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PERCEPTUAL AND COGNITIVE BIAS IN INTELLIGENCE ANALYSIS AND DECISION-MAKING

by

Lloyd (Chad) Jones

December 2005

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The history of man is written in choice. Whether simple or complex, on a whim or after labored consideration, inflamed by passion or calculated coolly, the judgments that we form and the choices that we make define who we are and what we want for the future. Yet most of us have little or no conscious awareness of the inner workings of our own minds. We often choose without understanding or accounting for the perceptions, intuitions, and inferences that underlie our decisions. So how do people make decisions? How do we cope with the volume and complexity of information in our environment without being overwhelmed? How do we use our senses to select and process this information, and how do we organize, contextualize, and conceptualize it once it reaches our brains? How do we form judgments about the value of a specific piece of information or about the likelihood of a particular event or outcome? And what are the factors that lead us astray? The search for answers to these questions is more than academic; understanding the fundamentals of perception and cognition is critical to effective analysis and decision-making. For those involved in national security, and particularly for those involved in the collection and analysis of national intelligence, an appreciation of the intricacies of these processes has real-world implications. As evidenced by the dramatic intelligence failures of the last few years, and in particular by the mistaken assessment concerning Iraqi weapons of mass destruction, understanding how we arrive at judgments and decisions can be quite literally a matter of life and death.

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PATTERNS OF ERROR: PERCEPTUAL AND COGNITIVE BIAS IN INTELLIGENCE ANALYSIS AND DECISION-MAKING

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ABSTRACT

The history of man is written in choice. Whether simple or complex, on a whim or after labored consideration, inflamed by passion or calculated coolly, the judgments that we form and the choices that we make define who we are and what we want for the future. Yet most of us have little or no conscious awareness of the inner workings of our own minds. We often choose without understanding or accounting for the perceptions, intuitions, and inferences that underlie our decisions. So how do people make decisions? How do we cope with the volume and complexity of information in our environment without being overwhelmed? How do we use our senses to select and process this information, and how do we organize, contextualize, and conceptualize it once it reaches our brains? How do we form judgments about the value of a specific piece of information or about the likelihood of a particular event or outcome? And what are the factors that lead us astray? The search for answers to these questions is more than academic; understanding the fundamentals of perception and cognition is critical to effective analysis and decision-making. For those involved in national security, and particularly for those involved in the collection and analysis of national intelligence, an appreciation of the intricacies of these processes has real-world implications. As evidenced by the dramatic intelligence failures of the last few years, and in particular by the mistaken assessment concerning Iraqi weapons of mass destruction, understanding how we arrive at judgments and decisions can be quite literally a matter of life and death.

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I. INTRODUCTION

The history of man is written in choice. Whether simple or complex, on a whim or after labored consideration, inflamed by passion or calculated coolly, the judgments we form and the choices we make define who we are and what we want for the future.

Yet most of us have little or no conscious awareness of the inner workings of our own minds. The functions associated with choice in particular are often "conducted prior to and independent of any conscious direction" (Heuer, 1999, p. 3). What spontaneously appears in our consciousness at the end of cognition is the product, not the process, of thinking. We often choose without understanding or accounting for the perceptions, intuitions, and inferences that underlie our decisions.

So how *do* people make decisions? How do we cope with the volume and complexity of information in our environment without being overwhelmed? How do we use our senses to select and process this information, and how do we organize, contextualize, and conceptualize it once it reaches our brains? How do we form judgments about the value of a specific piece of information or about the likelihood of a particular event? And what are the factors that lead us astray?

The search for answers to these questions is more than academic; understanding the fundamentals of perception and cognition is critical to effective analysis and decision-making. For those involved in national security, and particularly for those charged with the collection and analysis of national intelligence, an appreciation of the intricacies of these processes has real-world implications. As evidenced by the dramatic intelligence failures of the last few years, understanding how we arrive at judgments and decisions can be quite literally a matter of life and death.

A. THEORIES OF CHOICE

1. The Classic Theory

Any discussion of choice must begin with an acknowledgment of the long shadow cast by the classical model of rational choice. Applied most vigorously in the study of economics, the model's influence is apparent in virtually all of the behavioral and social sciences. According to this model, people choose which options to pursue by assessing the probability of each possible outcome, discerning the utility to be derived from each, and combining the two assessments. We pursue the option that offers the optimal combination of probability and utility (Gilovich, Griffin, & Kahneman, 2002, p. 1).[1]

"Calculations of probability and multi-attribute utility can be rather formidable judgments to make, yet the theory of rational choice assumes that people make them, and make them well" (Gilovich et al, 2002, p. 2). Proponents of this theory do not believe that people are flawless in these calculations, but they do insist that any mistakes are not systematic. The model assumes that a rational actor will follow the elementary rules of probability and expected value when calculating, for example, the likelihood of a particular candidate winning an election, the risks involved in a surgical procedure, or the odds of winning a game of poker (p. 2).

The rational choice model has a number of important implications. If we accept an actor's values as given (and consistent), if we postulate an objective description of the world as it really is, and if we assume the actor's computational powers are unlimited, then two important consequences follow. "First, we do not need to distinguish between the real world and the rational actor's perception of it; he or she perceives the world as it really is. Second, we can predict the choices that will be made by a rational actor entirely from our knowledge of the real world and without knowledge of the actor's perceptions or modes of calculation" (Simon, 1986, pp. 210-211).

Yet is the average person as attuned to the axioms of formal rationality as this stance demands? Countless studies and experiments over the past half century indicate that people's assessments of likelihood and risk do not conform to the mathematical laws necessary to validate this theory. In one of the earliest empirical studies on the subject, Paul Meehl (1954) compiled evidence comparing expert clinical prediction with actuarial methods and found that the statistics were consistently more accurate than the clinicians (as cited in Gilovich et al, 2002, p. 2). His research also uncovered a sharp discrepancy between the clinicians' assessments of their performance and their actual record of success. This juxtaposition of modest performance and robust confidence inspired a slew

[1] The classic theory of rationality assumes nothing about the content of the actor's objectives, only that whatever those objectives, the actor has reviewed all alternatives and accurately assesses all consequences in making the value-maximizing choice (Allison & Zelikow, 1999, p. 18).

of research on faulty processes of reasoning that yield compelling yet mistaken inferences. In what became a key methodological contribution by introducing Bayesian analysis to psychology, Ward Edwards (1963) provided a normative standard with which everyday judgments could be compared. From his research, and from much of what followed, it became clear that intuitive judgments of likelihood rarely match the normative standard (as cited in Gilovich et al, 2002, p. 2).

2. Bounded Rationality

Herbert Simon (1959) became the first to directly challenge the classical model of rational choice, noting that in practice, analysis and decision-making is less than fully rational; it is constrained by inescapable limitations in the knowledge and computational ability of the analyst or decision-maker. He proposed a more limited criterion for actual performance, famously dubbed "bounded rationality," that acknowledged the inherent processing limitations of the human mind. Because of these limits, Simon argued, the mind cannot cope directly with the complexity of the world. Instead, we construct a simplified mental model of reality and then work within it. And although we behave rationally within the confines of our mental model, it is not always well suited to the requirements of the real world (as cited in Heuer, 1999, p. 3).[2]

Like its classical predecessor, the theory of bounded rationality has important implications for analysis and decision-making. If we accept the proposition that both the knowledge and the computational power of the analyst or decision-maker are severely limited, we must distinguish between the real world and the analyst's perception of and reasoning about it. Rather than requiring perfect application of the laws of logic and probability, this more limited approach suggests that analysts or decision-makers reach conclusions in a way that is procedurally reasonable in light of the available knowledge and means of computation (Simon, 1986, p. 211).[3]

[2] The concept of bounded rationality has come to be recognized widely, though not universally, both as an accurate portrayal of human judgment and choice and as a sensible adjustment to the limitations inherent in how the human mind functions (Heuer, 1999, p. 26).

[3] Simon makes a further distinction between classical and bounded rationality. To deduce the classically rational choice in a given situation, we need only know the choosing organism's goals and the objective characteristics of the situation. We need to know absolutely nothing else about the organism. In contrast, to deduce the boundedly rational choice in the same situation, Simon contends we must know the choosing organism's goals, the information and the conceptualization it has of the situation, and its abilities to draw inferences from the information it possesses (Simon, 1985, p. 294).

B. HEURISTICS AND BIASES

Inspired by the examples of Meehl, Edwards, Simon, and others, Daniel Kahneman and Amos Tversky (1972) developed their own perspective on bounded rationality. Although they fully recognized the role of task complexity and limited computational capability on individual performance, the two became convinced that the processes involved in judgment and choice "were not merely simpler than the rational model demanded, they were categorically different in kind" (Gilovich et al, 2002, p. 3).

Acknowledging a "dual-processes" approach to cognition, Kahneman and Tversky (1972) recognized that people apprehend reality in two fundamentally different ways. The first, variously labeled intuitive, automatic, natural, nonverbal, narrative, or experiential, is typically thought of as fast, automatic, effortless, associative, and difficult to control or modify. The second, called inferential, analytical, deliberate, verbal, or rational, is typically thought of as slower, serial, effortful, deliberately controlled, and also relatively flexible and potentially rule-governed (Kahneman, 2002, p. 450).

Kahneman and Tversky (1972) also suggested that people rely on a limited number of heuristic principles that reduce complex inferential tasks, like assessing probabilities and predicting values, into simpler judgmental operations (Kahneman, 2002, p. 465). The two researchers tied these heuristics to "natural assessments," elicited by the task at hand, that influence judgment beneath the surface of consciousness. They noted, for example, that when deciding whether an elegantly-dressed lawyer is more likely to be a public defender or a member of a large corporate firm, we cannot help computing the similarity between the individual and the prototype of each professional niche. Kahneman and Tversky (1972) suggested that these assessments then inform such judgments of likelihood in the absence of deliberate intent (Gilovich et al, 2002, pp. 4-5). They further argued that while heuristics based on such assessments are generally quite useful, they often lead to unconscious biases that give rise to severe and systematic errors.

Kahneman and Tversky (1972) drew three overarching conclusions from their work. First, the two claimed that although these heuristics can be distinguished from normative reasoning processes by patterns of biased judgments, the heuristics themselves are sensible estimation procedures that are by no means “irrational.” Second, they argued that although these heuristics yield “quick and dirty” solutions, they draw on underlying processes that are highly sophisticated. Finally, the two argued that these heuristics are not exceptional responses to problems of excessive complexity or an overload of information, but normal responses even to the simplest questions about likelihood, frequency, and prediction (Gilovich et al, 2002, p. 3).

C. SUMMARY

In the thirty years since Kahneman and Tversky (1972) introduced the concept, the influence of heuristics and biases has gained widespread acceptance both within and outside the psychological community. Yet despite the admonitions of a number of visionaries, this appreciation has not typically extended to the U.S. intelligence community; few analysts or decision-makers seem to fully appreciate the extent to which heuristics can give rise to systematic error. As a result, many of their judgments have been colored by unintentional bias.[4]

The following chapters seek to illuminate this deficiency, in the hope that awareness of perceptual and cognitive baggage can help mitigate the severity of the errors that often result from it. Chapter II examines the perceptual and cognitive processes on which judgment is based, and illustrates how while necessary and often useful, they often give rise to error. Chapter III builds upon this foundation, exploring the heuristics and biases first introduced by Kahneman and Tversky (1972) more than thirty years ago. Chapter IV examines the concept of anchoring, both in terms of adjustment and activation, and suggests how it often compounds the errors caused by bias. Chapter V looks at a specific case, the Intelligence Community’s assessment concerning Iraqi Weapons of Mass Destruction, in order to demonstrate that an appreciation of heuristics and biases is more than academic, and that shortcomings in the perceptual and cognitive processes that underlie judgment can have the most serious of consequences.

[4] Richard Heuer (1999), a career analyst for the Central Intelligence Agency, notes that the impact of such bias is most pronounced in the very conditions “under which intelligence analysis is typically conducted – dealing with highly ambiguous situations on the basis of information that is processed incrementally under pressure for early judgment” (p. 14).

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II. FUNDAMENTALS OF PERCEPTION AND COGNITION

Human beings construct our own version of reality using information provided by our senses. Yet sensory input is mediated by complex psychological processes that determine the manner in which we select, organize, and attribute meaning and value to information. What people perceive, how readily we perceive it, and how we use this information to make judgments and decisions are all clearly influenced by past experience, education, cultural values, role requirements, and organizational norms, as well as by the specifics of the information and the environment in which it is received (Heuer, 1999, p. 4).

Yet our decisions are also shaped by heuristics and biases that operate apart from any experiential or environmental dynamics, beneath the surface of our consciousness. As the following sections describe, a number of processes essential to perception and cognition can also often give rise to systematic errors in judgment.

A. PERCEPTION

The process of perception links people to our environment and is critical to understanding the world around us. Cogent analysis and effective decision-making clearly begin with and depend on accurate perception. Yet research into human perception demonstrates that the process is beset with pitfalls (Heuer, 1999, p. 7).

1. Perception is Unavoidably Selective

People often think of perception as an objective process. “We see, hear, smell, taste or feel stimuli that impinge upon our senses” (Heuer, 1999, p. 7). We think that if we are careful and attentive, we are able to record what actually exists. Yet a growing body of evidence suggests that perception is an active passive process that *constructs* rather than *records* reality.

Bottlenecks in our mental machinery admit only a small fraction of what actually exists; we are simply unable to process all that there is to see. As a result, some view perception as an approximation of reality, in which the subjective world of the decision-maker resembles the external environment closely, but lacks, perhaps, some fineness of detail (Simon, 1959, p. 272). Others view perception as a filtered version of reality, in which only a small subset of what actually exists enters the central nervous system. Yet studies have shown that the perceived world is markedly different from the real world. Perception is neither a crude approximation nor some passive selection of part of a presented whole; it is "a deliberate process involving attention to a very small part of the whole and exclusion of almost all that is not within the scope of attention" (p. 273).

Consider the following description of a common perceptual field:

> I am standing at the window and see a house, trees, sky. And now, for theoretical purposes, I could try to count and say: there are . . . 327 nuances of brightness and hue. Do I see 327? No; I see sky, house, [and] trees (Wertheimer as cited in Woods et al, 2002, p. 28).

Wertheimer's realization reflects a fundamental aspect of human perception: Perception involves selection, simplification, reduction, and omission. If we count the basic elements in the perceptual field described above, for example, we find an overwhelming number varying in hue, saturation and brightness. Yet this avalanche of data does not incapacitate us. Perceptual organization reduces the stimulus data, "grouping a large number of picture elements into a small number of seen objects and their parts" (Goldmeier as cited in Woods et al, 2002, p. 28). It reduces a complex field into a few objects or events and the relationships between them.

2. Perception is Influenced by Expectations

People develop expectations from a myriad of diverse sources, including past experience, professional training, and cultural and organizational norms. All these influences predispose us to pay particular attention to certain kinds of information and to organize and interpret it in certain ways (Heuer, 1999, p. 34).

A number of experiments have been conducted to show the extraordinary extent to which what we perceive depends upon our own unconscious assumptions and preconceptions. "What people perceive, and how readily they perceive it, are strongly influenced by their past experience, education, cultural values, and role requirements, as well as by the stimuli recorded by their receptor organs" (Heuer, 1999, p. 7). Consider the following figure:

Figure 1. Perception and Expectations (Heuer, 1999, p. 8)

Most people overlook that in each of the three phrases, the definite (or indefinite) article is repeated. This simple exercise demonstrates a second fundamental characteristic of human perception: We tend to perceive what we expect to perceive (Heuer, 1999, p. 8).

In an experiment investigating this phenomenon, Jerome Bruner and Leo Postman (1949) showed subjects a series of playing cards, some of which were altered so that the spades were red and the hearts black. Each card was presented successively, for varying periods of time, until correct recognition occurred. The two researchers made a number of key observations. First, the subjects identified the normal cards more quickly and accurately than the anomalous ones. Second, after realizing that some of the cards had been altered, the subjects improved their overall speed and accuracy, but only moderately. Bruner and Postman concluded that perceptual organization is powerfully determined by expectations built upon past interaction with the environment. When such expectations are violated, the perceiver resists recognition of the unexpected (as cited in Chandler, 2004).

3. Perception is Shaped by Situational Context

Different circumstances evoke different sets of expectations. We are more attuned to hearing footsteps behind us when walking in an alley at night, for example, than along a city street in daytime. Moreover, the meaning we attribute to the sound of footsteps will vary under these differing circumstances (Heuer, 1999, p. 9). This simple analogy reflects a third characteristic of human perception: We tend to perceive objects or events differently based on the situation. In other words, perception is influenced by the context in which it occurs.

In an experiment investigating this phenomenon, B.R. Bugelski and Delia Alampay (1961) presented subjects with a drawing that could be interpreted either as rat or an old man wearing spectacles:

Figure 2. Old man or rat? (Chandler, 2004)

Prior to seeing this image, half of the group was shown drawings of various animals:

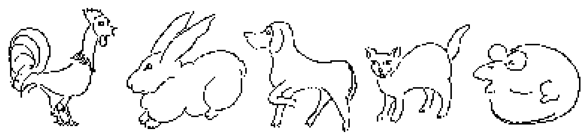

Figure 3. Animal series (Chandler, 2004)

The other half of the group was shown drawings of human faces:

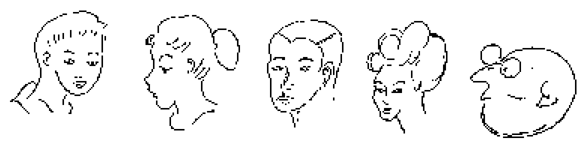

Figure 4. Faces series (Chandler, 2004)

A third (control) group was shown no pictures beforehand. The two researchers made a number of key observations. More than 80% of the control group characterized the ambiguous image as a man rather than a rat. Yet the group that was first shown the drawings of animals consistently characterized the ambiguous drawing as a rat rather than a man. In fact, the more animals that they were shown before seeing the ambiguous image, the more likely they were to see a rat. Bugelski and Alampay (1961) concluded that perception depends not only on the objective qualities of an object or event, but also on the condition or situation in which the object is found (as cited in Chandler, 2004).

4. Perception is Influenced by Blurred or Ambiguous Stimuli

Under ordinary circumstances, perception operates relatively effortlessly. If the clarity of the information presented is diminished in some way, however, recognition takes longer (Bruner & Potter, 1964, p. 424). A number of studies suggest that if a subject is initially exposed to a blurred or otherwise diminished image that he cannot recognize, subsequent recognition of the image in clearer form is substantially delayed. These studies reflect a fourth fundamental characteristic of human perception: initial exposure to blurred or ambiguous stimuli interferes with accurate perception even after more and better information becomes available (Heuer, 1999, p. 37).

In one such study, Jerome Bruner and Mary Potter (1964) showed subjects eight ordinary color photographs of common everyday objects, projected one at a time. Each photo was initially exposed in a state of blur and brought continuously into better focus in order to determine at what point the subjects could identify them correctly (Bruner & Potter, 1964, p. 424). The researchers made two key observations. First, they found that those who began viewing when the photos were most out of focus had substantially more difficulty identifying them as they became clearer than those who started viewing when the photos were less blurred. In other words, the greater the initial blur, the clearer the picture had to be before people could recognize it. Second, the longer people were exposed to a blurred picture, the clearer the picture had to be before they could recognize it (Heuer, 1999, p. 14).

Bruner and Potter (1964) concluded that what happened in this experiment is what presumably happens in real life: despite ambiguous stimuli, people form tentative hypotheses about what we see. The longer we are exposed to an ambiguous image, the greater confidence we develop in our initial impression of it. Even if this impression is later proven to be wrong, it still has a significant impact on subsequent perceptions. "For a time, as the picture becomes clearer, there is no obvious contradiction; the new data are assimilated into the previous image, and the initial interpretation is maintained until the contradiction becomes so obvious that it forces itself upon our consciousness" (Heuer, 1999, p. 14).

B. COGNITION

Because of limits in our mental capacity, the human mind cannot cope directly with the complexity of the world. Rather, we construct simplified mental models of reality and then work with them (Heuer, 1999, p. 3). Yet people rarely enter into the sense-making endeavor with a clean slate. We bring with us a set of theoretical predispositions that enter the process as mediating variables. These predispositions greatly aid our understanding of events and the construction of cause and effect attributions, "keeping us from having to reinvent the wheel at every decision-making juncture" (Bukszar, 1999, p. 108).

Like the processes involved in perception, our cognitive models influence our judgment. They play a central and unifying role in representing objects, states of affairs, sequences of events, the way the world is, and the social and psychological actions of daily life" (Johnson-Laird, 1993, p. 397). They allow us to make inferences and predictions, to understand phenomena, to experience events by proxy, and to decide what action to take and to control its execution (p. 397). Yet the processes involved in the construction and employment of cognitive models, like those fundamental to perception, are also often beset with pitfalls.

1. Mental Models are Unavoidable

Some people view mental models as something bad, to be avoided. They argue that people should have an open mind and be influenced only by the facts rather than by preconceived notions. Yet this ideal is unreachable. There is no such thing as "just the facts" of the case. "There is only a very selective subset of the overall mass of data to which one has been subjected that one takes as facts and judges to be relevant to the question at hand" (Heuer, 1999, p. 10).

In fact, mental models are unavoidable. The world, from the perspective of the human mind, is fundamentally uncertain. People have no conceivable way of coping with the volume of stimuli that impinge upon our senses, or with the volume and complexity of the data we have to analyze, without some kind of simplifying preconceptions about what to expect, what is important, and what is related to what (Heuer, 1999, p. 10). Although our brain does not often have sufficient information to know for certain what is out there, it is not paralyzed by uncertainty. Instead, it evaluates its environment and uses models to make a "best guess" (Gigerenzer, 2005, p. 197).

Consider the following illustration:

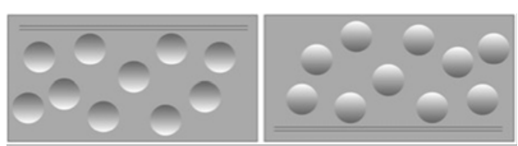

Figure 5. Convex or Concave (Gigerenzer, 2005)

The dots on the left side appear concave, receding into the surface away from the observer. The dots on the right appear convex, rising up from the surface toward the observer. When the page is turned upside down, however, the concave dots turn into convex dots, and vice versa (Gigerenzer, 2005, p. 197).

There is, of course, no third dimension, and there are no convex or concave dots. Our recognition of concavity or convexity is the result of a basic mental model. D.A. Kleffner and Vilayanur Ramachandran (1992) found that our brain assumes a three-dimensional world and uses the shaded parts of the dots to guess in what direction of the third dimension they extend. By experimentally varying factors such as the location of the light source and the shading, and documenting their effect on the illusion, they concluded that humans assume a single source of light from above. The two concluded that these ecological structures arise from our collective evolution, where the sun and moon were the only sources of light, and only one operated at a time. "The brain exploits these assumed structures by using a fast and frugal heuristic: If the shade is in the upper part, then the dots are concave; if the shade is in the lower part, then the dots are convex" (as cited in Gigerenzer, 2005, p. 197).

2. Mental Models are Quick to Form but Resistant to Change

The cognitive models that underlie judgment and decision are often quick to form, yet highly resistant to change. Consider the following image:[5]

Old or young woman? (Chandler, 2004)

This now-famous drawing, designed to be interpreted as either a young or an old woman, was first introduced into the psychological literature by Edwin Boring (1930).[6] In an experiment on sensory organization and learning, Robert Leeper (1935) had the image redrawn in two less ambiguous forms: one which emphasized the old woman and the other which emphasized the young woman:

[5] The old woman's nose, mouth, and eye are, respectively, the young woman's chin, necklace, and ear. Both are seen in profile looking left; we see the young woman mainly from behind so most facial features are not visible. Her eyelash, nose, and the curve of her cheek may be seen just above the old woman's nose (Heuer, 1999, p. 13).

[6] The image was published by the British cartoonist W. E. Hill in 1915, and is thought to be based on a French version of 15 years earlier. It is sometimes referred to as "The Wife and the Mother-in-Law" (http://www.aber.ac.uk/media/Modules/MC10220/visper05.html, n.d.).

Figure 6. Old or young woman: less ambiguous forms (Chandler, 2004)

Leeper enlisted a number of subjects and divided them into five groups. A control group was shown only the ambiguous drawing; 65 percent described the image as that of a young woman. The second and third groups were given a verbal description of the old woman and young woman respectively, before being shown any image. The fourth and fifth groups were shown the "old" version and the "young" version respectively. All of the groups (other than the control group) were then shown the original ambiguous image. An overwhelming majority of the subjects in the groups that saw or were told about the old woman described the ambiguous version as "old." All of the subjects in the groups that saw or were told about the young woman described the ambiguous version as "young." Leeper concluded that once the subjects had formed a mental model, they found changing it very difficult (as cited in Chandler, 2004).

3. New Information is Assimilated to Existing Content

Human beings constantly create or construct new mental models; the content of our minds is inherently open and difficult to define. Yet at the same time, we itemize and categorize this content in order to systemize the vast amount of data. "A tension therefore exists between our desire to update our mental models constantly versus our need to categorize and store (or delete) our knowledge" (Karp, 2005, p. 7).

Consider the following illustration:

Figure 7. Man or woman? (Heuer, 1999)

The figure, developed by Gerald Fisher in 1967 as part of an experiment on ambiguity, is part of a series of progressively modified drawings that change almost imperceptibly from a man into a woman:[7]

Figure 8. Man transforming into woman (Heuer, 1999)

When viewed alone, half of Fisher's subjects characterized the initial image as a man; the other half as a woman. When subjects were shown the entire series of drawings one by one, their perception of this drawing was biased according to which end of the series they started from. Subjects who started by viewing a picture that was clearly a man were biased in favor of continuing to see a man long after an objective observer recognized that the man had "become" a woman. Similarly, test subjects who started at opposite end of the series were biased in favor of continuing to see a woman (Heuer, 1999, p. 10).

The experiment demonstrates that once an observer forms a mental model concerning the phenomenon being observed, it conditions future characterizations of that phenomenon. This also explains why gradual, evolutionary change often goes unnoticed (Heuer, 1999, p. 11). Moreover, the tendency to assimilate new data into pre-existing images is greater "the more ambiguous the information, the more confident the actor is of the validity of his image, and the greater his commitment to the established view" (p. 11).

[7] In the series, the initial image occupies the right-most position in the top row.

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III. FUNDAMENTALS OF PERCEPTION AND COGNITION

Uncertainty is an unavoidable aspect of the human condition (Gilovich et al, 2002, p. 19). Many of the choices we make are necessarily based on beliefs or best guesses about the likelihood of uncertain events such as the guilt of a defendant, the result of an election, the future value of the dollar, the outcome of a medical operation, or the response of a friend. “Because we normally do not have adequate formal models for computing the actual probabilities of such events, intuitive judgment is often the only practical method for assessing uncertainty” (Kahneman & Tversky, 1984, p. 293).

Yet human intuition is far from perfect. In contrast to formal theories or beliefs, intuitive judgments of probability come neither from the rules of logic nor the mathematical laws governing probability. People do not normally analyze daily events into exhaustive lists of possibilities or evaluate compound probabilities by aggregating elementary ones. Instead, we employ a number of heuristics, “based on natural assessments that are routinely carried out as part of the perception of events and the comprehension of messages” (Gilovich et al, 2002, p. 20). For example:

> The mere mention of “horror movies” activates instances of horror movies and evokes an assessment of their availability. Similarly, the statement that Woody Allen’s aunt had hoped that he would be a dentist elicits a comparison of the character to the stereotype and an assessment of representativeness. It is presumably the mismatch between Woody Allen’s personality and our stereotype of a dentist that makes the thought mildly amusing (Gilovich et al, 2002, p. 20).

Although such assessments are based neither on frequency nor probability, they often play a dominant role when intuitive judgments are required. “The availability of horror movies may be used to answer the question, ‘What proportion of the movies produced last year were horror movies?’, and representativeness may control the judgment that a particular boy is more likely to be an actor than a dentist” (Gilovich et al, 2002, p. 20). The following sections examine these two powerful heuristics and the biases which they give rise to in greater detail.

A. REPRESENTATIVENESS

One of the most basic and most often employed natural assessment is the representativeness heuristic. It evaluates the degree of correspondence between a sample and a population, and instance and a category, an act and an actor, or an outcome and a model (Gilovich et al, 2002, p. 22). It allows people to reduce otherwise taxing inferential tasks into simple similarity judgments, in which objects, events, or processes are assigned to one conceptual category rather than to another based on how well they represent or resemble one category more than another (Nisbett & Ross, 1980, p. 7). We use the representativeness heuristic everyday when we shop for groceries, empty the dishwasher, or find a place to park our car. "Countless tasks, especially those requiring induction or generalization, depend on deciding what class or category of event one is observing. Such judgments invariably hinge on assessments of resemblance or representation" (Nisbett & Ross, 1980, p. 27).

Problems with representativeness arise when we use it as our primary (or our only) judgmental strategy. "This useful heuristic becomes an undesirable bias when we overestimate the extent to which a situation or sample is representative of the situation or population to which we wish to generalize" (Schwenk, 1985, p. 121). For example, "people express great confidence in the prediction that a person is a librarian when a given description of his personality which matches the stereotype of librarians, even if the description is scanty, unreliable, or outdated" (Kahneman et al, 1982, p. 9). When, for whatever reason, categorization based on the known features of an object or event is not possible, statistical considerations should take over. "In particular, the relative frequency of the categories in the population under consideration [should] become the normatively appropriate guide to categorization to the extent that the known features of the object are ambiguous guides to categorization" (Nisbett & Ross, 1980, p. 7). Yet few people understand these statistical considerations, or how to combine them with representativeness considerations.

Thomas Gilovich (1981) conducted a number of studies examining representativeness bias. In one, students enrolled in a political science class were asked to formulate U.S. foreign policy for a hypothetical international crisis. The students were divided into three groups; each group was given scenarios containing information irrelevant to the outcome of the crisis. One scenario was reminiscent of World War II; the other of Vietnam. The results were dramatic. The World War II group overwhelming favored an interventionist strategy, while the Vietnam group overwhelming favored an isolationist approach. Gilovich concluded that his subjects chose a course of action based solely on its representativeness to the scenario they were given, despite the fact that they had better information with which to make a decision (as cited in Stormer, 1991, p. 8).

1. Representativeness and the Misconception of Chance

People often expect that a sequence of events generated by a random process will represent the essential characteristics of that process even when the sequence is short (Kahneman & Tversky, 1982, p. 7). In considering a series of coin tosses, for example, people regard the sequence H-T-H-T-T-H to be more likely than the sequence H-H-H-T-T-T, which does not appear as random; and also more likely than the sequence H-H-H-H-T-H, which does not represent the fairness of the coin. "People expect that the essential characteristics of the process will be represented, not only globally in the entire sequence, but also locally in each of its parts" (Kahneman et al, 1982, p. 7).[8]

The "gambler's" fallacy, the mistaken belief that a successful outcome is due after a run of bad luck, is another example of the misconception of chance. After observing a long run of "red" on a roulette wheel, for example, people believe that "black" is due, because the occurrence of black would make the overall sequence of events more representative of the generating process than would the occurrence of another red (Plous, 1993, p. 113). The same dynamic may be seen in the following scenario:

> Suppose that an unbiased coin is flipped three times, and each time the coin lands on Heads. If you had to bet $100 on the next toss, would you choose Heads or Tails? (Plous, 1993, p. 113).

Because the coin is unbiased, the normatively correct answer is that there should be no preference between Heads and Tails. Scott Plous (1993) suggests, however, that most people believe Tails is more probable after a run of three Heads (p. 113).

[8] Of course, a locally represented sequence like the coin toss described above deviates systematically from chance expectation: it contains too many alterations and too few runs (Kahneman et al, 1982, p. 7).

Belief in the "law of small numbers" is another form of the misconception of chance (Kahneman et al, 1982, p. 9). A tongue-in-cheek reference to the law of large numbers, the basic statistical principle stating very large samples will be highly representative of the population from which they are drawn; the law of small numbers describes our tendency to place too much reliance on small samples. Even among professional psychologists, this bias has shown to result in "seriously incorrect notions about the amount of error and unreliability inherent in small samples of data, unwarranted confidence in the early trends from the first few data points, and unreasonably high expectations of being able to repeat the same experiment and get the same results with a different set of test subjects" (Heuer, 1999, p. 121).

2. Representativeness and the Illusion of Validity and Order

People often predict by selecting the outcome that is most representative of the input. The confidence they have in their prediction depends primarily upon the degree of representativeness (that is, the quality of the match between the selected outcome and the input), with little or no regard for the factors that limit predictive accuracy (Kahneman et al, 1982, p. 9). Consider the following example:

> Tom is of high intelligence, although lacking in true creativity. He has a need for order and clarity, and for neat and tidy systems in which every detail finds its appropriate place. His writing is rather dull and mechanical, occasionally enlivened by somewhat corny puns and by flashes of imagination of the science fiction type (Kahneman et al, 1982, p. 49).

Daniel Kahneman and Amos Tversky (1973) asked a group of graduate students to read this description of Tom and then predict in which of nine subject areas, ranging from computer science to humanities or education, Tom would most likely specialize. The two researchers found that the judgments of the graduate students drastically violated the normative rules of prediction. More than 95 percent predicted that Tom was more likely to study computer science than humanities or education, even though they knew there were significantly more students in the latter field. This unwarranted confidence, spawned by an apparent fit between the input information and the predicted outcome, produced an "illusion" of validity (as cited in Kahneman et al, 1982, p. 9).

Paul Slovic (1966) found that the perceived consistency or coherence of input is a related determinant of representativeness. "The more consistent the input, the more representative the prediction will appear and the greater the confidence [people have] in that prediction" (as cited in Kahneman et al, 1982, p. 65). In a series of experiments examining this phenomenon, Slovic found that when subjects were asked to predict the final grade-point average of a student, they were much more confident when the student's previous record consisted entirely of "B's" than when it included a mix of "A's" and "C's." This intuition that orderly or consistent profiles allow greater predictability than inconsistent ones is compelling. Yet it also happens to be wholly incompatible with the laws of statistics.[9] "Thus, redundancy among inputs decreases accuracy even when as it increases confidence, and people are often confident in their predictions that are quite likely to be off the mark" (Kahneman et al, 1982, p. 9).

3. Representativeness and the Perception of Cause and Effect

Representativeness can also manifest itself in our perception of cause and effect. We cannot see, of course, cause and effect in the same sense that we see a desk or a tree. "Even when we observe one billiard ball striking another and then watch the previously stationary ball begin to move, we are not perceiving cause and effect" (Heuer, 1999, p. 127). The conclusion that one ball caused the other to move results not from direct sensory perception, but rather from a complex process of inference that involves attributing an effect to the object or event that caused it.

Yet because we do not have an intuitive understanding of the kinds and amount of information needed to prove a relationship, people often perceive relationships that do not in fact exist (Heuer, 1999, p. 127). As early as the mid-nineteenth century, British philosopher John Stuart Mill proposed that humans often demonstrate a deep seated fallacy in casual reasoning: "the prejudice that the conditions of a phenomenon must resemble that phenomenon" (Mill, 1974, p. 765). More than 150 years later, Richard Nisbett and Thomas Wilson (1977), restating Mill's proposal, suggested that causal explanations are often strongly influenced by a primitive version of the representativeness heuristic. "People have strong *a priori* notions of the types and causes

[9] Specifically, this belief is incompatible with the commonly applied multivariate model of prediction in which expected predictive accuracy is independent of within-profile variability (Kahneman et al, 1982, p. 65).

that ought to be linked to particular types of effects, and a simple ‘resemblance criterion’ often figures heavily in such notions” (as cited in Nisbett & Ross, 1982, p. 115).

In a classic experiment examining this phenomenon, Lauren and Jean Chapman (1967) surveyed clinicians who were active in diagnostic testing. The two researchers wrote brief descriptions of six types of patients and asked each clinician which characteristics the patient might display in a common diagnostic tool known as the Draw-A-Person Test. The Chapmans found surprising agreement among the clinicians. For example, 91 percent said that a patient who was generally suspicious of others would draw a person with large or atypical eyes, and 82 percent said that a patient concerned with his own intelligence would draw a person with a large or emphasized head. Even at the time of the experiment, however, the Draw-A-Person test had been proven to have no validity. The correlations that the clinicians made were purely illusory: the result of shared clinical stereotypes (as cited in Plous, 1993, p. 165).

B. AVAILABILITY

When people are required to judge the frequency of an object or the likelihood of an event, we are often influenced by its availability in the processes of perception, memory, or construction from imagination (Nisbett & Ross, 1980, p. 18). In particular, psychologists have shown that cues such as the *ease* with which a scenario or event comes to mind, and the *frequency* of such events in memory, may significantly influence our estimation of their actual likelihood.

To the extent that availability is actually associated with normative frequency or likelihood, this heuristic can be a useful tool for intuitive judgment (Nisbett & Ross, 1980, p. 19). After all, if one thing actually occurs more often than another and is therefore more probable, we can probably recall more instances of it. And events that are likely to occur are usually easier to imagine than unlikely events (Heuer, 1999, p. 148). For example, we may assess the risk of heart attack among middle-aged people by recalling such occurrences among our acquaintances. Or we may evaluate the probability that a given business venture will fail by imagining the various difficulties it could encounter (Kahneman et al, 1982, p. 11).

Although the availability heuristic often works well, people are frequently led astray when the ease with which things come to mind is influenced by factors unrelated to their probability. "The ability to recall instances of an event is influenced by how recently the event occurred, whether we were personally involved, whether there were vivid and memorable details associated with the event, and how important it seemed at the time" (Heuer, 1999, p. 148). Yet all are unrelated to the event's true probability.

In an elementary demonstration of this effect, Daniel Kahneman and Amos Tversky (1973) presented subjects a list of celebrities and subsequently asked them to judge whether the list contained more men or more women. Different lists were presented to different groups of subjects; in some, the men were more famous, and in others, the women were more famous. For each of the lists, the subjects consistently and erroneously concluded that the gender that had the more famous celebrities was the more numerous. Kahneman and Tversky (1973) concluded that the availability bias was the source of the error: when the size of the class is judged by the availability of its instances, a class whose instances are easily retrieved will appear more numerous than a class of equal frequency whose instances are less retrievable (as cited in Kahneman et al, 1982, p. 11).

1. Availability and Vividness

"Information may be described as vivid, that is, as likely to attract and hold our attention and to excite our imagination, to the extent that it is emotionally interesting, concrete and imagery-provoking, [or] proximate in a sensory, temporal, or spatial way" (Nisbett & Ross, 1980, p. 45). Studies have shown that vivid or concrete information has a far greater impact on our thinking than pallid or abstract information, even when the latter may have greater value as evidence. For example, information that people perceive directly, that we hear with our own ears or see with our own eyes, is likely to be more available and therefore have greater impact than information received secondhand. And case histories and anecdotes have greater impact than more informative but abstract aggregate or statistical data (Heuer, 1999, p. 116).

This tendency to assign inferential weight to information in proportion to its vividness can be a useful heuristic: "vivid experiences and observations can be a source of new insights, can provide phenomenological reality to otherwise poorly understood propositions, and can inspire action in circumstances in which previous knowledge or opinion has not overcome inertia" (Nisbett & Ross, 1980, pp. 59-60). Yet because the vividness of information is correlated only modestly with its value as evidence, there are costs associated with its disproportionate weighting.

Richard Nisbett and Eugene Borgida (1977) conducted a series of experiments investigating this effect. In one, introductory psychology students were asked to rate the likelihood that they would enroll in a number of upper-level psychology courses. The students then divided into two groups: the first was given a statistical analysis based on evaluations of previous students, and the second was given a descriptive version of the same information from a panel of previous students. Subjects in the vivid group wanted to take more of the highly evaluated courses and fewer of the poorly evaluated courses, and felt more confident about their intentions, than did their counterparts in the statistical group. Nisbett and Borgida (1977) found that the impact of vividness was most pronounced for those students who intended to major in psychology (for whom the course selections were most important and least hypothetical). The two concluded that information that is vivid, concrete, or emotionally pertinent, or of temporal, spatial, or sensory proximity to the decision-maker, has far greater inferential value than that of abstract or statistical information of equal (or even greater) value (Nisbett & Ross, 1980, pp. 58).

2. Availability and Salience

Salience is similar to vividness; it refers to the fact that colorful, dynamic, or other distinctive stimuli engage people's attention (Kahneman et al, 1982, p. 192). This manifestation of availability can become an undesirable bias, however, when such stimuli disproportionately engage attention and accordingly disproportionately affect judgment. Also described as the fundamental attribution error, it often results in an overestimation of the role of people as causal agents in the environment. "That is, in a social setting in which either a person or some situational variable is a plausible causal candidate for an outcome, there exists a general bias to see people as causal agents, particularly in their enduring dispositional attributes" (pp. 192-193).

The link between salience and causal attribution was demonstrated in a series of experiments conducted by Shelley Taylor and Susan Fiske (1975). In one of the more famous, the two had six observers watch a two-man conversation from one of three vantage points: seated behind one of the men who was talking, seated behind the other man who was talking, or seated on the sidelines equidistant from the two men. At the end of the conversation, each observer was asked which of the men was more influential in the discussion. Each observer with a clear view of only one of the men believed that the man he saw clearly had set the tone of the conversation, had determined what information would be exchanged, and had caused the other man to behave as he did. The observers who could see both men equally well felt that each had contributed equally to the outcomes (Plous, 1993, p. 178). Taylor and Fiske (1975) concluded that “the more salient a potential causal agent is, the greater the causal role observers will assign to that agent in accounting for particular outcomes of events” (as cited in Nisbett & Ross, 1980, pp. 125).

Shelley Taylor (1982) notes some important social consequences of the salience bias, and their influence on judgment. Examining the impact of solo status or token integration on people’s impressions of individuals, Shelley suggests:

> When a company is about to desegregate and include members of a minority group, such as blacks, women, or the handicapped, often an intermediate step occurs prior to full integration. In this step, one or two members of this previously excluded group may be brought into what otherwise has been a white male work group, thus creating instances of solo status (as cited in Kahneman et al, 1982, p. 193).

Taylor notes that the significance of solo status is its novelty, and that such distinctiveness fosters a salience bias. And although her example may be somewhat outdated, a number of experiments in the last twenty years have validated her conclusion that when an individual is a token, a solo in a group, or is in some other way salient, they disproportionately influence the judgment of observers.

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IV. ANCHORING

The concept of anchoring was first introduced by Daniel Kahneman and Amos Tversky in 1974. At that time, it was seen as a third judgmental heuristic, akin to representativeness and availability, with its own implications for systematic error in analysis and decision-making. Today, this cognitive process is understood in terms of adjustment, in which decision-makers focus on an anchor and then make a series of dynamic adjustments toward a final estimate; and in terms of activation, in which an anchor acts as a suggestion, making information consistent with the anchor more available. In both cases, when employed inappropriately, such anchoring compounds the effects of representativeness and availability and magnifies the degree of error in judgment.

A. ANCHORING AS ADJUSTMENT

In a variety of situations, people make guesses by picking some natural starting point for a first approximation and then making a series of dynamic adjustments toward a final estimate. Like the heuristics described in the previous chapter, such anchoring can be helpful in making judgments and decisions. Consider the following example:

> Imagine that you are trying to set a value on an antique chair that you have inherited from a distant aunt. You might recall seeing a very similar chair in slightly better condition at a local antique dealer. You might start with that price as an anchor, and incorporate the difference in quality. This seems to be a useful and effort-saving use of anchoring and adjustment (Gilovich et al, 2002, p. 120).

Yet in many cases, people fail to properly adjust from the anchor; the starting point often serves as a drag that reduces the amount of adjustment, so the final estimate remains closer to the starting point than it ought to be (Heuer, 1999, p. 150). Consider some additional information regarding the above example:

> Now, however, imagine that you had seen (on Public Television's Antiques Road Show) a not-so-similar chair that, unlike yours, is signed by the designer and worth, as a result, many of thousands of dollars more. If you were to use this as an anchor, and if you did not properly incorporate the fact that your chair did not have a signature, you might end up with an estimate that was too high (Gilovich et al, 2002, p. 120).

Under the influence of anchoring, our revisions are often smaller than are justified by new information, and our final estimates are often biased toward the initial values (Schwenk, 1985, p. 116). It is not only people's eagerness to apply simple heuristics like representativeness and availability that leads to problems; it is also the failure to make necessary adjustments of initial judgments (Nisbett & Ross, 1980, p. 41). In many cases, once a simple heuristic has been used, subsequent considerations fail to exert as much impact as common sense or normative considerations might dictate that it should (p. 42).

A number of studies have shown that people use such adjustment to solve a variety of estimation problems. In one of the most direct, Amos Tversky and Daniel Kahneman (1974) asked subjects to adjust an arbitrary initial estimate of the percentage of African countries in the United Nations. Those starting with anchors of 10 percent produced an adjusted estimate of 25 percent; those with anchors of 65 percent produced an adjusted estimate of 45 percent. Even though it was made clear that the anchors were entirely arbitrary and unrelated to the judgment task, they nevertheless had a significant influence on final estimates (as cited in Nisbett & Ross, 1980, p. 41).

B. ANCHORING AS ACTIVATION

In recent years, researchers have suggested that the origin of anchoring lies in the influence of anchors on a retrieval stage of cognition, rather on a processing stage. In this view, an anchor acts as a suggestion, making information consistent with the anchor more available to the analyst or decision-maker, either in memory through priming mechanisms or because of a biased external search. "Because the anchor is considered as a candidate response that subjects entertain, at least as a transient belief, it influences the target value" (Gilovich et al, 2002, p. 130).

Fritz Strack and Thomas Mussweiler (1997) suggest that such anchoring is a special case of semantic priming. In a number of studies, they proposed that information retrieved in order to compare an anchor to a target is consequently more available for use when estimating the target value (as cited in Gilovich et al, 2002, p. 130). Further, they predicted that such primed information influences the target judgment only if it is relevant. In an experiment exploring this effect, the two asked subjects to estimate the size of the Brandenburg Gate. Strack and Mussweiler (1997) found that anchors representing the width of the Gate had a significant impact on judgments of its width, but little influence on judgments of its height.

Karen Jacowitz and Daniel Kahneman (1995) argue that such anchoring occurs not only in target estimation, but also in comparative judgment. The two conducted a number of studies suggesting that the retrieval of target information primed by an anchor is biased, such that target features similar to the anchor are retrieved disproportionally to that which is normatively appropriate (Gilovich et al, 2002, p. 131). In other words, the comparison between anchor and target often results in the anchor appearing too similar to the target. Gretchen Chapman and Eric Johnson (1999) hypothesize that the presence of an anchor increases the availability of features that the anchor and the target hold in common while reducing the availability of features of the target that differ from the anchor (as cited in Chapman & Johnson, 1999, p. 131).

Chapman and Johnson (1999) also suggest that analysts and decision-makers concentrate their attention on features of the target that are similar to the anchor. In an experiment exploring this phenomenon, the two had subjects compare apartments described by three attributes. When a provided anchor value was high, they spent more time looking at positive features of the apartment. When the anchor value was low, they spent more time looking at negative features (Chapman & Johnson, 1999, p. 131).

In a similar experiment, Fritz Strack and Thomas Mussweiler (1999) had subjects answer an anchoring question about the length of the River Elbe, and instructed them to list the features of the target that came most easily to mind. Subjects that were given a high anchor most often described thoughts that implied a high target value, whereas subjects given a low anchor most often described thoughts that implied a low target value (as cited in Chapman & Johnson, 1999, p. 131).[10]

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[10] Strack and Mussweiler (2000) also found evidence that the presence of an anchor primes target features that are similar to the anchor. In that study, they had subjects answer the anchoring question, "Is the annual mean temperature in Germany higher or lower than 5 degrees Celsius (or 20 degrees Celsius)?" and then participated in a lexical decision task. Subjects given the low anchor were faster at identifying words such as "cold" and "snow," whereas subjects given the high anchor were faster at identifying words such as "hot" and "sun." The two concluded that the anchor primed consistent information in memory (as cited in Chapman & Johnson, 1999, p. 132).

C. COGNITIVE ANCHORING

Richard Nisbett and Lee Ross (1980) describe a third manifestation of anchoring that involves both adjustment and activation. The two suggest that once analysts or decision-makers have made a first pass at a problem, their initial judgment may prove remarkably resistant to further information, alternative modes of reasoning, or even logical or evidential challenges. "Attempts to integrate new information may find the individual surprisingly conservative, that is, willing to yield ground only grudgingly and primed to challenge the relevance, reliability, or authority of subsequent information or logical consideration" (Nisbett & Ross, 1980, p. 42).

People hold on tightly to our opinions and beliefs. "We are confronted almost daily with the perversity of those who persist in their misguided political, social, and scientific beliefs even after we have informed them of the facts" (Nisbett & Ross, 1980, p. 167). Theories are useful because they structure knowledge, organize experience, and support comparison of new information with that which can be retrieved from memory. A reluctance to hastily abandon our theories or beliefs is often appropriate; neither laypeople nor scientists should reject well-established theory simply because it happens to conflict with new evidence. "It is often proper to look askance at, or even to totally ignore, reports of virgin births or new cancer cures. And it may even be proper to dismiss evidence collected by reputable scientists if it conflicts with some powerful, parsimonious, and integrative theory" (Nisbett & Ross, 1980, p. 168).

Yet impressions tend to persist even after the evidence that created those impressions has been fully discredited (Heuer, 1999, p. 124). Consider the following anecdotes:

> Jack believes that he dislikes abalone because of his first and only exposure to that food and then is assured by an abalone connoisseur that he sampled an inferior frozen product. Jane is heartened by a correspondence school's enthusiastic appraisal of her potential as a commercial artist and then finds out that three of her peers who answered the same advertisement received equally glowing assessments (Nisbett & Ross, 1980, p. 175).

Normatively, it is clear what effect discrediting the evidence should produce. Jack's opinion on abalone and Jane's belief about her potential as an artist should return to the levels they were at before hearing the (now-discredited) evidence. Studies have shown, however, that this is rarely what happens.

Some of the clearest cases of the persistence of impressions based on discredited evidence come from debriefing experiments. In one of the most well-known, Mark Lepper and Lee Ross (1975) recruited subjects for a study allegedly concerned with the effects of performance feedback, in which they were asked to distinguish between authentic suicide notes and fake ones. As they worked, they were given scripted feedback that suggested how well they had performed. One group was told they had generally succeeded, and the other group was told that they had generally failed. The subjects in both groups were then thoroughly debriefed about the predetermined and random nature of the evaluation of their performance.[11] Yet even after the debriefing, subjects in the "success" condition rated their performance and abilities as much higher than was normatively appropriate, and subjects in the "failure" condition rated theirs as much lower than was normatively appropriate (as cited in Heuer, 1999, p. 124).

This experiment and others have led to a number of important conclusions regarding such cognitive anchoring and the perseverance of beliefs. First, when people have an existing theory, exposure to probative evidence often results in a stronger belief in the original theory than is normatively appropriate. Second, when people approach evidence without an existing theory and then form a theory based on initial evidence, the theory will be resistant to subsequent evidence. Finally, when people formulate a theory based on some putatively probative evidence and then later discover that the evidence is false, the theory often survives (even total) discrediting (Nisbett & Ross, 1980, p. 169).

[11] The subjects were not only told that their feedback had been false, they were shown the experimenter's instruction sheet assigning them to the success or failure performance condition and specifying the feedback to be presented (Nisbett & Ross, 1980, p. 177).

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V. PATTERNS OF ERROR IN THE ANALYSIS OF IRAQI WEAPONS OF MASS DESTRUCTION

In the thirty years since Kahneman and Tversky (1972) introduced the concept of heuristics and biases, researchers have conducted countless studies and experiments examining human judgment under uncertainty. Yet the concept is more than academic; shortcomings in the processes that underlie judgment can have the most serious of consequences. For those involved in national security, and particularly for those involved in the collection and analysis of national intelligence, perceptual and cognitive bias can be quite literally a matter of life and death. The judgment made about Iraqi weapons of mass destruction represents just such a case.

In the spring and summer of 2002, as the Bush Administration contemplated an invasion of Iraq, the Intelligence Community[12] was charged with a comprehensive assessment of Saddam Hussein's nuclear, biological, and chemical weapons programs and ambitions. This assessment was codified in a National Intelligence Estimate (NIE) in October 2002. Published by the National Intelligence Council[13] and entitled Iraq's Continuing Programs for Weapons of Mass Destruction, the NIE assessed that Iraq had continued its weapons of mass destruction programs in defiance of U.N. resolutions and restrictions. Specifically, it concluded that Iraq had reconstituted its nuclear weapons program and could construct a device by the end of the decade; that Iraq's biological weapons program was larger and more advanced than it was before the Gulf War; that Iraq had begun renewed production of chemical warfare agents and had a few hundred metric tons in stockpiles; and that Iraq was developing delivery systems for its nuclear,

[12] The Intelligence Community is a federation of executive branch agencies and organizations that conduct intelligence activities necessary for conduct of foreign relations and protection of national security. It is comprised of 15 Federal government agencies, services, bureaus, or other organizations within the executive branch that play a role in national intelligence, including the Army, Navy, Air Force, and Marine Corps Intelligence Elements; the Central Intelligence Agency; the Defense Intelligence Agency; the Department of Homeland Security; the Energy Department; the Federal Bureau of Investigation; the National Geospatial-Intelligence Agency; the National Reconnaissance Office; the National Security Agency, the State Department; the Treasury Department; and the United States Coast Guard (http://www.intelligence.gov/ic_in_a_nutshell/index.htm, n.d.).

[13] The National Intelligence Center (NIC) is a center of strategic thinking within the US Government, reporting to the Director of National Intelligence (DNI) and providing the President and senior policymakers with analyses of foreign policy issues that have been reviewed and coordinated throughout the Intelligence Community (http://www.cia.gov/nic/NIC_home.html, n.d.).

biological, and chemical weapons that could be employed against deployed forces and potentially against the continental United States (CIA, 2002).

Yet each one of these assessments, which together served as the basis for the Bush Administration's decision to go to war, was ultimately proven wrong. Extensive investigations by the Iraq Survey Group (ISG) after the war found:

> No evidence that Iraq had tried to reconstitute its capability to produce nuclear weapons after 1991; no evidence of biological warfare (BW) agent stockpiles or of mobile biological weapons production facilities; and no substantial chemical warfare (CW) stockpiles or credible indications that Baghdad had resumed production of CW after 1991 (Silberman & Robb, 2005, p. 45).

How could the Intelligence Community have gotten it so wrong? The errors were not the result of simple bad luck, or a once-in-a-lifetime "perfect storm," as some have suggested. The Senate Intelligence Committee, chaired by Pat Roberts and John Rockefeller, and the Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, chaired by Lawrence Silberman and Charles Robb, both concluded that these errors were instead the product of poor intelligence collection, an analytical process that was driven by assumptions and inferences rather than data, and inadequate validation and vetting of dubious intelligence sources (Silberman & Robb, 2005, p. 47). Yet despite tens of thousands of hours of interviews and testimony, and thousands of pages of published reports, neither the Senate Intelligence Committee nor the WMD Commission acknowledged the significant role of perceptual and cognitive bias in the errors in judgment that led to war.

A. THE IMPACT OF BIAS ON PERCEPTION AND JUDGMENT

1. Representativeness in the Analysis of Aluminum Tubes

By October 2002, the Intelligence Community had concluded that more than ten years of sanctions and the loss of much of Iraq's physical nuclear infrastructure under IAEA oversight had not diminished Saddam's interest in nuclear weapons. And though there were a number of factors that contributed to this assessment, it hinged on two key judgments. First, the Intelligence Community saw Iraq's efforts to procure tens of thousands of proscribed high-strength aluminum tubes as clear evidence of a fully reconstituted nuclear weapons program, noting, "All intelligence experts agree that Iraq is seeking nuclear weapons and that these tubes could be used in a centrifuge enrichment program" (CIA, 2002). Second, the Intelligence Community concluded that although it was unlikely that Iraq could indigenously produce enough weapons-grade material for a deliverable nuclear weapon until the last half of this decade, Baghdad could produce a nuclear weapon within a year if it were able to procure weapons-grade fissile material abroad (CIA, 2002). Both judgments were largely the result of errors due to representativeness.

As Chapter III describes, representativeness is one of the most basic and most often employed heuristics that people use to make judgments. It allows people to reduce otherwise taxing inferential tasks into simple similarity judgments, in which objects, events, or processes are assigned to one conceptual category rather than to another based on how well they represent or resemble one category more than another (Nisbett & Ross, 1980, p. 7). Problems with representativeness arise when we use it as our primary (or our only) judgmental strategy; the otherwise useful heuristic becomes an undesirable bias when we overestimate the extent to which a situation or sample is representative of the situation or population to which we wish to generalize (Schwenk, 1985, p. 121).

The Intelligence Community insisted that Iraq's efforts to procure more than 60,000 high-strength aluminum tubes[14] proved Baghdad's intentions to reconstitute its nuclear weapons programs because the dimensions of the tubes were similar to the "Beams" configuration, a design used by Iraq before the Gulf War; and nearly matched the "Zippe" configuration, another publicly available design for gas centrifuges (Senate Intelligence Committee, 2004, p. 89).[15] In the twelve months following this original assessment, CIA produced at least nine additional reports discussing the aluminum tube

[14] In 2001, the CIA learned that the tubes were to be made of a specific grade of aluminum alloy which, due to its hardness and strength, and resulting suitability for nuclear applications, was prohibited for use in Iraq by a number of United Nations Security Council Resolutions. The tubes were to be manufactured from 7075-T6 aluminum, with an outer diameter of 81mm, and an inner diameter of 74.4mm, a wall thickness of 3.3mm, and a length of 900mm. The tubes were to be anodized using chromic acid and were to be shipped wrapped in wax paper and separated from each other. This type of aluminum alloy is extremely hard and strong when formed into a tube of more than 75mm in diameter. Moreover, it is a controlled item under the Nuclear Suppliers Group and Annex III of U.N. Security Council Resolution 687 and 707; these resolutions prohibited Iraq from importing the material because it could have nuclear applications (Senate Intelligence Committee, 2004, p. 88).

[15] The CIA, and later the National Ground Intelligence Center (NGIC), assessed that the tubes "had little use other than for a uranium enrichment program" (Senate Intelligence Committee, 2004, p. 88).

procurement efforts. Yet none provided any additional information to support the CIA's analysis that the tubes were intended for Iraq's nuclear program (p. 90). The complex inferential task of determining technical suitability was reduced into a simple judgment of similarity. Just as "people express great confidence in the prediction that a person is a librarian when a given description of his personality which matches the stereotype of librarians, even if the description is scanty, unreliable, or outdated" (Kahneman et al, 1982, p. 9), the CIA expressed great confidence that the tubes were for uranium enrichment because their description matched the Zippe design.

This judgment about the aluminum tubes was also based on an illusion of validity. In examining whether the walls of the tubes were of the necessary thickness for centrifuge use, the CIA sought the assistance of an independent contractor to perform a number of tests. The agency provided the contractor with stacks of intelligence data and analysis on Iraqi tube procurements, and the National Ground Intelligence Center's analysis that the tubes were most likely for use in uranium enrichment.[16] After an initial test questioned the suitability of the tubes for use in enrichment, the CIA complained that methodology used by the contractor was faulty (Silberman & Robb, 2005, p. 70). The contractors eventually provided a "correction" with new test data, which, the CIA believed, demonstrated that the tubes had sufficient strength for use in a centrifuge. Their report concluded that "the tubes [were] consistent with design requirements of gas centrifuge rotors" and "inconsistent with [conventional] rocket motor applications" (Senate Intelligence Committee, 2004, p. 94). Although there was no evidence of impropriety, the testing is an example of how unwarranted confidence, spawned by an apparent fit between the input information and the predicted outcome, produced an illusion of validity.

2. Representativeness in the Analysis of Samarra Tanker Trucks

By October 2002, the Intelligence Community had also described its "high confidence" in the fact that Iraq possessed chemical weapons and had begun to reconstitute its chemical weapons program. Specifically, analysts believed that gaps in Iraqi accounting and an analysis of current production capabilities strongly suggested that

[16] Although a number of analysts from the Department of Energy (DOE) disagreed with the assessment that the tubes were for use in uranium enrichment, their reports were never given to the independent contractor (Senate Intelligence Committee, 2004, p. 94).

Iraq had a stockpile of VX, sarin, cyclosarin, and mustard (CIA, 2002). And although the NIE cautioned that the Intelligence Community had "little specific information on Iraq's CW stockpile," it estimated that "Saddam probably [had] stocked at least 100 metric tons and possibly as much as 500 metric tons of CW agents (Silberman & Robb, 2005, p. 112). The Intelligence Community further concluded that "much" of Iraq's CW stockpiles had been produced in the past year, that Iraq had "rebuilt key portions of its CW infrastructure," and that Baghdad planned to expand dual-use infrastructure that it could divert quickly to CW production (CIA, 2002). This judgment, based substantially on the presence of Samarra tanker trucks at key ammunition depots and production facilities, was also influenced by bias.

Chapter III discusses how representativeness can also manifest itself in our perception of cause and effect. Because we do not have an intuitive understanding of the kinds and amount of information needed to prove a relationship, people often perceive relationships that do not in fact exist (Heuer, 1999, p. 127). Richard Nisbett and Thomas Wilson (1977) suggest that "people have strong a priori notions of the types and causes that ought to be linked to particular types of effects, and a simple 'resemblance criterion' often figures heavily in such notions" (as cited in Nisbett & Ross, 1980, p. 115).

The "Samarra" tanker is a specific type of delivery truck that was known to have been used by Iraq for chemical weapons shipments throughout the 1980s and before the Gulf War (Silberman & Robb, 2005, p. 122). In the spring and summer of 2002, satellite imagery suggested that a large number of these trucks were transporting materials to and from chemical plants and ammunition depots. Because of the similarity of this platform and activity with the trucks and shipment patterns known to be involved in chemical weapons programs in the 1980s, Community analysts concluded that current imagery confirmed chemical weapons activity. Instead of the detailed and multifaceted analysis that this determination required, the Intelligence Community again defaulted to a simple similarity judgment. Analysts then compounded this error in their perception of relationships that did not exist, as shown in a series of faulty cause and effect determinations:

> Based on the assessment that the presence of these Samarra-type trucks suggested CW shipments, CW analysts then judged that the frequency of

> such transshipments pointed to the assessment that "CW was already deployed with the military logistics chain," which, in turn, indicated to these analysts that Iraq had added to its CW stockpile in the last year. That assessment, in turn, indicated to analysts that Iraq had restarted CW production (Silberman & Robb, 2005, p. 123).

As this logic train illustrates, the October 2002 NIE conclusion that Iraq had reconstituted its chemical weapons programs was fundamentally based on the biased assessment that the "Samarra" trucks seen by imagery satellites were in any way involved in chemical weapon activity.

3. Availability in the Analysis of Uranium from Niger

The Intelligence Community's October 2002 conclusion that Iraq was reconstituting its nuclear weapons program was punctuated by the assessment that "Iraq was 'trying to procure uranium ore and yellowcake'[17] and that 'a foreign government service' had reported that 'Niger planned to send several tons' of yellowcake to Iraq" (Silberman & Robb, 2005, p. 76). Based almost entirely on a handful of reports from a foreign intelligence service, this judgment was due, at least in part, to the availability bias.

As Chapter III describes, our judgment about the likelihood of an event is often based on its availability in the processes of perception, memory, or construction from imagination (Nisbett & Ross, 1980, p. 18). Cues such as the ease with which a scenario or event comes to mind, or the frequency of such events in memory, exert a powerful influence on our estimation of their actual likelihood. Problems result when these cues are not normatively appropriate, or when we associate the likelihood of a scenario or event with information that is vivid, concrete, or emotionally pertinent, or of temporal, spatial, or sensory proximity to the decision-maker, when these factors are completey unrelated to its true probability.

From the time that the reports of uranium from Niger first surfaced in 2001, the CIA recognized the potential impact with policymakers. In a cable requesting additional information from the foreign intelligence service that first made the claims, the CIA

[17] Yellowcake (also known as urania and uranic oxide) is concentrated uranium oxide, obtained through the milling of uranium ore. It is created by passing raw uranium ore through crushers and grinders to produce "pulped" ore. This is then bathed in sulfuric acid to leach out the uranium. Yellowcake is what remains after drying and filtering (Retrieved November 20, 2005 from http://www.wikipedia.com).

acknowledged that "the issue of Iraqi uranium procurement continues to resonate with senior policymakers" (Senate Intelligence Committee, 2004, p. 67). And analysts within the Department of Energy cautioned their counterparts within the CIA against "converting strong statements [about uranium from Niger] into the knockout punch" (p. 60).[18] Yet the terms "uranium" and "yellowcake" seemed to be as radioactive as the elements themselves. And because the vividness of this information was correlated only modestly with its value as evidence, the Intelligence Community paid a high price in credibility for its disproportionate weighting.

4. Availability in the Analysis of Mobile Biological Weapons Labs

The October 2002 NIE also summarized the conclusions of the Intelligence Community regarding Iraq's biological warfare capabilities and ambitions, noting, "All key aspects, R&D, production, and weaponization, of Iraq's offensive BW program are active and most elements are larger and more advanced than they were before the Gulf war" (CIA, 2002). In particular, the Community believed that Iraq had some lethal and incapacitating BW agents and was capable of quickly producing and weaponizing a variety of such agents, including anthrax, for delivery by bombs, missiles, aerial sprayers, and covert operatives, potentially against the U.S. Homeland (CIA, 2002). Further, the Community believed that Baghdad had established a large-scale, redundant, and concealed biological agent production capability, which included mobile facilities that could evade detection, were highly survivable, and could exceed the production rates Iraq had prior to the Gulf war (Silberman & Robb, 2005, p. 80). This conclusion too was influenced by errors in judgment due to availability.

Chapter III describes salience as similar to vividness in that it refers to the fact that colorful, dynamic, or other distinctive stimuli engage people's attention (Kahneman et al, 1982, p. 192). Systematic errors in judgment occur, however, when our attention is engaged disproportionately compared with what is normatively appropriate. Moreover, people, particularly when they have token or solo status, are often seen as particularly

[18] The IAEA later found that the documents supporting the claims of uranium from Niger contained numerous indications of forgery, including flaws in the letterhead, forged signatures, misspelled words, incorrect titles for individuals and government entities, and anomalies in the documents' stamps, as well as serious errors in content (Silberman & Robb, 2005, p. 77).

salient. As Shelley Taylor (1982) suggests, such people often disproportionately influence the judgment of observers (as cited in Kahneman et al, 1982, p. 193).

The determinations regarding the reconstitution of Iraq's biological weapons programs were based almost exclusively on reporting from a single human source, codenamed "Curveball," who insisted that Iraq had mobile facilities for producing such agents (Silberman & Robb, 2005, p. 80).[19] There is no doubt that "Curveball" was appealing as a source; a number of factors made him particularly salient. First, his position as an Iraqi defector made him fairly unique, and granted him the solo status that Taylor describes in her study. Second, his status as a chemical engineer, coupled with his access to specific production facilities within Iraq, resulted in an uncommon level of technical detail and accuracy and gave him a great deal of credibility with his handlers. Finally, his hundreds of compelling eye-witness accounts seemed to repeatedly trump more abstract indicators that contradicted his assertions. In the end, the analysts' resistance to any information that could undermine Curveball's reliability suggests that the analysts were "unduly wedded" to a highly salient source that fully supported their expectations and assumptions (Silberman & Robb, 2005, p. 90).

B. THE IMPACT OF ANCHORING ON PERCEPTION AND JUDGMENT

Many within the Intelligence Community have acknowledged that their starting point for evaluating Iraq's WMD programs before the 2003 invasion was Iraq's past. Assumptions were formed based on Iraq's history of producing biological and chemical weapons, its use of chemical weapons, its history of effectively concealing its nuclear program before the Gulf War, and the regime's failure to account for its previously declared stockpiles. "Analysts operated from the premise that Iraq very likely still possessed biological and chemical weapons, was still hiding [them] from inspectors, and was still seeking to rebuild its nuclear weapons program" (Silberman & Robb, 2005, p. 168). The analytical flaw was not that this premise was unreasonable (for it was not); rather, it was that this premise hardened into a presumption, and analysts began to fit the

[19] In fact, it was almost entirely due to "Curveball" that the Intelligence Community changed its assessment of the 1990s that Iraq could have biological weapons to the assessment of the October 2002 NIE that Iraq had biological weapons (Silberman & Robb, 2005, p. 84).

facts to the theory rather than the other way around. The premise became an anchor that compounded the effects of representativeness and availability and magnified the degree of error in judgment.

1. Anchoring and the Influence of Expectations

The experiment by Jerome Bruner and Leo Postman (1949), during which playing cards were altered so that the spades were red and the hearts black, demonstrates the impact of expectations on human perception. It shows how people develop expectations from a myriad of diverse sources, including education, organizational norms, cultural values, and role requirements, as well as by the stimuli recorded by our receptor organs. In particular, the experiment shows how perceptual organization is powerfully determined by expectations built upon past experience (as cited in Chandler, 2004).

This was certainly the case with the U.S. Intelligence Community in its assessment of Iraqi WMD; its collective experience with Baghdad throughout the two decades preceding the invasion anchored its pre-war assessment and limited its analytical adjustment. In particular, a number of events led to powerful and well-defined expectations about Iraq's ambitions regarding WMD.

First, there was no doubt that Saddam developed and maintained huge stockpiles of chemical weapons throughout the 1980s. Following the Gulf War, the U.N. Special Commission (UNSCOM) supervised the destruction of more than 40,000 of these chemical munitions, nearly 500,000 liters of chemical agents, 1.8 million liters of chemical precursors, and seven different types of delivery systems, including ballistic missile warheads (CIA, 2002).

Second, there was no dispute that Saddam had used chemical weapons during his war with Iran. In at least ten different large scale attacks over seven years, Iraqi forces killed or injured more than 20,000 people, delivering chemical agents, including mustard agent and the nerve agents sarin and tabun2, in aerial bombs, 122mm rockets, and artillery shells (CIA, 2002). On March 16, 1988, Saddam used chemical weapons against his own people when Iraqi warplanes bombed the town of Halabja, where 80,000 Kurds lived. As many as 5,000 people are said to have died, according to international human rights organizations (CIA, 2002).

Third, during inspections in Iraq after the Gulf War, UNSCOM was shocked by the degree to which they underestimated Iraq's nuclear weapons program. According to David Kay, U.N. Chief Weapons Inspector from 1983 through 1992, inspectors were particularly surprised by the magnitude and advanced state of Iraq's efforts to obtain nuclear explosive devices:

> At the time of the Gulf War, Iraq was probably only 18 to 24 months away from its first crude nuclear device and no more than three to four years away from more advanced, deliverable weapons. Moreover, the amount of foreign assistance and technology that had fueled the Iraqi arms program was truly staggering (Kay, 1995).

Kay believed that the failure of both International Atomic Energy Agency (IAEA) safeguards inspectors and national intelligence authorities to detect a nuclear weapons program of the magnitude and advanced character of Iraq's "should stand as a monument to the fallibility of on-site inspections and national intelligence when faced by a determined opponent" (Kay, 1995). It did; as the October 2002 NIE suggests, this monument enshrined the expectations that Iraq was behaving as it had in the past, and that the Intelligence Community had to be careful to avoid being caught off-guard.[20]

Finally, even as late as 2002, Iraq had never fully accounted for major gaps and inconsistencies in its declarations and has provided no credible proof that it has completely destroyed its weapons stockpiles and production infrastructure (CIA, 2002). According to Kenneth Pollack, former CIA analyst and Director of Persian Gulf Affairs for the National Security Council, the discrepancies between how much WMD material went into Iraq and how much Iraq could prove it had destroyed became the final element in the context for the Intelligence Community's pre-war assessment. "The U.N. inspectors obtained virtually all the import figures. They then asked the Iraqis to either produce the materials or account for their destruction. In many cases the Iraqis could not" (Pollack, 2004).

The Intelligence Community's assessment of Iraq's pre-war WMD programs was clearly not made in a vacuum. Rather, as the Intelligence Community later explained, its assessments "were informed by its analysis of Iraq's ambitions and capabilities spanning

[20] The NIE specifically took note of "revelations after the Gulf war [that] starkly demonstrated the extensive efforts undertaken by Iraq to deny information" (CIA, 2002).

the preceding fifteen years, as well as by lessons learned from over a decade of dealing with Iraqi intransigence on this issue" (Silberman & Robb, 2005, p. 53). Given Saddam's history of using them, his previous deceptions, and his repeated efforts to obstruct the U.N., many people still wonder how the Intelligence Community could have concluded that Saddam Hussein did not have weapons of mass destruction (Silberman & Robb, 2005, p. 46).

2. Anchoring and the Influence of Situational Context

The experiment conducted by B.R. Bugelski and Delia Alampay (1961), in which subjects evaluated a drawing that could be interpreted either as rat or an old man wearing spectacles, demonstrates how different circumstances evoke different sets of expectations (as cited in Chandler, 2004). In the forty years since then, countless studies have validated the conclusion that we perceive objects or events differently based on the situation. In other words, our perception is influenced by the context in which it occurs.

Just as its past experience with Baghdad served as an anchor that influenced the Intelligence Community's perceptions, so too did the current situation. In fact, a number of key events occurred just prior to the decision to invade Iraq that resulted in a context that seemed to support many of the pre-war assessments.

First, there was no doubt that Saddam was a brutal dictator who ruled Iraq through a combination of violence, secrecy, mendacity, and fear (Silberman & Robb, 2005, p. 147). Up until the very end, his regime operated a robust and ruthless security system and engaged in sophisticated efforts to conceal or disguise its activities from outside intelligence services. The Intelligence Community characterized these efforts as "denial and deception," and pointed to them as evidence that Saddam was clearly hiding something (p. 48).

Second, there was Iraqi rhetoric. Consider what intelligence analysts must have thought after hearing Saddam make the following statement in June of 2000:

> If the world tells us to abandon all our weapons and keep only swords, we will do that . . . if they destroy their weapons. But if they keep a rifle and then tell me that I have the right to possess only a sword, then we would say no. As long as the rifle has become a means to defend our country against anybody who may have designs against it, then we will try our best to acquire the rifle (Pollack, 2005).

Kenneth Pollack (2005) notes that in this context, it would be very difficult not to interpret Saddam's remarks as an announcement that he intended to reconstitute his WMD programs.

Finally, there was Iraq's failure to comply with U.N. Resolution 1441, which declared Iraq in material breach of its obligations under previous resolutions, required new weapons declarations from Iraq, and included stringent provisions for Iraqi compliance, including access to all sites, interviews with scientists, and landing and over flight rights (ISG, Volume I, 2004, p. 43). According to Chief U.N. Weapons Inspector David Kay:

> Iraq was in clear violation of the terms of Resolution 1441. Resolution 1441 required that Iraq report all of its activities, one last chance to come clean about what it had. We have discovered hundreds of cases, based on both documents, physical evidence and the testimony of Iraqis, of activities that were prohibited under the initial U.N. Resolution 687 and that should have been reported under 1441, with Iraqi testimony that not only did they not tell the U.N. about this, they were instructed not to do it, and they hid material (Kay, 1995).

For many in the Intelligence Community, it seemed inconceivable that Saddam would thumb his nose at the U.N. and risk outright war with the United States if he wasn't hiding something. "Due in no small part to the pre-war situational context, the Intelligence Community failed to examine seriously the scenario which later turned out to be the case: domestic or regional political pressures or some other factors prompted Saddam Hussein to destroy his stockpiles and to forswear active development of weapons of mass destruction after the first Gulf War" (Silberman & Robb, 2005, p. 147).

VI. CONCLUSION

Commenting on Pearl Harbor, Roberta Wohlstetter found it easy after the event to sort the relevant from the irrelevant signals. "After the event, of course, a signal is always crystal clear; we can now see what disaster it was signaling since the disaster has occurred. But before the event it is obscure and pregnant with conflicting meanings" (as cited in Keane & Hamilton, 2004, p. 339). This is also quite clearly the case with the Intelligence Community's pre-war assessment of Iraqi weapons of mass destruction.

We now know that the Intelligence Community's conclusions regarding Iraq's nuclear weapons capabilities were almost entirely unfounded. Based on its extensive post-war investigations, the Iraq Survey Group concluded that Iraq had not tried to reconstitute a capability to produce nuclear weapons after 1991 (ISG Volume II, 2004, p. 7). Moreover, the ISG judged that Iraq's work on uranium enrichment, including development of gas centrifuges, essentially ended in 1991, and that its ability to reconstitute its enrichment program progressively decayed after that time. In particular, the ISG found that Iraq's effort to procure the aluminum tubes was "best explained by its efforts to produce 81-mm rockets" (p. 9); and uncovered no evidence that the tubes were intended for use in a gas centrifuge as the Intelligence Community believed. Finally, the ISG found no evidence to show that Iraq sought uranium from abroad after 1991 or renewed indigenous production of such material (p. 9).

We now know that the Intelligence Community's findings concerning Iraq's biological weapons programs were similarly without merit. In fact, the Iraq Survey Group concluded that by 1992, Iraq had unilaterally destroyed its undeclared biological weapons stocks and probably destroyed its remaining holdings of bulk BW agent. Moreover, the ISG found no direct evidence that Iraq, after 1996, had plans for a new BW program or was conducting BW-specific work for military purposes (ISG Volume III, 2004, p. 1).[21] Further, although Iraq had retained some dual-use equipment and

[21] In fact, from the mid-1990s, despite evidence of continuing interest in nuclear and chemical weapons, the ISG found absolutely no discussion or even interest in BW at the Presidential level (ISG Volume III, 2004, p. 1).

intellectual capital, the ISG found no evidence of any mobile BW program.[22] Finally, the credibility of the human source (code-named "Curveball") on which much of the pre-war assessment had been based came into question around the time of the publication of the NIE and collapsed under scrutiny in the months following the war (Silberman & Robb, 2005, p. 80).

We now know that the Intelligence Community's findings concerning Iraq's chemical weapons programs were also mistaken. The Iraq Survey Group concluded that Iraq had unilaterally destroyed its undeclared chemical weapons stockpile in 1991. Further, it found no credible indications that Baghdad had resumed production of chemical munitions thereafter, a policy ISG attributes to Baghdad's desire to see sanctions lifted, or rendered ineffectual, or its fear of force against it should WMD be discovered (ISG Volume III, 2004, p. 1). In fact, the ISG noted that the only chemical weapons it recovered after the war were those manufactured the first Gulf War, and that after 1991 only small, covert labs were maintained to research chemicals and poisons, primarily for intelligence operations (ISG Volume III, 2004, p. 3).[23] Finally, the ISG determined that pre-war concerns of Iraqi plans to use chemical weapons if Coalition forces crossed certain defensive "red lines" were groundless; the "red lines" referred to conventional military planning only (Silberman & Robb, 2005, p. 112).

How could the Intelligence Community have gotten it so wrong? By now, the answer should be apparent; though a short summary may be in order.

Lacking reliable data about the true nature of Iraq's nuclear, biological, and chemical weapons programs, the starting point of most analysts was firmly anchored in Baghdad's history: its past use of chemical weapons, its successful concealment of WMD programs both before and after the Gulf War, and its failure to account for previously

[22] Any attempt to create a new BW program after 1996 would have encountered a range of major hurdles. The years following Desert Storm wrought a steady degradation of Iraq's industrial base: new equipment and spare parts for existing machinery became difficult and expensive to obtain, standards of maintenance declined, staff could not receive training abroad, and foreign technical assistance was almost impossible to get. Additionally, Iraq's infrastructure and public utilities were crumbling. New large projects, particularly if they required special foreign equipment and expertise, would attract international attention. U.N. monitoring of dual-use facilities up to the end of 1998 made their use for clandestine purpose complicated full of risk (ISG Volume III, 2004, p. 2).

[23] ISG uncovered information that the Iraqi Intelligence Service (IIS) maintained a set of undeclared covert laboratories to research and test various chemicals and poisons, primarily for intelligence operations, from 1991 to 2003 (ISG Volume III, 2004, p. 3).

declared stockpiles. "The analysts' operating hypothesis, therefore, was that Iraq probably still possessed hidden chemical and biological weapons, was still seeking to rebuild its nuclear weapons program, and was seeking to increase its capability to produce and deliver chemical and biological weapons" (Silberman & Robb, 2005, p. 49). The WMD Commission found that

> In essence, analysts shifted the burden of proof, requiring evidence that Iraq did not have WMD. More troubling, some analysts started to disregard evidence that did not support their premise. Chastened by the effectiveness of Iraq's deceptions before the Gulf War, they viewed contradictory information not as evidence that their premise might be mistaken, but as evidence that Iraq was continuing to conceal its weapons programs (Silberman & Robb, 2005, p. 49).

Once analysts made a "first pass" at this problem, faulty indicators became much more representative and much more available than they otherwise may have been. Biased judgments became remarkably resistant to further information, alternative modes of reasoning, and even logical or evidential challenges. Attempts to integrate new information found many analysts and organizations surprisingly conservative, that is, willing to yield ground only grudgingly and primed to challenge the relevance, reliability, or authority of subsequent information or logical consideration. As a result, just as Daniel Kahneman, Amos Tversky, Richard Nisbett, Lee Ross, and a host of other cognitive psychologists might have predicted, the simple heuristics of representativeness and availability had disproportionate impact in the ultimate assessment.

More than three years after the dramatic failures of the Intelligence Community regarding Iraqi weapons of mass destruction, it is easy to find the mistakes in its judgments. Yet "intelligence analysis is a tricky business. Analysts are often forced to make predictions in the absence of clear evidence – and then are pilloried after twenty-twenty hindsight reveals that they failed to paint a full picture from conflicting and scattered pieces of evidence" (Silberman & Robb, 2005, p. 168). And while we should be reluctant to form too harsh a judgment about the analysts and decision-makers who made them, we cannot ignore the fact that few within the Intelligence Community have acknowledged the role of perceptual and cognitive bias in intelligence analysis and decision-making, and even fewer have sought to do anything about it.

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LIST OF REFERENCES

Allison, G. & Zelikow, P. (1999). *Essence of Decision*. New York: Addison-Wesley Educational Publishers.

Bacon, F. (1620). *The New Organon*. Retrieved August 13, 2005 from http://www.constitution.org/bacon/nov_org.htm.

Barnes, H, J. (1984). Cognitive biases and their impact on strategic planning. *Strategic Management Journal*, 5(2), 129.

Bottom, W. P. (2004). Heuristics and biases: The psychology of intuitive judgment. *Academy of Management Review*, 29(4), 695.

Bruner, J.S. & Potter, M.C. (1964). Interference in visual recognition. *Science,* 144(3617), 424-425.

Bukszar, E.,Jr. (1999). Strategic bias: The impact of cognitive biases on strategy. *Revue Canadienne Des Sciences De l'Administration*, 16(2), 105.

Chandler, D. (2004). Context and expectations, categorization and selectivity. Retrieved August 13, 2005 from http://www.aber.ac.uk/media/Modules/MC10220/visper05.html.

Chapman, B, G., Johnson, & J, E. (1999). Anchoring, activation, and the construction of values. Organizational Behavior and Human Decision Processes, 79(2), 115.

Chapman, J. A., & Ferfolja, T. (2001). Fatal flaws: The acquisition of imperfect mental models and their use in hazardous situations. Journal of Intellectual Capital, 2(4), 398.

Central Intelligence Agency (2002, December). *United States National Intelligence Estimate: Iraq's Weapons of Mass Destruction Programs.* Retrieved August 20, 2005 from http://www.cia.gov/cia/reports/iraq_wmd/Iraq_Oct_2002.htm)

Fisher, G. (1968). Ambiguity of form: old and new. *Perception and Psychophysics*, 189(4).

Gigerenzer, G. (2005). I think, therefore I err. *Social Research*, 72(1), 195.

Gilovich, T., Griffin, D., & Kahneman, D. (2002). *Heuristics and biases: the psychology of intuitive judgment.* New York: Cambridge University Press.

Heuer, R. (1999). *Psychology of intelligence analysis*. Washington: Center for the Study of Intelligence, Central Intelligence Agency.

Higgins, E. T. (1998). The aboutness principle: a pervasive influence on human inference. *Social Cognition*, 16(1), 173.

Iraq Survey Group (ISG). (2004). Comprehensive Report of the Special Advisor to the DCI on Iraqi WMD, Volume I, "Chemical," Retrieved August 12, 2005 from http://www.cia.gov/cia/reports/iraq_wmd_2004/

Iraq Survey Group (ISG). (2004). Comprehensive Report of the Special Advisor to the DCI on Iraqi WMD, Volume II, "Nuclear," Retrieved August 12, 2005 from http://www.cia.gov/cia/reports/iraq_wmd_2004/

Iraq Survey Group (ISG). (2004). Comprehensive Report of the Special Advisor to the DCI on Iraqi WMD, Volume III, "Biological," Retrieved August 12, 2005 from http://www.cia.gov/cia/reports/iraq_wmd_2004/

Johnson-Laird, P.N. (1983). *Mental models: toward a cognitive science of language, inference, and consciousness.* Cambridge: Harvard University Press.

Kahneman, D. (2002, December 8). *Maps of bounded rationality a perspective on intuitive judgment and choice.* Nobel prize lecture delivered at Princeton University, Princeton, NJ, Retrieved August 16. 2205 from http://www.nobel.se/economics/laureates/2002/kahnemann-lecture.pdf.

Kahneman, D., Tversky, A., and Slovic, P. (1982). *Judgment under Uncertainty: Heuristics and Biases*. Cambridge: Cambridge University Press.

Kahneman, D. and Tversky, A. (1984). Extensional versus intuitive reasoning. *Psychological Review*, 91, 293-315.

Kahneman, D. and Tversky, A. (1972). Subjective probability: a judgment of representativeness. *Cognitive Psychology*, Vol. 3, pp. 430-54

Karp, T. (2005). Unpacking the mysteries of change: mental modeling. *Journal of Change Management*, 5(1), 87.

Kay, D. (1995, Winter). Denial and Deception Practices of WMD Proliferators: Iraq and Beyond, *The Washington Quarterly* 18(1), 83.

Keane, T. & Hamilton, L. (2004). *The 9-11 Commission Report*. Washington, DC: Government Printing Office.

Leeper, R. W. (1935). A study of the neglected portion of the field of learning: the development of sensory organization. *Journal of Genetic Psychology*, 46, pp 41-75.

Mill, J.S. (1974). *A system of logic ratiocinative and inductive*. Toronto: University of Toronto Press.

Nisbett, R. & Ross, L. (1980). *Human Inference: Strategies and Shortcomings of Social Judgment.* Englewood Cliffs: Prentice-Hall, Inc.

Palmer, Stephen E. (1975). The effects of contextual scenes on the identification of objects. *Memory and Cognition* 3(5): 519-26

Plous, S. (1993). *The Psychology of Judgment and Decision Making.* New York: McGraw-Hill, Inc.

Pollack, K. (February 4, 2004). How did we get it so wrong. *The Guardian*, Guardian Features Page, p. 2.

Senate Intelligence Committee (2004). *Report on the U.S. Intelligence Community's Pre-War Intelligence Assessments on Iraq*, Washington: Government Printing Office.

Schwenk, & R, C. (1985). Management illusions and biases: Their impact on strategic decisions. *Long Range Planning*, 18(5), 74.

Schwenk, & R, C. (1988). The cognitive perspective on strategic decision making. The Journal of Management Studies, 25(1), 41.

Silberman, L. & Robb, C. (2005). *The Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction*, Washington: Government Printing Office.

Simon, H.A. (1959). Theories of decision-making and behavioral science. *The American Economic Review*, XLIX, 253-283.

Simon, H.A. (1985). Human nature in politics: the dialogue of psychology with political science. *The American Political Science Review,* 79(2), 293-304.

Simon, H.A. (1986). Rationality in psychology and economics. *Journal of Business,* 59(4), 209-215.

Stormer, W.P. (1991). *The decision dilemma: cognitive bias*. Carlisle, PA: United States Army War College.

Woods, D. D., Patterson, E. S., & Roth, E. M. (2002). Can we ever escape from data overload? A cognitive systems diagnosis. *Cognition, Technology & Work*, 4(1), 22.

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