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# Reasoning in Anxiety, OCD and Related Disorders: Can Formal Reasoning Theories Inform Us About Psychopathology?

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## 1. Introduction

Early cognitive theories of psychopathology evoked the use of reasoning rules to the explanation of how people's behaviour was influenced by the way they think. In effect, Beck (1979) proposed that cognitive distortions were at the root of misguided thinking and that the faulty thinking could be corrected through cognitive therapy (cognitive restructuring). The therapist would point out how automatic rules had been formed through faulty thinking and help the client correct these rules and test out new ones.

Ellis (1962) also referred to irrational thinking as a source of psychopathology by suggesting how rules based on premises like 'If...then...' shaped action. Rational emotive, involves identifying these rules of causality with the client and then questioning the rules, as well as identifying which emotions are triggered when such faulty rules are acted upon. However, empirical data to support how the development of faulty reasoning progresses and is maintained are less clear. Although, the technique of cognitive restructuring has shown to be clinically relevant and helpful in cognitive therapy, the mechanisms by which restructuring operates, remain vague: how do people start changing their minds, that they start perceiving situations differently? Hence, it seems and mechanisms of change in cognitive therapy are not very well understood (Brewin, 1996).

The present review paper makes an attempt at connecting of general reasoning theories to pathological thinking, in particular in anxiety disorders. Its fundamental question is the following: As cognitive psychologists, can we benefit from theories of reasoning in order to understand psychopathology? This paper is based on the idea that reasoning, whether rational or irrational is what people do, all or most of the time and to understand psychopathology, we need to look at which reasoning strategies are used when people are 'seeing', 'saying' and 'doing' pathological things. Are these strategies the same or different inside and outside psychopathology?

## 2. Theories of human reasoning

Theories of how people reason can be described according to three leading currents. First, mental logic or inference-rule based theory dating back to early philosophers like Aristotle who portrayed human thinking as an operation requiring the use of principles of logic.

Second, is a theory of reasoning according to heuristics, developed by Tversky and Kahneman (1982), viewing human thinking as a biased process where incorrect probabilistic estimates filter judgement and decision making. Third, the theory of mental models developed by Johnson-Laird (1983) and Johnson-Laird and Byrne (1991), viewing reasoning as a coherent system that is not necessarily logical in a mathematical sense, but consistent within itself according to each person's construction of their own mental models.

### 2.1 Theory of inference rules

Reasoning research concerned with inference rules originates from philosophical tradition, where it was assumed a person used mental logic, that is, pursued the goal of thinking in a logical manner. Hence, those who fail to be logical could be trained to think more logically. As Rachman (1983) noted, in this view humans are not irrational, but simply fallible. Theories of inference rules are said to be normative, that is, they describe what is considered to be the ideal process of correct logical thinking.

### 2.2 Deductive reasoning

In deductive reasoning, conclusions are made on the basis of premises that are presumed to be true. In principle, deduction should yield valid conclusions, i.e. those in which the conclusion must be true if the premises are true (Johnson-Laird, 1999). The structure of the argument is what gives the conclusion its validity and not the content of the premises per se (Manktelow, 1999). The following form would represent this theoretical argument:

- Initial premise: All A are B
- Proposition A
- Conclusion: B

Supposing you added content to such an argument, you would find the following:

- All beaches are sandy.
- This is a beach.
- This beach is sandy.

Regardless of the fact that some beaches are NOT actually sandy, in its pure form, the argument is valid. This is so because, in deductive reasoning, all the information required in order to draw a conclusion is explicitly found in the premises. Hence a logical argument does not require any semantic knowledge to be solved. Other forms of deductive arguments concern conditional statements, like a proposition in the form of: 'if p then q'. This conditional framing is also called modus ponens. Here is an example of a modus ponens:

• If the mountain is high then the oxygen is rare.	(If p then q)
• The mountain is high.	(p)
• The oxygen is rare.	(q)

If you negate the antecedent (not p) you then draw a different conclusion. An example of denying the antecedent (DA) is the following:

• If the mountain is high then the oxygen is rare.	(If p then q)
• The mountain is not high.	(not p)
• The oxygen is not rare.	not q)

On the other hand, if you use affirmation of the consequent (AC), you would find the following:

• If the mountain is high then the oxygen is rare.	(If p then q)
• The oxygen is rare.	(q)
• The mountain is high.	(p)

And finally, the modus tollens which states 'if p then not-q' describes the instance when the consequent is denied, as shown in the following example:

• If the mountain is high then the oxygen is rare.	(If p then q)
• The oxygen is not rare.	(not q)
• The mountain is not high.	not p)

Such invalid deductive reasoning shows itself in several clinical variants.

Example of affirming the consequent:

People who are physically attractive are popular.

I'm not physically attractive.

Hence I'm not popular.

Example of denying the consequent:

Only cowards run away from challenges.

I avoid challenges.

So I'm a coward.

In mental logic, only two forms of deduction yield valid conclusions and they are the modus ponens and modus tollens. A valid deductive conclusion is one that is true if the premises are true. So if we assume that it is true that if the mountain is high then the oxygen is rare, the reverse (the mountain is not high, the oxygen is not rare) is not necessarily true (DA) and neither is the converse (if the oxygen is rare, then the mountain is high) (AC), so DA and AC do not necessarily lead to valid conclusions. To summarise, a conditional rule is one of *implication* where  $p$  implies  $q$  but the rule is not one of equivalence, that is  $p$  is not equivalent to  $q$ . That is precisely why DA and AC forms do not produce valid conclusions. For example, other conditions than 'high mountains' can produce rare oxygen (extreme high heat, a closed space, dehydration, etc.) but a high mountain implies that oxygen is rare, so oxygen MUST be rare if in a high mountain.

### 2.3 Conditional reasoning

Conditional reasoning is meant to illustrate logical forms of reasoning but if applied to a clinical example, it becomes apparent that the different conditional forms would not be judged by the same logical validity criteria in everyday reasoning:

Take for example a modus ponens using everyday thinking:

• If I am pleasant to everybody then everyone will like me.	(If p then q)
• I am pleasant to everybody.	(p)
• Everyone likes me.	(q)

The same example when denying the antecedent DA would yield the following:

• If I am pleasant to everybody then everyone will like me.	(If p then q)
• I am not pleasant with everybody.	not p)
• Nobody likes me.	(not q)

Or AC as in the following:

• If I am pleasant to everybody then everyone will like me.	(If p then q)
• Everyone likes me.	(q)
• I am pleasant to everybody.	(p)

And finally, the modus tollens as shows the following example:

• If I am pleasant to everybody than everyone will like me.	(If p then q)
• Nobody likes me.	(not q)
• I am not pleasant to everybody.	not p)

From a logical point of view, both modus ponens and modus tollens forms are correct however, from a clinical point of view, all four examples would be invalid and disputed by the cognitive therapist simply because the initial premise is debatable (being pleasant to everybody does not necessarily lead to everyone liking you!). In that sense, conditional reasoning paradigms concern verifying logical validity of an argument rather than observing the actual process of human thinking which means its use in terms of research into pathology may be limited. Moreover, people are not very successful when trying to solve conditional reasoning tasks, as illustrated in the case of one of the most documented experimental task of deductive reasoning called the Wason Selection Task (WST).

#### 2.4 Wason selection task

The WST was created by Wason (1966) and has proved to be very informative about people's deductive reasoning abilities. In the WST, there are typically four cards with a letter or a number on each of them (for example A, M, 2 and 7). The following conditional rule: 'If there is a vowel on one side, then there is an even number on the other' is presented to a participant by the experimenter. The participant needs to indicate which card(s) MUST be turned over in order to find out if the conditional rule is true or false. It is expected that one uses the abstract rule of logic in both forms of modus ponens ('if p than q') in order to confirm the rule and in modus tollens, (if p than not-q), to seek evidence that would disconfirm the rule. Typically, people tend to use the modus ponens form, that is, they try and confirm the rule by turning over the 'A'. Fewer than 10% of people try to falsify the rule and this result has been consistent and replicated over the last two decades (Evans, 1982; 1989). Wason (1968) and Johnson-Laird and Wason (1970) supposed that the absence of falsification meant that people's reasoning was characterised by a *confirmation bias*, the tendency to look for confirming evidence without looking for disconfirmation. The confirmation bias proved useful to illustrate how people are simply not ruled by principles of logic. Hence here, what can be learned as cognitive psychologists, is that people are not inclined to look for falsifying evidence when it comes to abstract material. However, what it also seems to show is that abstract reasoning tasks do not describe thinking processes as they *are per se*, but more on how humans fail to be logical. In other words, by devising

logical abstract tasks and testing people on the standard of their logical abilities, it becomes apparent that human's natural tendency is to think illogically. Wason (1969), attempted to prompt people to use contradicting evidence in order to falsify the rule and found that people still preferred confirming evidence and avoided using falsifying information.

The 'confirmation bias', underlined by the WST results prompted Evans (1972, as cited in Manktelow & Over, 1990) to look for another explanation than the inability to disconfirm a rule which he called a 'matching bias'. In effect, he thought it more plausible that participants had a tendency to make unjustified inferences where they would verify only the cards that showed information *named* in the rule (so for example, the vowel and the even number). Thus, Evans and Lynch (1973, as cited in Manktelow & Over, 1990) found evidence for the *matching bias* using a modified version of the WST, proving that participants can arrive at the correct conclusion (falsifying the rule) by pure accident, that is, selecting the falsifying card not for logical reasons but because something in the rule states it's falsifying condition. Evans (1989) later underlined that it is not because people don't want to falsify information but rather an inability to do so.

An effect such as the matching bias underlines how relevance and context can be involved in reasoning tasks. It also points out how abstract rules of reasoning are not necessarily used to solve a particular task because knowledge and context can yield a conclusion, whether valid or not. Nevertheless, reasoning biases do inform us about the particularities of human reasoning and the following section will further illustrate how these reasoning strategies influence the outcome of reasoning tasks in particular.

## 2.5 Reasoning biases

The majority of research focusing on reasoning biases stems from experiments in syllogistic and conditional reasoning. As was mentioned earlier, the matching bias was illustrated by modifying a conditional reasoning task (WST) and realising how people tend to be influenced by the manner in which the conditional rule is presented. In syllogistic problems, participants are also influenced by 'non logical' issues that is, aspects of the task which are not *meant* to interact with its resolution (Evans & Over, 1996). For example, the belief bias is the tendency for people to accept invalid arguments because they are faced with believable conclusions, not necessarily correct ones. Evans et al. (1983) empirically demonstrated that belief interacts with reasoning in a series of experiments showing how people had a strong tendency to uncritically accept believable conclusions, while being more careful in their assessment about unbelievable ones.

Two explanations were proposed by Evans (1989) for the belief bias. One is the possibility that people are misunderstanding the logical prerequisites of what constitutes a valid argument, what the author calls 'misinterpreted necessity'. In effect for most people, the fact that an argument may follow from a premise is good enough to conclude that it is valid, whereas in logic, a conclusion *must* follow from an argument to conclude that it is correct. A second explanation for the belief bias, the 'selective scrutiny' argument, is that before solving any reasoning problem, people possess a 'selective heuristic'. In other words in the case of an unbelievable conclusion, they may be more prone to use logical analysis because of how surprising the conclusion is, whereas in a believable conclusion, they may be less rigorous. Oakhill and Johnson-Laird (1985) also showed how that the belief bias was equally apparent when people generated their own conclusions and in fact, that the interpretation of premises was correct but that the reasoning process was still altered by beliefs.

Some researchers have tried to diminish the belief bias effect by adding information in the instructions to help the participants avoid using prior knowledge and understand that a logical valid conclusion must follow from the given premises and only IF they do, should they conclude it is valid, regardless of whether the conclusion is plausible. For example, experiments by Newstead et al. (1992, 1994, as cited in Evans & Over, 1996) showed that the belief bias could be greatly diminished with the use of these 'augmented instructions' but not completely eliminated. Another study replicated these results by further validating how the belief bias was apparent irrespective of participants' abstract reasoning abilities (Markovits & Nantel, 1989).

As was pointed out earlier, the results of the Wason Selection Task demonstrated the occurrence of a confirmation bias. A very important experiment which further empirically validated this idea was devised by Wason (1960). What is called the '2-4-6 Problem' is meant to test inductive reasoning. A series of three numbers (typically: 2 4 6) are presented to participants and they are told that they need to uncover a rule (known by the experimenter), to which the series of three numbers conforms. For the participant to find out the experimenter's rule, he or she needs to write down a series of three numbers that would illustrate it. For each group of proposed numbers, the experimenter will say whether the participants guess matches the rule but participants are instructed to disclose the rule only once they are sure it is the correct one. The participant writes down each of his hypotheses. The main and consistent effect of this task is that participants have a tendency to verify only positive instances of the hypothesised rule which shows again that falsification is not a primary reasoning strategy used by people in general.

## 2.6 Rationality and reasoning

In summary, people do not naturally resort to strategies that would help them solve logical reasoning tasks on the one hand and on the other hand, individuals seem to be influenced more by prior knowledge and context. This is of great concern to reasoning researchers and increases the difficulty to solve the debate as to *how* we reason and arrive at conclusions. An alternative solution proposed by Evans et al. (1993) and Evans and Over (1996) considers that these '*reasoning biases*' should not stand as proof of human irrationality but rather, as evidence that reasoning may include a dual process: rationality1, which describes reasoning in a way that is usually reliable and efficient for achieving one's goals (based on prior experiences and beliefs) and rationality2, meaning reasoning with principles of logic when one has reason to. The theory contends that both types of rationality are also bound by 'cognitive constraints', meaning people's ability to process information. Hence, it is proposed that individuals use one, or the other type of reasoning, according to what presents itself to be solved. That is, normal, everyday decision making situations would require practical reasoning (rationality1) where deciding on actual facts would require theoretical reasoning (rationality2). This proposal could account for why people fail to be logical when tested on formal reasoning tasks. Evans (1989) had even proposed that 'debiasing', a procedure meant to reduce or even eradicate the impact of reasoning biases could enhance people's ability to use rationality2, that is, solve logical reasoning tasks.

Evans and Over's rationality1 and 2 theory has not been accepted unanimously as some researchers have argued for a more unified competence whether it be based on the premise that people reason with practicability (only using rationality1) or that people reason with theoretical principles (using only rationality2). For Johnson-Laird (1999), the theory's

strength is that it can indeed explain both reasoning competence and incompetence however, this would accommodate too much and thus become difficult to test and disprove.

### **2.7 Limits to reasoning studies**

Some critics have contested the use of formal tests of reasoning and asked or not people reason with the mechanisms inferred by the experimenter. Cohen (1981) puts forth what he calls the 'normative system problem' whereby for example, people may be using a more personal system of probability (based on experience) while the experimenter expects and intends a more statistical probabilistic mechanism of reasoning to be used. A second drawback to a normative system of reasoning concerns the problem of the cognitive load such abstract tasks can put on a participant. Effectively, it's been proposed that qualifying someone as being irrational if that person cannot solve a task that is beyond the limits of their human cognitive processing abilities, is incorrect.

Oaksford and Chater (1993) have considered another argument concerning cognitive processing abilities, which refers to a problem of 'external validity'. That is, a normative system theory does not transpose well into real-life problems because previous knowledge and beliefs are taken into account in 'real-life reasoning'. Cohen (1981) also argues that, because laboratory experiments are artificial and not representative of normal thinking and reasoning, then external validity may be in danger.

Finally, a third argument of 'interpretation' may account for why participants may not be assessing reasoning problems in the way intended by the researcher. Henle (1962) argues that people's personal representation of the problems would yield to conclusions that were logical if one considers that person's specific representation of the premises. Hence in this view, mental logic is actually existent, only the formal tests are unfit to represent it adequately.

### **2.8 Reasoning with heuristics**

Tversky and Kahneman (1973, 1982) developed a reasoning theory suggesting that reasoning is a decision making operation where premises are judged according to a restricted number of heuristics. Heuristics are general filters of reasoning which bypass calculating real probabilities. Yet, heuristics can lead to systematic errors because the assessment of premises is based on data of limited validity. Tversky and Kahneman (1982) claim that just as people's perceptions can distant reality, heuristics activate a bias on judgment of probability. So for example, the 'representativeness heuristic' leads a person to rely on the degree to which A resembles B, or how much A is a representative of B, e.g., social gatherings tend to be superficial so the people at my friend's party will be superficial. While this may be true, it is not always the case because base rates are not considered when the representativeness heuristic filters judgment. The 'availability heuristic' suggests that people estimate the frequency or probability of the occurrence of an event by bringing to mind the easiest example of a class of event, that is, instances of large classes of events are recalled quicker than infrequent ones. In other words, familiarity yields to erroneous decisions, according to the availability heuristic, e.g., I heard about a mugging lately on the news, so I could be mugged. The anchoring heuristic describes the fallacy of starting with an initial value biased to fit the final answer. In other words, the starting point seems to be suggested either by the formulation of the problem or by the result of a partial computation. Tversky and Kahneman (1982) report that several of the main heuristics described here are apparent even if participants are rewarded for correct answers and encouraged to be more accurate by the use of prompts. Heuristics research shows how common assumptions and the accessibility of information through personal experience can override logic.



### 2.9 Inductive reasoning

An inductive conclusion is drawn on the basis of selective evidence and tends to increase information. However in inductive reasoning, a conclusion is not necessarily true, since it is drawn from a person's own opinions, experiences and knowledge. Conclusions in inductive reasoning add information that is not necessarily in the premises which implies that contrary to deductive reasoning, here, the content of the argument cannot be separated from the form. Johnson-Laird (1993) proposes a comprehensive definition of inductive reasoning as 'any process of thought yielding a conclusion that increases the semantic information in its initial observations or premises'. Again, what this definition implies is that the content of the proposition has the implication of ruling out certain states of affairs. An important question that has preoccupied researchers is one concerning the 'correctness' of an inference, that is, how is induction justified? For Johnson-Laird (1994a), current research on induction is in a state of uncertainty and 'no adequate theory of the human inductive process exists' (p. 14). He argues that the mechanism of induction is almost inseparable from normal mental activity since it is part of how we make sense of the world and the way we do that is by having models based on the availability of pertinent knowledge to what we are reasoning about (see the 'availability heuristic' in Tversky & Kahneman, 1982). This leads us most of the time to use inductive reasoning in everyday life, which as we have seen, does not always lead to true conclusions. But it is the form that we use in everyday reasoning because valid deductions are not possible in the absence of all true or necessary information. Manktelow (1999) also reports on the dilemma that has prevailed for years on how one instance can yield a generalisation while at other times, many instances which should lead to a particular inference and yet, people do not generalise from them. A proposal from Johnson-Laird (1994a) concerns the strength of an argument and it suggests that such strength depends on the relation between the premises and the conclusion. That is, the strength of an inference will increase if the premises are considered consistent with the conclusion in at least one possible state of affairs. If there seems to be no counterexamples, the argument will stay strong, that is, the conclusion will be considered to follow reliably from the premises. To summarise, the strength of an inference is equivalent to the probability of the conclusion given the premises are true. This account is in relation to Johnson-Laird's theory of mental models, which will be exposed in the following section.

### 2.10 Mental models

Johnson-Laird (1983) initially developed his theory of mental models (MM) to explain verbal comprehension, inspired by the work of Kenneth Craik (1943, as cited in Johnson-Laird, 1994b) on how the mind creates 'small scale models' of reality. It is suggested that when people try to make sense of a proposition, they create a model in their mind of the situation that is discussed. The model itself can be a word or a visual image but most importantly, its structure corresponds with the way people organize their view of the world (Johnson-Laird, 1994a).

Johnson-Laird and Byrne (1991) broadened the MM theory, suggesting that there are three levels of thinking that people experience when they attempt to draw conclusions: First, people will try to understand the premises by using what they know in general. Then, they will construct models about what has been understood from these premises. The models can be images, words or instances of each premise. The next level involves combining the models in order to draw a description of the state of affairs they are trying to compose. This description must yield to a conclusion which includes new information, outside of the given

premises. If the person doing the reasoning does not find such a conclusion, he or she will reason that anything follows from the premises. However, if one does find a conclusion, the last stage will involve searching for alternative models which would be coherent with the premises but where the hypothesized conclusion would be false. This last level then involves validating that no falsifying model compromises the conclusion, that is, that the conclusion is valid. If alternative models do falsify the conclusion then it is false and the person will search for a new conclusion that will not be proven wrong by an alternative model.

In summary, in this section, the main differences between deductive and inductive reasoning have been described and the main reasoning paradigms that have been used to test these inference processes were outlined. The key result from this research is that people in the general population have trouble resolving logical tasks. Effectively, they are prone to different reasoning biases which lead them to false conclusions. Moreover, certain forms of deduction are invalid and yet, people do not seem to be able to differentiate between those which are valid and those which are not. Theories like Johnson-Laird's mental models theory or Tversky and Kahneman's heuristics theory have helped to view reasoning as guided by factors other than formal logic, as it stands. For example, the mental models theory tells us that people have representations of 'how the world is' and they will draw inferences based on these models. If the model is incorrect, invalid conclusions may be drawn from it. Tversky and Kahneman (1982) have shown that heuristics seem to guide reasoning so that it is understood that people will look for the easiest way to judge a probability, not necessarily the most valid judgement. Hence, it appears that context is important to inference as well as people's individual cognitive structure. It thus becomes clear from this review that certain reasoning models can serve as theoretical paradigms to test pathological reasoning since 'thinking' is how people behave, whether pathological or not. Moreover, studies using reasoning paradigms explain thinking behaviour by observing thinking performance which offers a more parsimonious explanation than those of information processing theory and studies, which tend to hypothesise about remote abilities like 'selective attention' or 'memory' to explain thinking behaviour. The next section will elaborate on studies that have used reasoning paradigms to test pathological thinking and the comprehension that these study results yielded in terms of diverse mental disorders.

### **3. Reasoning paradigms with pathological thinking**

Pathological expressions like repetitiveness, self contradiction and denial of facts have been observed and noted by authors like Wason and Johnson-Laird (1972) in their many reasoning studies. For example, the case of a participant persisting with a hypothesis in a task was presented by noting the participant's 'strong obsessional features', that is 'his fertile imagination, and intense preoccupation with original hypotheses, has narrowed his field of appreciation to the point where he has become blind to the obvious' (Wason & Johnson-Laird, 1972, p. 233). This trumping of the senses is typical of obsessional narratives which frequently lead to a conclusion in stark contradiction to the premise. Example: The car door is locked safely but maybe the sound wasn't quite right and the car is old and a friend of mine found the doors didn't lock properly and in any case anything can happen with these mechanical devices, so... the car door could well be unlocked (see O'Connor et al., 2005). The hint of a link between these observations and psychopathology which seems a valid invitation for exploring the field of reasoning and psychopathology. The following section reviews current state of research into reasoning and pathology looking at it from

these two perspectives: 1) reasoning processes in psychopathology: how reasoning performance can inform us about the mechanisms of psychopathology and 2) the effect of content on reasoning competence: how manipulating content with characteristics of a psychopathology can influence reasoning competence.

### **3.1 Mechanisms of psychopathology**

Researchers using reasoning paradigms as a means of understanding mechanisms of psychopathology consider that reasoning in itself, plays a determinant role in human behaviour. Observing variations in reasoning performance can inform us about the processes that guide behaviour. The advantages of working with reasoning paradigms are that the tasks used are well documented and have been tested in a variety of conditions in the general population. The results serve as an anchor for estimating differences. The following section describes a Bayesian probabilistic task, often used in clinical populations. This probabilistic task measures how people estimate the likelihood of an event and their decision making style.

### **3.2 A probabilistic reasoning paradigm**

The task involves imagining 10 bags containing 100 poker chips each, while manipulating the ratio of red versus blue chips in each condition. Participants estimate how likely it was that a bag containing predominantly red or blue chips is chosen, on the basis of the experimenter's draws of chips from a (presumably) randomly chosen bag. In the original version developed by Phillips and Edwards (1966), the effects of probability estimates on different variables such as: prior probabilities, amount of data gathered before making a decision, diagnostic impact of data, payoffs and response modes were evaluated. The results from Phillips and Edwards (1966) showed that people in the general population had a tendency to request more information to come to a decision than logical probability calculus would predict.

Volans (1976), Huq et al. (1988) and Garety et al. (1991) used modified versions of the probabilistic task in a series of studies with people suffering from diverse psychological difficulties. For example, Huq et al. (1988) decided to test groups of deluded, psychiatric and normal controls. Clinical observations of people experiencing delusions led them to hypothesize that fixity of belief and intensity of conviction would lead the participants to be less conservative than the other two groups. Their hypotheses were that people with delusions would require less information before making a decision and be overconfident about these choices compared to normal controls or other psychiatric participants. The results confirmed both hypotheses since deluded participants showed a significantly higher level of conviction on their 'initial certainty' estimates, and requested less evidence before making a decision compared to the two other control groups. The authors concluded that people with delusions showed a 'jumping to conclusion' (JTC) style of reasoning. It remains to be understood how this translates into everyday decision making and if this reasoning 'bias' means that people with delusions jump to conclusion about any information that is presented to them. The fact that the task is neutral would indicate that this is the case but a more realistic context may yield different results.

The study from Huq et al. (1988) had included a group of people diagnosed with schizophrenia without distinction of deluded participants without hallucinations hence their findings needed to be replicated. Garety et al. (1991) thus extended the work using the probabilistic reasoning task with better defined diagnostic groups so in addition to a group

diagnosed with schizophrenia, a 'pure delusional' group was included, that is, people diagnosed with DSM-III-R (American Psychiatric Association) criteria for delusional disorder (DD) (paranoia type). An anxious control group and a non-psychiatric control group served as comparisons. The hypothesis was that DD patients would show a greater bias in probabilistic reasoning than schizophrenic patients since their abnormal beliefs were more subtle, and they experienced no hallucinations. No significant differences were found between schizophrenic patients and paranoid delusional patients on their responses of the probabilistic task. Effectively, both these groups were overconfident and required less evidence before making a decision than the anxious and normal control group. Even if these results are consistent, more research is needed in order to differentiate between a possible task effect and a genuine different reasoning style. No other, studies have been conducted in order to test this idea, by using a different probabilistic task and exploring if this would lead to variations in style of reasoning. Further experiments using emotionally salient content confirmed these findings (see Dudley et al., 1997a, 1997b).

Dudley et al. (1997a) devised two separate experiments to examine whether people with delusions exhibited a general deficit in reasoning, when using different probabilistic material and by varying the ratio of beads from that of the standard probabilistic task. The first experiment verified performance on a 'biased coin task'. People with delusions, depressed controls and non-psychiatric controls needed to estimate the chance that a coin was biased to 'heads' when presented with a set of results from throwing the coin. The results on this task showed there were no differences in probabilistic estimates between the three groups. This finding is important because it indicates that people with delusions don't have any problems with estimating probabilities. However, the second experiment tested decision making with variations in the ratio of beads (an 85:15 condition and a 60:40 condition) the manipulation aimed to test whether a different base rate would yield a more cautious strategy from the delusional participants. Results showed that indeed, delusional patients took notice of the different base rate and were more cautious but still required less evidence than the two control groups for the same condition. Thus replication of the JTC bias was apparent. It seems that people with delusional disorder use the same reasoning process as normal controls but that they require less evidence to do so hence showing a different reasoning style. However, the question remains on how this translates into clinical reality, that is, how this applies to therapy. Colbert et al. (2010) suggest that jumping to conclusions may be a trait characteristic of those with a propensity to delusions and predictive of later symptomatology.

In their critical review of cognitive approaches to delusions, Garety and Freeman (1999) compare three main theories of development and maintenance of delusional disorder. Their own theory is the only one where reasoning is considered to play a part in delusions although they specify that this applies only to certain delusional types. Effectively, Garety (1991) and Garety and Hemsley (1994) propose a multifactorial model that includes past experience, affect, self-esteem and motivation as having a role in some delusions while biases in perception and judgment would be more crucial to other types. As described previously, the series of experiments using the probabilistic task have been consistent in demonstrating a JTC reasoning Style, later termed a 'data gathering deficit' (gathering less evidence to form a hypothesis) in people with delusions. The authors conclude that although erroneous conclusions are not always the result of this 'data-gathering deficit', it does predispose individuals to accept incorrect hypotheses. In a wider perspective, it also

implies that people who suffer from delusions show this style of reasoning when faced with neutral material and that both diagnostic groups, delusional and schizophrenic, are prone to reason in this manner.

### 3.3 Reasoning processes and anxiety and obsessive compulsive disorders

Cognitive theories use terms like 'irrational thinking', 'cognitive errors' and 'irrational beliefs', etc., and yet, little information is available about the mechanisms involved in the development of such pathological irrationality. In fact, reasoning processes in anxiety disorders have been relatively less investigated than in thought disorders. One of the reasons may be that thought disorders are more easily associated with the hypothesis that 'faulty reasoning' plays an important role in bizarre idea formation. Behavioural models based on classical conditioning of the fear response associated to catastrophic thinking are the explanation mostly agreed on, concerning the development of anxiety. But how 'catastrophic thinking' develops in the first place is less clear. Reasoning performance on neutral tasks may inform us on of diverse reasoning strategies in different psychopathologies.

Whether psychopathology influences reasoning performance or whether it is the opposite, that is, reasoning strategies cause psychopathology remains an important question. A second query relates to the implications of reasoning results: how does reasoning performance inform us about a particular pathology? As Garety and Freeman (1999) suggested, longitudinal studies are required to respond to the question of causality between psychopathology and reasoning strategies. Second, translating reasoning findings into clinical applications remains an important challenge for clinical researchers. For example, pioneer authors like Milner et al. (1971) examined decision-making in obsessive-compulsive disorder (OCD). They compared performance of a group of people with OCD and a non-clinical control group on an auditory signal detection task. A faint tone embedded in white noise was presented and participants had to decide whether they needed additional trials before stating if the tone was present. The results suggested that before making a decision, OCD participants requested a higher number of trials than people in the control group. It was hypothesized that 'in obsessional disorder decisions may be deferred to an abnormal extent' (Milner et al., 1971, p. 88). This finding marked the beginning of a series of experiments yielding consistent results about people with OCD needing more information before being certain of their decision. Unfortunately, no explanations were offered on how these findings contributed to the development or maintenance of OCD. However, the request for less information before making a decision as reflected in the JTC bias seemed to form an element of reasoning defining poor insight. Whereas people with OCD tend to take longer making decisions, people with delusional disorder are significantly quicker. Body dysmorphic disorder (BDD) may be considered a group in between OCD and DD in terms of insight and overvalued ideation and BDD show only a modest JTC reasoning bias (Reese et al., 2010)

Volans (1976) investigated reasoning in OCD using the standard probabilistic task (described earlier) with one modification involving a YES-NO response mode (ex: as to which jar, A or B, was chosen). Again, draws to decision were significantly higher in the OCD group than for the normal control group and the phobic group. These significant results were replicated by Fear and Healy (1997) who tested probabilistic reasoning in both OCD and DD groups as well as a 'mixed' group (people with both delusional and

obsessional beliefs) in comparison to a non-clinical control group. Results echoed those of Volans (1976), where the OCD group differed in their reasoning style from the DD and the mixed group by requesting more evidence before making a decision. So where people with DD seem to exhibit a 'data-gathering deficit' by requiring less evidence than normal control, they are still much closer to the norm than people with OCD. It would appear then, that people with OCD exhibit a 'data-gathering excess', because of their extreme deviation from the norm. Again, a clear explanation is lacking in terms of how this contributes to the conceptualization of OCD. In other words, which decisions in everyday life would be affected by this bias?

The 'data gathering excess' style of reasoning found in OCD was not present in another study using a probabilistic task. In effect, Rhéaume et al. (2000) used a modified version of the probabilistic task with people who showed pathological perfectionism. Here, the ratio of beads that was used was a proportion of 60:40, which renders the task more difficult and ambiguous because of the almost equal proportions of each colour of beads. Rhéaume et al. measured functional and dysfunctional perfectionism to form two separate groups. People with 'dysfunctional' perfectionism (which is hypothesized to be linked to OCD) required less draws before making a decision when compared to people with 'functional' perfectionism. Although the authors found a relationship between dysfunctional perfectionism and an obsessive-compulsive behaviour scale, current consensus does not yield perfectionism as a predictor of OCD (Frost et al., 2002) so it may be premature to draw any further conclusions.

The probabilistic reasoning paradigm was also used in a non clinical sample of people scoring high on the Intolerance of Uncertainty Questionnaire (IUQ) which distinguishes worriers meeting GAD criteria from those who do not. Ladouceur et al. (1997) used a modified version of the probabilistic task. Two levels of ambiguity, moderate and high, were created by varying the ratio of the coloured beads (moderate ambiguity = 85:15 and high ambiguity = 60:40). Results obtained from this sub-clinical population lead to contradicting conclusions. Indeed, the results suggested that under the moderate level of ambiguity condition, more people characterized with IU required a greater number of draws before making a decision. However, the effect disappeared in the high ambiguity condition and the authors explain the finding by postulating a lower threshold of perception of ambiguity by people with IU, which creates a need to precipitate a decision. The modification by the authors of the original probabilistic task meant that the order of appearance of the colour of the beads was undetermined. Therefore, the number of draws requested by the participants was determined by chance. Consequently, it is difficult to compare these results with previous probabilistic reasoning studies.

Probabilistic reasoning constitutes only one aspect of reasoning and other types of reasoning have been investigated in psychopathology like deductive and inductive reasoning processes. Effectively, Reed (1977, 1991) initiated such formal investigation with participants diagnosed with 'anankastic' personality disorder, the equivalent of the more modern diagnosis of obsessive-compulsive personality disorder (OCPD). In his study, he compared an OCPD group to psychiatric controls on a deductive reasoning arithmetic task and an inductive task requiring participants to infer a rule about a series of numbers. Results showed that the OCPD group performed better on the deductive task but that their results on the inductive task were inferior to that of the psychiatric control group. In the absence of

a non-psychiatric control group and a better diagnostic definition, the results are not sufficiently representative. However, Reed's research emphasized the relevance of exploring inductive and deductive reasoning in people with obsessions and prompted further investigation of such mechanisms.

Hence, Pélissier and O'Connor (2002) examined formal deductive and inductive reasoning in OCD and to date, this study constitutes the only research to have extensively examined such processes in OCD. A group of twelve people with OCD was compared to ten people with GAD and a normal control group of ten other participants, on a series of six inductive and deductive tasks. The deductive tasks involved were: the Wason Selection Task, the 2-4-6 problem and a deductive exercise designed by the authors. Essentially, no significant differences were found between groups on either of these measures. The inductive tasks were three exercises designed by the authors based on reasoning literature: estimating plausibility of 40 different given inferences ('Finding the evidence'), linking two separate, unrelated premises ('Bridging') and estimating the validity of an arbitrary statement before and after supplying arguments to support it ('Supporting an arbitrary statement'). The results in the inductive tasks suggested group differences in two of the three exercises. Effectively, the OCD group took longer to initiate their inference process than the two control groups. Also, they seemed to doubt an arbitrary statement in a higher proportion than the two other groups, even after generating supporting evidence for this particular statement. Drawing from Johnson-Laird's mental model theory, the authors hypothesized that these findings were due to an excessive production of alternative mental models on the part of people with OCD.

In effect, Pélissier and O'Connor's (2002) proposed that producing too many alternative mental models led people with OCD to be less certain of their conclusion, whereas in reality supporting arguments created greater certainty. This interpretation of the results was challenged by the same authors in a more recent study where Pélissier et al. (2009) tested inductive reasoning using a modified version of Johnson-Laird's (1994a, 1994b) probabilistic inductive reasoning task. In effect, Pelissier et al. tested the mental models hypothesis by creating a task expressly designed to measure the impact of alternative possibilities on conviction level. This supposed that an important parameter influencing reasoning might be the source of the alternative possibilities more than the quantity of alternative models. Hence the task devised to test inductive reasoning and the impact of the source of arguments involved whether arguments were given by an external source or were self-generated by the participants. Results revealed that people with OCD are more influenced when the alternative conclusions are given by the experimenter, that is, their level of confidence decreases much more in this condition than in the self-generated condition. Such enhanced doubting of the initial inference was not apparent in the control group, that is, the non-OCD control group was not specifically sensitive to whether or not conclusions were inferred by themselves or given by the experimenter. So the results actually refute the interpretation of results from the previous Pélissier's study, that is, people with OCD do not produce too many models but rather, doubt seems to influence reasoning processes by according too much importance to mental models coming from outside sources. Simpson et al. (2007) replicated the finding of differences in inductive reasoning in OCD and the higher level of doubt, and Keen et al. (2008), likewise, showed that participants with OCD were more influenced by simulation heuristics and able to simulate their OCD scenarios as if they were real.

### **3.4 Pathology in reasoning: effect of content on reasoning competence**

There is a line of research in which diverse reasoning paradigms are modified by including themes that are relevant to diverse psychopathologies. These studies explore whether reasoning patterns remain the same or diverge when pathological content is included the reasoning paradigm. If the patterns of reasoning are the same or just more pronounced to those observed in the neutral condition, it is possible to hypothesize that this particular reasoning style plays a role in the maintenance of the pathological symptoms while not being a causal factor. However, if the reasoning style is different in the pathology related content condition compared to the neutral condition it would be hypothesised that a special case of reasoning is employed in that particular condition. The studies using modified reasoning paradigms also manipulate variables other than reasoning. For example, a conceptual variable like perfectionism may be tested using a reasoning paradigm, serving more as a template to test whether a pathological construct is relevant or not to a particular psychopathology.

### **3.5 Effects of content in affective and thought disorder**

Young and Bentall (1997) developed an experiment to include content in a reasoning paradigm. The authors modified the Bayesian probabilistic task and replaced beads by descriptions of people ( a person that was liked and a person that was disliked) to create a 'personality' condition. The condition was designed to test whether the salience of the material would influence the groups' probabilistic estimates and decision making style. Three groups were tested: deluded patients, depressed patients and non-clinical controls. Results demonstrated that overall, the three groups reached an initial level of certainty and revised these certainty levels more rapidly in the personality condition than in the neutral condition. However, this effect was more pronounced in the clinical groups compared to the normal control group. The authors concluded that emotionally salient themes may produce 'abnormalities' of probabilistic reasoning which would be expected in the development and maintenance of delusions.

The results of this study show that although the control group showed a quick decision making strategy, people in the clinical groups exhibit an even quicker bias towards concluding rapidly.

These results were replicated by subsequent research by Dudley et al. (1997b) who tested whether a 'jumping to conclusions' (JTC) (strategy of coming to a conclusion on the basis of less information) was observed when using realistic material versus abstract material in delusional patients. Three groups were tested: people with delusions, people who were depressed and normal controls. The participants were presented with two versions of the probabilistic task where both versions used realistic material but one of them had emotionally neutral content and the other used emotionally salient themes. Results of these two experiments show that people with delusions request less evidence before coming to a conclusion when presented with realistic content, so the JTC bias was generalized to realistic content. The second finding was that all groups requested less evidence when the material was more salient. Therefore, emotionally relevant material increases the JTC reasoning style for everyone, although the authors underline the tendency for people with delusions to require even less evidence than the two other groups but this was not statistically significant.



Drawing on the previous results, Dudley et al. (1998) set out to explore whether the JTC bias using salient material was present in other forms of reasoning in order to rule out a task effect. The authors modified the Wason Selection Task (WST) by manipulating the content going from neutral to being more realistic. Hence, conditional reasoning performance of people with delusional disorder was compared to a depressed and a non-clinical control group. Four versions of the WST were devised to vary in content of realism. Results showed that people with delusional disorder reasoned in the same manner as the two control groups on all but one of the four versions. In fact, the difference in reasoning was found in the most realistic version of the WST where people in the delusional group solved the task less efficiently than the normal control and depressed group. The results were unexpected since increased realism generally increases the WST performance. Thus Dudley et al. (1998) suggested that people with delusions may have a working memory deficit limiting them from manipulating all the necessary elements. The authors state that this remains to be determined in future studies but seemingly, a more realistic context leads clinical groups to a stronger bias. The results stress the importance of tailoring reasoning tasks to particular psychopathologies in order to resemble clinical reality. In an attempt to tease out distinctions in reasoning between anxiety, depression and paranoia, Bennett and Corcoran (2010) reported that elevated levels of depression were associated with the tendency to underestimate the likelihood of future positive and neutral events, whereas subclinical paranoia was associated with overestimation of the likelihood of future threatening events (Bennett & Corcoran, 2010). Further, there is also evidence that anxiety states may interact in paranoia to produce even greater jumping to conclusions (Lincoln et al., 2010).

### 3.6 Effects of content in anxiety disorders

Research using reasoning paradigms in anxious clinical populations uses salient material more than reasoning studies in thought disorders. Essentially, most paradigms involve the modification of the WST by replacing the elements of the task (for example 'a vowel') with anxious content or simply using anxiety tailored scripts as the basis for requesting inferential performance. For instance, Arntz et al. (1995) investigated inductive reasoning processes biased toward danger and subjective anxiety in a population of anxious participants compared to non-anxious controls. Their study involved four groups of anxious patients (52 spider phobics, 41 panic patients, 38 social phobics, and 31 other anxiety patients) compared to 24 normal control participants. All participants had to rate the perceived danger in anxiety-tailored scripts, where objective danger vs. objective safety as well as objective anxiety vs. objective non-anxiety information were varied. It was hypothesized that anxious patients would not only infer danger on the basis of objective danger cues but also infer danger on the basis of subjective anxiety information where non-clinical controls would not. The hypothesis was confirmed and the authors concluded that a process termed 'ex-consequencia reasoning' was responsible, where participants conclude that feeling anxious implies danger. One possible limit to the implications of these results is the fact that the task requires all participants to infer either 'danger' or 'not-danger'. This dichotomous choice may lead anxious participants to consistently infer danger, not necessarily because they have faulty reasoning strategies but precisely because they never experience having anxiety symptoms that yield conclusions of safety. The results then seem to underline the difference between being anxious and not being anxious. In other words, it is unclear if the inability to conclude 'if I feel anxious, then I am not in danger' (presumably

the reasoning of normal controls), is based on faulty reasoning on the part of anxious participants or based on their symptoms. So although this would also need to be tested, it should not be ruled out that the inference of danger may simply be the absence of sufficient premises to permit a safety conclusion.

Spider fearful students were tested by de Jong et al. (1997) in two separate experiments: the first one tested phobic participants on a conditional reasoning task where they had to assess the validity of conditional statements in the context of general threats or phobic specific threats. Modified versions of the WST were used where danger rules (if p than danger) and safety rules (if p than safety) were proposed to two groups (high and low level of fear towards spider). In the second experiment, the same material was used but was administered to three groups: treated and untreated spider phobic women, and a group of non fearful control participants. The results of these two experiments showed that in the general threat condition, reasoning strategies were guided by utility judgment, that is, all participants in all groups relied on confirming evidence when faced with a danger rule (selecting the q card) and relied on disconfirming information when given a safety rule (selecting the not-q card). In the phobic threat condition, this pattern was even more pronounced especially in the non-treated spider phobic group. What these results seem to be saying is that the more salient the content for phobic participants, the more they use a reasoning strategy that the authors call 'fear-confirming reasoning' and which seems to be a natural progression on a continuum of these danger-safety reasoning strategies. However, presumably the control participants did not respond to the anxiety-salient condition because the content was irrelevant to them. This makes sense since they do not suffer from spider phobia. This 'fear-confirming pattern' was tested to validate it's consistency by verifying it's use in other anxiety disorders.

The 'fear-confirming reasoning' was tested by de Jong et al. (1998) in hypochondriacal patients on a series of modified versions of the WST. Echoing previous results with the spider phobics, hypochondriacal patients did use the fear confirming strategies but this was not significantly different from the control group. The authors conclude that the threat of health problems would be more prone to make even non-hypochondriacal people search for disconfirmation, because of it's universal nature where as spider information would be neutral to non-spider phobics. A group of hypochondriacal patients and controls using the same modified WST were tested by Smeets et al. (2000). However this time, the authors deleted a worry statement presumed to have influenced normal controls in the de Jong et al. (1998) study. The results of the revised study confirmed a fear-confirming reasoning style that was more pronounced in the health threat condition for hypochondriacal patients. So although it is not a specific trait of hypochondriasis to reason in a 'better safe than sorry' manner, this fear confirming reasoning pattern may serve to maintain the health fears in place. More recent work by Vroling and de Jong (2010) has attributed a threat confirming belief bias and its interference on logical reasoning to a better 'safe than sorry' heuristic. But the belief bias was not directly correlated with anxiety symptoms, which suggests the bias may be more likely a diathesis for the development of anxious psychopathology.

### **3.7 Ex-consequentia reasoning**

Both judgements and interpretative biases are linked with anxiety and mood congruent effects. Emotion can exert complex effects on decision-making and reasoning, sometimes

hindering adaptive thinking (Blanchette & Richards, 2010). One example is 'ex-consequentia reasoning' where feeling stages can dictate conclusions about the world, e.g., I feel bad, so there must be a reason. A further study devised by Engelhard et al. (2001) expanded on the concept of 'ex-consequentia-reasoning' (Arntz et al., 1995) by comparing 'emotion-based reasoning' (ER) with 'intrusion-based reasoning' (IR). Both concepts are described as the process of inferring danger respectively on the basis of emotion or on the basis of the occurrence of an intrusion (an upsetting thought about an anxiety-related stimulus). The study tested a population of Vietnam combat veterans suffering from posttraumatic stress disorder (PTSD) compared to a group not diagnosed with PTSD. The experimental task aimed to discover if people inferred danger on the basis of anxiety responses in the case of ER and on the basis of intrusions in the case of IR when presented with objective danger information and objective safety information. The scenarios presented to all participants varied in content with objective danger/safety information and anxiety/no anxiety response for the ER condition and with objective danger/safety information and intrusions/ no intrusions for the IR condition. Inference of danger was measured by asking people to assess how dangerous each scenario was, by scoring a visual analogue scale for each of them. Results confirmed that all participants inferred more danger on the basis of objective danger information compared to objective safety information. Nevertheless, combat veterans with PTSD rated the scenarios as being significantly more dangerous on the basis of both anxiety responses and intrusions where non-PTSD participants did not show such a significant difference. Engelhard and colleagues (2001) suggested that ER and IR were linked to PTSD and may serve to maintain PTSD symptoms. That is, the maintenance of pathological symptoms may be characterized by the tendency for anxious people to infer danger on the basis of anxious symptoms and here, on the basis of anxious thoughts. However yet again, the question remains to be answered about whether this is due to a faulty reasoning strategy ('if I feel anxious and think about scary events, then there must be danger') or due to the induction process itself, which involves providing additional information to the premises, from which one infers conclusions. For instance, the additional information may be different for PTSD sufferers than for non-PTSD sufferers because by definition, people with PTSD must have experienced a richer array of anxiety symptoms and intrusions at the time of the experiment. In order to establish a causal link between ER/IR and the development of PTSD, a subsequent study was devised by the authors.

In this study, Engelhard et al. (2002) did not use the ER condition and simply tested the IR condition to establish whether IR predicted PTSD symptoms, following a train disaster. Twenty-nine participants who were directly exposed witnesses of a train crash were compared to fourteen non-witness people from a small Belgium town where this disaster occurred. The task used to assess the inference of danger was similar to Engelhard et al.'s (2001) previous study in that scenarios were designed to manipulate objective danger/safety information with intrusions/ no intrusions segments. Participants were required to assess how dangerous each scenario was, using the visual analogue scale. Results revealed to the people who were direct witnesses rated the scenarios with the intrusion segments as more dangerous than the scenarios without such intrusions and this was significantly different than the control group (non witnesses). Also, participants within the directly exposed group who showed higher ratings in IR reported higher levels of chronic PTSD symptoms at 3.5 months follow-up. The authors caution about their conclusion on how intrusions can predict PTSD symptoms by reminding us that completing a task involving intrusions may have

prompted the witnesses to experience similar intrusions. Also, since the non-witnesses, by definition, were not exposed to the trauma, they may have found the intrusion segments unrelated to their own experience.

#### 4. Discussion

The first section of this review article delineated the key differences between deductive and inductive reasoning and described the chief reasoning paradigms that have been used to test these reasoning processes. The main finding from this research is that people in the general population do not easily solve logical tasks. That is, people are prone to diverse reasoning biases which lead them to false conclusions. Thus theories like Johnson-Laird's mental models or Tversky and Kahneman's heuristics theory have helped to view reasoning as depending more on a person's own strategies than formal logical strategies. Hence, it seems context is important to inference as well as people's own cognitive structure. Studies using reasoning paradigms may explain thinking behaviour, be it normal or pathological, by observing thinking performance. The line of research going into reasoning seems to offer a simple, more direct way of studying cognitive aspects of psychopathology.

The second part of this article has outlined a novel line of research in clinical psychopathology. Effectively, research into reasoning and pathology is twofold: studies that manipulate content in order to understand reasoning processes in particular psychological disorders; and studies that inform us about psychopathology by using reasoning paradigms to show how reasoning performance can inform us about the mechanisms of pathology.

The question of how reasoning performance can inform us about psychopathology has been partly answered by replication of well devised studies on probabilistic reasoning. For instance, extensive work of Garety et al. (1991, 1994, 1999), Dudley et al. (1997a, 1997b, 1998) and Dudley and Over (2003) have yielded consistent results about delusional disorder and other thought disorders. Garety and Freeman (1999) do point out in their review of research in delusional disorders that most of the studies are not longitudinal and do not lead to any causal explanation of the disorders. However, the implication of their findings can be translated into clinical applications. For example, the 'data-gathering deficit' or 'jumping to conclusion' style of reasoning would prompt clinicians to develop techniques to help patients collect greater evidence before concluding or hypothesizing about events involving their delusional thoughts. In the case of anxiety disorders, consistent results of people with OCD exhibiting a 'data-gathering excess' may involve helping obsessionals accept less information before making a decision. In a way, exposure and response prevention encourages this strategy by asking patients to inhibit repetitive actions (excessive gathering of information) so they can process information without additional checking for example.

The second line of reasoning research concerning the effect of content on reasoning competence, yields less compelling answers for the understanding of psychopathology. Effectively, the results of most probabilistic studies show that emotionally salient themes increase the reasoning patterns already observed when using neutral content. So in essence, when it comes to personally relevant themes, people are increasingly biased in their reasoning pattern but how this applies to everyday life remains unclear. Research in anxiety and reasoning shows conclusively that anxious people infer danger on the basis of feeling anxious. But these results do present difficulties which have been underlined: inferring danger may not originate from faulty reasoning strategies but precisely because people who

are anxious, by definition, have no credible experience that would help them to infer 'no danger' in the face of anxiogenous material, inhibiting them to conclude that 'if I feel anxious, then I am not in danger' (presumably the reasoning of normal controls). The induction process itself involves producing additional qualifiers to the premises and drawing conclusions. It may be that the additional qualifiers are different in people with anxiety than for non anxious people.

#### 4.1 Future directions

Earlier, we cited the view of Rachman (1983) that cognitive research had taken two separate directions and that both could benefit our understanding much more if they were integrated: clinical cognitive theories versus cognitive reasoning research. In effect, Rachman suggests that clinical cognitive theories such as those developed by Beck could benefit from more empirical support with the use of reasoning theories, for example reasoning with heuristics, developed by Tversky and Kahnemann (1982). On the other hand, he proposed cognitive research should consider psychopathology when testing thinking.

Research including pathological content that is relevant to each psychological difficulty seems a potentially rewarding route to understand psychopathology. How people reason within the psychopathology should be observed but we are lacking in reliable empirical measures. Essentially, reasoning may not be simply about fragmented premises and the logical combination of such statements but a complex script which is hardly accessible through the formal standard reasoning paradigms. Hence, future studies should try to observe reasoning strategies in context, using tailored scripts or narratives taken from people suffering from psychological disorders and drawing conclusions from the reasoning processes involved in these narratives. This would mean tailoring exercises to reflect everyday reasoning process, as they occur and as close as possible to thinking as it presents itself in everyday reasoning.

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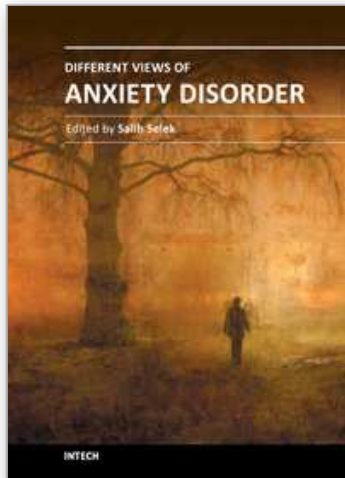
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Anxiety, whether an illness or emotion, is a term with historical roots even in the Bible, but it was not popular until the modern age. Today, we can group, diagnose and treat several anxiety disorders to an extent, but the assessment of symptoms and severity, dealing with resistant conditions, new treatment modalities and specific patient population, such as children, are still the challenging aspects of anxiety disorders. This book intends to present anxiety disorders from a different view and discuss a wide variety of topics in anxiety from a multidimensional approach. This Open Access book addresses not only psychiatrists but also a broad range of specialists, including psychologists, neuroscientists and other mental health professionals.

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