudence, and moral principles and ideals) to do this. Which of the four do you think would be most effective? Which least?

8. You have been hired as a consultant to a project promoting population control in an over-populated developing country. Your thoughts here will have to be somewhat tentative, since you don't know the culture, but your co-workers do. How might you use each of the four measures discussed above to do this? Which of the four do you think would be most effective? Which least?

9. Tensions have been mounting between two nuclear super powers. They have become increasingly distrustful of each other, and each now fears a surprise attack. In high level meetings in both countries, the defense ministers argue that the only sensible option is a quick, surprise strike of their own. What reasoning might those in the meeting go through at this point? What might be done to avert the worst outcomes?

10. Over-fishing of various areas has dramatically depleted the number of fish in local waters. In what ways does this situation resemble the Tragedy of the Commons? Can you think of any other contemporary counterparts of the Tragedy of the Commons?

11. Why *should* we vote?

12. We began with a simple game that has implications for many social situations. We'll conclude with another game called 'chicken'. It is named after the game where two people (mostly teenage males) drive their cars straight at each other and the first one to swerve out of the way is a chicken; there is a gripping depiction of this game in the movie *Rebel without a Cause*. In Figure 26.4, each person prefers *a* to *b* to *c* to *d*. Can you say what these outcomes amount to?

		B	
		Swerve	Not Swerve
A	Swerve	b,b	c,a
	Not Swerve	a,c	d,d

Figure 26.4: Playing Chicken

1. Describe what a, b, c and d stand for in a standard game of chicken.

2. The structure of this game differs from the Prisoner’s Dilemma. Here we hope to get the other person to cooperate (swerve first) by trying to convince them that we will not cooperate. What real life situations exhibit the structure of this game?

3. What dilemmas and traps can such situations generate?

Part X

Representation and Recognition

Part X. Representation and Recognition

In Chapter 27, you will learn to draw diagrams that make it easier to reason about the logical structure of many arguments and the probabilistic structure of many problems. Pictorial representations often allow us to see—literally—the solution to a problem.

In Chapter 28, we turn to a few very general tools for thinking more critically and accurately and discuss the best ways of learning to reason more effectively. Among other things, we discuss ways to become sensitive to cues that a cognitive tool is relevant in situations outside the classroom.

Chapter 27

Diagrammatic Reasoning: Using Pictures to Think

Overview: In this chapter, you will learn to draw pictures and diagrams that make it easier to reason about certain sorts of problems. We begin with diagrams of the logical structure of arguments, then move on to diagrams that are useful in various types of inductive reasoning. Such diagrams often allow us to see—literally—the key aspects of a problem, and sometimes even its solution, in a flash. We focus on diagrams that can be drawn easily, often in just a few seconds on the back of a napkin.

Contents

27.1 Using Vision to Think

Pictures can Make Problems Easier

There is an ancient saying that a picture is worth a thousand words. Is it true? Well, it all depends on the picture, the words, and the problem we want to solve. But many problems that seem hopelessly confusing when described in words often become surprising clear when we find a way to represent them in a diagram. Indeed, with the right picture, a problem may pretty much solve itself; the answer just jumps out at us.

We have all heard about first cousins twice-removed, second-cousins one-removed, great uncles, and the like, but most of us aren't very clear about what such relationships amount to; if we draw a family tree, however, things begin to fall into place. And the detailed workings of supply and demand and equilibrium in Econ 101 leave our heads spinning, but they begin to make sense when we learn to draw supply and demand graphs or curves. Indeed, there are many graphical or pictorial representations that make thinking easier: blueprints, seating charts, maps, flow diagrams and, increasingly, computer graphics and animations.

Pictures make many problems easier

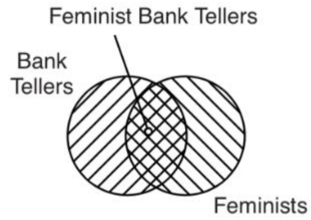


Figure 27.1 Bank Teller

Remember Linda, the outspoken, bright, philosophy major (16.4). We asked whether it is more probable (1) that she is a bank teller, or (2) that she is a bank teller who is active in the feminist movement. If we give the second answer, we commit the conjunction fallacy, but the problem can be confusing, and it may be difficult to see why this answer involves bad reasoning.

Once we draw a picture, though, the answer pops out at us. Here the crosshatched area where the circles overlap represents the set of bank tellers who are also feminists. Clearly this area cannot be larger than the entire circle on the left (which represents bank tellers in general) or than the entire circle on the right (which represents feminists in general).

Why are Pictures so Useful?

A large portion of the human brain (the visual cortex) is devoted to vision, and we are highly visual creatures. So, representing problems pictorially plays to our strengths.

One reason it is useful to present information pictorially is that this format helps compensate for limitations on working memory. We can't focus directly on very much information at a time; our attention and working memory are very limited.

You can keep a six- or seven-digit number (like a phone number) in your working memory if you keep repeating it to yourself, but once you get to nine or ten digits it's very difficult, and with twenty or so it's hopeless.

Reasoning frequently requires us to focus on a good deal of information at once, and often we just can't keep everything straight. Pictures can help. For one thing, they allow us to keep information that needs to be used together close together, so that we don't have to keep searching around for the information we need.

Diagrams allow us to represent abstract relationships between individuals or sets with simple geometrical relationships like the inclusion of one circle in another (as in Figure 27.2) or the overlap of a pair of circles (as in the above diagram of feminist bank tellers). We can also represent facts about percentages and proportions (which is often a good way to think about probabilities) by the relative size of different parts of a diagram, as we do in a bar graph or pie chart (see Figure 27.9).

Such representations are useful because humans are very good at recognizing geometrical relationships like overlap, inclusion, and relative size. When we exploit such structure in a diagram, the information is organized in a way that we can take in at a glance, and often we can draw visual inferences almost automatically.

Diagrams are also useful for exploration and communication. When we draw a diagram, we can tinker with it, erasing the circle here, adding a dot over there, patching it up by trial and error as we grope our way to clarity. And in many cases, it is easier to communicate an idea with a diagram than with words.

Don't make pictures any more complicated than necessary

Different situations and problems call for different sorts of diagrams, and some problems aren't usefully represented by diagrams at all. Furthermore, diagrams, like all representations, can distort, muddy, and confuse. Still, when we can draw a good diagram, it often cuts a very confusing problem down to a manageable size.

In this chapter, we will get a feel for the sorts of problems that can be tackled with diagrams, and learn something about which sorts of diagrams are useful where. The goal is to add diagramming to the set of cognitive tools that you can use, so we will focus on simple diagrams, ones you can often construct in a matter of seconds on the back of a napkin.

27.2 Picturing Logical Structure

Just as a good blueprint can help us visualize the spatial layout or structure of a house, a good diagram can help us grasp the logical layout or structure of a sentence or an argument. Indeed (as we will see below), in some cases when we draw the picture of the premises of an argument, the conclusion is automatically drawn in the process.

Consider the two very simple arguments below:

P1. All humans are mortal.
P2. Wilbur is human.
So, Wilbur is mortal.

P1. All even numbers are divisible by 2.
P2. 18 is an even number.
So, 18 is divisible by 2.

The two arguments have very different content or subject matter (human mortality vs. numbers), but they also have something very important in common. Both are valid, and they are valid *for the same reason*. As always, validity is based on form or structure, rather than content or subject matter, and these two arguments have the same logical structure. We can represent this common structure by erasing the content and just leaving the logical skeleton behind:

P1. All ____are____ .
P2. x is a _____.
So, x is a _____.

No matter how we plug content into these blanks, if we plug the same word or phrase into the same placeholder each time it occurs, and the result is a grammatical sentence, the resulting argument will be valid.

In the best case, you can draw a picture of the premises and you will find that your picture, without any further additions, also includes a picture of the conclusion. This is the case in some of the simpler examples of deductively valid arguments. Indeed, in these cases, teachers often draw a picture to convince their students that a given argument format is valid.

It will help if we imagine constructing a picture of this argument structure step by step (see Figure 27.2). We begin by drawing the first premise, putting a smaller circle representing humans entirely inside a larger circle representing creatures that are mortal (in the subfigure at the left).

Next, we draw the second premise by placing a letter representing Wilbur in the second circle (in the middle subfigure).

Finally, we need to draw the conclusion. But we find that in drawing the two premises, we already drew the conclusion. This occurred because the argument is valid, and as we saw earlier, the information in the conclusion is already contained in the premises. Since the information in the conclusion is already in the premises, our representation of the premises will automatically contain a representation of the conclusion.

The left and center diagrams in Figure 27.2 are already abstract, but in the diagram on the far right we remove the very last bit of content. This leaves just a picture of the argument's form. It is now easy to see that—and why—any argument with this form must be valid. Some sentences and arguments do not lend themselves to a graphical representation, but many do, and for those that do, pictures can be very helpful. Of course, this is an easy example, and we don't really need a diagram to understand it. But pictures really come into their own when we turn to more difficult or complex problems that can be hard to grasp without pictures (we will see an example below with the card-selection problem).

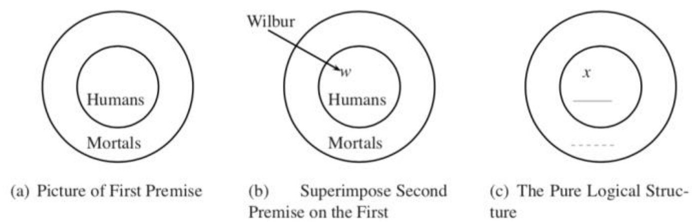


Figure 27.2: Picture of the Structure of an Argument

Conditionals and Conditional Arguments

Necessary and Sufficient Conditions

Thinking in terms of frequencies or proportions not only helps us get clearer about probabilities. It can also sometimes help us reason about conditionals. Take the conditional:

- If Fido is a dog, then he's a mammal.
-

This sentence is about a specific dog, Fido, rather than about groups of any sort. But many (not all) conditionals like this are true (or false) because of facts about groups. Here, the fact that all *dogs are mammals*.

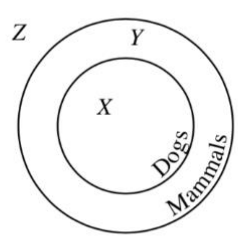


Figure 27.3: Picture of Necessary and Sufficient Conditions

We can represent *this* statement with a diagram like that in Figure 27.3, and then we can use it to help us in our reasoning. We can place the dot representing Fido in the *dog* circle, and it's immediately clear that he's in the *mammal* circle.

So far, things are obvious. Our diagram also shows us why various, more complicated sentences are true or false. For example, if we place Fido's dot anywhere outside the mammal circle, say out at location Z, there is no way he could be in the dog circle. So, the conditional:

> If Fido is not a mammal, then he's not a dog.

is also true.

Now let's return to Figure 27.3 to see how necessary and sufficient conditions work.

- If something is *inside* the smaller, dog, circle, then it must be inside the larger, mammal, circle. Being in the smaller circle is *sufficient* – all that it takes – for being inside the outer circle. Since X is a dog, X is a mammal.

- If something is *outside* the outer circle, there is no way it could be inside the inner circle. As Y shows, being in the larger circle isn't sufficient for being in the smaller one, but it is necessary.

In those cases where we can think of conditionals in terms of sets of things, the set (e.g., dogs) mentioned in the antecedent is the inner circle and the set (e.g., mammals) mentioned in the consequent is the outer circle. This makes it clear pictorially why antecedents are sufficient conditions and consequents are necessary conditions.

This is possible in many instances where it may be less obvious. Consider:

- If my alarm breaks tomorrow, I'll miss my flight.

We can think of this as saying: on all occasions in which my alarm didn't go off, I would miss my flight. This is so, anyway, on all the normal occasions that are likely to arise. We can then draw a picture of the familiar sort, with the circle containing the occasions where my alarm breaks inside the circle of the occasions on which I miss my flight.

When we commit the fallacy of *affirming the consequent* (3.3), we are arguing as though being in the larger circle is enough to ensure being in the smaller one. But Y's location in Figure 27.3 on the preceding page shows this is wrong. And when we commit the fallacy of *denying the antecedent* (3.3), we are arguing as though not being in the smaller circle is enough to ensure not being in the larger one. Again, Y shows that this is invalid. It's all pretty clear when we stick to dogs and mammals, but we'll now look at a case that many people find confusing.

The Card Selection Task

One of the exercises in the chapter on conditionals went like this:

> Wilbur has a pack of cards, each of which has a letter [either a consonant or a vowel] on one side and a number [either even or odd] on the other. Some of the cards are lying flat on a table (Figure 27.4). Which cards should you turn over to test the hypothesis:

Hypothesis: If a card has a vowel on one side, then it has an odd number on the other.

Figure 27.4: Cards in the Selection Task

Hint: only two of the four kinds of labels are relevant. The problem can be confusing, but once we draw a picture that represents the hypothesis, things become easier. The hypothesis means that if any card has a vowel on one side then it has an odd number on the other, so it's claiming that all cards with vowels on one side have odd numbers on the other. And we know how to draw a picture of this, which we do in Figure 27.5.

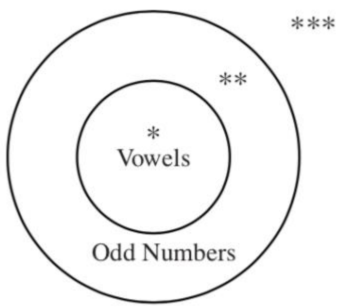


Figure 27.5: Testing the Hypotheses in the Selection Task

Note that the hypothesis only says that all vowels have odd numbers on the other side. It does *not* say anything about what odd numbers have on the other side, and it does *not* say anything about what consonants have on the other side. This means that there is no point in flipping either of these sorts of cards. Suppose that I do flip a card with an odd number. Will it matter what is on the other side? No, because our hypothesis doesn't make any prediction about that. No matter what is on the other side, it's compatible with the hypothesis.

But what about cards that have even numbers on them? Those are the ones lying outside the big circle in Figure 27.4, out in areas like those occupied by the three stars (***). We can see that cards out here cannot be vowels. So, we do need to flip cards out here (which all have even numbers face up). If a card out here has a vowel on it, the hypothesis we are testing is false.

We can also use the diagram to explain the answer in terms of necessary and sufficient conditions. The hypothesis says that having a *vowel* on one side is *sufficient* for having an odd number on the other. So, we need to flip each vowel card, and if we find even one without an odd number on the other side, the claim is false. Similarly, the hypothesis says that having an *odd* number on one side is a *necessary* condition for having a vowel on the other. So, if we find just one even card with a vowel on the other side, the claim is false. We can see from our picture that the hypothesis requires that if a card is not odd (= even), then it is not a vowel. If we find a card, say ***, that is not odd but is a vowel, the hypothesis is false. The relevant argument pattern here is denying the consequent.

There is some evidence that people are better at problems like this when they involve rules and obligations. We do much better if you ask us which people a policeman must check to see if everyone is obeying the rule:

- Rule: If you buy beer, you must be at least twenty-one.

What is the answer? Why might we do better with problems like this?

Picturing Validity

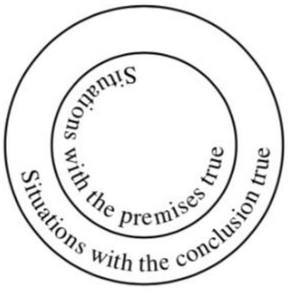


Figure 27.6: Picturing Validity

An argument is valid just in case it is impossible for all its premises to be true while its conclusion is false. This means there is no way all the premises could be true and the conclusion false. So, in every possible situation in which all the premises are true, the conclusion must be true as well.

We can draw a picture of this by representing the set of all the possible situations in which the premises are true by the inner, smaller circle in

Figure 27.6 on the preceding page and the set of all the situations in which the conclusion is true by the larger, outside circle.

By contrast, if an argument is *invalid*, there is some possible scenario in which the premises are true and the conclusion is false. Of course, the definition of validity allows for the conclusion to be true in additional situations in which one or more premises are false.

27.3 Picturing Probabilistic and Statistical Structure

We can use simple diagrams to illustrate various probabilistic concepts. Indeed, we can often use them to show why certain probabilistic rules are correct. Some of the diagrams appeared in earlier chapters, but it will be useful to collect them together here and to add a few new tricks.

Probabilities of Disjunctions

We begin with two diagrams we encountered earlier, to remind ourselves how pictures can help us think about probabilities. Recall that a disjunction is an *either/or* sentence. What is the probability that a disjunction, *A* or *B*, has incompatible disjuncts?

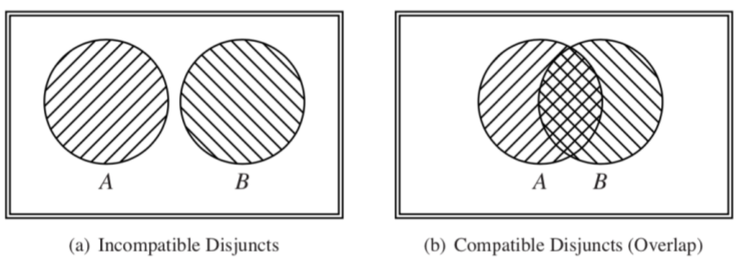


Figure 27.7: Probabilities of Disjunctions

We can represent the situation with the left subfigure in Figure 27.7. To know how much area is covered by either *A* or by *B*, we would simply add the two areas together. We represent the fact that the disjuncts are incompatible by a picture in which the two circles representing them do not overlap, so it is easy to see that we didn't count any portion of the area twice when we added things up.

By contrast, if the disjuncts *A* and *B* are compatible, then they can occur together. We represent the fact that they are compatible by a picture in which the two circles representing them do overlap. And this makes it easy to see that if we simply add the area of *A* to the areas of *B*, we will count the overlapping (crosshatched) area twice (once when we consider *A* and a second time when we consider *B*). The solution is to subtract the probability that *A* and *B* both occur so that this area only gets counted once.

We now turn to more difficult problems that are much easier to solve with pictures than with numbers.

Wilbur Fails his Lie Detector Test

The police have word that there is a large conspiracy to sell stolen software. To halt the sales of these stolen goods, they round up a hundred random suspects and give them lie detector tests. Suppose, hypothetically, that the following numbers are correct.

- The machine says a person is lying in 90% of the cases where they really are lying.
- The machine says a person is lying in 20% of the cases where they are not lying.
- 10% of the suspicious characters in town really are guilty. Wilbur failed his test; the machine says he lied. What is the probability that he is guilty?

It is tempting to reason like this: the test is 90% reliable, so there must be about a 90% chance that Wilbur is guilty. The 90% here is the conditional probability of someone's failing the test if they are guilty.

But this is *not* what we want to know. We want to know the opposite or *inverse* of this; we want the probability that someone is guilty, given that they failed. The first figure is Pr(Fails| Guilt), but we want to know the inverse of this, Pr(Guilt |Fails). The two probabilities can be very different; compare: Pr(Male|Pro football player) ≠ Pr(Pro football player |Male)

In the appendix to this chapter we will see how to use our rules to calculate the probability of Wilbur's guilt. But a simple picture can be used to to solve the problem, and it is much easier to understand.

Figure 27.8, which is drawn to scale, represents the relevant information. Remember that there are 100 people in our group.

- 90% of them are *not* guilty, and they are represented by the wide column on the left of the diagram. Ten percent *are* guilty, and they are represented by the much thinner column on the right.
- 90% of the guilty people fail the test, and we indicate this with a minus, in 90% of the rows in the thin column.

- 20% of the people who are not guilty fail the test (perhaps they are nervous), and we indicate this with a minus in 20% of the area of the wide, non-guilty column.

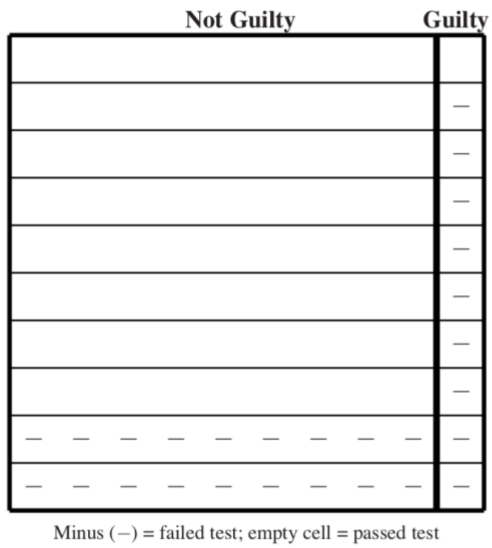


Figure 27.8: Probability of Guilt Given Test Results

Now we just need to consult the figure and check the percentages. When we do, we find that 9 of the 10 guilty people fail the test, but 18 of the innocent people also fail (18 is 20% of the 90 people who are innocent). So only one person in three who fails the test is guilty. If we have no additional information to go on, the probability that Wilbur is a conspirator is 1/3. It is important that you count, literally, the number of minus signs in the figure to verify this.

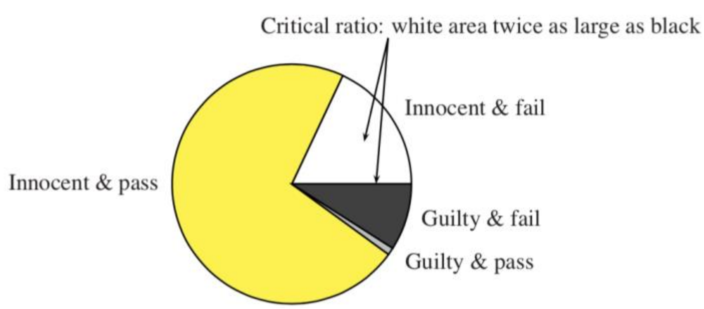


Figure 27.9: Pie Chart of Lie Detector Test

Similar points apply in many other situations. For example, we may want to know about the probability of having breast cancer, given a small lump and a certain result on a mammogram. Problems like these require us to integrate knowledge about the present case (e.g., what the lie detector says) with prior information about base rates (proportion of guilty people among the suspects). We often focus too much on the present information (Wilbur failed) and ignore information about the base rates of guilty people among the suspects (only 1 in 10).

There are often various ways to display information. We could also depict Wilbur's plight with a pie chart in which each of our four groups is represented by a slice of the pie (Figure 27.9); it is drawn to scale, so that 10% of the pie represents 10% of the group). Such diagrams are often easy to read, but it takes a bit more work to construct them than it does rectangular diagrams.

You should use whatever sorts of pictures you find most helpful, but it is important to construct quick and simple figures; otherwise they will take so much work that (if you are like most of us) you will rarely put in the effort to construct anything at all.

Exercises

1. Draw a picture like that in Figure 27.8, and determine the probability of Wilbur's guilt if all the numbers remain the same, except that the probability of failing the lie detector test if you are not guilty is only 10% (instead of 20%, as above).

2. Draw the picture and determine the probability of Wilbur's guilt if all the numbers remain the same, except that the base rate of guilty people among the suspicious people is 20% (instead of 10%, as it was above).

3. The staff at the Suicide Prevention Center know that 2% of all people who phone their hot line attempt suicide. A psychologist has devised a quick and simple verbal test to help identify those callers who will attempt suicide. She found that:

    a. 80% of the people who will attempt suicide have a positive score on this test.

    b. But only 5% of those who will not attempt suicide have a positive score on this test.

If you get a positive identification from a caller on this test, what is the probability that they would attempt suicide?

4. Suppose that we have a test for the HIV virus. The probability that a person who really has the virus will test positive is .90, while the probability that a person who does not have it will test positive is .20. Finally, suppose that the probability that a person in the general population has the virus (the base rate of the virus) is .01. Smith's test came back positive. What is the probability that he really is infected?

Construct a diagram to determine the answer (we will work it out by the numbers in the appendix, so you can check your answer against the answer there).

Correlations Revisited

The discussion of correlations in Chapter 15 emphasized pictures, so we will simply recall the basic points here. We saw that the easiest way to understand the basics of correlation is to use a diagram like Figure 27.10 on the following page. It depicts four hypothetical relationships between smoking and getting lung cancer. The fact that the percentage line is higher in the smoker's column than it is in the nonsmoker's column in the top two diagrams in Figure 27.10 indicates that there is positive correlation between being a smoker and having a heart attack. It is the relationship between these two horizontal lines that signifies a positive correlation. And the other diagrams work in the same way. It bears repeating that you do not need to know exact percentages to draw most of these diagrams. You only need to know which column has the higher percentage, i.e., the higher horizontal line.

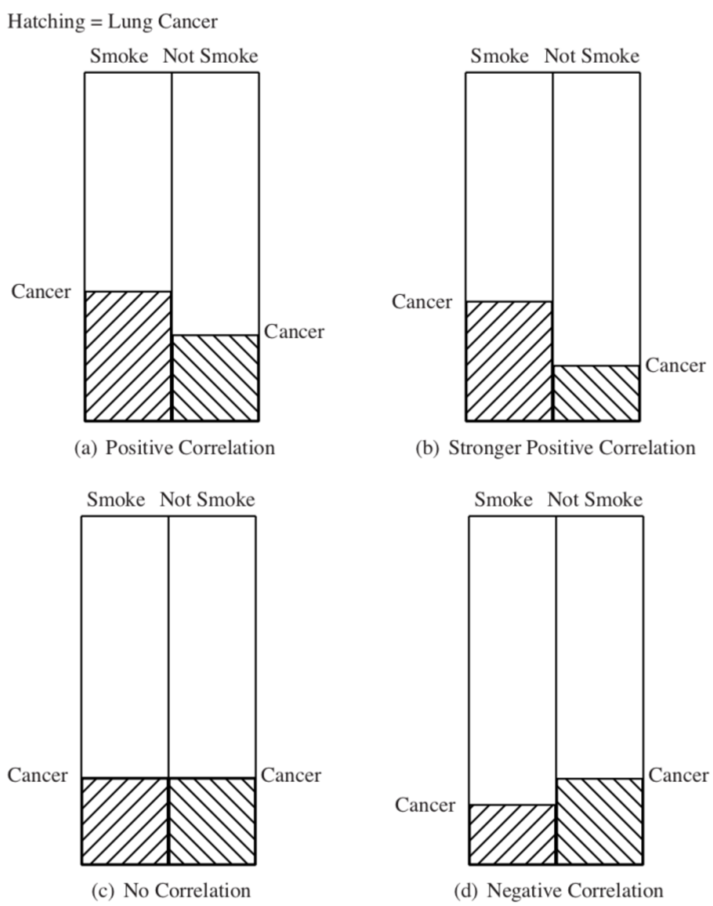


Figure 27.10: Diagrams of Correlations between Smoking and Lung Cancer

Probability Trees

Rectangular diagrams are very clear, but only work well when we are considering two factors, variables, or outcomes. Figure 27.11 shows how to represent three variables; here the outcomes of three successive flips of a fair coin, with each flip is a separate variable.

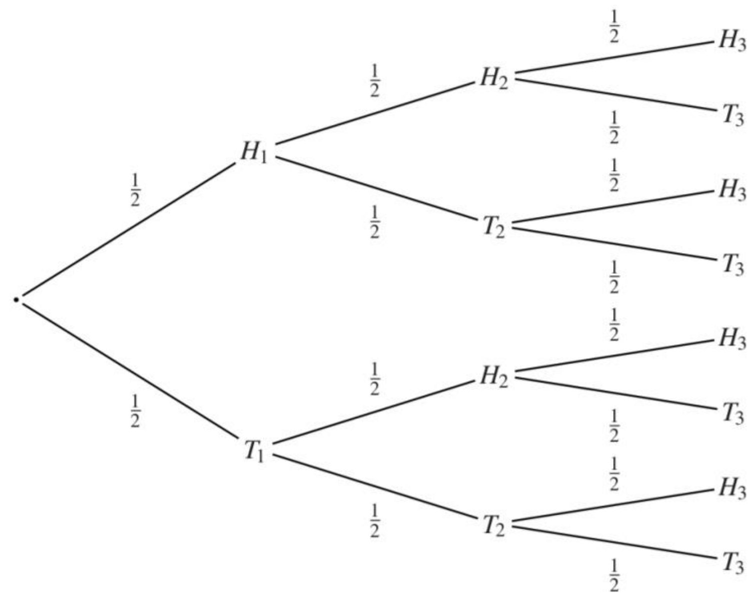


Figure 27.11: Tree for Three Variables

In the tree, the numbers along each path represent the probabilities of the outcomes. The probability of a heads on the first flip (represented by the first node of the top path) is 1/2, and the probability of a second heads as we move to the right along that path is also 1/2. There are eight complete paths through the tree, and to assess the probability of any of them (e.g., $H_1T_2H_3$) we simply multiply the numbers along the path. Since the coin is fair, the probability for each of the eight outcomes represented by the eight full paths is 18.

Trees can also be used when we have fewer than three variables. In Figure 27.12, we represent in a tree format the data about Wilbur's lie detector test that we displayed above in a rectangular diagram. Here we represent the probabilities as labels on the branches.

For example, the branch beginning with Suspects and running to Guilty is labeled 10%, to indicate that 10% of the suspects are guilty. And the bottom branch, from Suspects to Not Guilty, is labeled 90%, to indicate that 90% of the people rounded up are innocent. The additional labels represent the additional probabilities. For example, the top right branch is labeled 10%, to indicate that 10% of the guilty people manage to fool the machine and pass the test.

The arrows point to the number of people who fail the test. There are 9 guilty people who fail plus 18 innocent people who fail, for a total of 27 failed tests. Of these 27 failures 18, or 2/3, are innocent. So, if we have no additional information, our best guess is that the probability that Wilbur is guilty is 1/3.

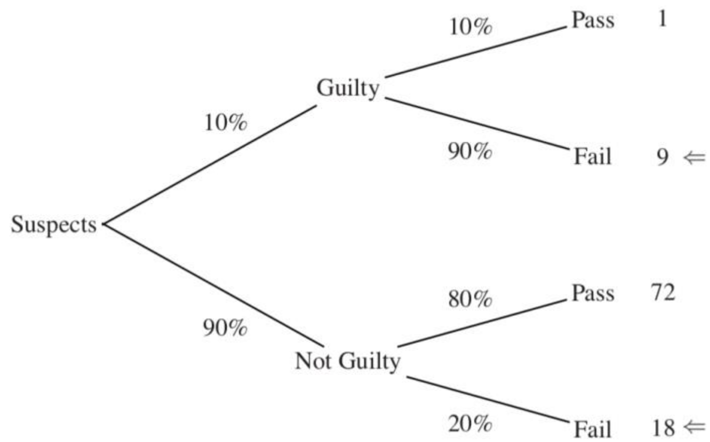


Figure 27.12: Tree Diagram of Wilbur's Lie Detector Test

Exercises

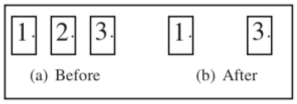
1. Represent the information about the officials at the Suicide Prevention Center above as a tree and use it to solve the problem.

2. Represent the information about the HIV test above as a tree, and use it to solve the problem.

Brute Enumeration of Percentages

Pictorial Solution to Monty Hall Problem

In the appendix to this chapter we will solve the Monty Hall Problem using probability rules, but most people find a picture of the situation more illuminating. Recall the problem: there are three doors in front of you. There is nothing worth having behind two of them, but there is $1,000,000 behind the third. Pick the right door and the money is yours.



Suppose you choose door 1. But before Monty Hall opens that door, he opens one of the other two doors, picking one he knows has nothing behind it. Suppose he opens door 2. This takes 2 out of the running, so the only question now is about door 1 vs. door 3.

Monty then lets you reconsider your earlier choice: you can either stick with door 1 or switch to door 3. What should you do? More generally, whatever door a person originally picks, should they switch when given the option?

You are better off switching. The basic idea is that when Monte opens one of the two doors you have acquired new information. To represent things pictorially, we begin by figuring out the various things that could occur in this game. You could pick any of the three doors, and the money could be behind any of the three. We represent this situation in Figure 27.13 (ignore the thumbs-up signs for now). The first three numbers on the left represent the door you select (either 1, 2, or 3). And for each selection you could make, there are three places where the money could be. So, there are nine possibilities. In the figure, the arrow points to the situation where you selected door 2, but the money was behind door 3.

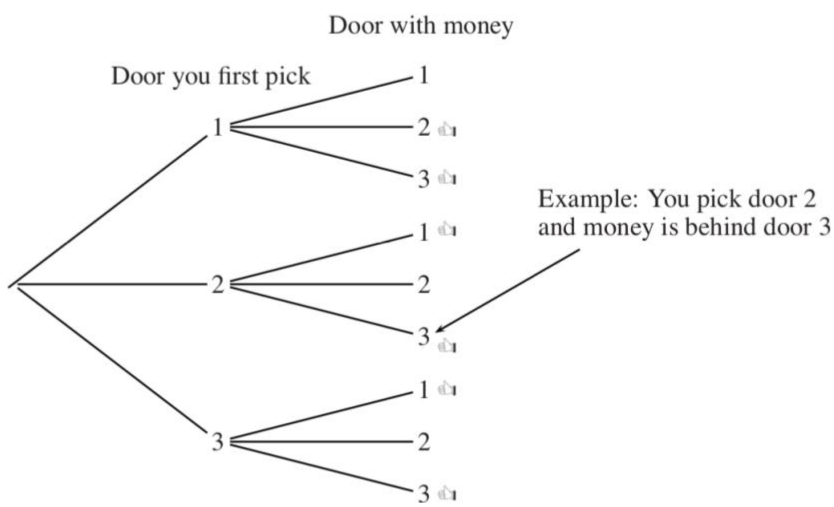


Figure 27.13: Tree of Possible Outcomes in Monty Hall Problem

How to Read the Table

The rows involving switching doors and its outcomes are shaded. Still, Figure 27.14 contains a good deal of information so, let's consider a couple of examples.

- *Row one*: I picked door 1, and that's where the money is. Monty can open either door 2 or door 3, since the money isn't behind either. The only place I can move to is the door he didn't open. If he opened door 2 I can move to 3; if he opened 3. I can move to 2. In this case, if I switch, I lose.
-
- *Row two*: I picked door 2 and the money is behind door 1. The only door Monty can open is door 3. If I stay with door 2 I lose; if I switch to door 1, I win. If I always stick with my original pick, I will win in only 3 of the 9 cases (rows 1, 5, and 9). If I adopt the policy of

switching, I will win in 6 of 9 cases (all the other rows). So, I am twice as likely to win the money if I switch. We can present the information more compactly in Figure 27.2. Each column indicates what happens in each of the nine situations if I stay or if I switch.

$	Original pick	Monte opens	Switch to	Result	Stay	Result
1	1	2 or 3	3 or 2	L	1	W
1	2	3	1	W	2	L
1	3	2	1	W	3	L
2	1	3	2	W	1	L
2	2	1 or 3	3 or 1	L	2	W
2	3	1	2	W	3	L
3	1	2	2	W	1	L
3	2	1	3	W	2	L
3	3	1 or 2	2 or 1	L	3	W

Figure 27.14: Using a Picture to Solve the Monte Hall Problem

We can also represent these outcomes with a tree; indeed, the thumbs-up signs in Figure 27.15 indicate the cases where you will win if you switch doors. Like our other representations, they show that you double your chances of winning if you switch.

Original pick	1	1	1	2	2	3	3	3	3
Door with $	1	2	3	1	2	3	1	2	3
Stay	W	L	L	L	W	L	L	L	W
Switch	L	W	W	W	L	W	W	W	L

Figure 27.15: Simplified Diagram of Monty Hall Problem

As usual, it is helpful to think in terms of proportions or frequencies. Imagine that you play the game many times. What should you expect to happen, on average, every hundred times played? You would win about sixty-six of the hundred games if you switch. You would lose sixty-six if you stick with your original door.

Pictorial Solution to the Two Aces Problem

Remove all the cards except the aces and eights from a deck. This leaves you with an eight-card deck: four aces and four eights. From this deck, deal two cards to a friend. He is honest and will answer exactly one question about his cards. The issue isn't one about which order in which he got his two cards; indeed, let us suppose he shuffled them before looking at them so that he doesn't even know which of his cards was dealt first.

1. You ask if his hand contains at least one ace. He answers yes. What is the probability that both of his cards are aces?

2. You ask if his hand contains a red ace. He answers yes. What is the probability that both of his cards are aces?

3. You ask if his hand contains the ace of spades. He answers yes. What is the probability that both of his cards are aces? Using a bit of makeshift but obvious notation, we want to know:

   1* Pr(2 aces|at least 1 ace)

   2* Pr(2 aces| at least 1 red ace)

   3* Pr(2 aces|ace of spades)

All three probabilities are different. We can see the basic point with fewer cards, but the goal here is to examine a problem that needs a little bit bigger diagram than fewer cards would require.

The most difficult part of this problem is figuring out how to represent the various possible hands. We note that there are eight cards one could get on the first draw and seven on the second, so when we take order into account, we have 8 x 7 = 56 hands. Order isn't relevant here, however, since we aren't concerned with what card came first, so we can cut 56 in half (counting the outcome of eight of hearts on the first draw and ace of hearts on the second, and the reverse order with the same two cards as the same hand; if you want to consider all 56 cases you can, but it will mean more work).

Indeed, if worst came to worst, you could simply write down all the possible hands in some systematic way, and you would end up with the same 28 hands we'll begin with here. This takes work in the present case, but with simpler problems it is entirely feasible.

$A_s A_h$	$A_s A_d$	$A_s A_c$	$A_s E_s$	$A_s E_h$	$A_s E_d$	$A_s E_c$
	$A_h A_d$	$A_h A_c$	$A_h E_s$	$A_h E_h$	$A_h E_d$	$A_h E_c$
		$A_d A_c$	$A_d E_s$	$A_d E_h$	$A_d E_d$	$A_d E_c$
			$A_c E_s$	$A_c E_h$	$A_c E_d$	$A_c E_c$

Figure 27.16: Diagram for Thinking about Two Aces Problem

There are more efficient ways to solve this problem than by enumerating the hands, but such an enumeration can sometimes give us a better feel for the situation. Such an enumeration is given in Figure 27.16, and once we have it, we can determine the answers simply by inspecting the proportions of various sorts of hands (ones with at least one ace, ones with at least one red ace, and so on).

In all three scenarios Wilbur has at least one ace, so only hands with at least one ace are relevant here. A little calculation, or a little trial-and-error doodling, will show that there are 22 hands with at least one ace. Since the ace of spades showed up in the problem, we can begin by enumerating all the two-card hands that contain it. Then we can enumerate those with the ace of hearts, diamonds, and clubs, taking care not to list the same hand twice (if worse comes to worst, you can simply list all the hands and then go through and cross out any duplications).

We are dealing with *conditional probabilities*, here. Remember how these cut down the set of possibilities (what is sometimes called the sample space). You roll a die and can't see where it landed. When Wilma verifies it came up an even number, this eliminates all the odd numbers from consideration, and the probability you rolled a two goes up from 1/6 to 1/3. Similarly, when Wilbur tells you he has at least one ace, this eliminates all the hands without any aces, and it also changes various probabilities.

Probability of Two Aces, Given at Least One

First, we'll see what the probability of Wilbur's having two aces is, given that he has at least one ace. The 22 hands enumerated in our diagram all contain at least one ace, and 6 of them (those shaded in Figure 27.17) have two aces. So, there are 6 ways out of the 22 of having two aces, for a probability of 6/22 (which reduces to 3/11 = .27).

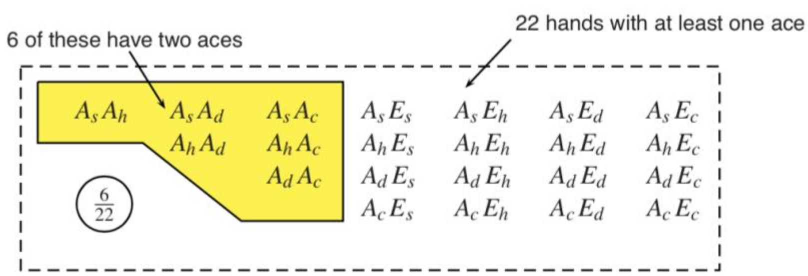


Figure 27.17: Two Aces Given at Least One

Probability of Two Aces, Given the Ace of Spades

Now we'll see what the probability of two aces is, given that one of the cards is the ace of spades. This cuts down the cases we consider—our sample space—to just those hands with the ace of spades. These occupy the first row of our diagram, and there are exactly seven of them. They are enclosed with a dashed line in Figure 27.18.

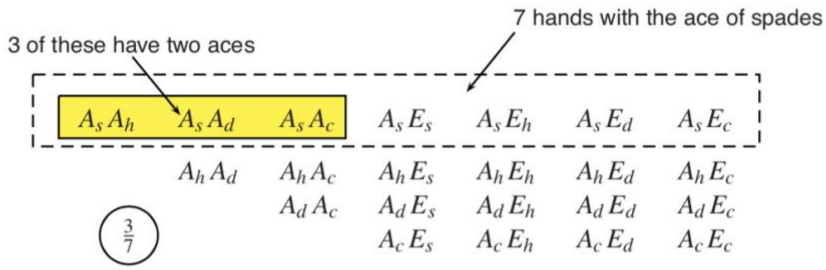


Figure 27.18: Two Aces Given the Ace of Spades

Of the seven hands that contain the ace of spades, only three contain two aces (these are enclosed with a solid line and shaded). So, there are 3 two-ace hands out of 7. This yields a probability of 3/7(= 0.43). Hence, the probability of two aces given an ace of spades is substantially higher than the probability of two aces given at least one ace. We leave the last of the three puzzles as an exercise.

Decision Trees

Decision trees: picturing the contingencies

We can often represent situations where we must make a difficult decision with trees. In cases where we have a good estimate of the relevant probabilities and payoffs, we can also represent these on the tree, and use it to help us calculate expected values. Here we will simply note the way in which trees, even in the absence of such information, can help us sort of the relevant alternatives and help us focus those that matter the most.

We will consider a hypothetical example, but situations like this are common; at some point, virtually all of us must make difficult, very possibly life-or-death, decisions about medical treatment, either for our self, or a child or an aging parent. John’s test results are not good. They suggest some possibility of a brain tumor, although the probability is considerably less than 50%. If it is cancer and it’s not surgically removed, John will die in the next year or so. But there is also a genuine risk from the surgery; in a few cases it is fatal, and it leads to lasting damage in other cases. Unless John has the surgery within two months, it will be too late, so the decision needs to be made soon. Of course, John could choose just to not think about it, but this amounts to the decision not to have surgery.

We can represent John’s situation with a tree like that in Figure 27.19. This helps us chart the various possibilities. In real life, we rarely can obtain very precise values for probabilities, but in some medical situations a good deal is known about the percentage or proportion of those who have cancer given certain test results or mortality rates in surgeries of a given sort. Where we have these, even if they aren’t completely precise, we can incorporate them into our tree. Such trees can be developed in considerable detail, but we won't explore them further here.

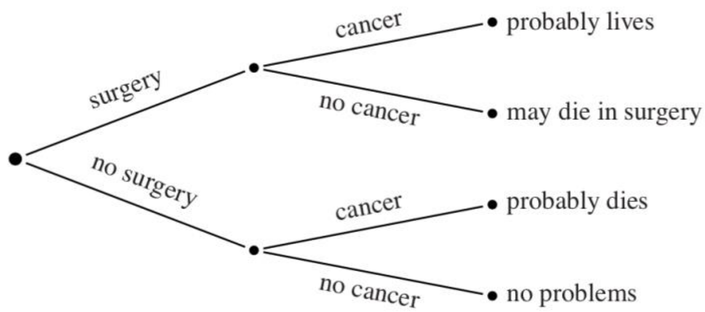


Figure 27.19: Simple Decision Tree

Rectangular Diagrams for Logic and Probability

In this section, we develop a simple method for representing important logical and probabilistic relationships with 2 by 2 diagrams. It takes a few minutes practice to become skilled with these diagrams, but it's a good investment, because it allows us to see many important logical and probabilistic relationships. Where there are only two variables or factors, say A and B, it is often very useful to represent them with a 2 x 2 rectangle like that in Figure 27.20.

Columns represent A and its negation ~A.

Rows represent B and its negation ~B.

For easy reference, we can think of these four areas as numbered regions, starting with 1 in the lower right and working our way around (Figure 27.20).

	A	$\neg A$
B	3	2
$\neg B$	4	1

Figure 27.20 Numbering the Regions

(a) Horizontal Lines: *A* true

(b) Horizontal Lines: *B* True

Figure 27.21: Areas Corresponding to A and B

In the diagram on the left in Figure 27.21, the region with horizontal (left-to-right) hatching (quadrants 3 and 4) represents the area of the rectangle in which A is true. The area with vertical (up-and-down) hatching (quadrants 1 and 2) represents the remaining region where A is false, so the vertical region represents ~A. Similarly, the horizontal region of the diagram on the right in Figure 27.21 represents the area where B is true, and the vertical region represents that in which B is false.

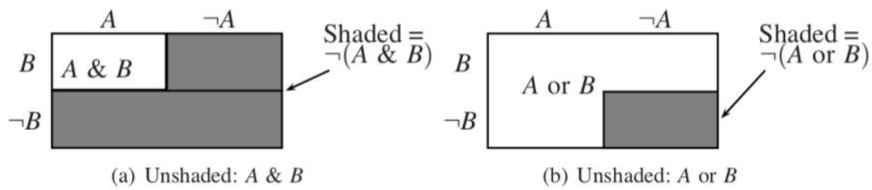


Figure 27.22: Regions Corresponding to Conjunction and Disjunction

When we are thinking about probability, we interpret the total area of the rectangle as 1. This shows us why the probability of a negation like *A* will be whatever portion of the unit of probability that isn't taken by *A*. *A* and *A* must divide the one unit of probability between them, so Pr(~*A*) = 1-Pr(A).

In the left-hand diagram of Figure 27.22 the white, unshaded region (quadrant 3) is where both *A* and *B* are true, so it represents the situation where the *conjunction*, *A* & *B*, is true. The remaining, shaded regions (1, 2, and 4) are where this conjunction is false, which is just to say the region where the conjunction's negation, ~(*A* & *B*), is true.

In the right subfigure in Figure 27.22, we see that the *disjunction*, *A* or *B*, is true in all the regions except region 1. The white area represents the area where the disjunction is true, so the shaded area represents the area where it is false, i.e., the area (just quadrant 1) where its negation, ~(*A* or *B*) is true. But we see that this is also the exact area in which *A* is false and *B* is false. After all, *A* is false in the right-hand column and *B* is false on the bottom row. And this column and row overlap in the first quadrant. So, this bottom right region is the area where ~*A* & ~*B* is true.

Since the regions for ~(*A* or *B*) and ~*A* & ~*B* coincide (right hand diagram in Figure 27.22), they say the same thing. This is a one of two equivalences known as De Morgan's Laws. In terms of our regions: ~(*A* or *B*) = ~*A* & ~*B*. The claim that neither *A* nor *B* is true is equivalent to the claim that both *A* and *B* are false.

There is another, mirror image, version of De Morgan's laws: ~(*A* & *B*) = ~*A* or ~*B*. The claim that *A* and *B* are not both true is equivalent to the claim that at least one or the other is false.

We relabel an earlier diagram as Figure 27.23 to illustrate this. Here, the non-shaded region is *A* & *B*, so the shaded region is its negation, ~(*A* & *B*) (in other words: not both *A* and *B*). But with a bit of looking, you can see that this corresponds to the region in which *A* is false or *B* is false (or both), i.e., to ~*A* or ~*B*

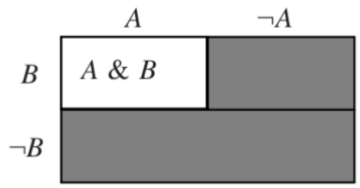


Figure 27.23: Shaded: ~(A & B) = ~A or ~B

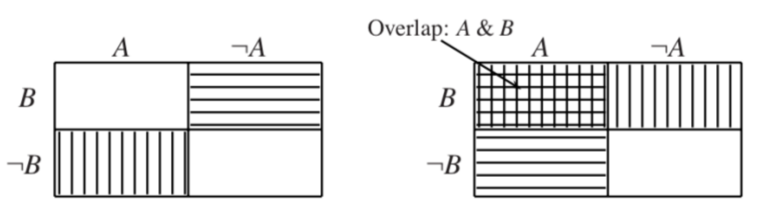
Equivalence here amounts to two-way validity, so our diagrams show that four separate argument patterns are valid (Figure 27.24).

$$\frac{\neg(A \,\&\, B)}{\text{So } \neg A \text{ or } \neg B} \qquad \frac{\neg A \text{ or } \neg B}{\text{So } \neg(A \,\&\, B)} \qquad \frac{\neg(A \text{ or } B)}{\text{So } \neg A \,\&\, \neg B} \qquad \frac{\neg A \,\&\, \neg B}{\text{So } \neg(A \text{ or } B)}$$

Figure 27.24: Four Valid Argument Patterns

We apply all this quite directly to probability by taking the total area of a 2 x 2 rectangle to have the area 1 (representing the total amount of probability). Sentences represented by the same area must have the same probability. Hence, by De Morgan's Laws, Pr(~(*A* or *B*)) = Pr(~*A* & ~*B*) and Pr(~(*A* & *B*)) = Pr(~*A* or ~*B*). We can also use rectangular diagrams to illustrate several of our rules for calculating probabilities. Recall the rule for disjunctions with incompatible disjuncts.

To say that they are incompatible is to say that there is no overlap in their areas of the diagram.



(a) Incompatible Disjuncts (b) Compatible Disjuncts (Overlap)

Figure 27.25: Rectangular Diagrams for Disjunctions

In the diagram on the left in Figure 27.25, A is represented by the horizontal hatching and *B* by the vertical hatching. Since *A* and *B* do not overlap (quadrant 3 is empty), we simply add their probabilities to get the probability for *A* or *B*. By contrast, in the diagram on the right in Figure 27.25, *A* and *B* do overlap, and so when we add their areas, we add *A* & *B* (quadrant 3) twice. To make up for this we must subtract it once. Pr(*A* or *B*) = Pr(*A*) + Pr(*B*) - Pr(*A* & *B*).

27.4 Chapter Exercises

1. Draw a diagram like those in Figure 27.10 that indicates a stronger negative correlation between smoking and heart attacks.

2. Your dog has a litter of four. Which proportion of males and females is more likely? (a) two of each, (b) three of one and one other the other (i.e., three males and one female or else three females and one male). Draw a diagram to determine the answer. (From "Ask Marilyn," *Parade* Magazine, August 10, 1997.)

3. Inspect Figure 27.4 to determine the probability of two aces, given at least one red ace.

4. Go back to the two aces problem and write out the remaining hands, those that contain only eights.

5. If you (or someone you cared a lot about) was in John's position (Figure 27.16), what additional information would you want? How would it help you make your decision? What would you do if you were John?

27.5 Appendix: Inverse Probabilities and Bayes' Rule

Only two cab companies operate in Belleville, KS. The Blue Company has blue cabs, and the Green Company has green cabs. Exactly 85% of the cabs are blue and 15% are green. A cab was involved in a hit and run accident at night. An eyewitness, Wilbur, identified the cab as a green cab. Careful tests were done to ascertain peoples' ability to distinguish between blue and green cabs at night. The tests showed that people identified the color correctly 80% of the time, but they were wrong 20% of the time. What is the probability that the cab involved in the accident was indeed a green cab, as Wilbur says?

Problems like this require us to integrate knowledge about the present case (here, what the eyewitness says) with prior information about base rates (here, what proportion of the cabs are green). In many cases, we focus too much on the present information and ignore information about base rates. The correct way to give both pieces of information their proper due is to use Bayes' Rule.

Bayes' Rule

Bayes' Rule (named after the Reverend Thomas Bayes, who discovered it in the eighteenth century) is just another rule for calculating probabilities. It tells us how we should modify or update probabilities when we acquire new information. It gives the *posterior probability* of a hypothesis *A* given a piece of new evidence *B* as:

$$\Pr(A|B) = \frac{\Pr(A) \times \Pr(B|A)}{\Pr(B)}$$

We say that Pr(*A*) is the prior probability of the hypothesis, Pr(*B*|*A*) the *likelihood* of *B* given *A*, and Pr(*B*) the *prior probability* of evidence *B*. For example, *A* might be the hypothesis that Smith is infected by the HIV virus, and *B* might be the datum (piece of evidence) that his test came back positive.

By way of illustration, let's work through example one above (we will work through example two below). This example involved the Blue Company, which has all blue cabs, and the Green Company, which has all green cabs. Exactly 85% of the cabs are blue and the other 15% are green. A cab was involved in a hit and run accident at night. An honest eyewitness, Wilbur, identified the cab as a green cab. Careful tests were done to ascertain witness' ability to distinguish between blue and green cabs at night; these showed that people were able to identify the color correctly 80% of the time, but they were wrong 20% of the time. What is the probability that the cab involved in the accident was indeed a green cab? The fact that witnesses are reliable leads many people to suppose that Wilbur probably right, even that the probability that he is right is 8. But is this correct? A large part of the battle is often setting up clear notation, so let's begin with that:

- Pr(*G*) = .15

This is the *base rate* of green cabs in the city. It gives the prior probability that the cab in the accident is green. Similarly, Pr(*B*) = .85.

- Pr(*SG*|*G*) = .80 This is the probability the witness will be correct in saying green when the cab in fact is green, i.e., given that the cab really was green. Similarly, Pr(*SB*|*B*) = .80.

These are the probabilities that witnesses are correct, so by the negation rule, the probabilities of misidentifications are:

- Pr(*SG*|B) = .2 and Pr(SB|G) = .2

What we want to know is the probability that the cab really was green, given that Wilbur said it was green, i.e., we want to know Pr(*G*|*SG*). According to Bayes' Rule, this probability is given by:

$$\Pr(G|SG) = \frac{\Pr\,(G) \times \Pr\,(SG|G)}{\Pr\,(SG)}$$

We have the values for the two expressions in the numerator—Pr(*G*) = .15 and Pr(*SG*|*G*) = .8 – but we must do a little work to determine the value for the expression Pr(SG) in the denominator. To see what this value—the probability that a witness will say that the cab was green—must be, note that there are two conditions under which Wilbur could say that the cab in the accident was green. He might say this when the cab was green or when it was blue. This is a disjunction, so we add these two probabilities. In the first disjunct, Wilbur says green and the cab is green; in the second disjunct Wilbur says green and the cab is blue. Putting this together we get:

$$\Pr(SG) = \Pr(G\&SG) + \Pr\,(B\&SG)$$

Now our rule for conjunctions tells us that Pr(*G* & *SG*) = Pr(*G*) x Pr(*SG*|*G*) and Pr(*B* & *SG*) = Pr(*B*) x Pr(*SG*|*B*). So,

$$\begin{aligned}\Pr(SG) &= \Pr(G) \times (SG|G) + \Pr\,(B) \times \Pr\,(SG|B)\\ &= (.15 \times .80) + (.85 \times .20)\\ &= .12 + .17\\ &= .29\end{aligned}$$

Finally, we substitute this number, .29, into the denominator of Bayes' Rule:

$$\begin{aligned}\Pr(G|SG) &= \frac{\Pr\,(G) \times \Pr\,(SG|G)}{\Pr\,(SG)}\\ &= \frac{.15\,x.80}{.29}\\ &= .414\end{aligned}$$

So, the probability that the witness was correct in saying the cab was green is just a bit above .4 –less than fifty/fifty – and (by the negation rule) the probability that he is wrong is nearly .6. This is so even though witnesses are reliable. How can this be? The answer is that the high base rate of blue cabs, and the low *base rate* of green cabs, makes it somewhat likely that the witness was wrong in this case.

Rule for Total Probabilities

In calculating the value of the denominator in the above problem we made use of the *Rule for Total Probabilities*. We will use a simple, but widely applicable version of this rule here. If a sentence *B* is true, then either *B* and *A* are true or else *B* and ~*A* are true (since any sentence *A* is either true or false). This allows us to express the probability of *B* – Pr(*B*) – in a more complicated way. This may seem like a strange thing to do, but it turns out that it is often possible to calculate the probability of the more complicated expression when it isn't possible to obtain the probability of *B* more directly.

$$\begin{aligned}\Pr(B) &= \Pr\,[(B\&A)\ or\ (B\&{\sim}A)] \\ &= \Pr(B\&A) + \Pr(B\&{\sim}A) \\ &= [\Pr(A) \times \Pr(B|A)] + [\Pr({\sim}A) \times \Pr(B|{\sim}A)])\end{aligned}$$

In short:

$$\Pr(B) = [\Pr(A) \times \Pr(B|A)] + [\Pr({\sim}A) \times \Pr(B|{\sim}A)]$$

This rule can be useful in cases that do not involve Bayes' Rule, as well as in many cases that do. It is particularly useful when we deal with an outcome that can occur in either of two ways.

Example: A factory has two machines that make widgets. Machine *A* makes 800 per day and 1% of them are defective. The other machine, call it ~*A*, makes 200 a day and 2% are defective. What is the probability that a widget produced by the factory will be defective (*D*)? We know the following:

- Pr(*A*) = .8 – the probability that a widget is made by machine *A* is .8 (since this machine makes 800 out of the 1000 produced everyday).
- Pr(~*A*) = .2 – the probability that a widget is made by the other machine *A* is .2.
- Pr(*D*|*A*) = .01 – the probability that a widget is defective given that it was made by machine *A*, which turns out 1% defective widgets, is .01p.
- Pr(*D*|~*A*) = .02 – the probability that a widget is defective given that it was made by machine *A*, which turns out 2% defective widgets, is .02p.

Plugging these numbers into the theorem for total probability we have:

$$\begin{aligned}\Pr(D) &= [\Pr(A) \times \Pr(D|\mathrm{A})] + [\Pr(\sim\mathrm{A}) \times \Pr(\mathrm{D}|\sim\mathrm{A})] \\ &= [.8 \times .01] + [.2 \times .02] \\ &= 0.012\end{aligned}$$

Odds Version of Bayes' Rule

Particularly when we are concerned with mutually exclusive and disjoint hypothesis (cancer vs. no cancer), the odds version of Bayes' rule is often the most useful version. It also allows us to avoid the need for a value for Pr(*e*), which is often difficult to come by. Let H be some hypothesis under consideration, and *e* be some newly acquired piece of evidence (like the result of a medical test) that bears on it. Then:

$$\frac{\Pr\,(H|e)}{\Pr\,(\sim H|e)} = \frac{\Pr(H)\Pr\,(e|H)}{\Pr(\sim H)\Pr\,(e|\sim H)}$$

The expression above gives the posterior odds of the two hypotheses, Pr(*H*)/Pr(~*H*) gives their prior odds, and Pr(*e*|*H*)/Pr(*e*|~*H*) is the likelihood (or diagnostic) ratio. In integrating information our background knowledge of base rates is reflected in the prior odds, and our knowledge about the specific case is represented by the likelihood ratio. For example, if *e* represents a positive result in a test for the presence of the HIV virus, then Pr(*e*|*H*) gives the *hit rate (sensitivity)* of the test, and Pr(*e*|~*H*) gives the *false alarm rate*. As the multiplicative relation in (2) indicates, when the prior odds are quite low, even a relatively high likelihood ratio won't raise the posterior odds dramatically.

The importance of integrating base rates into our inferences is vividly illustrated by example two above. Suppose that we have a test for the HIV virus. The probability that a person who really has the virus will test positive is .90, while the probability that a person who does not have it will test positive is .20. Finally, suppose that the probability that a person in the general population has the virus (the base rate of the virus) is .01. How likely is Smith, whose test came back positive, to be infected?

Because the test is tolerably accurate, many people suppose that the chances are quite high that Smith is infected, perhaps even as high as 90%. Indeed, various studies have shown that many physicians even suppose this. It has been found that people tend to confuse probabilities and their converses. The probability that we'll get the positive test, *e*, if the person has the virus is .9, i.e., Pr(*e*|*H*) = .9. But we want to know the probability of the converse, the probability that the person has the virus given that they tested positive, i.e., Pr(*H* |*e*). These need not be the same, or even close to the same. In fact, when we plug the numbers into Bayes' Rule, we find that the probability that someone in this situation is infected is quite low.

To see this, we simply plug our numbers into the odds version of Bayes' rule. We have been told that:

- $\Pr(e|H) = .9$
- $\Pr(e|{\sim}H) = .2$
- $\Pr(H) = .01$
- $\Pr({\sim}H) = .99$.

Hence,

$$\frac{\Pr\,(H|e)}{\Pr\,({\sim}H|e)} = \frac{\Pr\,(H)}{\Pr\,({\sim}H)} \times \frac{\Pr\,(e|H)}{\Pr\,(e|{\sim}H)} = \frac{.9}{.2} \times \frac{.01}{.99} = \frac{1}{22}$$

This gives the odds: 22 to 1 against Smith's being infected. So, $\Pr(H|e) = 1/23$. Although the test is relatively accurate, the low base rate means that there is only 1 chance in 23 that Smith has the virus.

Similar points apply to other medical tests and to drug tests, if the base rate of the condition being tested for is low. It is not difficult to see how policy makers, or the public to which they respond, can make very inaccurate assessments of probabilities, and hence poor decisions about risks and remedies, if they overlook the importance of base rates.

As we noted earlier, it will help you to think about these matters intuitively if you try to rephrase probability problems in terms of *frequencies* or *proportions* whenever possible.

Further Matters

Bayes' Rule makes it clear when a conditional probability will be equal to its converse. When we look at:

$$\Pr(A|B) = \frac{\Pr\,(A) \times \Pr\,(B|A)}{\Pr\,(B)}$$

we see that $\Pr(A|B) = \Pr(B|A)$ exactly when $\Pr(A) = \Pr(B)$, so that they cancel out (assuming, as always, that we do not divide by zero). Dividing both sides of Bayes' Rule by $\Pr(B|A)$ gives us the following ratio:

$$\frac{\Pr(A|B)}{\Pr(B|A)} = \frac{\Pr(A)}{\Pr(B)}$$

which is often useful.

Updating via Conditionalization

One way to update or revise our beliefs given the new evidence *e* is to set our new probability (once we learn about the evidence) as:

$$New\ \Pr(H) = Old\ \Pr(H|e)$$

with Old Pr($H|e$) determined by Bayes' Rule. Such updating is said to involve *Bayesian conditionalization*.

The Problem of the Reference Class

There are genuine difficulties in selecting the right group to consider when we use base rates. This is known as the *problem of the reference class*. Suppose that we are considering the effects of smoking on lung cancer. Which reference class should we consider: all people, just smokers, or just heavy smokers?

Similar problems arise when we think about regression to the mean. We know that extreme performances and outcomes tend to be followed by ones that are more average (that regress to the mean). If Wilma hits 86% of her shots in a basketball game, she is likely to hit a lower percentage the next time out. People do not seem to have an intuitive understanding of this phenomenon, and the difficulty is compounded by the fact that, as with base rates, there is a problem about reference class. *Which* average will the scores regress to: Wilma's average, her recent average, or her team's average?

Up to a point, smaller reference classes are likely to underwrite better predictions, and we will also be interested in reference classes that seem causally relevant to the characteristic we care about. But if a reference class becomes too small, it won't generate stable frequencies, and it will often be harder to find data on smaller classes that is tailored to our concerns. There is no one right answer about which reference class is the correct one. It often requires a judicious balancing of tradeoffs. With base rates, it may be a matter of weighing the costs of a wrong prediction against the payoffs of extreme accuracy, or the value of more precise information against the costs of acquiring it or (if you are a policy maker) the fact that the number of reference classes grows exponentially with each new predictor variable. But while there is no uniquely correct way to use base rates, it doesn't follow that it is fine to ignore them; failing to take base-rate information into account when we have it will often lead to bad policy.

Exercises on Bayes' Theorem and Conditional Probabilities

1. In the section on the Rule for Total Probability (13.3.2) we encountered the factory with two machines that make widgets. Machine *A* makes 800 per day and 1% of them are defective. The other machine, call it ~*A*, makes 200 a day and 2% are defective. What is the probability that a widget is produced by machine A, given that it is defective? We know the probability that it is defective if it is produced by A—$\Pr(D|A) = .01$—but this asks for the opposite or converse probability; what is $\Pr(A|D)$? Use Bayes' Rule to calculate the answer.

2. Earlier you were asked to draw a picture to solve the following problem; now solve it by calculation and see if your answers agree. Officials at the suicide prevention center know that 2% of all people who phone their hot line attempt suicide. A psychologist has devised a quick and simple verbal test to help identify those callers who will attempt suicide. She found that:

    1. 80% of the people who will attempt suicide have a positive score on this test.

    2. Only 5% of those who will not attempt suicide have a positive score on this test.

If you get a positive identification from a caller on this test, what is the probability that he would attempt suicide?

3. A clinical test, designed to diagnose a specific illness, comes out positive for a certain patient. We are told that:

    1. The test is 79% accurate: the chances that you have the illness if it says you do is 79%, and the chances that you do not have the illness if it says you don't is also 79%.

    2. This illness affects 1% of the population in the same age group as the patient. Taking these two facts into account, and assuming you know nothing about the patient's symptoms or signs, what is the probability that this particular patient actually has the illness?

4. Suppose that you are handed two bags of poker chips, but from the outside you can't tell which is which.

    1. *Bag 1*: 70 red chips and 30 blue chips

    2. *Bag 2*: 30 red chips and 70 blue chips

You pick one of the two bags at random and draw a chip from it. The chip is red. You replace it, draw again, and get another chip, and so on through twelve trials (i.e., twelve draws). In the twelve trials, you get 8 red chips and 4 blue chips. What is the probability that you have been drawing chips from Bag One (with 70 red and 30 blue) rather than from Bag Two (with 30 red and 70 blue)? Most people answer that the probability that you have been drawing from Bag One is around 75. In fact, as Bayes' Rule will show, it is 97. But people often revise their probabilities less that Bayes' Rule says they should. People are conservative when it comes to updating their probabilities in the light of new evidence. Use Bayes' Rule to show that 97 is the correct value.

5. Wilbur has two children. We run into him at the mall with a teenage boy he introduces as his son. What is the probability that Wilbur's other child is a boy? Second scenario: Wilbur introduces the boy as his oldest son. Now what is the probability that his other child is a boy? (Hint: think about the two-aces problem above).

6. One thousand people, including you, bought one ticket in the local lottery. There were ten winners, all of whom were notified correctly that they had won. But because of a clerical error, 1% of the people who didn't win also received notifications that they did. You received a letter saying you were a winner. What is the probability that you really did win?

7. *Monty Hall Problem* In an earlier chapter, we approached the Monty Hall Problem in an intuitive way. Now we will now verify our earlier answers using Bayes' Rule. Recall that in this problem you imagine that you are a contestant in a game show and there are three doors in front of you. There is nothing worth having behind two of them, but there is $100,000 behind the third. If you pick the correct door, the money is yours. You choose A. But before the host, Monty Hall, shows you what is behind that door, he opens one of the other two doors, picking one he knows has nothing behind it. Suppose he opens door B. This takes B out of the running, so the only question now is about door A vs. door C. Monty ('M', for short) now allows you to reconsider your earlier choice: you can either stick with door A or switch to door C. Should you switch?

    1. What is the probability that the money is behind door A?

    2. What is the probability that the money is behind door C?

Since we are asking these questions once Monty has opened door B, they are equivalent to asking about:

Answers to Selected Exercises

1. We are given all the relevant numbers except that for Pr(D), but we calculated this in the section on total probabilities. By Bayes' Rule:

$$\Pr(A|D) = \frac{\Pr\,(A) \times \Pr\,(D|A)}{\Pr\,(D)}$$
$$= \frac{.8 \times .01}{.012}$$
$$= \frac{2}{3}$$

7. Let's give the doors letter names so they don't get confused with our numbers. Then, to solve the Monty Hall problem we must calculate:

    1' Pr($ behind A|M opened B)

    2' Pr($ behind C|M opened B)

Bayes' Rule tells us that Pr(Money behind A|M opened B) =

$$\frac{\Pr\,(\$\ behind\ A) \times \Pr\,(M\ opened\ B|\$\ \text{behind}\ A)}{\Pr\,(M\ opens\ B)}$$

We know the values for the two items in the numerator:

1. Pr($ behind A): the prior probability that the money is behind door A is 1/3 (going in, it could equally well be behind any of the three doors).

2. Pr(M opened B|$ behind A) is ½ (there is a fifty/fifty chance that he would open either door B or door C, when the money is behind door A).

3. But Pr(M opens B), the number in the denominator, requires some work.

To see the value of the denominator—Pr(M opens B)—note that Monty will *never* open door B if the money is behind B. Hence, he could open B under exactly two conditions. He could open B when the money is behind A or he could open B when the money is behind C. So,

$$\begin{aligned}\Pr(M\ opens\ B) &= [\Pr(\$\ behind\ A) \times \Pr(M\ opens\ B|\$\text{ behind A})]\\ &+ [\Pr(\$\text{ behind C}) \times \Pr(\text{M opnes B}|\$\text{ behind C})]\\ &= \left[\frac{1}{3} \times \frac{1}{2}\right] + \left[\frac{1}{3} \times 1\right]\\ &= \left[\frac{1}{6}\right] + \left[\frac{1}{3}\right]\\ &= \frac{1}{3}\end{aligned}$$

Plugging this into the denominator in Bayes' Rule, we get:

$$\begin{aligned}\Pr(\$\ behind\ A|\text{M opened B}) &= \frac{\Pr\ (\$\ behind\ A) \times \Pr\ (M\ opened\ B|\$\text{ behind A})}{\Pr\ (M\ opens\ B)}\\ &= \frac{1/3 \times 1/2}{1/2}\\ &= \frac{1/6}{1/2}\\ &= 1/3\end{aligned}$$

So, the probability that the money is behind your door, door A, given that Monty has opened door B, is 1/3. Since the only other door left is door C, the probability that the money is there, given that Monty opened door B, should be 2/3. Use Bayes' Rule to prove that this is correct.

Derivation of Bayes' Rule

Where does Bayes' theorem come from? It is straightforward to derive it from our rules for calculating probabilities. You don't need to worry about the derivation, but here it is for anyone who likes such things.

$$\begin{aligned}\Pr(A|B) &= \frac{\Pr\ (A\&B)}{\Pr\ (B)}\\ &= \frac{\Pr(A) \times \Pr\ (B|A)}{\Pr\ (B)}\end{aligned}$$

In actual applications we often don't have direct knowledge of the value of the denominator, Pr(B), but in many cases we do have enough information to calculate it using the *Rule for Total Probability*. This tells us that:

$$\Pr(B) = \Pr(B\&A) + \Pr\,(B\&{\sim}A)$$

$$= [\Pr(A) \times \Pr(B|A)] + [\Pr\,({\sim}A) \times \Pr\,(B|{\sim}A)$$

So, the most useful version of Bayes' Rule is often

$$\Pr(A|\mathrm{B}) = \frac{\Pr\,(A) \times \Pr\,(B|A)}{[\Pr(A) \times \Pr(B|A) + [\Pr({\sim}A) \times \Pr(\mathrm{B}|{\sim}A)]}$$

Bayes' Rule can take more complex forms, but this is as far as we will take it in this book.

Chapter 28

Recognizing Where Cognitive Tools Apply: Cues, Transfer, and Habits

Overview: You will only be able to apply the concepts and skills you learn here in situations outside the classroom if you can recognize those situations as ones where an appropriate cognitive tool is relevant. This is often difficult, and in this chapter, we will examine ways to become more sensitive to cues that signal the applicability of certain concepts and skills. We also discuss three very general slogans that, if frequently called to mind, would improve a good deal of reasoning: Consider alternatives! Is there invisible data? Is some data too visible? We conclude with a discussion of transfer of reasoning skills to situations outside the classroom and the steps for developing the habits necessary for transfer to occur.

Contents

28.1 Good Thinking

The world is changing rapidly, and much of what you learn now will be outdated in a few years. Many of your grandparents, and perhaps even your parents, had just one or two jobs during their adult life, but studies show that many people now in their twenties will have a succession of jobs, often in quite different fields, and this will require the acquisition of new skills throughout their lives.

By contrast, the tools and skills learned for critical reasoning will not go out of date. They are skills you can use to *learn how to learn*. But if they are going to help you, you must be able to apply the appropriate concepts and principles to new situations. This is easier said than done, and in this chapter, we will focus on ways to make it a little easier.

What Counts as Good: Who Decides?

Throughout this book, we have recommended some ways of reasoning as good and criticized others as flawed, often labeling the latter as fallacies, biases, or errors. But who decides what counts as good or bad reasoning? Indeed, nowadays one sometimes hears that the strategies and tools recommended in books like this foster rigid linear thinking, old-fashioned thinking within the box that limits, rather than improves, reasoning.

Talk like this sounds better in the abstract, though, than it does when we get down to concrete cases (as we will in a moment). The point of reasoning is typically to help us decide what to do, to assist us in our actions, and the worst thing about bad reasoning is that it often leads to actions that no one, not even the person who acts, wanted or intended.

Everyone makes mistakes in reasoning that are costly, to themselves and to others. You need only glance at the morning headlines or the evening news to hear about peoples' miscalculations and follies, about reasoning and actions that are utterly self-defeating, even by the agents' own standards. Indeed, you have probably seen instances of this first hand. Here are three illustrations:

Bay of Pigs

On April 17, 1961 John F. Kennedy launched an attempt to overthrow Fidel Castro in Cuba. The operation was a complete failure, and it cast doubt on Kennedy's ability to govern. The assumptions and planning of Kennedy and his advisors were full of mistakes that led to the so-called Bay of Pigs fiasco (24.6).

Enron

In the fall of 2001, the giant company Enron collapsed. Many people, including employees, had invested a great deal of their money in it. The danger signs probably seem clearer in retrospect (due to hindsight bias), but even when things began to *look* shaky, many people continued to invest. Similar problems occurred, on a smaller scale, with the collapse of many dot.com companies.

Covid-19

Florida governor Ron DeSantis was very slow to close public beaches and to issue a shelter-in-place order during the Covid-19 pandemic. Concern for profits in resort communities during Spring Break resulted in thousands of extra people getting sick, and hundreds dying.

Many of the pitfalls and problems discussed in earlier chapters affect us in ways that matter to us a lot. For example, issues about framing, anchoring, and contrast effects arise in many negotiations: determining how to divide up domestic labor, buying (or selling) a car or a house, trying to get the best salary you can at the new job, or (more depressingly) deciding who gets what, including access to the children, after a divorce.

Here are just a few of the ways good and bad reasoning have an impact on our lives.

Framing Effects

Our reasoning and choices about options often depend on the way the options are framed or described. If an issue is framed in terms of a gain, we are likely to think about it one way; if it is framed as a loss, we are more likely to think about it differently (25.7). If we aren't on guard, our choices may not be based on the real features of the situation, but on the details, often quite trivial ones, of how the situation is described. Furthermore, since other people often supply the frames, this makes us vulnerable to manipulation.

We also noted a study (18.1.2) where physicians recommended different treatments (surgery or radiation therapy), depending on how the same situations (involving cancer) were described. But no one would want to their cancer treatment determined by something as irrelevant as this.

Conditional Probabilities

We tend to confuse conditional probabilities with their inverses (i.e., we tend to confuse $\Pr(A|B)$ with $\Pr(B|A)$, (14.1.2)). This can lead to many problems. For example, such probabilities are easy to confuse when we interpret medical tests (e.g., a test for HIV), drug tests, and lie detector tests.

Indeed, diagnoses and treatment are often based on beliefs about conditional probabilities (e.g., the probability of recovery given treatment *A* vs. the probability of recovery given treatment *B*), beliefs that even some physicians get wrong. You don't want mistakes like this to occur when a doctor is treating your child for a serious disease, or when a prospective employer learns that you failed a drug test.

Fallacy of Irrelevant Reason

We commit this fallacy if we base our reasoning or conclusions on irrelevant premises (11.6). Premises that are irrelevant are ones that simply *do not bear* on the truth or falsity of the conclusion one way or another, so they can never provide good reasons for believing a conclusion. When we commit this fallacy, we end up believing things *for no (good) reason at all*.

Cumulative Risk

Many of the things we do are relatively safe each time we do them. For example, the probability that you will be in an automobile accident on any given outing or have a single condom fail are low. But when we do things over and over, we are dealing with probabilities of disjunctions. These instances mount up, so that over time the risk can become reasonably large (16.5). This is a simple fact about probabilities, and ignoring it leads to bad risk management.

Availability

If we base our inductive inferences on samples that come readily to mind—that are available (17.2)—we will often be basing our inductive reasoning on biased samples, and this is likely to lead us to conclusions that are simply false. If we don't appreciate how large the difference between the probability of having a heart attack and the probability of dying at the hands of a terrorist are (even after September 11), it will be difficult to make rational plans about smoking, diet, and travel. Thousands and thousands of Americans die from heart disease every year, whereas even now very few Americans die at the hands of terrorists.

Causal Fallacies

If our actions are to be effective, we need to act in ways that bring about—that *cause*—the effects we want. If we reason badly about causation (20.6.1), so that we don't really know what causes what, many of our predictions will be false, and many of our plans and decisions based on those (faulty) predictions will lead to outcomes that we don't desire.

Problems also arise when we confuse necessary and sufficient conditions, fall victim to confirmation bias or illusory correlations, ignore regression to the mean, underutilize base rates, and so on.

In many of these cases, our own bad reasoning opens the door for others to manipulate us, e.g., by framing things in a way favorable to them (rather than us), by setting anchors that skew our reasoning, by manipulating our actions and attitudes by dissonance reduction mechanisms (19) or by the various tools of professional persuaders (22.6.1).

Wanting to avoid being at the mercy of flawed reasoning and manipulation is not just some prejudice in favor of "linear" reasoning. It is an essential part of wanting to be in control of our own life and to base our actions on a realistic assessment of the facts, rather than on irrelevant information or false assumptions.

How Good, or Bad, are We?

How good—or bad—is our reasoning? People who study the matter are not in complete agreement, though in many ways we are stunningly good. No one has a clue how to build a computer with a perceptual system or memory remotely as good (at some things) as ours. And even in cases where we have lapses, our judgments and decisions are not hopelessly flawed. We couldn't make it through the day if they were.

The spotty picture emerging from several decades of research suggests that we can reason pretty well under some conditions. But this ability is fragile and unstable, and it can be affected, diverted, and even subverted by a variety of influences, as the follies and fiascoes noted above make clear.

It doesn't really matter exactly how good—or bad—we are, though. The important points are that we could all do better, and that we would be better off if we did. You don't need to know whether the rate of a serious disease is 12% or 20% before you try to find ways to cure it. Similarly, we don't need to know precisely how widespread bad reasoning is to try to improve it.

No Quick Fixes

In many cases, the first step to better reasoning is to learn about tempting, but faulty, ways of reasoning, such as ignoring base rates or regression effects. But, unfortunately, there is a great deal of evidence that merely learning about such pitfalls, and being warned against them, is not an effective way to avoid them, especially over the long run.

It would help us understand how to reason better if we knew more about why we reason badly. We can often help sick people feel better by treating their symptoms, e.g., giving them aspirin to ease the aches and pains. But it is usually more effective if we can identify the underlying cause of an illness (e.g., infection by a certain bacterium) and intervene to change things at the level of root causes (e.g., by killing the bacteria with an antibiotic).

Similarly, it would probably be easier to improve reasoning by designing interventions that work on the underlying mechanisms that produce suboptimal reasoning, rather than by trying to work on the symptoms directly (e.g., by nagging at people to use base rates).

We do have some understanding of the various causes of suboptimal reasoning, but we do not yet know nearly as much as we would like. In cases where we do know a little, we can try to change the basic causes of bad reasoning; in cases where we don't, we can still try to treat the symptoms.

Unfortunately, there are no magic bullets for either sort of case. It is more accurate to think of the techniques we have studied in much the way we think about exercise and a healthy diet. Neither guarantees that things will always go well— that we will always be healthy or that we will always reason carefully—but with them, things will go well more often than they would with a bad diet, or with faulty reasoning. Moreover, again, as with staying healthy, learning to reason better isn't an all-or-nothing proposition. It is a life-long process, and all of us have room for improvement.

In a moment, we will examine some general ways we can improve our reasoning, but first let's ask how each one of us—individually—might discover how good, or how flawed, our own reasoning is.

28.2 Feedback: Learning from Experience

Ironically, suboptimal reasoning is one obstacle to finding out how well we really *do* reason. We learn many of the things we do by trial and error: we often don't get things right the first time, but frequently we can improve if we see what went wrong and try to adjust to do better. This only works, though, if we note the errors; without **feedback** telling us how accurate our reasoning has been, we can't learn from our mistakes.

There are various reasons why it can be difficult to get good feedback about the quality of our reasoning, but the common pitfalls in reasoning we have encountered in earlier chapters are among the culprits. Here are three quick examples.

Hindsight Bias

Hindsight bias is the tendency to overestimate the likelihood that we would have predicted an outcome after we learn that it occurred (8.6). It impedes accurate feedback, because it confirms our view that we are right ("I knew what would happen") more often than we really are. This makes it more difficult to correct our mistakes by learning from past errors, since we underestimate how often we are in error.

Confirmation Bias and Availability

Since most of us like to think we are reasonably accurate, we may notice and remember evidence showing our success, while ignoring evidence that suggests failures. This positive evidence will then be more available in memory, so we will be inclined to think that we have a better track record than we do.

Feedback can be Unpleasant

Feedback can be painful. Wishful thinking, various self-serving biases, and perhaps even defense mechanisms like denial can lead us to avoid feedback. After all, we may find out that we didn't do as well as we had thought or hoped—maybe we didn't do very well at all. Some teachers find their teaching evaluations so unpleasant that they don't read them. They could probably learn things that would help improve their teaching (and lead to better evaluations). But they prefer not to know. Since these obstacles to getting good feedback involve flawed reasoning, we would get more accurate feedback if we did a better job of reasoning.

28.3 Recognizing the Relevance of a Cognitive Tool

Cognitive Tools

The emphasis throughout this book has been on learning about, understanding, and using a diversified kit of *cognitive tools*. These are concepts and principles and rules that can help us reason more carefully and accurately.

1. **Error Avoidance**

Some of these tools are used primarily for spotting and avoiding faulty reasoning. Many of these come with the labels of *fallacy*, *bias*, or *error*. For example, we learned about the fallacy of affirming the consequent, the strawman fallacy, and the gambler's fallacy. We also learned about self-serving biases, confirmation bias, and hindsight bias, and we encountered the fundamental attribution error. And we studied strategies for avoiding errors in perception and memory, recognizing regression to the mean, and being more sensitive to base rates. These tools for recognizing problems are important, because the things they help us avoid are sure-fire ways to reason badly.

2. **Positive Tools**

We also learned to use tools for reasoning well. For example, we learned about valid arguments, necessary and sufficient conditions, inductive strength, rules of determining probabilities, evaluating samples, detecting correlations, tracking down causes, assessing risk, and drawing diagrams to make reasoning easier.

3. **Getting Good Information**

We can't reason without something to reason about, and we also spent some time on tools to help us find, and evaluate, information from various sources.

The three sorts of tools shade off into one another. The key point here is that the more skilled you become in the use of these tools, the better your reasoning will be.

28.3.1 Recognizing when these Tools are Relevant

The greatest obstacle to reasoning well in the real world does not involve mastering the fine points of concepts and principles and other cognitive tools. The greatest problem is *recognizing situations where they apply*. When the times comes where we really could benefit from a given tool, we're often oblivious; it simply doesn't register that a given tool would help us in the situation we are in. You can learn all the checklists and definitions and rules in the world, but if you can't recognize situations where they apply, they are useless. Finding a way to overcome this obstacle is the greatest challenge in teaching, and *learning*, critical reasoning.

The main problem is failing to realize when a particular cognitive tool is applicable

Recognition is the Key

The general point that recognition is the key will be clearer if we consider several examples.

Example 1: Sample Size

Earlier, we encountered the two hospitals in Smudsville (15.2.4). About 60 babies are born every day in the larger one, and about 15 are born every day in the smaller one. On average, 50% of the births in both hospitals are girls and 50% are boys, but the number varies some from day to day. Which hospital, if either, is more likely to have more days per year when over 70% of the babies born are boys?

Many people say that the number of 70% boy days should be about the same in each hospital, but in fact it's more likely in the smaller one. Since about half of all births are boys, and about half are girls, the true percentages in the general population are about half and half. Since a smaller sample will be less likely to reflect these true proportions, the smaller hospital is more likely to have more days per year when over 70% of the births are boys. The births at the smaller hospital constitute a smaller sample.

We all know that bigger samples are likely to be more representative of their parent populations, but we sometimes fail to realize that we are dealing with a problem that involves samples. We don't recognize or identify it as a problem involving sample size. We don't represent it to ourselves as ones where our tools for thinking about samples and populations are relevant. Once we recognize that the problem involves sample size, most of us see what the answer must be.

Example 2: Probabilities of Conjunctions

Consider a frequency version of the conjunction fallacy: Are there are more six letter words ending in 'ing' than having 'n' as their fifth letter? All six letter words ending in 'ing' have 'n' in fifth place— and 'i' in forth and 'g' in sixth. So, if we suppose there are more six-letter 'ing' words, we commit the conjunction fallacy (16.4).

But when people get this wrong, they are rarely thinking of it as a conjunction and then making an error in reasoning about probabilities of conjunctions. They simply don't think of it as a conjunction in the first place. They don't recognize or code it as a conjunction, and so their tools for thinking about probabilities of conjunction are never applied. When people do see it as a conjunction, especially if they draw a diagram, they tend to get it right.

Example 3: Anchoring and Adjustment

We fall victim to an anchoring effect whenever some number or other reference points leads us to skew our reasoning in the direction of the anchor (17.5). We all know that we should ask whether an anchor is a reasonable one or not, but the problem is not that we typically identify something as an anchor and then fail to make sufficient adjustments. The most difficult thing is realizing that something is serving as an anchor at all, much less that we are being influenced by it. We simply don't recognize or represent the situation as one involving an anchor.

There are many other examples of our failure to identify situations as ones where specific cognitive tools could make our lives easier. For example, even people who avoid the gambler's fallacy when thinking about the tosses of a coin may fail to ask whether a similar situation applies when we ask about the probability of Wilbur's and Wilma's sixth child being a girl after an initial string of five boys (16.3). And even if we have studied conditionals, we may have trouble with the card selection experiment (27.2) because we don't realize that it involves conditionals, necessary conditions, and the like.

Some of the questions we have encountered in the book, e.g., ones about the conjunction fallacy, are a little tricky, and they are often tricky because they make it difficult to represent the problem in the best way, e.g., as one about sample size or about the probability of a conjunction. But the fact that some of the problems seem tricky shouldn't mislead us into thinking that they are just tricks in textbooks. Every day, all of us fail to recognize or identify situations as ones in which various cognitive tool are applicable.

28.3.2 Cues That Signal when a Tool Applies

We could phrase the problem in a sound bite:

- Cognitive tools to not apply themselves.
- Situations do not come labeled as ones where a certain tool is applicable.

Knowing whether a concept or principle applies in a given situation can be very difficult, but there are a few cues that *signal* the relevance of a particular tool. Here are a few examples:

A good representation suggests the relevance of an appropriate cognitive tool

Argument Indicators

One of the questions we face over and over in reasoning tasks is this: do these premises or reasons or assumptions support that conclusion? Such situations involve arguments, but we will never be able to apply the relevant tools for dealing with arguments (e.g., validity, conditional arguments, inductive strength, various fallacies) unless we recognize that a situation *involves* an argument.

Fortunately, there are some obvious and easy cues that signal the presence of an argument. Conclusion indicators (e.g., 'therefore', 'so', 'hence') and premise indicators (e.g., 'because', 'since') tell us that we have probably encountered an argument, suggest which parts are premises and which conclusions, and give us a fighting chance of evaluating it.

Necessary and Sufficient Conditions

Any time we encounter talk of requirements or prerequisites, we are probably dealing with necessary conditions. And talk of guarantees, or things that are enough, usually signals sufficient conditions (3.2).

Probability Indicators

There are some obvious cues that signal the relevance of our concepts and rules involving probabilities. When words like 'probable' or 'likely' appear, or when we are dealing with cases everyone knows involve chance (the lottery, flipping a coin), it is usually clear that probabilities could be relevant. Less obvious cues include words like ‘proportion’ and ‘percentage’ and ‘frequency’, since these can often be translated into probabilities. We also are dealing with probabilistic concepts and principles when we ask which of two (or more things) is more likely (is Wilbur more likely to have gone to the show or the bar?). And when we try to decide what to do or predict what will happen, we are often dealing with probabilities. Should I major in business or engineering? Well, if I major in business I’ll probably have an easier time finding a job, but on the other hand I probably won’t like the work as much.

Remember that we don’t need precise numbers to use many of our probability tools. You reason better even if you only remember that—and why—disjunctions are typically more probable than their disjuncts and conjunctions are typically less probable (often much less probable) than their conjuncts.

Why? When someone (including you) makes a claim that isn’t obviously true, that can serve as a cue to ask, ‘why?’ What reasons are there to think that it’s true? Are there good reasons to suspect that it’s false? Getting in the habit of asking ‘why?’ when you encounter a claim is one of the simplest steps you can take to improve your reasoning. Not in an impolite way, where you quickly become a pain in the neck, or in the spirit of the child who will continue asking why no matter what answers we give. Ask in a spirit where you would accept a good answer.

Realistic Tools

In the real world, we rarely have the time, energy, or inclination to devote a huge amount of thought to the problems we encounter. We have better things to do on a Saturday night than sit home and calculate probabilities, but even if we enjoyed such things, the limitations on human attention, working memory, and computational abilities mean that there are limits to what we can do. So, realistic cognitive tools, ones we are likely to us when we need them, must be ones we can use without a great deal of time and effort.

We have encountered ways to avoid specific fallacies and cognitive biases. In the next section, we consider a strategy that is simple enough to be realistic, yet general enough to help us in a wide range of situations.

28.4 Consider Alternatives

We approach many situations with certain expectations or preconceptions, with a “mindset” that makes it easy to overlook the relevance of various cognitive tools and skills. We often think about a problem in the way it is presented to us, or in the way that we have gotten used to thinking about similar problems. Although there are no magic cures, there is a general strategy that can help overcome this obstacle to good reasoning.

The basic idea is to think about a situation from several points of view or in several different ways, rather than to simply jumping to the first conclusion that occurs to us. Although this involves somewhat different things in different cases, it is easier to remember if we have a single, catchy label for the general strategy, so we will refer to it as "Consider Alternatives."

In some cases, consideration of alternatives means considering actual alternatives or options we have overlooked; in other cases, it means considering hypothetical alternative or options. All this sounds rather abstract, but we can bring it down to earth by considering a few concrete examples.

Alternative Explanations

We constantly seek to explain the world around us. When something happens that matters to us, we want to know why. What *explains* it? What caused it? Wilbur has been friendly to Wilma all semester but suddenly he begins insulting her. She naturally wonders why. Unfortunately, we often jump to conclusions about causes and explanations. One corrective is to ask ourselves whether there might be alternative explanations that would explain what happened better than the explanation that first occurred to us.

Regression Effects

We often overlook regression to the mean, the fact that more extreme outcomes or performances tend to be followed by ones closer to the mean (i.e., closer to average; (21.6)).

We often do something, note what happens, and conclude that our action led to – caused – the outcome. For example, if the implementation of a new policy is followed by a decrease in something undesirable or an increase in something desirable, it is often tempting to conclude that the new measure caused the shift. Unemployment went up last year; this year the City Council lowered property taxes, and now unemployment has come back down to its normal level.

In at least some cases like this, however, the return to normal would have occurred without the new measure, simply due to regression to the mean. In such cases, we are likely to explain the reduction in unemployment by the decrease in taxes, but we will be wrong, and the new measure will be given credit it doesn't deserve. Here, the alternative explanation to consider is that the return to a normal level is simply a result of regression to the mean; perhaps it would have happened anyway, even without the new policy.

Illusory Correlation

Suppose that some people recover from a given illness after taking megadoses of Vitamin C. It is tempting to conclude that the vitamin led to – *caused* – their recovery, that it *explains* why they got better. But might they have gotten better anyway? In the case of many diseases and illnesses, some people do get better without any medication, vitamins, or treatment. To know whether the Vitamin C helped, we need to compare the rate of recovery among those who took it with the rate among those who did not. In short, if we fail to consider the rate of recovery of those who don't take Vitamin C, we may come to believe in an illusory correlation between taking the drug and getting better.

In this case, belief in an illusory correlation leads us to give a faulty explanation (the people got better because they took the vitamin). Here the *alternative explanation* we need to consider is that they would have gotten better *anyway*, without the vitamin, (and the alternative evidence we need to consider to test either explanation is the group of people who did not take the vitamin).

Fundamental Attribution Error

The fundamental attribution error is the tendency to overestimate the role of our dispositions and traits, and to underestimate the importance of the context, in *explaining* their behavior (23.2). For example, it is easy to believe that people in a crowd who don't help an injured person are selfish and uncaring, when in fact many kind and decent people are reluctant to help in such *situations*. There are various situational pressures – *causes* – that inhibit helping.

In cases like this we give a wrong, or at least one-sided, explanation when we explain what others do in terms of their character traits or other internal causes. Considering the alternative explanation, that there are strong situational pressures that would lead most people (including them) to do what they did, can help us see that an explanation weighted more in terms of external causes might be more accurate.

Gambler's Fallacy

In the cases thus far, we need to consider alternative explanations for events that have already occurred, but similar points can hold for events in the future. We commit the gambler's fallacy when we treat independent events as though they were dependent (16.3). For example, even if we believe that a coin is fair, we may think that if we have flipped three heads in a row we are more likely to get a tail on the fourth flip.

Such a belief can result from accepting a bad explanation while ignoring alternative explanations about why we should not expect a tail the fourth time around. The bad explanation is that we think a tail is more likely because it would "even things out," or satisfy the "law of averages."

The good explanation we overlook is that there is nothing about the coin that would enable it to "remember" what it did on earlier flips. There is no mechanism that can change the probability of a given flip based on the outcome of previous flips. We might well see this quite easily if we paused and asked how the outcome of one flip *could* affect the outcome of the succeeding flip. What could explain how the coin could remember (answer: nothing—so it doesn't)?

Alternative Possibilities

Sometimes asking how things might have turned out differently helps avoid fallacies and cognitive biases. Here we *consider alternative outcomes or possibilities*.

Hindsight Bias

Hindsight bias is the tendency to overestimate the likelihood that one would have predicted an outcome after they learn that it occurred (8.6). It has been found in judgments about elections, medical diagnoses, sporting events, and many other topics. It is also the key ingredient of Monday morning quarterbacking and second guessing.

As with many other biases and fallacies, simply warning people of the dangers of hindsight bias has little effect. But various studies suggest that we can reduce this bias by considering how past events might have turned out differently. Consider alternative scenarios: ask yourself what alternatives *might have occurred* and what things would have made it likely that they would have happened? For example, if we consider how easily a couple of charging fouls against the opponent's star could have gone the other way, it may be easier to see how they could have won the game. Considering alternative outcomes can make it easier to break free of the "mindset" that the occurrence of this event would have been obvious before it occurred.

Overconfidence

We tend to overestimate the probability that our own judgments or predictions are correct. This means assigning high probabilities to hypotheses or claims that turn out, reasonably often, to be false. There is evidence that considering alternatives can help us make a more realistic assessment of our own accuracy.

For example, if we imagine plausible scenarios in which the candidate we predict to win would turn out to lose, we may become less confident in our prediction. Here the key is to consider ways our views and beliefs might turn out to be wrong. This can help us break free of the belief that our belief or prediction is "obvious."

The Either/Or Fallacy

We commit the either/or fallacy (the fallacy of a "false dilemma") when we assume that there are only two alternatives when in fact there are more or, more generally, when we assume that there are fewer alternatives than there are (11.2). Here, pausing to ask if we have overlooked genuine alternatives may help us find additional, and with luck better, options.

Alternative Evidence

Sometimes we need to consider evidence (data, facts, information) that we have overlooked: here the strategy is to consider alternative (or, perhaps more accurately here, overlooked) evidence.

Testing

It often seems easy to explain how we were right, *whatever* the evidence turns out to be. We read earlier about the members of a doomsday cult who gave away all their possessions because they believed that the world would end on a given day (19.6.1). Their belief turned out to be false; obviously so, since the world did not end when they said it would.

Most of us would see this as rock solid proof that they were simply mistaken about things. But when the appointed time came and went, many cult members strengthened their beliefs in the pronouncements of their leader (by concluding that their efforts had postponed the end). To take another example, the predictions of many pseudoscientists are often sufficiently fuzzy that they can be reconciled with almost anything that happens later.

In such cases, it is useful to consider alternative ways that the evidence might have turned out. What outcomes, what possible evidence, would we have taken as disconfirming our views? How would we have reacted if the evidence *had* turned out differently? This can help us see whether we are basing our beliefs on evidence (which could turn out to disconfirm them), or whether we are simply holding them, "no matter what," whatever the evidence might be.

Alternative Frames

Framing

Framing effects occur when the way in which options or situations are described influences how we think about them (7.5.1). It is always a good policy to imagine alternative ways to frame things, especially frames in terms of gains (if the current frame is in terms of loses) or in terms of loses (if the current frame is in terms of gains). And when evaluating the arguments of others, it is always wise to ask yourself how the points they are making might be reframed.

Anchors

We discussed anchoring effects earlier in this chapter. Here, we simply note that considering alternative anchors can help us avoid insufficient adjustment to anchors that are skewed.

Alternative Points of View

Sometimes the alternative we need to consider is some other person's point of view. We may need to put ourselves in their shoes.

Straw Man

We commit the straw man fallacy if we distort someone else's position to make it easier to attack (10.4). Here, considering alternatives means asking how the person who defends the view we dislike would state their position. What reasons would they give to support it? The point here is just to play fair, to try to find the strongest version of the view in question and evaluate it. Consider the alternative, stronger, ways to defend it.

Actor-Observer Asymmetry

We tend to see other people's behavior as internally caused, but to see our own as externally caused (23.3). Wilbur donated money to the Cancer Society because he is kind and generous. By contrast, we tend to see ourselves as giving a donation because we think the cancer victims need help.

The actor-observer asymmetry is a bias in our reasoning about people's actions, both our own and those of others we observe. But it turns out that if an actor imagines herself in the situation of the observer, or if an observer imagines himself in the situation of the actor, this bias is reduced.

Out-Group Homogeneity Bias

This is the tendency to see out-groups (e.g., people of other races, religions, countries, sexual orientation) as more homogeneous than they really are (25.5.1). Groups tend to see themselves as quite varied, whereas members of other groups are thought to be much more alike one another. One way to consider the alternative is simply to learn more about the other group. But imagining what the group must seem like to those in the group may also make it easier to see that they probably vary as much as the members of groups with which we are more familiar. For example, people in familiar groups with quite different backgrounds, occupations, and ages often see things in different ways. So, are members of an out group with quite different backgrounds, occupations, and ages likely to see things in the same way?

Dissent

We encountered several cases in Chapter 22 (Ash's conformity studies, Milgram's studies of obedience) where the most effective way of reducing conformity or obedience was to have at least one person who refused to go along. Often even one dissenter was enough to eliminate groupthink or conformity or mindless compliance.

Here one way to consider alternatives is to imagine what a dissenter might say or do. It is also good to encourage the actual presentation of alternative points of view by encouraging free expression. Some group biases are less likely, for example, if group members are allowed to express disagreement, since the group will be exposed to alternative points of view. It will be easier to break the grip of a certain way of looking at the relevant issues.

Evaluating Sources of Information

We have no choice but to rely on others for information, but some people are better sources than others. When someone who seems like an expert makes a claim, it is useful to consider perspectives or points of view from which the claims would seem less plausible, and ones from which it would seem more plausible. Then, consider it from the source's own point of view: would they have any reasons to make this claim if they didn't think it was true?

28.4.1 Is there "Invisible Data"?

Good reasoning requires us to stay focused on issues that are *relevant* to the points we are reasoning about. Many pitfalls in reasoning, including some of those discussed earlier in this chapter, involve one of two kinds of mistakes about relevance. Sometimes we overlook or ignore evidence or facts that *are* relevant. And sometimes we rely on evidence or facts that are irrelevant. We might think of the first sort of error as one of omission (we overlook relevant information) and the second as one of commission (we incorrectly treat irrelevant information as though it were relevant).

We will begin with cases where we overlook or underutilize relevant data. The slogan here, the question to ask ourselves, is: "Is there invisible data?" Is there relevant data that is "invisible" to us because we overlooked it?

Confirmation Bias

Confirmation bias is our tendency to look for, notice, and remember confirming or positive evidence (that supports what we think) while overlooking or downplaying disconfirming or negative evidence (which suggests that what we think is wrong (18.5)). We often have a blind spot for outcomes and possibilities at odds with our beliefs and expectations.

Relevance

Relevance involves a relationship between one statement and another. A piece of information can be highly relevant to one conclusion but completely irrelevant to others. For example, if Wilma is convinced that people with red hair have bad tempers, she may be more likely to notice or remember cases where red heads fly off the handle and to overlook or forget cases where they don't. Here the invisible data is obvious—*once we mention it*.

Here is another example. People who make admissions decisions at universities typically receive limited feedback on how well they are making their selections. They probably do learn about the performance of the students they do admit, but they rarely get feedback on the people they reject. How well did they do in the university they ended up attending? How well might they have done at this university, the one that rejected them. Here, half of the relevant evidence is "invisible" to the admissions officers, so it is difficult for them to form an accurate assessment about how well they are doing.

In cases like this it is often difficult to get the invisible data, although there are a few exceptions like football recruiting, where someone who wasn't offered a scholarship goes on to be a star at another university. But often invisible data is easy to see – as with Wilma and red heads – once it occurs to us to look.

Illusory Correlations

Belief in illusory correlations often results from considering only some of the relevant cases, e.g., the people who took Vitamin C and got better. We might learn that the apparent correlation is illusory if we also considered people who did not take Vitamin C (since at least as many of them might have gotten better too). The problem is that we often overlook or ignore data or information about this group, so it remains invisible to us. To take another example (15.4), if we looked for invisible data it might also show that various superstitions are based on illusory correlations.

Insensitivity to Base Rates

We often ignore or underutilize information about base rates in judging probabilities and making predictions (17.4). For example, we may think that a person has a high probability of being infected with the HIV virus after testing positive on an accurate, but not-perfect test, without accounting for the relatively low incidence of such infections in the general population. Or we may think that someone has a certain job, like being a professional football player, because they fit the profile or stereotype, we associate with that job, while ignoring the low base rate of professional football players in the general population.

When we overlook base rates, we ignore relevant information; it remains invisible to us. Pausing to ask whether information about bases rates is relevant can help make that information visible. Remember that you usually do not need any precise knowledge of base rates. Just knowing that there are a lot more of one sort of thing (e.g., bankers) than another (e.g., professional football players) is often enough.

How Do We Know What Might be Relevant?

It's easy for a book to tell us we shouldn't overlook relevant information, but how can we tell what is relevant, especially in fields we don't know much about? Things are typically open-ended, and we could go on collecting evidence for years. We often must act soon, however, and it's important to know when to stop looking and act.

There is no guideline for this, but in the real world the problem is rarely that people spend too much time looking for relevant information. The problem is that we usually don't look enough. Indeed, often we don't look at all. Moreover, the information we need is often obvious, once we pause to think about it. In short, in many other cases fostering the habit of asking: "what's been omitted?" can help us reason more effectively.

Is Some Data *Too* Visible?

The flip side of overlooking relevant information is basing our reasoning on irrelevant information. Even worse, in some cases we *have* good information, but for one reason or another we don't use it. Indeed, bad information sometimes drives out good information. In cases like this the evidence doesn't start out invisible, but bad or irrelevant information makes it difficult to keep it in sight (as with the dilution effect (17.4)).

We saw several cases on this sort in Chapter 10, where we examined various species of the fallacy of irrelevant reason. Later we saw that we often focus on samples that are highly available in memory or imagination, while ignoring more relevant and representative samples, even when we know about them (17.2).

28.5 Acquiring Cognitive Skills

The most important step toward better reasoning is learning to spontaneously recognize situations where a cognitive tool or skill should be applied. Simply learning to fill in a blank saying whether one sentence is a necessary or a sufficient condition for a second won't be of much help when you need to think about necessary and sufficient conditions in the real world. Situations (outside textbooks) do not come marked with labels saying that they involve necessary or sufficient conditions, so you need to be able to recognize them on your own. Similar points hold for most of the other concepts and tools we have learned about, including the very general strategies of considering alternatives or asking whether there is invisible data.

We encountered this general issue early in the book when we discussed inert knowledge (8.7). Psychologists and educators also speak of transfer of learning – being able to transfer the concepts and principles you learn in one setting (like the classroom) to use them in other settings (on the job, or in dealing with your family).

Transfer of learning: being able to apply knowledge and skills acquired in one setting in quite different settings

How *can* we teach and learn how to apply cognitive tools in life outside the classroom? These are empirical questions, and we are still discovering the answers. Experienced teachers know a good deal about such things, but they are not immune to the biases and mistakes discussed in earlier chapters. Fortunately, in addition to first-hand experience, there has now been a good deal of research on the transfer of cognitive skills, and much of it points to two conclusions:

- Teaching reasoning tools and skills requires teaching for transfer.
- Learning reasoning tools and skills requires learning for transfer.

Teaching for Transfer

How do we teach for transfer? First, it is important that students *understand why* principles and rules work the way they do, rather than merely learning to apply them to simple examples by rote. Second, students need a lot of practice applying the concepts and principles for critical reasoning in a wide range of situations, to a wide range of subject matters. If you want to be able to apply a skill (like noticing the relevance of base rates) in a wide range of circumstances, you need to practice it is a wide range of circumstances. If you want to be able to apply a skill (like spotting skewed anchors) in new and novel situations (like a new job), you need to practice it in new and novel situations.

It is especially important for students to apply the skills they are acquiring in situations that matter in their own lives. But it is unlikely that they will immediately see the relevance of some principles (e.g., regression to the mean) to such situations (e.g., ones involving choices of a major or job) without help.

It is also probably easier to gain a lasting mastery of cognitive tools if the course work (e.g., chapters exercises, exams) is cumulative. It is obvious that most of the exercises at the end of a section on necessary and sufficient conditions involve these concepts, and so the student is primed to use them. But real-life situations rarely come labeled to prime us in this way.

It also appears that a variety of instructional tools are useful: lectures, individual projects, group discussion, group projects, computer projects, assembling a few randomly selected problems from earlier chapters every so often, and graded portfolios of actual situations the student encounters that involve the things learned in class.

Habits

Much of what we do, we do out of habit—almost automatically, without giving it much thought. Good reasoning typically results from good cognitive habits (e.g., a habit of looking for relevant evidence before drawing a conclusion). Bad reasoning often results from bad ones (e.g., a habit of jumping to conclusions without considering the evidence).

This means that changing how we reason often requires changing habits, many of which are deeply ingrained, and learning for transfer requires enough practice that new and better habits can begin to take root. At first this requires conscious effort, but with further practice at least some reasoning skills can become more automatic, and second nature. This takes effort, and it requires real motivation to sustain it when there are more appealing things to do.

Although there is a good deal of research to support these points, the basic point is also a matter of common sense. No one supposes that you can learn to become a good cook just by reading cookbooks, without setting foot in the kitchen, or that you could learn to play the guitar merely by reading manuals. These are skills, and like all skills they can only be learned by practice. Lots of it. Critical reasoning is no different in this regard, but since it affects all aspects of our lives, it is more important.

28.6 Chapter Exercises

1. Unfortunately, it will often be easier to apply lessons about obstacles to critical thinking that exploit human fallibility, rather than to reduce it.

For example, when policymaking is poll driven, shifting the views of two or three percent of the electorate may determine what law gets enacted, or who gets elected. A 30 second TV spot warning people about regression effects is unlikely to have much impact on this, but an attack ad that frames an issue in a frightening way very well may (of course this gives us more reason to learn to think well—as self-protection). Give an actual example (from your own life, TV, some other course) where someone has done this. Explain the situation in detail, then analyze the tendencies to faulty reasoning that it exploits.

2. Earlier in this chapter we listed three examples (Enron, the Bay of Pigs, Covid-19) where bad reasoning and bad decision-making led to serious troubles. List another example, either from the news or from history. Explain the ways that some of the pitfalls we have studied may have been involved in the case you describe.

3. Earlier in this chapter we noted three pitfalls in reasoning that can make it difficult to get accurate feedback about the accuracy of our reasoning: hindsight bias, confirmation bias, and wanting to avoid unpleasant feedback. Give another way one of the biases or fallacies we studied could make it difficult for us to get accurate feedback, and explain why.

4. You are a teacher, and one of the topics you must cover is critical reasoning. What would you do to combat the problem of inert knowledge? Pick (and identify in your answer) the level of the class (e.g., sixth grade, junior in high school, college freshman).

   1. Give a specific, detailed (200 word) example of an assignment on the concept of illusory correlation that is designed to give your students a working (rather than merely inert) grasp of the concept. Don’t just say that you would ask students to give real life examples. Give one or two examples of the sort of that they might encounter and find interesting, then say what additional directions you would give.

   2. Give a specific, detailed (200 words) example of an assignment on the fundamental attribution error that is designed to give your students a working (rather than merely inert) grasp of the concept. Don’t just say that you would ask students to give real-life examples. Give one or two examples of the sort of that they might encounter and find interesting, then say what additional directions you would give.

5. One of the problems we encountered in earlier chapters is the card selection problem. Wilbur has a pack of cards, each of which has a letter [either a consonant or a vowel] on one side and a number [either even or

odd] on the other. Some of the cards are lying flat on a table (Figure 27.3). Which cards should you turn over to help test the hypothesis:

> *Hypothesis*: If a card has a vowel on one side, then it has an odd number on the other. As we saw, the answer is that only two sorts of cards are relevant: vowels (most people get this right) and even numbers (many people get this wrong). This is a problem involving the basic features of conditionals, but even after studying them many people find the problem difficult. Why do you think this is so? What could you do (over and above those mentioned in class) to help someone see the correct answer?

6. Good performances are likely to be followed by less outstanding performances simply because of regression, and unusually bad performances by better ones. Discuss the ways in which this could lead us to make flawed predictions and to give faulty explanations.

7. Recall this exercise from an earlier chapter: Suppose that you are a good chess player and that Wilbur is good, but not as good as you. Would you be more likely to beat him in a best of three series or in a best of seven series (or would the number of games make any difference)? Like the hospital problem above, this is a problem about sample size, but many of us fail to realize this when we first encounter the problem. First, explain what the correct answer is and say why it is correct. Then, discuss reasons why it might be difficult to identify this problem as one that involves sampling.

Answers to Selected Exercises

6. *Hint*: if we neglect the possibility of regression effects, this may lead us to suppose that criticizing someone for a bad performance is a more effective way to getting them to do well, rather than praising them for a good performance. How could this encourage us to make flawed predictions and to give faulty explanations

Part XI

Philosophical Application

Part XI. Philosophical Application

Throughout this book, we have focused on how to engage in critical thinking in our day-to-day lives. Over the next three chapters, we will take a brief look at ways the material we've learned in this class can be applied to other areas of philosophy. Metaphysics, epistemology and ethics will all be addressed in their own chapters. These discussions are not intended to be exhaustive, but rather to direct your attention such that your newly acquired critical thinking skills can be put to good use in other areas of philosophical inquiry. We'll point to a few examples in each of the broad subdivisions of philosophy, and then it will be up to you to take it from there.

Chapter 29

Application to Metaphysics

Overview: In this chapter, we will look at some areas of metaphysics and identify some applications for concepts and practices learned throughout this book.

Contents

29.1 Metaphysics

Metaphysics is the area of philosophy concerned with fundamental questions about reality. In all honesty, it's a terrible name with a dubious origin (it goes back to Aristotle scholars who coined the term to refer to the content Aristotle talked about in the book after the Physics – it literally means 'after the physics'), but it looks like we are stuck with it. In the following sections, we will look at some ways to apply what we learned in the preceding ten parts of this text to our study of metaphysics. This is by no means meant to be exhaustive look at the intersection of critical reasoning and metaphysics. Instead, we are looking to model some basic application of concepts that should help you think about further uses of these tools in your own studies.

29.2 God's Existence

The area of metaphysics with probably the most spilled ink is that of arguments for and against the existence of God. There are a lot of complicated and interesting arguments on both sides of this issue. Rather than address these arguments, though, we want to observe that perhaps more than any other area of philosophy, this debate is populated by individuals who are not acting completely in good faith. Remember, to be critical thinkers we need to be *fallible*, and being fallible means acknowledging that we could be wrong. Many people arguing both sides (although certainly more on one side) of this issue are actually engaging in **apologetics**. Apologetics is the practice of arguing in defense of a position you've already assumed to be true. Apologetics is antithetical to philosophy and to critical thinking because, rather than looking at the reasons and arguments and trying to come to the right answer, apologetics calls for the defense of a position in the face of any and all criticism. Apologetics has led many very intelligent people to make some truly bizarre arguments (for example, Anselm of Canterbury attempting to define God into existence with the ontological argument). Remembering the importance of *fallibility* should serve as a check to make sure we don't overcommit to a view we want to be true, and it can also help us at least understand how some arguments end up being made. It also may give us a reason to happily ignore some arguments people are making (like those people who are still trying to defend Anselm's ontological argument).

While it can be incredibly frustrating to see reasonably smart people engage in such an intellectually risible practice, it is easy to see how it happens. The pull of the *explanation reflex* is very strong. We want to understand the world, and for a lot of people, answering the question of God's existence helps them shape a robust worldview. Matters are made worse in this case because of the *certainty effect*. All things being equal, we want certain outcomes, and so an answer of agnosticism or a probabilistic answer is conceptually off the table for some people. Lastly, most people come to religion as children, well before they are critical thinkers. This can lead to especially strong *belief perseveration*, as the longer we hold something to be true, the harder it is to reevaluate or reject that view.

29.3 Free Will

Another major topic within metaphysics is the possibility of human free will. There are a lot of arguments worth our time that conclude that we don't have free will (a view called hard determinism). This possibility is unacceptable for most people, though. After all, we feel free don't, we? This experience-based line of reasoning is the primary "argument" for a belief that we have free will. As we have seen time and time again in this course, however, we have good reason to question whether our feelings and perceived experiences correspond to reality. If your *perceptual sets* can be influenced by *expectation* to the point where you perceive a yellow tent to be a brown bear, how much can we trust our feeling of being free? We have also learned that reflecting on past situations isn't going to be all that helpful in thinking our way through this. A strong view one way or another on this issue is likely to lead to *elaboration* in favor of that position when you try to remember past experiences.

The free will debate also gives us a potent lesson in being mindful of the either/or fallacy. Often, these discussions are framed as a choice between free will and determinism. Either we have complete control of our actions, or they are all caused by external factors. This type of frame is a false dichotomy that is likely to lead us astray, however. Some philosophers argue for compatibilism (sometimes called soft determinism), a view which holds that free will and determinism are not incompatible at all (so it's both/and, rather than either/or). Additionally, Patricia Churchland has argued that thinking about these issues in terms of free or determined choices confuses the issue and distracts us from what we should be concerned with, which is how much control a person has over a given action.

29.4 Personal Identity

Some of the same issues we found with the debate concerning free will resurface when we consider the question of whether our personal identity endures over time. Do we remain the same person from birth until death? Is it something less than that, but still mostly that we are the same person? While there are plenty of arguments for various positions on personal identity, most people can't shake the feeling that they are the same person over time. Some philosophers, like John Locke, even appeal to our ability to remember past actions as important evidence of the belief that we are the same person over time. We learned in this course, though, that memory is pretty unreliable. Whether or not we remember something often has to do with whether the right *context* or *state dependent retrieval cues* are present. Even when we do remember something, we need to be mindful of *elaboration* and *revision*. We also know that some of our most powerful memories – *flashbulb memories* – are no more likely to be true just because they are vivid. So, it is entirely possible we can have strong memories of having experienced something that simply didn't happen.

Others like to appeal to consistency of personality traits (beliefs, desires and temperaments) to justify a belief in identity permanence. Unfortunately, we have also discovered that we often overstate the degree to which these features stay consistent over time. The Markus study of attitudes discussed in Chapter 7 showed that over long periods of time people often remember their views as having been consistent, even when they have changed. We have also discovered that problematic thinking, like the *hindsight bias*, can lead us to believe that we always had certain expectations (when that isn't true).

And, once again, we can see the *either/or fallacy* rearing its head. While this debate is typically framed in terms of identity relationships (requiring two objects or beings to be exactly the same in order for them to be the same thing over time), Derek Parfit has argued that we should instead be thinking in terms of continuity, asking how similar we are over time, are rather than focusing on mere identity.

29.5 Teleology

A less popular consideration in metaphysics is teleology. 'Teleology' is just the jargon-heavy way of saying we are looking to ascertain purpose. Most famously, teleology is used as an argument for God's existence. While the argument actually predates him by hundreds of years, the teleological argument is most commonly associated with William Paley. Paley argued that the fact that naturally occurring phenomena are often complex and seem to be designed with a purpose in mind was proof that nature must have had an intelligent designer (who Paley then went ahead and assumed was the Judeo-Christian god) .

Teleology can be found elsewhere in philosophy though. The question most students show up to their Introduction to Philosophy class jazzed to discuss, (but which virtually no philosophy instructor has any interest in talking about) is, "what is the meaning of life?" This is just a teleological question in a different frame – it's the same as asking, "what is the purpose of life?" Don't get your hopes up; we aren't going to answer that question. In fact, we aren't even going to address the various answers people have suggested over the years. Instead, we want to observe that questions of teleology are themselves an extension of the *explanation reflex*. Most people jump straight to questioning what the purpose of something is, skipping right over the possibility that there could be no purpose at all. We should be careful not to assume there must be a purpose for all things. In fact, *existentialism* is a school of philosophical of thought that explicitly rejects the idea that things have innate purposes. Instead, existentialists argue that purposes are assigned to things, including lives, by people.

Two jointly related concepts worth thinking about when considering teleology are *testability* and *falsifiability*. Imagine you or someone you know thinks they have identified the purpose of a naturally occurring thing. How would you go about testing if they were right? Our old friend Wilbur says he has determined that the purpose of trees is to make baseball bats. It won't be enough for Wilbur to show us that trees *can* be used to make baseball bats; his claim is much stronger than that. We would need some way of knowing that trees are *for* baseball bats even though they can be used for all sorts of things.

29.6 Essentialism

Let's wrap up this section by considering a view in metaphysics that often goes hand-in-hand with a belief in purpose – **essentialism**. Essentialism is the ontological view that objects, beings and concepts have essences – the what-it-is-to-be-a-thing – and anything lacking that essence is not a true instance of the thing. This is often tied up with the concept of purpose – what is the thing *for*? – which is why this is closely tied to teleology. For instance, horses – and only horses – have the essence of horse-ness, setting them apart from donkeys, zebras, etc.

Although essentialism was the standard view for centuries, it's a lot harder to make sense of today. We now know that species don't remain stagnant over time – the horses of Aristotle's day are not biologically (nor essentially) identical to the horses of today. And once we start talking about the hybridization of species, things get even crazier. Is the essence of a mule 50% horse-ness and 50% donkey-ness? Does a new essence – mule-ness – get created at that magic moment when horse and donkey genetic material comingle? None of these answers look great.

This topic might seem antiquated, low-stakes, or both, but essentialism is actually alive and well in some circles – and doing quite a bit of harm – in the form of gender essentialism. This is the view that there is something essential about man-ness, and woman-ness, such that the two categories are rigid, distinct, and unchanging. Gender essentialists reject the validity of transgender identity and gender nonbinary identity. And, harkening back to the discussion of teleology, tend to have very firm ideas about men and women's purposes. It should surprise no one to learn that men's purposes include being powerful and in control, and women's purposes include being nurturing and submissive.

The problem is, gender essentialism flies in the face of both biological evidence and the lived experience of countless individuals. Biologists have long understood that the idea of just two sexes – male and female – is inaccurate. The vast majority of human beings can be biologically classified as XX or XY, but 1-2% of us are neither, and are instead classified as intersex.

What's more, about .6% of Americans today identify as transgender or gender nonbinary. A gender essentialist will diagnose such identification as a mental disorder, because they have already accepted a *schema* that does not allow for the possibility that the testimony of individuals regarding their own experience of being a person of a certain type could be accurate.

Essentialism is pretty hard to reconcile with a modern understanding of biology. So, why does this view stick around? The *status quo bias* very often lurks in the background when we talk of essentialism. When one's understanding of the world is comfortable, there's no reason to question it, and in fact every reason to continue to double down on its acceptance. A good way to do this is to insist that this is "simply the way it is," at a deep down, essential level. This can be really detrimental to our understanding of the what-is-it-ness of our world, though. There are countless examples of scientific breakthroughs that were significantly delayed due to an insistence that something was a certain way, which prevented researchers from seeing that it plainly was not. We can thank Aristotle for asserting that every living organism is either a plant or an animal. These were essential categories, and everything must fit into one or the other. We can't fault Aristotle for not realizing, thousands of years before the invention of the microscope, that the world is full of microscopic organisms. But we can blame an unwillingness to think outside of the established frame for the fact that it took us several hundred years after the discovery of these little beings to stop trying to awkwardly shove them into one of the two available categories, and instead to revise our understanding of the kingdom taxonomy.

The problem with essence talk is the essences are usually assigned by people who have already accepted a certain *schema*. If Wilbur operates within a schema that says Ghostbusters are male, then a female Ghostbuster will automatically be ruled out. Where does it say that maleness is an essential property of 'busters? Nowhere. But, just as the students "remembered" books in graduate students' offices that weren't actually there, because their "office schema" contained books, so Wilber will be confident that a female instantiation of a Ghostbuster must be a fraud.

29.7 Chapter Exercises

For each of the following areas of metaphysics: 1) identify at least one bias, pitfall, or fallacy that could impact our judgment on the issue, and 2) identify at least one safeguard we could employ to protect ourselves.

1. The possibility of strong artificial intelligence.

2. The existence of a soul.

3. Ontology of art.

4. Material causation—Lumpl and Goliath.

5. Identity over time—the Ship of Theseus.

6. Wittgenstein's beetle in a box.

7. Possible worlds talk.

8. The possibility of miracles.

9. The mind-body problem.

10. The nature of time.

Chapter 30

Application to Epistemology

Overview: In this chapter, we will look at some areas of epistemology and identify some applications for concepts and practices learned throughout this book.

Contents

30.1 Epistemology

Epistemology is the area of philosophy concerned with the nature of knowledge. The name is strange, but if you are considering a question about what knowledge is, or how we can understand something, then you are doing epistemology. And the dirty secret is, if you have made it this far into the text, you have already done a lot of epistemology. Questions about how to acquire scientific knowledge or how to evaluate testimony are major areas of epistemology that you've already spent some time thinking about. In the following sections, we will look at some ways to apply what we learned in the preceding ten parts of this text to our study of epistemology. This is by no means meant to be an exhaustive look at the intersection of critical reasoning and epistemology. Instead we are looking to model some basic application of concepts that should help you think about further uses of these concepts in your studies.

30.2 Skepticism

The primary goal of epistemology is to fight back against skepticism. Skepticism is the view that we don't know anything. Nobody wants skepticism to be true, but it turns out it's a really difficult view to argue against. Much of what we talked about in our chapters on *perception* and *memory* help to motivate skepticism. How can you claim to know anything empirical, a skeptic will argue, if you can't trust what you see and hear to be real? *Top-down processing* shows us that *beliefs, desires, expectations, schemas* and *biases* can all cause us to experience things incorrectly. Those same features impact what we remember and how we remember it. Understanding these things should cause any rational person to question the veracity of their experiences and memories. With this foot in the door, the skeptic has everything they need. If you might be wrong about some particular perception or memory, then you might be wrong about all of them – including ones you think are fundamental. If you push back, they can always refer you to *false-memory syndrome*. From there, we find ourselves at the radical skepticism Descartes was concerned about – we might just be dreaming about all of this (what a boring dream).

30.3 Appearance and Reality

Bertrand Russell had an interesting response to skepticism. To make his point, Russell made a distinction between appearance (how things seem to us) and reality (how things really are). Ultimately, he says it doesn't really matter if appearance and reality correspond; all that matters is that we agree on appearance. Russell's goal was to get us to just move on from attempting to "defeat" skepticism. The *information cost* is just too high (think of all the time and energy put into trying to solve the problem) and there isn't much to be gained (even if we did somehow successfully argue against, it our lives would remain the same). If we all agree on how things appear to us, there isn't anything for us to compare those experiences to in an effort to disconfirm or falsify. So, Russell says we might as well move on to other problems.

30.4 Belief without Justification

William James was concerned that our pursuit of epistemic rigor was at times preventing us from accepting beliefs that would benefit us. This concern led him to argue that at times we would be justified in believing certain claims without adequate evidence. James argued that if we had a forced choice between two options, and the consequences of belief would be significant (he said momentous) then we would be justified in choosing to believe if we could. This way, at the very least we can reap the potentially beneficial consequences that we would be locked out of if we chose not to believe due to a lack of justification. James was primarily thinking about belief in the existence of God when he made this argument, but he also says it applies to slightly more mundane beliefs, like someone being a good person to marry. This is an interesting view, and one that has been discussed at length in the literature.

You can see how he managed to talk himself into this view, though. The *explanation reflex* is strong, and, in this case, it is accompanied by a fair amount of *psychological accounting*. Just think – there is a benefit you could have if you just ignored traditional standards of justification. As easy as it is to see why this view would seem appealing, it is also easy to see why it is problematic. One issue is, this type of thinking often requires that you ignore *base rates*. It might be that we can't ever know for certain if God exists or that a person will make a good spouse, but that doesn't mean that these things are literal coin flips. There might be really good underlying reasons that suggest that Marvin and Jenny Beth are unlikely to have a happy marriage. It would be absurd to ignore these factors and just choose to believe it will work out. At its heart, deciding to believe something without adequate evidence because of how you hope it will positively impact you is *wishful thinking*, and using the lack of absolute proof that you are wrong as evidence that you are justified is the *appeal to ignorance fallacy*.

30.5 Epistemic Injustice

The concept of *epistemic injustice*, coined by Miranda Fricker, is the particular form of injustice that occurs with regard to people in their capacity as knowers. Since a great deal of this book has focuses on knowledge – how we know things, what we think we know when in fact we don't, and barriers that keep us from knowing – it's not surprising that much of what we learn can be applied directly to this relatively new area of philosophical thought. Epistemic injustice can be broken down into two subcategories, testimonial injustice and hermeneutical injustice, each of which we will discuss in turn.

30.5.1 Testimonial Injustice

Testimonial injustice occurs when someone's testimony is rejected, or not taken seriously, in the absence of sufficient reason for doing so. This occurs most commonly with respect to members of historically marginalized groups, but a role-based version is also quite common.

With regard to members of marginalized groups, this can be understood in terms of harmful *stereotypes* and *biases* about those groups. Women are irrational and hysterical, so Wilma's version of events cannot be accurate. Immigrants are not to be trusted, so Alejandro must be lying about what happened. Oscar is in his 80's so he must not know what he's talking about. *Out-group homogeneity bias* can lead entire demographics of individuals to be lumped into a single, inaccurate category, their testimony discredited. This is extremely common – and high stakes – in matters involving criminal investigations. When the testimony of people of color is seen as lacking credibility, it is extremely unlikely that their treatment by the criminal justice system will be fair.

The reverse of this phenomena can also occur. *In-group preference* can grant an individual unmerited *epistemic privilege* when their testimony is being considered by another member of their group. We see this tendency exhibited strongly when parents refuse to belief copious testimony from others over the testimony of their child, regarding that child's behavior.

Role-based testimonial injustice occurs when a person is discredited due to the role that they hold in a situation. This typically occurs when there is a power differential between the individuals whose testimony is in question. This can happen in testimonial disputes between teachers and students, adults and children, supervisors and employees, and police officers and community members.

Physicians are granted significant power and authority in our society, and thus have a great deal of testimonial privilege. Patients are in a vulnerable, subordinate position relative to their physicians. Thus, health care is an area where testimonial injustice runs rampant. Physicians, over-confident in their medical judgments, may refuse to believe the testimony of their patients regarding their own experience of pain, or their insistence that something is very wrong with their bodies, when the physician can find no cause. This literally costs people their lives in cases where, if their testimony had been taken seriously, the cause could have been discovered and treated before it was too late. Remembering the *halo effect* can help us out, here. Certainly, physicians are experts on particular matters of medicine, and their medical knowledge far outranks their patients. But no one is more of an authority on a particular patient's body than the owner of that body. So, we should take care not to extend the physician's halo beyond where it actually belongs, and both patient and physician should recognize that they are both *experts* in the physician-patient relationship, rather than either of them assuming one of them knows more than they do.

30.5.2 Hermeneutical Injustice

Hermeneutical injustice occurs when someone is unable to understand their own experience – or the experience of others – because they lack the concepts that would allow them to understand and process that data. Because our dictionaries and textbooks are written by the people in power – white men – the concepts that we are taught and that are culturally accepted by society are going to be ones that come from – and advantage – that perspective.

Think about the concept of rape. For the concept of rape to exist within a society, there must also be the concepts of consent and bodily autonomy. Without these concepts integrated into our *schemas*, there's no way to understand rape as anything other than a particular flavor of sex. Thus, women in societies that have not had these concepts were unable to conceptualize their own experiences of sexual assault. It is only in gaining the conceptual framework that we're able to recognize what is happening. In putting words to it, we can understand it, talk about it, and fight it.

Similar hermeneutical progress has been made just within the authors' lifetimes regarding the concepts of marital rape and date rape. It wasn't until the 1970s that a wife could bring a charge of rape against her husband. Even in 1993, when Lorena Bobbitt famously relieved her husband of his penis with a kitchen knife after he had repeatedly sexually assaulted her, there was a great deal of skepticism that she could have minded so much, given this was a person with whom she had had consensual sex many times.

When society tells a woman there is no language to capture what her husband is doing to her, she has no frame in which to process it as abuse and get out. Even today, when it is widely accepted that marital rape is a crime, it can be hard for a woman to find her way to understanding an experience that could look very different from the *schema* for rape that she's internalized from the media, in which rapists are masked men in alleys, not the father of your children.

The concept of hermeneutical injustice also lets us see some problems we discussed in this class in a new light. Hermeneutical injustice can lead to wildly inaccurate statistical analysis. Think about what sexual assault statistics looked like prior to our concept of marital rape, or assault statistics before the concept of domestic violence was realized. We had inaccurate data because we had inaccurate conceptual frameworks. It can also lead us to interpret and apply data incorrectly. There isn't really any hope that the *availability* or *representative* heuristics are accurate when applied to *schemas* that fail to recognize important factors. Similarly, we can end up understanding *base-rates* incorrectly because they aren't accurately capturing what is going on.

It can be really hard to combat this issue. One thing we can do is allow members of marginalized groups to share and name their experiences. The resistance to this, as with testimonial injustice, has a lot to do with the *status* *quo bias*. If you're not a member of the group being assaulted, you might see little need to try to conceptualize the experience, and your allegiance to your *in-group* might prompt you to actively oppose changes in understanding that could mean members of your group might be deprived of some of the privileges they've long enjoyed.

30.6 Objectivity and Investigation

One final epistemic issue worth reflecting on is the nature of investigation and our assumption of objectivity. Many criticisms have been offered, coming originally from feminist philosophy, but later philosophy of race and gender more broadly, arguing that *bias* plays a far greater role in the natural and social sciences the we would like to admit. The concern is that we often conflate the fact that the scientific method is objective with the idea that scientific investigation is objective. Observation and investigation do not happen in a vacuum. As we have discussed, in order to engage in scientific research, we need to have a *hypothesis* that we are testing. The hypotheses come from people making decisions about what is a reasonable claim, and what is worth investigating. These same people decide how to frame research questions, what data should be collected, how that collection should happen, and what conclusions should be drawn from the data. At all of these stages we are susceptible to *bias*, and even when we are trying to be impartial, we are influenced by our existing *schemas*.

The consequences of this are not slight. What we can know is determined by what we study. As you may have observed from the *social dimension* section of this text, we have spent a good deal of time studying conformity and obedience, certainly more than we have cooperation (and much of that cooperation research is focused on explaining defection rather than on how best to facilitate working together). Might this be different if a more diverse group was involved in psychological research from the start? 90% of women suffer moderate to severe pain and discomfort from premenstrual syndrome, while only 19% of men experience erectile dysfunction. Yet erectile dysfunction studies outnumber PMS research 5 to 1. Can you think of an explanation for this other than a lack of objectivity?

30.7 Chapter Exercises

For each of the following areas of epistemology: 1) identify at least one bias, pitfall or fallacy that could impact our judgment on the issue, and 2) identify at least one safeguard we could employ to protect ourselves.

1. Reflective knowledge.

2. Testimonial knowledge.
3. Knowledge as a mental state.
4. Occurrent Knowledge.
5. Dispositional Knowledge.
6. Necessary and Contingent propositions.
7. A priori and a posteriori knowledge.
8. Analytics and synthetic propositions.
9. Certainty.
10. Tautological and significant propositions.

Chapter 31

Application to Ethics

Overview: In this chapter, we will look at some areas of ethics and identify some applications for concepts and practices learned throughout this book.

Contents

31.1 Ethics

Ethics is the area of philosophy concerned with questions regarding the moral permissibility of actions. The greatest challenge with approaching ethics as an academic pursuit is the tacit assumptions most people have that they understand how to reason morally, and that ethics is easy. Our lives are filled with moral choices, and many aspects of applied ethics encourage us to think more critically about those choices. Because these choices are so integral to our lives, though, it can be hard to get people to approach these choices differently. In the following sections, we will look at some ways to apply what we learned in the preceding ten parts of this text to our study of ethics. This is by no means meant to be an exhaustive look at the intersection of critical reasoning and ethics. Instead, we are looking to model some basic application of concepts that should help you think about further uses of these tools in your studies.

31.2 General Concerns

There are some critical reasoning missteps that trend to creep up no matter what ethical topic we are considering. The first of these is *belief perseveration*. As we have discussed several times in this text, it is very easy to continue to believe something, even after acquiring evidence that it isn't so. Most ethical arguments move very quickly from academic considerations to identifying changes you need to make in how you live your life. If you are looking at arguments about the moral obligations we have to non-human animals, the conclusion you draw should have a direct impact on whether you are a vegan or vegetarian. Similarly, understanding microaggressions and the effect they have on people might lead to an implication that you need to stop telling certain jokes. Many people are uninterested in making difficult changes to how they live their lives, and so they find it easier to just reject the evidence and arguments that require these changes.

In academic settings, most of us are trying to do a good job and have a genuine interest in coming to the right answer, even if that means having to change our minds. This is not always the case for people engaging with moral arguments in the public sphere. Given people might be presenting arguments in bad faith or misrepresenting information to make their views seem more reasonable, we need to be mindful of the *misinformation effect* and the *validity effect*. Because being exposed to false claims can cause us remember things incorrectly, and the mere repetition of claims increases the likelihood that we will begin to believe them, we need to be quite vigilant. To the best of your ability, you should make sure to actually investigate the claims made on these issues, and you should do your best to avoid sources that you have established to be disreputable in the past.

Going along with this, we should keep in mind that *framing effects* impact the way we think about things. Our current public conversations about "cancel culture" are a good example of this. Some parties try to frame the issue as mean-spirited attempts to silence intellectuals or to punitively take away the jobs of people who are controversial. The people on the other side are typically talking about holding people accountable for the things they say, and making sure that we have a more equitable representation in the media. The frame you are given will likely color how you understand what is going on, and as a result what you think should be done about it. Whenever possible, you should try to remove the frame and consider the morally relevant factors independent of the presentation.

31.3 Ethics and Public Policy

When thinking about how to make morally just public policy, there are a number of concerns to keep in mind. Chief among these concerns is that policy disagreements are often framed as *clashes of values*. Gun control is seen as a tension between freedom or safety, abortion as freedom of choice vs a right to life, and so on. While concerns about these values are often part of what is going on, reducing disagreements to clashes of values more often results in bad arguments built on the either/or fallacy.

People are also very likely to fall victim to the *status quo bias* when considering matters of public policy. Changes to public policy means changes to how our society works. For many, change can be scary. and doubly so when that change may directly impact them. The result is a willingness to accept substandard conditions rather than risk disruption. You see this most often when the potential benefits of the policy change is likely to have a greater impact on others. Most white people prefer the status quo over serious change to the criminal justice system, and most people who can afford to send their children to private school prefer the status quo to restructuring the education system, and so forth.

A more subtle version of the *status quo bias* in public discourse is incrementalism. Advocates for incrementalism call for small, slow change over large revisions to how society works. That said, incrementalists are very often on the same side of history as the people who want no change at all. Personally, it might seem reasonable to enact changes slowly, so as to allow for people to adjust to changing norms and conventions. Objectively though, what incrementalists are often asking is for people to delay experiencing equal rights in favor of the comfort of others. Civil unions were the incrementalist response to gay marriage, and banning chokeholds is an incrementalist response to police violence. These measures may be better than nothing, but they aren't much more than the status quo.

Another form of psychological accounting that happens a lot with issues of public policy is *sunk costs*. When something is a feature of society and we've already invested in the institution, it can be difficult for people to acknowledge a need to reform or eliminate it. Many argue that the U.S.'s war on drugs is an area in which we can see this happening. Increasingly more money is invested in policing and incarcerating drug users with very little to show for the financial and human cost. Rather than invest in alternative methods to address drug addiction, however, we double down on the strategies that we have been using for years. To do otherwise would be to admit that the money we already invested was not worth it.

Lastly, we should remember the lessons learned about the *illusion of explanatory depth*. Public policy decisions are almost always quite complicated. We should keep this in mind when considering the arguments people give about these issues. People who claim to have all the answers about immigration, healthcare, criminal justice reform, or any number of other issues might have ideas worth considering, but they likely do not have a comprehensive understanding. Certainly, we should be skeptical of simple solutions to these complicated problems. And we should make sure we understand what people actually mean, especially when it sounds like a simple solution. A position like defund the police sounds simple enough, but when you actually look into what it means, it is a call to radically restructure our society.

31.4 Identity-Based Ethics

The most important point for us to keep in mind when engaging in moral decision-making regarding issues concerning identity is the role our existing *schemas*, *stereotypes* and *biases* are likely to play. If you are not a member of the group being discussed, you likely don't have much of a sample to be working from in terms of what their experience is like. Worse still, your sample may largely be populated by representations from fiction or other media sources which themselves are unlikely to be fair and accurate depictions of the lived experiences of the group members. You can end up in a situation where you are applying the *availability* and *representativeness* heuristics (which can already be problematic) to bad data sets that lead to the *out-group homogeneity bias*, rendering your reasoning close to worthless.

A better strategy would be to listen to members of these groups. If you are willing to listen, women, people of color, trans people, people with disabilities, etc. are pretty clear about what their experiences are like. This way, you don't need to be as reliant on the stereotypes and biases you may have formed, and you can develop more accurate schemas. The *information cost* to listening is low, and it will lead to a must more robust understanding of others.

More often than you might think, we can also consult *base-rates*. Rather than relying on subjective experience or anything else about an issue like discrimination in law enforcement, we can look at the numbers. Comparing the incarceration rates for drug possession based on race to drug use rates based on race helps make the case the such discrimination is real. Similarly, looking at the rates at which people of various races are pulled over for pretext stops helps tell the story. We should always remember to consult the data when there is good data available. When people are justifying racially prejudicial views, they typically fall back on reasoning supported by *confirmation bias*. If we focus on the objective data, we can avoid this problem.

One final element to keep in mind when evaluating these issues is the way some people leverage *appeal to emotion*. When considering trans bathroom access, for instance, you will find that people looking to restrict bathroom access engage in a fair amount of fear-based arguments. Aren't you concerned about you wife and children? What if it makes things easier for sexual predators? As we discussed in Chapter 9, we should be very skeptical of *scare tactics*. These arguments are intended to hit us on an instinctual level, and if we react to them, we are likely to miss the bigger picture. In the case of these arguments in particular, some calm reflection should lead you to realize: 1) that trans people are far less likely to sexually assault someone than cis people (it's a numbers game); 2) people who commit sexual violence clearly aren't all that concerned with rules, as we already have laws against that behavior (so they are likely to enter a bathroom even with restrictions if they think it is advantageous); 3) these bathroom restrictions would require transmen to use the women's room (something that would likely make the proponents of these restrictions uncomfortable as well); and 4) if people really are concerned about violence, then they should also be concerned about sending transwomen into the men's room.

Scare tactics about identity issues are not new. In 2003, U.S. Senator Rick Santorum literally argued that if we allowed same-sex couples to get married it would lead to people marrying their dogs. This argument in particular does double duty, as it is also a twist on the *line-drawing fallacy*, as Santorum is saying that if we don't uphold his view of marriage, then the term will cease to have any real meaning.

31.5 The Wisdom of Repugnance

The most sophisticated appeal to emotion to grace the world of academic ethics comes from bioethicist Leon Kass, and is known as the "wisdom of repugnance." Appealing to a naturalistic account of morality, whereby nature itself is imbued with moral value, Kass argued that disgust is a good moral indicator. Just as repulsion at the smell of rotting food serves as protection against food poisoning, Kass argued that moral repulsion protects us from morally abominable acts. The consequence of this view is, even if we can't offer a cogent argument against a view, we have license to assume that any practice which makes us uncomfortable is immoral. This argument has been applied fairly broadly, being used to argue against homosexuality, abortion, cloning, and even the legalization of drugs. While repugnance arguments can be very popular, especially among non-academics, we should be very skeptical of the type of argument being made by Kass. We are often disgusted by things we don't really understand, and had we been raised in a different environment, we likely would have felt differently. It was not that long ago that disgust arguments like Kass suggests we follow were made about interracial marriage and women wearing pants in public. Contrary to Kass's thinking, we should try to look past our initial emotional reactions and focus on the arguments and reason. It is pretty unlikely that your disgust about something is a reason for others not to do it (and much like a child who thinks they don't like broccoli, your initial disgust reaction may not even be much of an indicator of what you will end up appreciating).

31.6 Criminal Justice Reform

When we are trying to establish what our criminal justice system should look like and what reforms might be necessary, there are a couple of pitfalls we should keep in mind. Chief among these is the *just world hypothesis*. The impulse to view the world as fair, and to expect people get what they deserve, can really impede our ability to recognize it when justice fails. Wrongful convictions are real and all too common. There are a lot of organizations like the Innocence Project that do the underfunded and relatively thankless job of fighting for exonerations for the wrongfully convicted. Most of these wrongful convictions were preventable if we took the effort to reform the way police interrogations work, prevented plea bargaining for testimony, restructured the jury selection process, worked to prevent bias in witness identification, and a number of other well-documented factors. Unfortunately, it is very difficult to convince people who are not well educated on these issues that something needs to be done, because of the assumption that they wouldn't have been convicted if they hadn't done something wrong.

We can also see how the *fundamental attribution error* can impact how people on juries and the public at large view the accused. It is all too easy to recognize external mitigating or causal factors when we are accused of wrongdoing, but to ignore those factors when others are in similar situations.

31.7 Parenting Ethics

Even when dealing with smaller scale moral issues, such as how to parent, people are prone to a variety of reasoning errors. The most common mistake in this regard is to make *appeals to tradition* and *popularity*. When discussing issues from spanking to whether preteens should be allowed to have cell phones, it is fairly common for people to argue that since they were raised under certain conditions, their children should be as well. It should be clear that just because some of us were spanked growing up, this doesn't mean that spanking is a reasonable thing to do. If a person wants to spank their children, they will need to appeal to legitimate moral reasons, rather than their own upbringing. Similarly, some parents will institute policies, like limited screen time on school nights, because they know that other parents do it. This is just a combination of the appeal to popularity and *social proof*. This isn't to say that limiting screen time isn't a good idea, but the mere fact that other people are doing it is a bad reason to have the rule.

The mistaken thinking that leads to these appeals to traditions and popularities are really the mirror image of another issue – that of neglecting experts. This book has taught us the value of relying on experts for advice, and there is no reason parents shouldn't do this as well. Should you spank your children? Well, to help you decide, rather than recalling what your parents did, or checking out what your social media friends have to say about it, it's probably worth listening to what the child and developmental psychologists have to say (they say don't do it). Should you vaccinate your children? Probably you want to talk to some pediatricians (they say you should). Parenting is really hard, and there are a lot of decisions to be made. There is no reason to go it alone or to just rely on what little experience you have when you could consult overwhelming bodies of evidence.

31.8 Chapter Exercises

For each of the following areas of ethics: 1) identify at least one bias, pitfall or fallacy that could impact our judgment on the issue and; 2) identify at least one safeguard we could employ to protect ourselves.

1. The moral status of non-human animals.

2. Fair hiring practices.

3. Sexual consent.

4. The death penalty.

5. Euthanasia and assisted suicide.

6. Employee rights.

7. Doctor-patient relationships.

8. Obligations of children to their parents.

9. Freedom of speech.

10. Gun control.

Part XII

Formal Logic

Part XII. Formal Logic

In this final part of the text we will provide a very brief introduction to formal logic. There are a number of excellent resources for formal logic. This section is not looking to compete with those. Rather, the goal here is to provide a brief discussion of the basics so as to allow courses that cover both critical thinking and formal logic to use one text – although the instructor might want to augment with additional resources.

Chapter 32 will introduce the concept of formal logic, demonstrate how to symbolize complex sentences, and offer strategies for reducing the complexity of symbolized claims.

Chapter 33 will present truth tables and explain how they are used to test claims and arguments for various concepts that have been discussed in this class.

Chapter 32

Formal Logic, Symbolization and Negation Manipulation

Overview: In this chapter, we introduce the concept of formal logic. Following that, we will learn how to symbolize complex sentences, and discuss methods for reducing symbolized complexity by manipulating negations.

Contents

32.1 Formal Logic

The bulk of this book has been devoted to what is typically referred to as *informal logic*. Informal logic, or critical reasoning, is needed to evaluate arguments in everyday life. Professional logicians, mathematicians, and the like often deal with far more complicated arguments than we see in everyday life, and to help evaluate these arguments, several systems of what is known as *formal logic* have been developed. In formal logic, claims and arguments are symbolized by logical operators and variables that can be used with various systems. A full exploration of formal logic is beyond the scope of this book, but since many logic classes will offer a mix of formal and informal logic, we will spend the final two chapters of this book looking at basic methods of formal logic. In this chapter, we will learn how to symbolize sentences using logical notation, and some basic strategies for manipulating these symbolizations to make them easier to use.

32.2 Symbolization

When we symbolize a claim, what we are doing is breaking it down into propositions, and the logical connectors that join the propositions. We will represent the propositions with letter variables, and we will represent the logical connectors with symbolic operators. A **proposition** is a simple sentence. For example: 'men are mortal', 'it is raining', 'Tom is left-handed.,' etc. When we translate ordinary sentences into logical notation (we call this symbolization), we condense the information down into its most basic parts and represent it with a kind of shorthand. Each proposition is abbreviated with a single capital letter. So, corresponding to the examples of simple sentences from above, we can stipulate the symbolization: 'M', 'R' and 'T'. There is no rule that says which letter you should use, so you should just pick one that makes sense, usually based on the letters in the sentence you are symbolizing.

- 'Men are mortal' is symbolized as:
    - M
- 'It is raining' is symbolized as:
    - R
- 'Tom is left-handed' is symbolized as:
    - T

Linking these symbolized propositions are **logical operators**. Logical operators are the symbolic representation of basic features of our grammar that connect propositions into more complicated claims. We have talked about these features at length in Chapter 2 and Chapter 3. They are features like: 'and', 'or', 'if…then', 'if and only if' and 'not'. The chart of these operators can be found below.

Operator	Name	Function	Sense	Translation
&	ampersand	conjunction	and	P & Q: "P and Q"
v	wedge	disjunction	or	P v Q: "P or Q [or possibly both]"
→	horseshoe	conditional	if… then	P → Q: "if P then Q"
←→	triple bar	biconditional	if and only if	P ←→ Q: "P if and only if Q"
~	tilde	negation	not	~P: "not P" or "it is not the case that P is true"

Again, using the examples from above:

- ‘Men are mortal, and it is raining’ is symbolized as:
    - M & R
- ‘Men are mortal, or it is raining’ is symbolized as:
    - M v R
- ‘If men are mortal, then it is raining’ is symbolized as:
    - M →R
- ‘Men are mortal, if and only if it is raining’ is symbolized as:
    - M ←→ R
- ‘Men are not mortal’ is symbolized as:
    - ~M

When typing your symbolizations, a trick for the conditional and the biconditional is to use the ‘<’ ‘>’ signs and two dashes ‘--'. If you are using Microsoft Word, it will replace what you typed with the correct symbol.

It’s important to remember that every proposition needs to be assigned its own unique letter, but if a proposition repeats, then you need to repeat the letter. So, while:

- ‘Men are mortal or it’s raining’ is symbolized as:
    - M v R
- ‘Men are mortal, or men are not mortal’ is symbolized as:
    - M v ~M

You should also keep in mind the ways that logical connectors can be implied, as we learned in Chapter 3. ‘When it’s raining, the lot is full’ is a conditional, even though it doesn’t explicitly say ‘if’ or ‘then’. Similarly, there are plenty of ways to express a negation that don’t explicitly say ‘not’. Lists often confuse people new to symbolization as well. When you encounter a list, think of the commas in the list as saying either ‘and’ or ‘or,’ depending list you’re looking at. Think carefully about what the is actually meant by the propositions.

- ‘Go to the store and get milk, crackers and apples.’

is actually three propositions connected by '&s':

- 'Go to the store and get milk,' *and*
- 'Go to the store and get crackers,' *and*
- 'Go to the store and get apples.'

So, we will symbolize it as:

- M & C & A

On the other hand:

- 'For my birthday, I want to go to the beach, the amusement park or shoot heroin.'

is three propositions connected by 'v'.

- 'For my birthday, I want to go to the beach,' *or*
- 'For my birthday, I want to go to the amusement park,' *or*
- 'For my birthday, I want to shoot heroin.'

So, we will symbolize it as:

- B v A v H

The final element used in symbolization is parentheses: '( ).' Parentheses are used to separate independent clauses. When all the logical connectors in the sentence are the same, it doesn't really matter which pairs of propositions get put in the parentheses. The birthday example above can be symbolized:

- '(B v A) v H' *or* 'B v (A v H)'

Outside of lists, though, we will need to be careful about separating the clauses the properly. So:

- 'Men are mortal and it is raining, or Tom is left-handed.'

is symbolized as:

- (M & R) v T, *not* M & (R v T)

Grammar can be tricky, so it will sometimes be difficult to quickly parse sentences with a large number of variables and connectors. If you get confused, just take your time and think through carefully what is being expressed (and if you are symbolizing the claims of others and they are available, you can always ask them what they meant). Since formal logic is a tool we use academically, it won't often be the case that you need to go quickly (unlike informal logic, where you are trying to reason while living your life).

Lastly, when parentheses need to go with another set of parentheses, we use brackets for the outside ones. So, for example:

- [M v (M & R)] v (T v R)

More complicated formal logic systems utilize additional logical operators (for instance 'all' and 'some'). Since we are focused on introducing these concepts, however, we will stop with the five most important operators.

One last thing to keep in mind, if you are looking at materials in other sources, some of the logical operators might be represented differently. There are a number of ways that philosophers have represented 'not', 'and', 'or', 'if/then' and 'if/only/if' over the years. It doesn't actually matter which symbols are used, as long as the person writing and the person reading know what is going on. That said, it's important to consistently use a standard; if you are using this text as your primary resource, we encourage you to use the symbols given to you here.

Practice is key to learning formal logic-stick with it and things will get easier

This really is all there is to symbolizing. While it isn't actually all that much information, it is confusing for most people at first. We promise you if you stick with it and keep practicing, it will begin to make sense. The only thing you can do to speed up the process is to start working through examples. This is going to be true of everything in formal logic. Things may be hard or confusing at first, but confidence comes from repetition.

Exercises

Symbolize each of the following sentences using the logical notation you have just learned.

1. I hate cats and dogs.
2. I need a fork.
3. The groceries can go in either paper or plastic.
4. John will have a sandwich or a burger, but not fish.
5. Either your mom and dad love you or they don't.
6. Critical reasoning was interesting, but this isn't.

7. If we take the bus we can’t take the plane or the train.

8. The Marx Brothers are Harpo, Chico, Groucho and Zeppo.

9. If it rains then the game will be canceled.

10. The dog will bite if and only if you bother it.

Selected Answers

1. This sentence actually contains two simple sentences: ‘I hate cats,' and 'I hate dogs'. There is also one connector 'and'. So, we assign any letter we want to each of the simple sentences. Let’s use C for 'I hate cats' and D for 'I hate dogs'. We then just put the connector for 'and' in between them and we are done. So: C & D.

2. This is just one simple sentence, 'I need a fork,' and there are no connectors. So, all we have to do is assign a letter to the sentence (let’s use F), and then we are done. So, the final answer is: F.

4. Here we have three simple sentences: 'John will have a sandwich', 'John will have a burger' and 'John will have fish'. The first thing to do is ascribe each of these sentences a letter. Let’s use S, B, and F, respectively. Now, let’s look at the connectors as they appear in the sentence. The first one we run into is 'or,' and it connects simple sentences S and B. So, now we look at the chart to see that the symbol for 'or' is ‘v’. We are now able to symbolize the first part of the sentence: S v B. There are still two more connectors, however. The next one we see is 'but.' If you recall from earlier in the course, 'but' works just like 'and'. We can now connect another part of the sentence. Remember when you have more than two simple sentences, you need to use parentheses. The way you determine where they go is based on the syntax of the sentence. In this case, the comma is able to indicate which part of the sentence is separate from the rest (the last part). This gives us: (S v B) & F. The last connector to add is the 'not'. Negations can range over any part of a sentence, or over the whole sentence, and where it gets placed will depend on the sentence. In this case, it is easy to figure out the 'not' is in front of 'fish,' so we put the symbol for ‘not’ in front of the letter for the simple sentence about fish. This leaves us with the final answer: (S v B) & ~F.

32.3 Negation Manipulation

As mentioned above, formal logic is especially useful when we are dealing with very complicated claims. There isn't a lot that we can do to manage how complex symbolized sentence can get, but one thing we can do is manipulate sentences that contain negations to make them a bit more manageable. In this section, we will look at some rules that will help simplify claims. Simplified claims will be easier to work with in the next chapter, when we start to use tables to test our sentences in various ways.

The easiest and most intuitive way to simplify a claim is to reduce the number of negations. Sometimes, you will find yourself with a double negation. As you might expect, we can take a double negative and cancel them out. So, ~~A can be turned into A. The '~'s may be completely removed any time there are an even number of '~''s next to each other. So, ~~~~~~A can be turned into A. Odd numbers of '~''s can be reduced to just one. So, ~~~A becomes ~A and ~~~~A also becomes A. This process is referred to as **negation elimination**. You won't often find yourself with a bunch of negations, but it can happen, and when it does, it's helpful to be able to get rid of them

Elimination is not the only way to manipulate negation symbols. We may also move them through parenthesis. When you move a negation symbol inside a set of parentheses for '&' and 'v' statements, you negate the terms inside of the parenthesis and change the logical operator. So:

- ~(A & B) becomes ~A v ~ B

Likewise:

- ~(A v B) becomes ~A & ~B

You may also move negations outside of parentheses through a similar process. To remove negations from parentheses, remove a negation symbol from each term and change the logical operator. So:

- ~A v ~B can move back to ~(A & B) and

- ~A & ~B can move back to ~(A v B)

If this seems strange, in the next chapter we will learn how to test claims to see if they are logically equivalent using truth tables. At that time, you will be able to use tables to prove that these claims are saying the same thing (*logical equivalence*), but for now let's just think it through. When someone says:

- "I don't like Thai or Indian food."

they are actually saying:

- "I don't like Thai food" *and* "I don't like Indian food".

Likewise, when someone says:

- "I'm not going to date both Amy and Carl."

They mean that they aren't going to date both Amy or Carl (but maybe they will date one of them).

Things get more complicated when it comes to moving negations for conditionals and biconditionals. For conditionals, you can move a negation inside a set of parentheses by negating the first term and changing the operator to an '&'. So:

- ~(P → Q) becomes P & ~Q

Thinking back to Chapter 3, you should recall that a conditional says that if the antecedent is true then the consequent is true. If someone is negating a conditional, then they must be telling us that when the antecedent is true the conditional is false, thus: P & ~Q. You can also remove negations in the reverse way. So:

Logic is hard-reach out to your instructor when you have questions

- P & ~Q can become ~(P→Q)

For now, it's ok for you to just accept that this rule works, and you will be able to use the test for logical equivalence in the next chapter to prove it.

Biconditionals are even more complicated. A negated biconditional:

- ~(P←→ Q), becomes (~P & Q) v (P & ~Q)

Remember that a biconditional is really saying these things happen together and never alone. So, if the biconditional is being negated, it means P or Q are happening alone. Again, this can be reversed. So:

- (~P & Q) v (P & ~Q) can be simplified to ~(P←→ Q)

In all honesty, the biconditional manipulation rule doesn't come up all that often, but you will be thankful when you can turn 5 logical operators, two sets of variables, and two sets of parentheses into two variables, two operators, and one set of parentheses. Again, if the reason doesn't make sense now that's fine. In the next chapter you will learn how to prove it.

Exercises in Negation Manipulation

Simplify the following sentences by using negation manipulation.

1. ~~A v ~~B
2. ~ (~A v ~B)
3. ~ (~A & ~B)
4. ~ (~~A v B)
5. ~ (~A & B)
6. ~~~ [A → (~~B v A)]
7. (~P & Q) v (P & ~Q)
8. ~A v (~B v ~C)
9. ~A → (~B ↔~C)
10. (A v B) & ~C
11. ~A & [(~B v C) & D]
12. ~[(~P & Q) v (P & ~Q)]
13. ~~~A → (~~~B & ~C)
14. ~ A & [~B &(~C & D)]
15. [(A v ~~~B) v C] & ~~D
16. ~A v (~~B & ~~C)
17. A → (B → C)
18. B ↔ ~~C
19. (~A v B)
20. ~~~[~~~~A → (~~~B ↔~~~~~C)

Selected Answers

6. ~~~ [A → (~~B v A)]

The first step is always to remove any pairs of negations (remember that odd numbers of negations adjacent to each other can always be reduced down to one, and even numbers can be reduced to zero). This sentence doesn't reduce any further, so the final answer is: ~ [A → (B v A)].

10. (A v B) & ~C

This one is already as simple as it can be.

13. ~~~A → (~~~B & ~C)

First, remove any pairs of negations to get: ~A → (~B & ~C). Then, pull the negation out of the parentheses: ~A → ~(B v C). There is no rule for what to do when a conditional looks like this, so you're done.

14. ~ A & [~B &(~C & D)]

There are no pairs of negations, so we can skip that step. Looking at the problem it might not be clear, but we can make things simpler. The key is to use the rule for pulling a negation out of an 'and'. This gets us: ~ A & [~B &~(C v ~D)]. Notice that since D was not negated before, we have to add a ~ to it. Now, we can do the part in the brackets: ~ A & ~[B v (C v ~D)]. We can take it one step further by adding another set of ( ) around what we have and pulling the ~ out: ~(A v [B v (C v ~D)]). There is nothing left to pull out, so we're done.

16. ~A v (~~B & ~~C)

The first thing to do is remover the pairs of negations: ~A v (B & C). With that done, the sentence is as simple as it can be. You could change the 'v' to an '&' by adding ( ) and pulling the negation out, but that would make it more complicated.

17. A → (B → C)

We don't have a rule to deal with this case so there is nothing to do.

Chapter 33

Truth Tables

Overview: In this chapter, we introduce the concept of truth tables and then learn how to use them to test if a statement is a tautology, contradiction or contingency; if pairs of sentences are consistent or equivalent, and if arguments are valid.

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33.1 Truth Tables

The whole point of learning how to symbolize sentences in the last chapter is that we are now able use them in truth tables. Truth tables are a formal logic tool that allow us to determine under what conditions a statement or group of statements are true or false or, in other words, the statement's truth-value. 'Truth-value' is the term we use to refer to whether a statement is true, false, or indeterminant. We will be able to use these tables to determine:

1. If a statement is a tautology, a contradiction, or a contingency.

2. If a pair of statements are consistent or logically equivalent.

3. If an argument is valid or invalid.

This will be a fair amount to take in. For now, let's focus on tables and how to make them.

33.1.1 Getting Started

This is going to be confusing at first-just stick with it

It is helpful to think of a truth table as a type of spreadsheet chart. On one side of the chart there will be columns representing the possible truth-value combinations for the terms in the statement, and on the right we will be using these truth-values to "solve" the table by getting information about the sentence. The left side will look more or less the same for every truth table, so you should be able to get the hang of setting them up fairly quickly. The number of columns and rows the left side of the table has depends on the number of variables (one for each symbolized simple sentence in the statement we are considering. For every simple sentence in the claim, there will be one column for that variable and the number of rows will start at 2 and double for every additional simple sentence. So, for a claim 'P' we would have one column and two rows. For 'P & Q,' we would have two columns and 4 rows, for '(P & Q) & R' we would have three columns and 8 rows, etc. Technically speaking, there is no cap to how big a table can be, so you could make one for any number of simple sentences. They get pretty unwieldy pretty quickly though, so we won't ever ask you to work one for more than three variables. At this point, it will help to look at some examples.

P

P	Q

P	Q	R

Now that we have the blank tables, we need to fill them in with the truth value combinations. To do that, we will enter T's and F's into the boxes. As you might expect, 'T' stands for 'true,' and 'F' stands for 'false.' The idea is that these T's and F's will show us all the possible combinations in which our simple sentence can be true or false relative to each other. Let's go back to the examples. When there is only one simple sentence, there are only two possible options: P can be true or false. So, the table looks like this.

P
T
F

If there are two variables, there will be twice as many possibilities, because both can be true, the first can be false and the second true, the first can be true and second false, and both can be false. This gives us a table that looks like this:

P	Q
T	T
F	T
T	F
F	F

Things get more complicated for our set of three variables. Rather than write out all the options, we can just look at the table below. Notice that each row has a different combination of truth values for each letter, starting with them all being true and ending with them all being false.

P	Q	R
T	T	T
F	T	T
T	F	T
F	F	T
T	T	F
F	T	F
T	F	F
F	F	F

Just as a reminder, you can always build a table with more simple sentences, but every time you will be doubling the number of rows.

The most observant of you will likely have noticed a pattern in how these three examples were set up. The furthest right column is T's halfway down and then F's the rest of the way down. The column furthest to the left alternates T's and F's, and the middle column alternates by twos. This will always be the case, and the great thing about this is it helps us populate the truth values on the left side of the table very quickly. There is no need to worry about whether we've covered all the permutations. If we alternate like this, we will have all the options with no repeats. (If we did find ourselves making a table for 4 simple sentences, then we would just add another row to the inside; the table would be twice as long, so we'd have 8 T's and then 8 F's).

33.1.2 The Rules

The right side of a truth table is where the work really gets done. On the right side, we use the values we entered on the left side and a handful of rules to determine the truth-values of complex sentences. Each of the logical connectors we used to symbolize sentences in the last chapter (&, v, →, ←→, ~) have a corresponding chart that tells us what the truth-value should be for a given row on the right side. Let's look at the charts one by one, starting with the and (&) function.

P	Q	P & Q
T	T	T
F	T	F
T	F	F
F	F	F

In order for 'P & Q' to be true, both 'P' and 'Q' need to be true. This should be obvious, given the way 'and' works in our traditional grammar. It should also be obvious that no other combination of truth-values will make 'P & Q' true, because either 'P' or 'Q' will be false on every other line of the table, and they can't both be true if one of them is false. This is what the above table tells us. When we want to know the truth value for the '&,' we look to the columns on the left side of the table for the variables on either side of the '&' symbol. Going down each row, we look to see if both of them are true. If they are, we put a 'T,' and if even one of them is false, we put an 'F'.

The 'or' (v) function is a little more complicated. This is because 'or' is a tricky word in English. Sometimes we use 'or' to mean 'just one of two options,' and sometimes we mean 'either or both'. The former we call an exclusive 'or,' and the latter is an inclusive 'or'. What's important to keep in mind is that when we use the logical operator 'v,' we always mean the inclusive 'or'. So, the conditions of 'v' are met if one or both of the variables are true. This means that the truth of 'P' is enough to make 'P v Q' true, as is the truth of 'Q,' and the truth of 'P' and 'Q'. 'P v Q' is represented in the following chart.

P	Q	P v Q
T	T	T
F	T	T
T	F	T
F	F	F

This chart should look as you expected – the only line of the table where 'P v Q' is false is the line where neither 'P' nor 'Q' are true.

Conditionals (→) complicate things a bit more. We talked about conditionals at length in Chapter 3. As a reminder, a conditional says that if the first statement is true, then the second one is also. Thinking about what this means in reverse, the only way that a conditional would be false is if the first statement is true, and the second one false. If that makes sense to you, then this table should as well. If not, hopefully the table will help.

P	Q	P → Q
T	T	T
F	T	T
T	F	F
F	F	T

Looking at first line of the table, it should be obvious that 'P' and 'Q' being true makes 'P → Q' true (if the 'P' is true, and it is, then 'Q' will be true, and it is). Now, look at the second line. It is saying: 'P' is not true, and 'Q' is. The conditional says that if 'P' is true, then 'Q' will be true, but it doesn't say anything about 'P' not being true. So, the conditional is still true. It is the third line where we see the conditional shown to be false. The conditional requires that if 'P' is true, then 'Q' is as well, and that isn't the case with this truth-value pairing. The last row is true for the same reason the second line is. The conditional only cares about cases where 'P' is true.

Next, we will look at the biconditional (←→). Essential to understanding the biconditional table is grasping that the second statement is *only* true when the first one is as well. Since the second statement is only true when the first statement is, when the first is not true, the second one cannot be true either. Thinking about this in terms of the concepts from Chapter 3, a biconditional occurs when the antecedent and consequent of a conditional are jointly necessary and sufficient for each other. Here is the table:

P	Q	P ←→ Q
T	T	T
F	T	F
T	F	F
F	F	T

The final table is the negation (~). The negation just means when the proposition that follows the negation is false, the negation is true, and when the proposition following the negation is true, the negation is false. Negations are the easiest connector to deal with because all you have to do is take the opposite – turn T's to F's and F's to T's. Here is the table:

P	~P
T	F
F	T

You now have all the basic tools to make truth tables. These tools can be used to make tables for any complex sentence, using any number of logical connectors.

Section 33.1.3 Completing the Table

This is a lot to take in-go slow

With these rules in place, we can now use them to solve some tables. Let's start with the complex sentence:

~(P v Q)

The first step is set up the left side of the table. With two variables, that will mean 4 rows.

P	Q
T	T
F	T
T	F
F	F

Next we set up the right side. We are solving for ~(P v Q), so that will go at the top of the right column.

P	Q	~ (P v Q)
T	T	
F	T	
T	F	
F	F	

Next, we need to determine the truth-values for the complex sentence. We can see that two logical operators – '~' and 'v' – are being used, so we know we need to refer to the tables that direct us on how to use those operators. The '~' table tells us we need to take the opposite of what follows the '~' symbol. But before we can do that, we need to know the truth value for (P v Q). To figure that out, we use the 'v' rule. As we can see from the 'v' table, P v Q is true every time either P or Q is true. Giving us:

P	Q	~ (P v Q)
T	T	T
F	T	T
T	F	T
F	F	F

Lastly, we take the opposite of those truth-values (applying the negation rule) and we get:

P	Q	~ (P v Q)
T	T	F
F	T	F
T	F	F
F	F	T

Thinking through what ~(P v Q) means, that neither P or Q are true, this table should make sense. The only line that is marked as true is the last one (where P and Q are both false).

For more complicated tables, it helps to have some scrap paper on hand. Consider [~(P v ~Q)] & (Q → P)]. In these complex sentences, just like in math, we work from inside the parentheses out. Let's look at it step by step. We know that 'P v ~Q' is true on every line where 'P' is true. So, we put a 'T' on rows 1 and 3. We also know it is true on every line that 'Q' is false. So, we put a 'T' on row 4 (and there already is one on line 3). The only row left is the second, and that one gets an 'F'.

P	Q	[~(P v ~Q)] & (Q → P)]
T	T	T
F	T	F
T	F	T
F	F	T

Now we apply the negation rule and take the opposite of that to get:

P	Q	[~(P v ~Q)] & (Q → P)
T	T	F
F	T	T
T	F	F
F	F	F

Next, we do the second side of the conjunction. Using the conditional rule, we know if ‘Q’ is true, then ‘P’ must be true. Look for the line where this isn’t the case (line 2). This line is false, and all other ones are true.

P	Q	[~(P v ~Q)] & (Q → P)
T	T	F & T
F	T	T & F
T	F	F & T
F	F	F & T

All that is left now is to apply the conjunction rule and identify the lines where both [~(P v ~Q)] and (Q → P) are true. The table shows that there is no line where this is the case, so they all get an ‘F’.

P	Q	[~(P v ~Q)] & (Q → P)
T	T	F
F	T	F
T	F	F
F	F	F

And that is how you make truth tables. The complex sentences we are solving for can get more complex either by involving more logical operators or more variables, but we will solve them by making tables like we just did in the previous two examples. Keep in mind that you can also use the tricks you learned last week for negation reduction to make the table simpler. So, if you have to do a table for ~ (~P v ~Q), you can first pull the negation out, turning it into: ~~(P & Q), and then eliminating the negation, making it: P & Q.

Some of you probably feel pretty confident, and others likely are feeling a bit uneasy. As we mentioned at the start of this section, just like with math, the only real way to get comfortable and to make sure you know what you're doing is to work through examples. The next section will ask you to construct tables for some complex sentences. If you take your time and think it through step by step, it will start to click, even if you are feeling lost. The appendix for this section also has all the rules from section 33.1.2 on one page. You might want to have that open as you work through the tables.

Exercises

Construct a truth table for the following complex sentences.

1. ~ (~P & Q)
2. P ←→ (P v Q)
3. P v (Q v R)
4. P & (~P → Q)
5. P ←→ (Q ←→ ~P)
6. Q v ~P
7. (P & ~Q) & R
8. P → ~Q
9. (P & ~Q) v P
10. Q v (P ←→ ~P)
11. ~Q ←→ (P & ~Q)
12. P → (Q v ~R)
13. (P v R) ←→ (P ←→R)
14. ~(~Q v P) & Q
15. R & [(R → P) → Q]
16. ~P v [(~Q → P) v ~(P → ~Q)]
17. [(P v ~P) v (Q v ~Q)] v ([(R v ~ R) v (P & ~P)] v [(Q & ~Q) v (R & ~R)])

18. (~P v ~R) → [~Q & (~P → ~R)]

19. ~[(P v ~P) v (Q v ~Q)]

20. (~~[(P --?~Q) & (P v R)]) ←→ [(~R v R) v (P & Q)]

Answers to Selected Exercises

1. ~(~P & Q)

We start by using the negation manipulation rules from last chapter to make this simpler. ~(~P & Q) is the same as P v ~Q, but there are fewer logical operators to deal with. The sentence has two variables, so the table will be four lines long. The values for P come from the left side of the table, so all we have to do is copy them down. For ~Q, we take the opposite of Q on the left side of the table.

P	Q	P v ~Q
T	T	T v F
F	T	F v F
T	F	T v T
F	F	F v T

Now, we use those new values and the 'or' rule to complete the table. The 'or' rule says we put a T in the box any time either the claim to the left of the 'v' or the one to the right of the 'v' is true, and we put an F when both of them are false. So, lines 1, 3 and 4 get T's and line 2 gets an F.

P	Q	P v ~Q
T	T	T
F	T	F
T	F	T
F	F	T

Now we're done.

2. P ←→ (P v Q)
There is no way to simplify this sentence, so we just start by making a table. Again, there are only 2 letters (although one appears twice), so the table is 4 lines long. The first step is to put the truth values for P and Q under the letters on the right. Again, these values just come from the left of the table.

P	Q	P ←→ (P v Q)
T	T	T T T
F	T	F F T
T	F	T T F
F	F	F F F

Now we can start solving the table. We have to work from inside parentheses out, just like in algebra, so we will use the 'or' rule, just as in problem 1. The first three lines will be T, and the last will be F.

P	Q	P ←→ (P v Q)
T	T	T T
F	T	F T
T	F	T T
F	F	F F

Now we solve for the ←→, the last step. The rule for the ←→ says that when the left and the right side of the symbol are true then you put a T. It also says that whenever the left and right side of the symbol are false you put a T and in all other cases you put an F. So, Lines 1, 3 and 4 are all T and line 2 is F.

P	Q	P ←→ (P v Q)
T	T	T
F	T	F
T	F	T
F	F	T

3. P v (Q v R)

Just like with question 2, this sentence can't be simplified. So, we will make a table for the sentence as it stands. This time there are three variables, so the table will be 8 lines long. As always, the first step is to put in the truth-values for all of the letters on the right.

P	Q	R	P v (Q v R)
T	T	T	T T T
F	T	T	F T T
T	F	T	T F T
F	F	T	F F T
T	T	F	T T F
F	T	F	F T F
T	F	F	T F F
F	F	F	F F F

Now we work from the parentheses out. So, using the 'or' rule, we look for any line where the Q is false and the R is false, as this is the only line where we put an F. On every other line, we put a T.

P	Q	R	P v (Q v R)
T	T	T	T T
F	T	T	F T
T	F	T	T T
F	F	T	F T
T	T	F	T T
F	T	F	F T
T	F	F	T F
F	F	F	F F

Now we use the 'or' rule again, using the values for P and the ones we just computed from the parentheses. Again, every line gets a T except when both sides of the 'v' are false.

P	Q	R	P v (Q v R)
T	T	T	T
F	T	T	T
T	F	T	T
F	F	T	T
T	T	F	T
F	T	F	T
T	F	F	T
F	F	F	F

Now we're are done.

With those examples under our belts let's move on to learning how to actually use the tables.

Section 33.2 Tautology, Contradiction, and Contingencies

Tautology: A claim that is always true

When we are looking to evaluate a single claim, it can often be helpful to know if it is a tautology, a contradiction or a contingency.

Tautologies are statements that are always true. The following are examples of tautologies:

- Either it will rain tomorrow, or it won't.

- It is what it is.
- There's nothing you can do that can't be done.

Contradictions are statements that are always false. The following are examples of contradictions:

Contradiction: A claim that is always false

- It is raining right now, and it isn't raining right now.
- The glass is both full and empty.
- The triangle is a circle.

Contingencies, often called contingent statements, are true in some cases and not true in others. For example:

- If we go to the store, then we will buy some apples.
- If a high pressure zone meets a low pressure zone, there's be a tornado.
- If you have a cat, you won't have mice.

Contingency: A claim that is sometimes true and sometimes false

In all honesty, we don't often need help determining if a sentence is a tautology, contradiction or contingency. We often say that tautologies are trivial, and contradictions are obvious. Certainly, this is true in the examples given here. That said, sometimes claims will be very complex, and it may be less obvious which category they fall in. This is where tables can help us. It is also the case that these are the easiest things we can test for using tables, so it is a good place to start, even if ultimately, we don't use the test very often.

Since tautologies are always true, the way we test for them is to make a truth table for the statement and then to check every row of it to see if there are any Fs. If there are, then the statement is not a tautology. In other words, all Ts means that it is a tautology. 'P v ~P' is a tautology, as this truth table shows:

P	P v ~P
T	T
F	T

'P v Q' is not a tautology, as the following truth table shows:

P	Q	P v Q
T	T	T
F	T	T
T	F	T
F	F	F

Notice that on row four of the table, the claim is false. Even one F on the right side will mean that the claim is not a tautology (since there is at least one case in which it won't be true).

Remember, when things get confusing you should reach out to your instructor with questions

Testing for contradiction works exactly opposite as testing for tautology. For a statement to be a contradiction, it has to always be false, so the table has to show all 'F's on the right side. So, if there are any 'T's in the table, then the statement is not a contradiction. 'P & ~P' is a contradiction, as the following table shows:

P	P & ~P
T	F
F	F

'P v Q' is not a contradiction, as the following table shows:

P	Q	P v Q
T	T	T
F	T	T
T	F	T
F	F	F

Notice on the first three rows of the table the claim is true, so it can't be a contradiction.

A contingent statement will have a truth table with both true and false rows. As seen above, 'P v Q' is a contingent statement – there are instances where it is true (row 1, 2 and 3), and an instance where it is false (row 4).

Exercises

Construct truth tables to test the following sentences for **t**autology, contradiction and contingency.

1. P → Q

2. (P v ~P) & (Q & ~Q)

3. P ←→ Q

4. ~ (P & ~P)

5. ~ (P v ~P)

6. ~ (P v P)

7. (P & ~P) v (Q & ~Q)

8. ~ (P v ~~Q) & (P & ~Q)

9. (P ←→ Q) v (Q ←→ P)

10. ~ [(P → Q) → R]

11. [P → (Q → R)] & (P → R)

12. (P & Q) → (P → Q)

13. ~P → P

14. ~P → (Q v P)

15. ~P & ~(~P v ~Q)

16. P v (Q → P)

17. (P ←→ Q) & [(~P v ~Q) & P]

18. (P ←→ Q) & (P → Q)

19. [P → (Q → R)] & (R → P)

20. (P ←→ Q) v ~ [(~P & Q) v (P & ~Q)

Selected Answers

2. (P v ~P) & (Q & ~Q)

Contradiction. As you can see from the table below all rows are false.

P	Q	(P v ~P) & (Q & ~Q)
T	T	T
F	T	T
T	F	T
F	F	T

7. (P & ~P) v (Q & ~Q)

Contradiction. As you can see from the table below all rows are false.

P	Q	(P & ~P) v (Q & ~Q)
T	T	F
F	T	F
T	F	F
F	F	F

16. P v (Q → P)

Contingent. As you can see from the table below there is a mix of true and false rows.

P	Q	P v (Q → P)
T	T	T
F	T	F
T	F	T
F	F	T

33.3 Multiple Claims

When we have more than one claim, we can use truth tables to compare them, and in doing so determine more complicated relationships.

33.3.1 Consistency

Two claims are consistent when they can both be true at the same time

The first relationship we will test for is **consistency**. Consistency is a pretty simple relationship. It means the claims can be true at the same time. As with tautology, contradiction and contingency sometimes it will be obvious that two claims are consistent. Unrelated claims are always going to be consistent for instance. Troy likes apples and Godzilla is the king of monsters are consistent because they have nothing to do with each other, and we don't need a table to test that. Still, there will be times where claims are complex (or when you want to compare a large number of claims) and tables can be very useful in those cases. For simplicity's sake, we will focus on pairs of complex sentences, but there is no limit to the number of claims you could test for consistency at the same time.

In terms of what the tables should look like, two claims are consistent if there is any row in which both the claims are true at the same time. Let's look at the table comparing 'P v Q' and 'P & Q'.

P	Q	P v Q	P & Q
T	T	T	T
F	T	T	F
T	F	T	F
F	F	F	F

Both claims are true on row 1, so these claims are consistent.

Now let's look at an example where the claims aren't consistent. Below is the table comparting 'P & Q' and '~P & ~Q'.

P	Q	P & Q	~P & ~Q
T	T	T	F
F	T	T	F
T	F	T	F
F	F	F	T

Notice there is no line where both claims are true, so the claims are not consistent. When claims are not consistent, we say they are **inconsistent,** and to reiterate, this means that they can't both be true at the same time.

33.3.2 Equivalence

We can also use tables to compare statements to determine if they are **logically equivalent**. When claims are logically equivalent, they both contain the same information. You can think of it as the two statements saying the same thing (even if they don't look like they do). To test for equivalence, we make a truth table and again put both statements on it. If the statements have the same truth value on all lines, then they are logically equivalent. The following truth table shows that '~(P v Q)' and '~P & ~Q' are logically equivalent:

Two claims are equivalent when they both say the same thing-even if they don't look like it

P	Q	~ (P v Q)	~P & ~Q
T	T	F	F
F	T	F	F
T	F	F	F
F	F	T	T

The following truth table shows that 'P v Q' and 'P & Q' are not logically equivalent, because the results on the table differ on rows 2 and 3.

P	Q	P v Q	P & Q
T	T	T	T
F	T	T	F
T	F	T	F
F	F	F	F

Exercises

Construct truth tables for the following sets of statements to test for consistency and logical equivalence.

1. P v ~Q ; P → Q
2. ~(P v ~P) ; P & ~P
3. ~(Q v P) → P ; ~Q
4. P v [P & (Q → R)] ; P v (Q v R)
5. (P → Q) & (Q → P) ; P ↔ Q
6. P v ~P ; P v Q
7. P ↔(Q ↔ R) ; P ↔ R
8. P↔Q ; Q↔ P
9. ~(P v ~Q) ; P → Q
10. P v ~(P ↔ Q) ; (P & ~Q) v (~P & Q)
11. P → Q ; Q → P
12. P → Q ; ~(Q → P)
13. ~ (P ↔ Q) ; (~P & Q) v (P & ~Q)
14. ~ (~P v ~~Q) : P & ~Q
15. P ↔ (Q → ~R) ; ~P v ~Q
16. P v (Q v R) ; (P v Q) v R
17. P & (Q & R) ; (P & R) & Q
18. P & (Q v R) ; (P & Q) v R

19. P & (Q v R) ; (Q v R) & P

20. ~(P → Q) v [P v (~Q → P)] ; (P ←→ Q) v [(P v ~P) & (Q v ~Q)]

Selected Answers

1. P v ~Q ; P → Q

These claims are consistent as they agree on rows 1 and 4, but they are not equivalent as they disagree on lines 2 and 3.

P	Q	P v ~Q	P → Q
T	T	T	T
F	T	F	T
T	F	T	F
F	F	T	T

8. P←→Q ; Q←→ P

These claims are equivalent as they agree on all rows. All equivalent claims are consistent so they are also consistent.

P	Q	P←→Q	Q←→ P
T	T	T	T
F	T	F	F
T	F	F	F
F	F	T	T

14. ~ (~P v ~~Q) : P & ~Q

Before even doing a table in this case we can use the negation manipulation rules to make things simpler for us. '~ (~P v ~~Q)' becomes 'P & ~Q'. Now we could do a table, but we turned the first claim into exactly the same thing as the second one, so we know they are equivalent.

33.4 Validity

The thing we are going to use tables to test for *validity*. We discussed validity back in Chapter 2, but as a reminder, an argument is valid just in case *if* all the premises are true *then* the conclusion *must* be true. So far, we have been looking at testing sentences and relationships between sentences. Validity, however, applies only to arguments. To test for validity, we need to construct a truth table with all of the premises and the conclusion on it. So, for the argument:

P v Q
~P
~Q

The table will look like:

P	Q	P v Q	~P	~Q
T	T	T	F	F
F	T	T	T	F
T	F	T	F	T
F	F	F	T	T

When you say an argument is invalid you should always say on what row of the table.

Reading a table for validity is slightly more involved than with past concepts. The first step is to restrict our focus to only the rows where all the premises are true. From there, we need to look at the truth value of the conclusion. If there is a row where all the premises are true and the conclusion is false, then the argument is **invalid**. Under any other circumstances the argument is **valid**. So, if the conclusion is always true when the premises are true, then the argument is valid, and if there are no row where all the premises are true, then we don't even need to look at the conclusion; we know the argument is valid. So, back to the table above, the second row has all true premises and a false conclusion. When explaining the results of a table it is also helpful to refer to the row that shows the invalidity. So, we would say the argument is invalid on row 2.

Let's work an example where the argument is valid.

P v Q
~P
Q

P	Q	P v Q	~P	Q
T	T	T	F	T
F	T	T	T	T
T	F	T	F	F
F	F	F	T	F

In this case, we have one row in which all the premises are true – row 2 – and on that row the conclusion is also true. So, this argument is valid.

Exercises

Construct truth tables for the following arguments to test for validity.

1. $P \vee \sim P$
$\underline{P}$
$\sim P$

2. $P \rightarrow Q$
$\underline{Q}$
P

3. $P \vee (Q \vee R)$
$\underline{\sim Q}$
$P \vee R$

4. $\underline{P \vee Q}$
$Q \vee P$

5. $P \rightarrow Q$
$\underline{Q \rightarrow R}$
$P \rightarrow R$

6. $\sim P \rightarrow Q$
$\underline{\sim Q}$
$P \leftrightarrow Q$

7. $\underline{\sim (P \vee Q)}$
$\sim P \;\&\; \sim Q$

8. $\underline{\sim (P \rightarrow Q)}$
Q

9. $Q \vee \sim Q$
$\underline{P \vee \sim P}$
$(Q \vee \sim P) \;\&\; (\sim Q \vee P)$

10. $P \rightarrow Q$
$\underline{\sim Q \vee P}$
P

Selected Answers

4. $\underline{P \vee Q}$
$Q \vee P$

Valid. There is no row where the premise is true and the conclusion false.

P	Q	P v Q	Q v P
T	T	T	T
F	T	T	T
T	F	T	T
F	F	F	F

6. ~P → Q
~Q
P ←→ Q

Invalid. On row 3 the premises are true and the conclusion is false.

P	Q	~P → Q	~Q	P ←→ Q
T	T	T	F	T
F	T	T	F	F
T	F	T	T	F
F	F	F	T	T

33.5 Appendix: Truth Table Quick Reference Guide

Truth Table Quick Reference Guide

P	Q	P & Q
T	T	T
F	T	F
T	F	F
F	F	F

P	Q	P v Q
T	T	T
F	T	T
T	F	T
F	F	F

P	Q	P → Q
T	T	T
F	T	T
T	F	F
F	F	T

P	Q	P ↔ Q
T	T	T
F	T	F
T	F	F
F	F	T

P	~P
T	F
F	T

Appendix: Pretest

Circle the number that you think gives the best answer to each question. Don't agonize over the questions but give each a serious answer. Disregard the numbers in brackets (e.g., [8]); this just refers to the chapter that deals with the question.

1. Suppose that you toss a fair coin several times. Which of the following sequences of heads (H) and tails (T) is most likely?) [13 & 16]

    1. HHHHHTTTTT

    2. HTTHTHHHTH

    3. They are equally likely.

2. Suppose someone has fallen and is bleeding. Which of the following do you think is most likely? [23]

    1. People would be most likely to help if they were the only person around.

    2. People would be most likely to help if they among several other people around.

3. Are there more 6 letter English words (a) ending in 'ing' or (b) with 'n' as their fifth letter? [16]

    1. There are more ending in 'ing'.

    2. There are more with 'n' as their fifth letter.

    3. There are the same number of each sort of word.

    4. It is impossible to tell without counting all the English words.

4. If you were a juror, you should: [7 & 8]

    1. Place a good deal of weight on eyewitness testimony.

    2. Place some, but not a huge amount, of weight on eyewitness testimony.

3. Not place much weight on eyewitness testimony at all.

5. Which alternative seems most likely to occur in the next ten years? [16]

   1. An all-out nuclear war.

   2. An all-out nuclear war that accidently develops out a confrontation in the Middle East involving Iraq, Iran, and some of their neighbors and that then spreads out of the region to other countries?

6. Which is the more likely cause of death? [17 & 21]

   1. homicide

   2. suicide

7. Which is the more likely cause of death? [17 & 21]

   1. fire

   2. drowning

8. About how many people would need to be sampled to make a reasonably accurate prediction (say within 5 percentage points) about who U.S. voters prefer for President (suppose that there are about 100 million voters)? [15]

   1. about five thousand

   2. about five hundred thousand

   3. about five million

   4. more than five million

9. Suppose a normal student signed up to be a subject in a psychological experiment. When they arrived, the experimenter asked the student to administer a series of ever more painful shocks to another subject who showed up at the same time. [22]

   1. Most subjects would not administer any shocks at all.

   2. Most subjects would just administer a few shocks but quit before they got to the extremely painful ones.

3. Most subjects would administer shocks but quit as soon as the other subject screamed in pain.

4. Many subjects would continue to administer ever more painful shocks, even after the other subject screamed in pain and disclosed they had a heart condition.

10. Sally and Bob have had five children, all of them boys. They would like very much to have a girl. [16]

   1. They should go ahead and have another child, because by the "law of averages" things are likely to even out, and they will probably have a girl.

   2. They have always had boys, so they would probably have a boy again.

   3. The chances of having a girl and the chances of having a boy are virtually the same.

11. Which of the following alternatives—1 or 2—do you prefer? [18]

   1. a 100% chance of losing $50

   2. a 25% chance of losing $200, and a 75% chance of losing nothing

12. There are two hospitals in Belleville, KS. About 50 babies are born every day in the larger one, and about 15 are born every day in the smaller one down the street. On average, 50% of the babies are boys, but the number bounces around some from day to day. Which hospital, if either, is more likely to have more days per year when over 65% of the babies born are boys? [15]

   1. The big hospital

   2. The small hospital

   3. The two hospitals should be about the same.

13. Suppose that you have a pack of special cards, each of which has a letter [either a consonant or a vowel] on one side and a number [either even or odd] on the other. If you have some of the cards lying flat on a table, which ones would it be relevant to turn over if you were trying to disprove the following claim? [3] Cards with vowels on one side always have odd numbers on the other side.

1. Cards with consonants and cards with even numbers on them.
2. Cards with vowels and cards with even numbers on them.
3. Cards with consonants and cards with odd numbers on them.
4. Cards with vowels and cards with odd numbers on them.
5. You need to turn over all the cards.
6. None of the above.

14. Linda is 31 years old, single, outspoken and very bright. She majored in philosophy in college. As a student, she was deeply concerned with issues of discrimination and social justice, and participated in antinuclear demonstrations. Which of the following is most likely? [16]

    1. Linda is a bank teller.
    2. Linda is a bank teller and is active in the feminist movement.

15. Exactly two cab companies operate in Belleville, KS. The Blue Company has blue cabs, and the Green Company has Green Cabs. Exactly 85% of the cabs are blue and the other 15% are green. A cab was involved in a hit-and-run accident at night. A witness, Wilbur, identified the cab as a green cab. Careful tests were done to ascertain peoples' ability to distinguish between blue and green cabs at night. The tests showed that people identified the color correctly 80% of the time, but they were wrong 20% of the time. What is the probability that the cab involved in the accident was indeed a green cab, as Wilbur says? [17 & 28]

    1. Very likely, almost 100%.
    2. The chances are about 85%.
    3. The changes are about 40%.
    4. Less than 10%.

16. Which conclusion (a, b, etc.) follows best follows from premises 1 and 2? [2]

    1. No members of the ad-hoc committee are women.
    2. Some U.S. Senators are members of the ad-hoc committee.

Therefore:

(a) All U.S. Senators are women.
(b) No U.S. Senators are women.
(c) Some U.S. Senators are women.
(d) Some U.S. Senators are not women.
(e) None of the above really follow from the two premises.

17. The grade school in Belleville, KS administers an achievement test to all the children who enter fifth grade. At the end of the school year they give the same test again. The average score each time is 100, but something odd seems to have happened. Children who scored below average on the test the first time tend to improve (by about five points), and children who scored above average tend to do worse (by about five points). What's going on? [16]

    1. When the two groups interact, their members influence the other group (high scorers pull up low scorers and low scorers pull down high scorers).

    2. The two groups probably don't affect each other's abilities very much, but each group may affect the way the other group takes tests.

    3. This is simply the sort of thing one should expect in a situation like this.

18. Mike is 5'2", muscular, and in excellent physical condition. He was a college athlete and is aggressive. Although one can't be sure, which of the following two is more likely? [17]

    1. Mike is a banker.

    2. Mike is a pro football player.

    3. They are about equally likely.

19. Visual perception: [4]

    1. works very much like a video camera (or video tape recorder).

    2. is not much like a video camera at all.

20. How likely (probable) is it that your vote could determine the outcome of a U. S. Presidential election? [13 & 26]

    1. Quite likely

    2. Somewhat likely

    3. Not very likely, but still possible

    4. No real chance whatsoever

21. There are three doors in front of you. There is nothing worth having behind two of them, but there is a suitcase containing $50,000 behind the third. If you pick the correct door, the money is yours. You choose door number 1. But before the host of the game show shows you what is behind that door, he opens one of the other two doors, picking one he knows has nothing behind it. Suppose he opens door number 2. This takes 2 out of the running, so the only question now is about door 1 and door 3. He allows you to reconsider your earlier choice: you can either stick with door 1 or switch to door 3. What is the probability that the money is behind door 3? [14 & 27]

    1. 1/3

    2. 2/3

    3. 1/2

    4. There is no way to tell

22. Which conclusion (a, b, etc.) follows best follows from premises 1 and 2: [2]

    1. No U.S. governors are members of the Rotary Club.

    2. Some Canadian premiers are members of the Rotary Club.

    Therefore:

    (a) All Canadian premiers are U.S. governors.
    (b) No Canadian premiers are U.S. governors.
    (c) Some Canadian premiers are U.S. governors.
    (d) Some Canadian premiers are not U.S. governors.
    (e) None of the above really follow from the two premises.

23. Wilbur is on his way to class and encounters someone slumped over in a doorway. The person is obviously in distress and needs help. Suppose you had to predict whether Wilbur would stop and help. Which single piece of information would help you make the most accurate prediction? [23]

    1. You would need to know a good deal about Wilbur's personality and traits to make a very good prediction.

    2. You would need to know if Wilbur was in a hurry or not.

24. Suppose that you are an excellent chess player and Wilbur is good, but not as good as you. [16]

    1. You would have the best chance of beating Wilbur in a best of seven series.

    2. You would have the best chance of beating Wilbur in a best of three series.

    3. Your chances of beating Wilbur would be the same in either case.

25. It takes about eleven days for a million seconds to tick off. Roughly how long does it take for a billion seconds to tick off? [16 & 20]

    1. About 8 to 10 weeks

    2. Between 6 and 11 months

    3. 2.5 years

    4. 32 years

    5. 8,000 years

26. A number of college students participated in an experiment. They were divided into two groups. Each subject was tested with just themselves and an experimenter present. The students in the first group were asked nicely by a warm, friendly experimenter to eat several fried grasshoppers on a plate in front of them (to help her gather data for her dissertation). Those in the second group were pressured by a cold, aloof experimenter eat several grasshoppers. Most subjects in both groups ate several grasshoppers. Later they were asked by a third person how much they liked the grasshoppers. What do you think happened? [19]

1. Those who had been asked by the nice friendly experimenter said that they liked the grasshoppers more than those in the other group.

2. Those who had been pressured by the cold, unfriendly experimenter said that they liked the grasshoppers more than those in the other group.

3. On average, subjects in the two groups reported liking the grasshoppers about the same.

27. A group of men (the members of a club in Belleville, KS) consists of 70 engineers and 30 lawyers. Suppose that we select Marcos at random from the group. The following is true of Marcos: Marcos is a 30-year-old man, married, with no children. He has high ability and high motivation, and promises to be quite successful in his field. He is well liked by his colleagues. Based on this: [17]

    1. It is more likely that Marcos is an engineer.

    2. It is more likely that Marcos is a lawyer.

    3. Marcos is equally likely to be an engineer or a lawyer.

28. When it comes to learning the material in a course: [7 & 8]

    1. Tape recording the lectures is a good way to learn.

    2. Tape recording the lectures is a hopeless way to learn.

    3. Tape recording the lectures works about as well as most other methods.

29. Which of the alternatives, 1 or 2, do you prefer? [18]

    1. An insurance policy with a $50 premium that protects you against losing $200.

    2. A 25% chance of losing $200, and a 75% chance of losing nothing.

30. In five seconds or less give you best estimate of: 12345678 [17]

    1. about 512

    2. about 2250

3. about 11,00

4. about 40,000

5. About 200,000

Index of Key Concepts