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The Decisive Moment *The Science of Decision Making under Stress*

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CHAPTER 13

The Decisive Moment

The Science of Decision Making under Stress

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In January 2009, US Airways Flight 1549 performed an emergency landing in the Hudson River after hitting a flock of birds and losing thrust in all engines. Decisions made by the pilot not to return to the airport of the flight's origin or to attempt to land at surrounding airports, but instead to bring the aircraft down in the icy cold waters between New York City and New Jersey, saved all 155 people on board. A few years earlier, on September 11, 2001, another plane had flown down the Hudson River, this time intentionally crashing into the North Tower of the World Trade Center. Seventeen minutes later, hijackers flew a second plane into the upper floors of the South Tower. On that fateful morning, there were two other deliberate plane crashes, one into the Pentagon and the other into a field in Pennsylvania. People around the world watched intently as firefighters and other emergency responders made critical decisions in their efforts to rescue some 20,000 people thought to have been in the towers that day. Subsequently, in Afghanistan and Iraq, military commanders made life and death decisions on battlefields. Through the use of mass media, people around the world are often eyewitnesses in near real time to the decisive moment when leadership is on the line and critical decisions are made to adapt to the danger of extreme events. Those watching the decision makers have infinite time to second-guess after the fact, free of the stress and personal drama that surround these decisions.

Many who operate and lead in dangerous contexts have stories of decisive moments of exercising their leadership. The *in extremis* (dangerous) core of decision making, however, is one of the least studied elements of the human

dimension.[1] The physical realities of professionals undertaking decisions in dangerous contexts, like firefighting and military operations, make this one of the most difficult environments for the application of science. Few researchers have endured the risk or unpredictability of studying human processes in the presence of danger, preferring instead less meaningful post hoc strategies. Nonetheless, understanding decision making in dynamic, complex situations where people's lives are at stake provides important insights into leadership in dangerous contexts.

Part of decision making involves when to employ which method to increase the odds of succeeding when leading in a dangerous context. To demystify this process, decision-making research will be applied here to personal experiences while peering inside the World Trade Center on September 11, visiting the battlefield, and going inside a cockpit during an emergency landing to see what it is like to make decisions when it counts the most. Examining the decisive moments for firefighters, soldiers, and airline pilots provides unique insight into how decisions are made under the stress and pressure of extreme events. Knowledge gained about decision making in dangerous environments can be applied to a broad range of businesses, governmental and nongovernmental services, or wherever leadership is expected to make critical decisions in a crisis.

THE ELEMENTS OF COMMAND AND DECISION MAKING

Extreme events require leaders to make critical decisions under a haze of uncertainty and perform complex organizational tasks, usually under tremendous stress. These leaders are asked to act decisively, yet remain flexible to a changing threat environment. The actual unpacking of decision making is a monumental task because researchers define the term in different ways, such as in relation to strategic thinking, psychology, neuroscience, and so on. In the nineteenth century, the military strategist Carl von Clausewitz wrote that during pre-battle evaluations, great commanders, such as Napoleon Bonaparte, saw how to win a battle in a "glance." Clausewitz uses the French expression coup d'oeil, which he describes as "the rapid discovery of a truth that to the ordinary mind is either not visible at all or only becomes so after long examination and reflection."[2] This "glance" is the moment during which commanders make sense of a situation and quickly envision a plausible course of action. Having this capability is the first element of command.

The second element of command is having the resolve to carry through with one's strategic intuition despite surrounding uncertainty. A simple plan

vigorously executed in a timely manner is almost always better than a complicated plan performed too late.[3] The third element is having the "presence of mind" not to ignore uncertainty but to remain flexible to the unexpected, which may require analytical thinking. Clausewitz discovered that great commanders first see what needs to be done and then resolve to follow their insights while adapting to the unexpected. These three elements of command are also seen today during emergency and military operations. Examples of the three elements can be seen in the actions of firefighters in New York City following the al-Qaeda attacks of September 11.

> On September 11, 2001, at 8:46 a.m., while operating in the street at a gas emergency in Lower Manhattan, a group of firefighters heard the roar of a low-flying commercial airliner accelerating as it flew down the Hudson River. Suddenly, the plane appeared, then aimed and crashed into the North Tower of the World Trade Center. No one could believe that on a perfectly clear day, a plane would crash into New York's tallest building. In an instant we knew that we were going to the biggest fire of our lives. I remembered trying to comprehend what took place and at the same time take command. My first order was a direct command: "Go to the World Trade Center." This was followed by a brief description on fire dispatch radio that a plane has crashed into the World Trade Center and to transmit a second alarm. Based on past experience at major fires, I knew I had to give concise orders to maintain command and control. These orders were given almost automatically, within seconds of impact and without fully understanding the magnitude of the event. Without hesitation, firefighters immediately mounted their fire trucks. With flashing lights and blasting sirens, we raced to the World Trade Center. The fire and the smoke coming from the upper floors of the World Trade Center fit the pattern of a high-rise building fire. But this was no routine fire.
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> The World Trade Center attack was a novel and complex event. Never before had a commercial plane deliberately crashed into a modern skyscraper. It did not match anything from our firefighting experience and was quit different from the accounts of a much smaller military B-25 plane crashing into the Empire State Building on July 28, 1945. As we responded to the World Trade Center, I remember telling myself that I had to slow my thoughts down and deliberately think of what I had to do next. There were tens of thousands of people that needed to be evacuated or rescued. I forced myself to remain calm.
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> Within a minute of my first radio transmission, I gave additional orders very precisely and deliberately over the Manhattan fire dispatch radio: "Battalion One to Manhattan, we have a number of floors on fire. It looked like the plane was aiming for the building. Transmit a third alarm. Have the second alarm report to the North Tower and have the third alarm stage at

> Vesey and West Street." This message began with an intuitive statement of the plane aiming for the building, denoting a terrorist attack, and an analytical order envisioning the initial resources needed and where to deploy these units. Over the next 100 minutes after this transmission, dramatic events of rescue and building collapse unfolded rapidly requiring critical decisions that combined intuition and analysis.

In a crisis, leaders are expected to not only use intuitive, gut feelings but also to apply rational thinking when making critical decisions. Each mode of decision making uses different parts of the brain, with one mode outperforming the other depending on the task that needs to be accomplished. The key to good decision making in dangerous situations is knowing when to rely on which mode of thinking and when to use both. The battlefield is replete with examples of commanders constantly switching from one mode to another or sometimes applying a hybrid approach. For example, on April 5, 2003, less than two weeks after ground forces started moving north into the country of Iraq, U.S. military forces conducted raids through the center of the Iraqi capital, Baghdad. Three battalions, fewer than a thousand combat soldiers, had launched an aggressive thrust of Abrams tanks and Bradley fighting vehicles into the heart of the city, and in three days of bloody combat ended the initial phases of the Iraq War. The surprise assault on Baghdad, spearheaded by the Spartan Brigade commander, Colonel David Perkins, who led the 2nd Brigade of the 3rd Infantry Division (Mechanized), is an illustration of one leader's intuition that a single armored brigade would be able to successfully penetrate and literally capture a city defended by one of the world's largest armies.

Using a combination of intuition (I have sufficient combat strength to accomplish the mission) and analytical thinking (my logistics can support this initiative), Perkins declared on April 7, "If I can spend a night in Baghdad, then this war is over." Organized resistance by defenders of the regime of Saddam Hussein essentially ended after this commander's bold action. Thus, a decision by a commander on the ground potentially saved lives by ending the immediate armed resistance. Some of the highest officers in the U.S. military command found out about Perkins' tactical exploitation of the enemy only after seeing media coverage of it. The operation exceeded their expectations. The critical combination of intuition and analytical thinking were paramount. The decisive moment in dangerous situations requires the ability to switch and combine the different modes of thinking.[4]

INTUITIVE THINKING VERSUS ANALYTICAL THINKING

The most widely accepted rational model for decision making derives from the work of I. L. Janis and L. Mann, who define decision making as a process of comparing a range of options, evaluating them, reexamining their positive and negative consequences, rating them, and then determining the best option.[5] The difficulty is that rational decision making has limited application in a dangerous situation, where leaders are forced to act quickly and without comprehensive information. Rational decision making works well with simple events or even complicated ones when there is sufficient time to analyze and compare the facts; this, however, is not how firefighters, soldiers, or pilots operate at the scene of complex or dangerous incidents, where fire or bullets are flying or a plane has no power. Those confronted with such situations depend heavily upon their intuition in deciding what actions to take. Yet, analytical decision making is also called upon during emergencies to craft creative solutions for novel events. Problems might arise from a lack of guidance regarding when best to use intuition and when to switch to rational analysis. To fully comprehend decision making, one should examine research on it in the psychology and neuroscience literature.

The psychologist Gary Klein has done extensive research on the decision making of firefighters and combat soldiers. Based on his analysis, they make decisions by using cues to recognize a situation as typical (or atypical) and to decide a course of action by relating it to their experience.[6] Developing a quick course of action benefits from pattern matching and envisioning how actions will be carried out while also adapting to the evolving situation. This means that firefighters and soldiers do not compare all possible options, but choose the solution most likely to work based on prior experience.[7] These experiences are rooted in past events or training or are vicariously experienced through the study of after action reviews and history. If an option is not working, it is immediately customized or abandoned and a new solution created. This permits firefighters and soldiers to adapt quickly and avoid being paralyzed by evaluating endless possibilities. These types of decisions are further defined by A. Dijksterhuis and L. F. Nordgren as a gut feeling and by the popular writer Malcolm Gladwell as decisions that occur in "blink."[8] Here, researchers believe that intuition, which is recognizing what to do without fully being conscious of why one has this knowledge, plays a critical role in decision making.

To explain intuition, J. Lehrer explores the inner working of the brain. He argues that emotions that trigger intuitive insight occur when the neural transmitter dopamine is released. Dopamine automatically detects subtle patterns based on experiences that are not consciously noticed.[9] The more

experience and knowledge one has, the more likely a new incident will match a pattern from the past. Intuition or the emotional brain is especially useful in making immediate decisions in life-threatening situations. It is the supercomputer of the brain, rapidly scanning past experience to find relevant information that matches the current condition.[10]

Another example of high-stakes decision making with lives on the line occurred on January 15, 2009. After taking off from New York's LaGuardia Airport, US Airways Flight 1549 struck a flock of geese, which caused the plane to lose thrust in both engines. Captain Chesley "Sully" Sullenberger radioed a Mayday message, stating that the plane had lost power and was turning back toward LaGuardia. The air traffic controller suggested runway 13. Sullenberger "knew intuitively and quickly that the Hudson River might be [the] only option, and so articulated it." He responded to the controller, saying, "We're unable; we may end up in the Hudson."[11] Sullenberger next, however, considered Teterboro Airport, in nearby New Jersey. After being told by the air traffic controller that he was cleared for an emergency landing on runway 1, Sullenberger said, "We can't do it." Not wanting to believe the gravity of the situation, the air traffic controller again asked Sullenberger which runway he would like at Teterboro. Sullenberger immediately replied, "We're gonna be in the Hudson."

Desperate to come up with another option, the air traffic controller suggested Newark International Airport, which was a few miles away, but the decision was already made. Captain Sullenberger then narrowed his focus to concentrating on landing the aircraft in the icy Hudson. The airplane skidded along the surface of the water and turned slightly left before it came to a stop near the Intrepid Air and Sea Museum. Sullenberger, realizing that the airplane was in danger of sinking, opened the cockpit door and gave a single order: "Evacuate."

During three critical minutes of flight, Captain Sullenberger did not try to compare all of his options before determining the best choice, but instead considered one at a time that he thought might work. He later wrote that there was not enough time to calculate the plane's rate of decent. Instead, he created a "three-dimensional mental model" of the situation to determine if his choice could be executed.[12] This type of decision making fits Klein's recognition-primed decision-making model. As each of Sullenberger's mental simulations failed in his search for the likely option that might work, he came to realize the best option was the Hudson River.[13] Making decisions in dangerous circumstances requires the intuitive brain to size up the situation and form the initial impulse about what to do.[14] The analytical brain then can be used to process the mental simulations to see if the option will work. Pilots

often refer to the skill to think during a crisis as creating a "deliberate calm," which blends intuitive pattern matching with analytical thinking. Analytical thinking occurs in the prefrontal cortex of the brain.[15] It is where calculations are computed, logical sequences processed, and rational thinking takes place. This part of the brain also can turn off impulses, which is what Sullenberger did when he decided not to act on his first thought—to return to LaGuardia—but decided instead to land in the Hudson River.

COMBINING INTUITION AND ANALYSIS TO MANAGE DANGEROUS SITUATIONS

Intuition is good for matching patterns based on experience, but when someone encounters a novel problem that does not match his or her experience, and dopamine secretions fail to generate the desired neuronal connections, it is essential, Lehrer argues, to remain calm and analyze the situation to generate a flash of insight.[16]

On September 11, 2001, even the smallest decision was the difference between life and death. As events rapidly evolved, it was essential that emergency responders blend intuition with analytical thinking. Upon arriving at the World Trade Center, firefighters initiated rescue operations by evacuating people from the buildings and trying to rescue those trapped by the raging inferno. Firefighters carried heavy rescue equipment and self-contained breathing apparatus as they ascended the narrow stairs. Along the way they encouraged people not to stop to rest, but to keep moving down the stairs and to exit the buildings. Little did anyone know that the fires were weakening the structural integrity of each building, and time was running out.

> At 9:59 a.m., we heard a load roar and felt the building rumble. Unbeknown to us in the North Tower, this was the sound of the collapsing South Tower. In a fraction of a second, we knew something was seriously wrong and quickly moved a few meters from the lobby command post to a passageway leading up to a pedestrian walkway over six lanes of traffic on West Street. This gut feeling or intuition was generated not by knowledge of the collapsing South Tower, but by matching the loud roar to the experience of similar sounds of structural collapse. Immediately we interpreted this sound as a dangerous condition to us in the lobby and looked for shelter. This took place within an instant, without any analysis or second thought. I knew we had to move quickly from where we were standing. Seconds later, we were covered with choking dust and complete darkness, making it difficult to breath and impossible to see the hand in front of your face.

Many firefighters, without consciously understanding what was taking place, made this intuitive decision, which saved them from being killed by flying debris. J. LeDoux proffers that intuition or gut feeling buys time while rational thought searches for a solution to a novel event.[17] In the example above, instead of spending time analyzing what was happening, the intuitive part of the firefighters' brains quickly processed information and came up with the idea to leave the lobby. Firefighters and soldiers often use this type of decision making in times of danger. Klein also suggests that intuition precedes analysis.[18] People with expertise know what to look for when sampling environmental stimuli. L. Shattuck, J. Merlo, and J. Graham found that more experienced military leaders, based on time in service and rank, tend to ask for less information when making decisions than do officers with less experience.[19] Their study of military leaders' decision making, which they termed "cognitive integration," suggests that experienced leaders' intuition allows them to sample a small number of sources, ignoring those they deem not worthy of consideration. Less-experienced officers sample all sources of information available and usually as much of each as allowed.[20]

> Switching from intuitive thought to rational analysis is even more difficult under dangerous and high-stress conditions. Immediately after the loud rumbling stopped (later we learned the sound was from crashing steel and concrete), some of the Chiefs continued to use their intuition to issue orders that "we have to get out of here." Certainly, this was a good idea and a major concern when you do not know how to get out of the building. But this was a building that I was very familiar with and I had been to hundreds of times. Even in total darkness I had a good idea on how to get out. My experience and knowledge of the World Trade Center complex allowed me a few seconds to switch my thinking from intuition to analyze. Here I was able to focus on the next most important action to take, besides our own escape. It was clear that if we could no longer command from the lobby of the North Tower (Tower 1), we had to withdraw the firefighters from the building. I depressed the transmission button on my portable radio and gave the following firm order, "Command to all units in Tower 1, evacuate the building."[21]

While this may sound like an obvious decision for those watching broadcasts of events on September 11, it was not that obvious for those at the World Trade Center who did not have the same information, that is, that the South Tower had collapsed. Those in command at the North Tower had to overcome cognitive biases to continue rescue operations and instead to make a decision that had never been made in the history of the New York City Fire Department—abandon a burning building with hundreds of people still

trapped inside. The novelty of the 9/11 attacks did not allow the firefighters to match their experience to past patterns of commanding and follow standard procedures. Instead, it forced them to become creative in the decisions they made. A. Howitt and H. Leonard note that emergency responders need to improvise when confronted with novel events.[22] Many of the people that were saved on September 11 owe their lives to improvisational thinking.

Lehrer points out that emotions are adept at finding patterns based on experience, but when someone encounters an event never before experienced, he or she needs to deliberately analyze the situation to devise innovative solutions.[23] On 9/11, instead of responding to the gut feeling to get out of the North Tower, the firefighters there concentrated on continuing to command. The prefrontal cortex is uniquely designed to manage emotions, filter out extraneous information, and search for creative solutions to complex problems. Switching from intuitive to analytical thinking allowed emergency responders to focus on commanding, which led to the flash of insight to evacuate firefighters from the North Tower.

In immediately dangerous contexts, people act first and then try to make sense of the situation.[24] In complex contexts, however, leadership involves probing first, making sense of the situation, and then responding.[25] Leaders allow new patterns to emerge. The decision making in the North Tower of the World Trade Center is an example of this blending of intuition and cognition. Intuition gave the firefighters the extra seconds needed to conduct more analytical reasoning to adapt to the novelty of the situation.

> After giving the evacuation order and finding our way out, we stood under the north pedestrian bridge over West Street, connecting the World Trade Center to the World Financial Center. The street was covered with paper and the air filled with a brownish-gray dust. The Marriott hotel that was between the North and South Towers was heavily damaged and the incident command post, overseeing command of rescue operations in both towers, was abandoned. This critical situation with novel sensory information made little sense. Even standing in the street, we never received word that a 110-story office building just collapsed nor could we see the collapsed South Tower because of the dust. I remember forcing myself to comprehend what possibly could have taken place. The more I tried to analyze the situation, the longer it took to make a decision on what to do next. Little did we know that the North Tower was about to collapse and crush the overpass we were standing underneath. My intuition could not match what I was seeing to any experience and my analysis failed to make sense of the scene.
>
> Then suddenly, I felt this cold chill running down my spine that this was a bad place to stand. Immediately, I acted quickly to lead the group

> I was with out from under the pedestrian bridge and north to the corner of West and Vesey Streets. Key to this decision was the ability to have the presence of mind to switch between the two modes of thinking and not be paralyzed by too much analytical thinking.

Adaptability in dangerous contexts requires the ability to oscillate between intuitive and analytical modes of thinking for decision making.

BARRIERS TO DECISION MAKING

Dangerous conditions demand that personnel who perform in such contexts prevail over physical, cognitive, and organizational limitations to carry out their mission. In extreme danger, these limitations become barriers for leaders to overcome in their decision making.

Physical Limitations

Warriors and emergency responders operate in conditions that can and do impose significant demands on the senses, limiting the ability to communicate through normal auditory and visual pathways. Noise (e.g., vehicle engines, power tools and gushing water, weapons fire) and murky conditions (e.g., smoke, sandstorms) can hinder the ability to communicate critical information. Under high stress, an attentional narrowing of the senses occurs that can, for example, reduce one's peripheral vision.[26] This affects perception by the senses as outlined in the above example of the environmental factors present at ground zero. These physical challenges make it extremely difficult to scan, focus, make decisions, and act. Heat, cold, exhaustion, and a host of other stressors can have debilitating effects on the long-term and working memory.[27]

Cognitive Limitations

Many military strategists emphasize that the strength needed to win future wars will be more cognitively based than kinetically based.[28] This assertion rings true for emergency responders as well. Early tactical decisions made in the handling of dangerous emergencies will have significant operational-level effects on outcome. In such situations, leaders will need to overcome their cognitive biases to increase the quality of their decisions when lives are involved.

Decision makers constantly try to make sense of context. M. Endsley points out that sensemaking is backward focused, finding reasons for past events, while situation awareness is typically forward looking, projecting what is likely to happen in order to inform effective decision-making processes.[29] Decision making relies on seeing what has happened and anticipating what

Table 13.1 Common Decision Making and Behavioral Biases

Automation bias	The tendency to trust information provided via electronic information systems over intuition or humans; accepting information derived from the use of automation as a "best guess" instead of vigilant information seeking and processing
Bandwagon effect	The tendency to do (or believe) things because other people do, with the goal of gaining in popularity or being on the winning side
Confirmation bias	The tendency to search for or interpret information in a way that confirms one's preconceptions or course of action.
Professional deformation	The tendency to look at things according to the conventions of one's profession, ignoring broader points of view
Denial	The tendency to disbelieve or discount an unpleasant fact or situation
Expectation bias	The tendency to believe or certify results or analysis that agree with one's expectations of an outcome and to disbelieve, discard, or downgrade corresponding weightings for information that appears to conflict with those expectations
Extreme aversion	The tendency to avoid extremes, being more likely to choose an option if it is the intermediate choice
Framing effect	The drawing of different conclusions based on how data are presented
Illusion of control	The tendency to believe that one can control or at least influence outcomes that one clearly cannot
Information bias	The tendency to seek information even when it cannot affect action
Loss aversion	The disutility of giving up an object is greater than the utility associated with acquiring it
Normalcy bias	The tendency to discount novelty and to respond to such events with only routine procedures
Neglect of probability	The tendency to completely disregard probability when making a decision under uncertainty
Not invented here	The tendency to ignore that a product or solution already exists because its source is seen as an adversary
Reactance	The urge to do the opposite of what someone wants one to do out of a need to resist a perceived attempt to constrain one's freedom of choice
Selective perception	The tendency for expectations to affect perception
Unit bias	The tendency to want to finish a given unit of a task or an item often resulting in sequential behavior limiting simultaneous tasks
Wishful thinking	The formation of beliefs and making decisions according to what might be pleasing to imagine instead of by appealing to evidence or rationality
Zero-risk bias	Preference for reducing a small risk to zero instead of a greater reduction in a larger risk

might happen. So, how does an expert process information? Along with understanding context and noticing information, cues, and data in the environment, or the lack of certain cues, an expert often also has the ability to tune out unnecessary information. Sometimes leaders can successfully employ cognitive shortcuts by utilizing heuristics, or rules of thumb. These tactics and techniques, however, cannot alone be relied upon.

Instructing leaders on the dangers and benefits of types of cognitive shortcuts or strategies that are used consciously and unconsciously will potentially make a better decision maker, or at least a more informed one, especially under extreme conditions, when physical and cognitive resources are potentially at their limits. The benefits of shortcuts for decision making are self-evident, for example, deciding which exit of a plane one would choose in an emergency or formulating an escape route when searching an apartment on fire. The pitfalls of certain heuristics and biases are, however, well known, from the framing of decisions to the readiness to use what is available to the memory, or the availability heuristic.[30]

Cognitive biases are essentially mental errors caused by simplified information-processing strategies. It is important to distinguish cognitive bias from other forms of bias, such as cultural bias, organizational bias, or bias that results from one's own self-interest. In other words, a cognitive bias is not necessarily the result of an emotional or intellectual predisposition toward a certain judgment, but rather of subconscious mental procedures for processing information.[31] One of the ways to avoid the pitfalls and shortcomings associated with cognitive heuristics and biases is to be aware of them and to use simulations to practice overcoming them. Table 1 lists some common decision-making and behavioral biases of which all decision makers should be aware.

Organizational Limitations

While cognitive bias may blind individuals to emerging threats, organizational factors may prevent the integration of information until it is too late.[32] As events move from routine to complex, emergency responders and members of the military tend to "segregate" functional tasks. What was once a convenient division of labor mutates into specialized fiefdoms, with little contact or communication between people performing one task and those performing another.[33] This separation creates organizational blind spots in decision making. There is a natural tendency for people with similar backgrounds to form homogeneous groups and provide more information to members of their own group and less to members outside the group. The organizational behavior of separating and providing information only within a certain group is known as organizational bias.[34] In some businesses, such behavior is necessary for

maintaining a competitive advantage over the competition. In dangerous contexts, however, such behavior potentially limits situational awareness, which creates barriers for decision making and commanding.

The propensity of similar individuals to migrate to each other is called homophily.[35] Evidence has been found that as the stress and complexity of a crisis increase, people tend to narrow their focus on aspects they judge to be most important to them.[36] In extreme danger, they often feel little obligation to share valuable information with those outside their group, since responsibility for acting is diffused across the in-group. In most cases, people think that someone else in their organization will share the information. In social psychology this concept is referred to as a diffusion of responsibility and is what often leads to the well-known bystander effect.

NOVELTY AND COMPLEXITY POINTS TO INTERDEPENDENCE

Fire chiefs, military commanders, and airline pilots dominate the examples cited here, but most professionals who regularly operate in dangerous contexts have the authority and often the experience to deal with critical situations—until perhaps they are faced with novel and complex events. These events by their very nature are characterized as having interagency dependencies for collaborative intelligence, requiring decisive leadership to overcome cognitive and organizational biases. A failure to address biases will result in a lack of situational awareness and poor decision making, which places leaders and managers at a disadvantage in handling crises. During complex and novel events, incident management does not rest with a single person; rather, leaders should increase the rate of information exchange and foster collaboration to generate new tactics and ideas. The key issue for decision makers is often not the ability to acquire more knowledge, but the ability to harness the knowledge of others.

On May 1, 2010, emergency responders had to overcome cognitive and organizational biases when they were called to a possible vehicle fire in New York's Times Square. When firefighters arrived, they noticed that something "did not seem right." The owner of the SUV was nowhere to be found, and there was white smoke coming from the car rather than black smoke. A handheld thermal camera showed no sign of fire, and an odor of fireworks emanated from the rear of the vehicle. Firefighters exchanged this information with police and asked them to run the license plates. The plates did not match the car. The fire lieutenant had to quickly process all these pieces of information.

It would have been easy for the lieutenant to have fallen victim to a number of cognitive biases and treat the incident as a routine car fire. Instead, he

concluded that they had a car bomb on their hands. He avoided organizational bias by collaborating with police throughout the process, which led to a decision to evacuate people from the area. Combining intuition with analysis and overcoming biases to recognize interdependencies of information were critical for safety. It was later determined that the SUV had the potential to be a lethal bomb.

IMPROVING DECISION MAKING

An ongoing effort exists to find technological answers to address the physical dangers, cognitive puzzles, and organizational challenges that push leaders to their limits. The New York City Fire Department has developed an electronic command board (ECB) system to assist chiefs in decision making at fires and emergencies. ECBs are touch-screen computers for a network that displays such information as unit deployment, emergency distress signals, and digital blueprints of floors and other building information. Large (32-inch) ECB displays are used for major fires, but there are also smaller (10-inch) tablets, both of which graphically present essential information for decision making. As an incident increases in complexity, incident commanders are forced to remember dozens of unit names and locations within a building, while still managing the fire (or fires). Trying to manage too much information can overload the brain's working memory, adding to the stress of command and limiting one's ability to concentrate on critical aspects of incident management. The ECB frees the brain from memorizing facts by displaying them in easy-to-grasp pictures. This prevents chiefs from being overwhelmed by information occupying valuable cognitive space, and instead to concentrate on managing the incident, which requires the brain to blend intuitive and analytical decisions. ECB is part of a wireless decision-support system that can share information with other first responders at the scene and emergency operation centers elsewhere, thus creating a common operational picture and collaborative decision-making environment.

The military strategist Clausewitz states that war is influenced primarily by human beings rather than technology or bureaucracy, although technology advancements indeed change the tactics, techniques, and procedures used. Exercising leadership in dangerous contexts is not only about individual decisions, but also about getting others to adapt to a new threat environment. In extreme events, such as those terrorist attacks, military conflicts, and aviation emergencies, decision making is an interdependent activity, requiring collaborative intelligence. The challenge is to design a response system able to support and adjust readily to the urgent demands of events.

Providing decision makers with access to information from within and outside their agencies that normally would not be available can now be done through networks. Such networks have the emergent property of the whole being greater than the sum of its part because of the interaction and interconnection of their members.[37] This fact was acknowledged through the Goldwater Nicholas Act of 1986 and by the 9/11 Commission by requiring and reiterating that military and emergency responders must operate together in a unified system to be as effective as possible.

Initiatives are under way to develop means to allow military and emergency responders to accumulate life experiences through the use of virtual simulations. These simulations should be designed to adapt and respond to decision makers in an intelligent manner and portray cognitively, culturally, and intellectually accurate and challenging scenarios focused on identifying, developing, improving, and assessing intuitive and analytical decision-making skills. The development of such simulators will provide leaders with the chance to learn and train through scenarios that replicate life experiences, repetitiously and with low overhead and little risk.

Human factors—the cognitive, cultural, and intellectual aspects of conflict—are proving increasingly to be the vital elements determining success on the battlefield. It is the proper application of technology to aid the human, that is, engineered with the human in mind, that will leverage human capabilities and enhance human performance. For example, a well-designed interface that elicits personal interaction could lead to a self-referent memory approach by a trainee, potentially improving accurate recall when a similar situation arises.[38] This type of interaction with a simulator supports the theory of recognition-primed decision-making.[39] If properly exploited through interfaces it could promote perceptual learning in the areas of intentional weighting, stimulus imprinting, differentiation, and unitization.[40] These facets of cognitive psychology and learning are addressed in flight simulators, while military and law enforcement organizations try to do the same with firearm and gunnery simulators and fire departments with high-rise building fire and flashover simulators.

While a positive transfer of training is expected from virtual experiences, a host of other benefits can be realized with a well-made decision trainer. One can build crisis decision-making proficiencies—the deliberate practicing of skills—using dynamic scenarios for use on tabletops as well as devising full-scale exercises that promote intuitive and analytical decision making under stress, teaching leaders to blend reason with emotions. These simulators could be used to assist the development of individual and collaborative decision making.

Instructional methods for developing expertise must couple new technologies with seasoned experts, allowing simulations to compress experience into efficient repetition. The simulations should challenge trainees to adapt to novelty as well as act reflexively based on a strong grounding from what has happened in the past. Because time will not stop, and junior leaders require skills immediately upon entering high-risk occupations, it is necessary to accelerate the development of expertise by forming a cognitive apprenticeship with leaders recognized as being successful. Effective instructional methods provide mental schemas, allowing the organization of learning so leaders can match solutions to past or ongoing problems and create innovative courses of action for tomorrow's new problems. This type of approach should aim to improve long-term memory for ready recall in dealing with future extreme situations. Training needs to support guided discovery using the experiences of veteran leaders and include learning from errors through naturalistic feedback. Leaders must be given time to reflect individually as well as collaboratively with peers and coaches on how to use the two modes of decision making to adapt to threat environments or crises.

LEADERSHIP IMPLICATIONS

Extreme events require leaders to place people in dangerous situations to contain and mitigate hazard. Using their understanding of decision making and behavioral biases, and with the help of simulations and repetitive training, successful leaders employ a blend of intuition and analytical decision making. Although technology continues to influence decision makers at all levels, tactics, techniques, and procedures only change as a direct result of the coupling of humans with the technology. The skillful integration of human and machine results in improved performance, which in the end can save lives.

In stressful situations, leaders overcome ever-changing physical, cognitive, and organizational environments to make critical decisions by producing a deliberate calm. The professionals who make leadership decisions under such extreme conditions exhibit remarkable fortitude and resilience. Those who operate in dangerous conditions have chosen a lifestyle that embraces challenges. They not only aim to survive harsh environments, but they thrive in them as well. Effective decision making under stress requires a balance between cognitive intuition and analysis. The stirring stories of 9/11, military battles in Iraq, and the emergency landing in the Hudson River illustrate the need to be armed with the knowledge of human cognitive capabilities and the understanding of strengths and weaknesses of the modes of decision making.

Decision making in a crisis becomes more difficult with increased complexity and the need for rapid solutions. Not only will firefighters, military, and pilots face decisive moments in their careers, executives will also find themselves making critical leadership decisions in business. Supplementing the individual decision making skills discussed in this chapter, collaborative decision making is the next inescapable leadership challenge and thus necessitates further research.

NOTES

Joseph Pfeifer of the New York City Fire Department served as a battalion chief on September 11, 2001. He was the first chief on the scene and directed part of the operations that day. The firsthand accounts in this chapter are his.

1. T. Kolditz, *In Extremis Leadership: Leading As If Your Life Depended on It* (San Francisco: Jossey-Bass, 2007).
2. C. von Clausewitz, *On War* (London: Penguin, 1968; original work published 1832), 142.
3. R. Marshal, ed., *Infantry in Battle* (Washington, D.C.: Marine Corps Association, 1982).
4. D. Zucchino, *Thunder Run: The Armored Strike to Capture Baghdad* (New York: Grove, 2004).
5. I. L. Janis and L. Mann, *Decision Making: A Psychological Analysis of Conflict, Choice and Commitment* (New York: Free Press, 1977).
6. G. A. Klein, *Sources of Power: How People Make Decisions* (Cambridge, Mass.: MIT Press, 1998).
7. G. A. Klein and D. MacGregor, *Knowledge Elicitation of Recognition-Primed Decision Making* (Fairborn, Ohio: Klein Associates, 1987). Report under contract MDA903–86-C-0170 for the U.S. Army Research Institute Field Unit, Ft. Leavenworth, Kansas.
8. A. Dijksterhuis and L. F. Nordgren, "A Theory of Unconscious Thought," *Perspectives on Psychological Science* 1 (2006): 95–109; M. Gladwell, *Blink: The Power of Thinking Without Thinking* (New York: Little, Brown, 2004).
9. J. Lehrer, *How We Decide* (New York: Houghton Mifflin, 2009), 48.
10. Ibid., 248.
11. C. Sullenberger, with J. Zaslow, *Highest Duty: My Search for What Really Matters* (New York: Harper Collins, 2009), 223.
12. Ibid., 223–224.
13. G. A. Klein, *Streetlights and Shadows* (Cambridge, Mass.: MIT Press, 2009), 92.
14. Ibid., 94.
15. Lehrer, *How We Decide*.
16. Ibid., 128.
17. J. E. LeDoux, *The Emotional Brain* (New York: Simon and Schuster, 1996), 175.

18. Klein, *Sources of Power*.
19. L. G. Shattuck, J. L. Merlo, and J. Graham, "Cognitive Integration: Exploring Performance Differences across Varying Types of Military Operations," in *Proceedings from the Fifth Annual Federated Laboratory Symposium on Advanced Displays and Interactive Display* (College Park, Md.: Army Research Laboratory, 2001).
20. Ibid.
21. National Commission on Terrorist Attacks Upon the United States, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States* (New York: W. W. Norton, 2004), 306.
22. A. M. Howitt and H. B. Leonard, eds., with David Giles, *Managing Crisis: Response to Large-Scale Emergencies* (Washington, D.C.: CQ Press, 2009).
23. Lehrer, *How We Decide,* 128.
24. Ibid.
25. D. J. Snowden and M. E. Boone, "A Leader's Framework for Decision Making," *Harvard Business Review*, November 2007, http://hbr.org/magazine.
26. C. M. Janelle, R. N. Singer, and A. M. Williams, "External Distraction and Attentional Narrowing: Visual Search Evidence," *Journal of Sport and Exercise Psychology* 21 (1999): 70–91.
27. W. C. Harris, P. A. Hancock, and S. C. Harris, "Information Processing Changes Following Extended Stress," *Military Psychology* 17 (2005): 115–128.
28. R. H. Scales, "Clausewitz and World War IV," *Armed Forces Journal*, July 2006, http://www.armedforcesjournal.com/2006/07/1866019.
29. M. R. Endsley, "Situation Awareness: Progress and Directions," in *A Cognitive Approach to Situation Awareness: Theory, Measurement and Application,* ed. S. Banbury and S. Tremblay (Aldershot, UK: Ashgate, 2004), 317–341.
30. A. Tversky and D. Kahneman, "The Framing of Decisions and the Psychology of Choice," *Science* 211 (1981): 453–458; D. Kahneman, P. Slovic, and A. Tversky, *Judgment under Uncertainty: Heuristics and Biases* (New York: Cambridge University Press, 1982).
31. D. Kahneman and G. Klein, "Conditions for Intuitive Expertise: A Failure to Disagree," *American Psychologist* 64 (2009): 515–526.
32. M. H. Bazerman and M. D. Watkins, *Predictable Surprises* (Boston: Harvard Business School Press, 2004).
33. P. M. Senge, *The Fifth Discipline* (New York: Doubleday, 2006), 24.
34. J. W. Pfeifer, "Understanding How Organizational Bias Influenced First Responders at the World Trade Center," in *Psychology of Terrorism,* ed. B. Bongar et al. (New York: Oxford University Press, 2007), 207–215.
35. M. McPherson, L. Smith-Lovin, and J. M. Cook, "Birds of a Feather: Homophily in Social Networks," *Annual Review of Sociology* 27 (2001): 415–444.
36. K. E. Weick, *Sensemaking in Organizations* (London: Sage, 1995).
37. N. A. Christakis and J. H. Fowler, *Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives* (New York: Little, Brown and Company, 2009), 26.

38. T. B. Rogers, N. A. Kuiper, and W. S. Kirker, "Self-Reference and the Encoding of Personal Information," *Journal of Personality and Social Psychology* 35 (1977): 677–688.
39. G. A. Klein, "Recognition-Primed Decision," *Advances in Man-Machine Systems Research* 5 (1989): 47–92.
40. R. L. Goldstone, "Perceptual Learning," *Annual Review of Psychology* 49 (1998): 585–612.