

**Deciding analytically or trusting your intuition? The advantages and disadvantages of analytic and intuitive thought**

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## Abstract

Recent research has highlighted the notion that people can make judgments and choices by means of two systems that are labeled here *tacit* (or intuitive) and *deliberate* (or analytic). Whereas most decisions typically involve both systems, this chapter examines the conditions under which each system is liable to be more effective. This aims to illuminate the age-old issue of whether and when people should trust “intuition” or “analysis.” To do this, a framework is presented to understand how the tacit and deliberate systems work in tandem. Distinctions are also made between the types of information typically used by both systems as well as the characteristics of environments that facilitate or hinder accurate learning by the tacit system. Next, several experiments that have contrasted “intuitive” and “analytic” modes on the same tasks are reviewed. Together, the theoretical framework and experimental evidence leads to specifying the trade-off that characterizes their relative effectiveness. Tacit system responses can be subject to biases. In making deliberate system responses, however, people might not be aware of the “correct rule” to deal with the task they are facing and/or make errors in executing it. Whether tacit or deliberate responses are more valid in particular circumstances requires assessing this trade-off. In this, the probability of making errors in deliberate thought is postulated to be a function of the analytical complexity of the task as perceived by the person. Thus the trade-off is one of bias (in implicit responses) versus analytical complexity (when tasks are handled in deliberate mode). Finally, it is noted that whereas much attention has been paid in the past to helping people make decisions in deliberate mode, efforts should also be directed toward improving ability to make decisions in tacit mode since the effectiveness of decisions clearly depends on both. This therefore represents an important frontier for research.

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## Deciding analytically or trusting your intuition? The advantages and disadvantages of analytic and intuitive thought

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The idea that judgments and choices involve distinctive analytic and intuitive components resonates with most people's everyday experiences. It is also an idea that has been discussed by philosophers and scientists across at least two millennia. More recently, the distinctive nature of intuitive and analytic thought has been the subject of much psychological research with many theorists postulating so-called "dual models" of thought (see, e.g., Bruner, 1986; Chaiken & Trope, 1999; Epstein, 1994; Hammond, 1996; Sloman, 1996).

Accepting this dichotomy, a natural question is whether and when one form of thinking is more "valid" (however defined) than the other. At one extreme, it is tempting to think that analytic ways of making decisions must be better. After all, a large part of the educational process involves teaching people to think more analytically under the assumption that people's untrained intuitive processes will lead them astray. On the other hand, there is a mass of anecdotal evidence that supports the use of intuition (as well as much that does not!) and the term intuition itself is often accorded a mystical status akin to truth. Moreover, people sometimes find themselves in situations where their analysis contradicts their intuitions. What should they do?

The purpose of this chapter is to illuminate the issue of when and where analytic or intuitive judgment is likely to be more effective. To achieve this, I first discuss some of the dual-process models of thought advanced in the literature. This, in turn, leads to my own definition of the dual models that I refer to as the *tacit* and *deliberate* systems of thought and which I use to make operational the concepts of *intuition* and *analysis*. I further present a framework for understanding how these two systems work in tandem. Critical to this framework is the notion that stimuli encountered by the organism are first filtered by a *preconscious* processor and that

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much cognitive activity takes place outside of cognitive awareness. The tacit system is thus always involved in making judgments and choices but can be subject to control by the deliberate system. I also emphasize the importance of the state of the organism when it first meets any triggering stimulus and that the kinds of information processed by the tacit and deliberate systems differ. The former tends to operate on information that is *partial* (relative to the task at hand) but also *holistic*. The latter operates on *unitary* cues and also depends heavily on *additional* information that is absent from the stimulus that initially triggered the process of deliberate thought.

I further stress the role of learning in the acquisition of tacit system responses and point out that the nature of the environment in which learning takes place has a huge effect on the subsequent quality of tacit responses. In *kind* learning environments, people receive accurate and timely feedback that allows the tacit system to shape accurate responses. In *wicked* learning environments, feedback is lacking or misleading and people can learn to have confidence in responses that are quite inaccurate.

To treat the issue of when and where tacit or deliberative responses are more accurate or valid, I first make a number of general comments about the relative validities of both systems prior to reviewing a number of experimental studies. As I point out, despite the fact that few studies have actually pitted the two systems against each other, there is still quite a lot of relevant evidence. Next, I elaborate on the trade-off that underlies this issue. Tacit system responses can be subject to biases. In making deliberate system responses, however, people might not be aware of the “correct rule” to deal with the task they are facing and/or make errors in executing it. Whether tacit or deliberate responses are more valid in particular circumstances requires assessing this trade-off. I therefore present a framework that illustrates the implications of the trade-off. Critical to this framework is that the probability of making errors in deliberate thought is postulated to be a function of the analytical complexity of the task as perceived by the person. Thus the trade-off is one of bias (in implicit responses) versus analytical complexity (when tasks are handled in deliberate mode).

Finally, I conclude by noting that the important issue is not necessarily to decide whether tacit or deliberate processes are more valid than the other. *The important task is to make valid responses* and, in these, both systems are typically implicated. I also argue that whereas much has been done to help people develop

their analytical abilities (and correctly so), little has been done to train people in the use and development of intuition. I believe that the payoff from understanding the relative strengths of analysis and intuition lies in identifying ways in which the latter can be educated (cf. Hogarth, 2001).

### Dual-process theories

Although grounded in quite different psychological research traditions, the work of Seymour Epstein (1994) and Kenneth Hammond (1996) nicely illustrate the distinctions between intuitive and analytic thinking that characterize modern treatments of this topic. Epstein has developed a cognitive-experiential self-theory of personality that specifies two ways in which people process information. He calls one mode the *experiential*, the other the *rational*. The experiential system is automatic and driven by emotions and intuition (which he does not define explicitly). It

is assumed to have a very long evolutionary history and to operate in non-human as well as human animals.....it is a crude system that automatically, rapidly, effortlessly, and efficiently processes information....Although it represents events primarily concretely and imagistically, it is capable of generalization and abstraction through the use of prototypes, metaphors, scripts, and narratives (Epstein, 1994, p. 715).

As to the rational system, it is

a deliberative, effortful, abstract system that operates primarily in the medium of language and has a very brief evolutionary history. It is capable of very high levels of abstraction and long-term delay of gratification (Epstein, 1994, p. 715).

Some of Epstein's tests of his dual-processes model have been inspired by the work of Amos Tversky and Daniel Kahneman on judgmental "heuristics and biases" or the class of simple-to-use strategies that people rely on to make many everyday judgments in the face of uncertainty (Kahneman, Slovic, & Tversky, 1982). For example, in one set of experiments, subjects are presented with imaginary scenarios and are asked to indicate (1) how most people would react to the situations in the real world, (2) how they themselves would react, and (3) how a rational person would react (Epstein, Lipson, Holstein, & Huh, 1992). In one scenario (inspired by Tversky and Kahneman), two women arrive at an airport each a half hour late for a scheduled flight. One of the women learns that her flight left on time; the other is told that her

flight was delayed and has just left. Who would be more annoyed? Subjects' responses indicated that, in the real world, the second woman would be more annoyed as they would themselves in the same situation. However from a rational viewpoint, they acknowledged that there should be no difference in reactions because both women missed their flights. According to Epstein, this pattern of results indicates that people clearly recognize that they can reason according to different modes of thought and that these two modes can lead to different answers.

In further experiments, Epstein and his colleagues have investigated how people react differently to gambles that highlight the differences between probabilities and frequencies (Kirkpatrick & Epstein, 1992; Denes-Raj & Epstein, 1994). The paradigm involves winning a prize if a red jelly bean is drawn at random out of a jar containing 10% red and 90% white jelly beans. The choice faced by subjects is whether the draw is to be made from a jar containing 10 or 100 jelly beans. When asked to make this choice for hypothetical situations, people are typically indifferent between the two jars. However, when faced with real choices, people tend to choose the jar containing 100 jelly beans. Once again, Epstein interprets this choice pattern as reflecting two systems of thought. In the hypothetical situation, people are triggered to reason analytically. They are indifferent because the probabilities are the same in both jars. In the real situation, however, a more primitive form of reasoning takes over whereby people react to the greater frequency of potentially winning jelly beans in one jar as opposed to the other (i.e., there are 10 ways to win and not just one!).

It is important to stress that Epstein does not claim that people reason in only experiential or rational mode. Instead, both are involved in much of our cognitive activity. Typically, however, he claims that reasoning starts with the experiential mode and can then be modified by the rational. I shall return to this point explicitly below.

Compared to Epstein's model, Kenneth Hammond's work makes a clearer distinction between the concepts of intuition and analysis. In particular, he defines intuition by contrasting it with analysis or logical thought. He states,

The ordinary meaning of intuition signifies the opposite – a cognitive process that somehow produces an answer, solution, or idea without the use of a conscious, logically defensible step-by-step process (Hammond, 1996, p. 60).

Thus, the key distinction made by Hammond is between a process that can be made explicit (analysis) and one that cannot (intuition). Note, however, that the fact that one process can be made explicit whereas the other cannot does not mean that one is more accurate or valid than the other. Errors can arise in both systems and, indeed, Hammond argues that the types of errors produced by intuition and analysis tend to be different. In analysis, errors can be quite spectacular. Consider, for example, using analysis to make mathematical calculations. A small error, such as a misplaced decimal place point, can lead to a huge error in the final result.<sup>1</sup>

Intuition, according to Hammond, involves the tacit aggregation of different informational cues and, as a consequence, rarely results in responses that are precisely correct. On the other hand, in the absence of systematic bias, errors are not likely to be large. (For some experimental evidence on this point, see Peters, Hammond, & Summers, 1974). Indeed, Hammond's distinction between intuition and analysis was heavily influenced by Egon Brunswik's work on perception (1956) and the distinction that Brunswik made between the *covert* process of perception that depends on integrating and balancing many different correlated cues ("vicarious functioning") and the *explicit* world of analytic or logical thought.

Like Epstein, Hammond does not claim that people reason only in a dichotomous way, i.e., either intuitively or analytically. Instead, he argues that people's cognitive activity can be described across a range of styles that "can be ordered in relation to one another on a continuum that is identified by intuitive cognition at one pole and analytical cognition at the other" (Hammond, 1996, p. 147). In other words, people can exhibit a range of cognitive processes that mix different levels or inputs of intuition and analysis. He labels this intermediate form of cognition *quasi rationality* and claims that most judgments involve compromises between different modes of thought as well as between different sources of information.

In an important development, Hammond further argues that the particular mode of cognition that people use is heavily influenced by the kind of tasks that they face. Thus, in the same way that people's modes of cognition can be arranged on a continuum from intuitive to analytic, tasks can also be arranged on a continuum that reflects the extent to which they are likely to induce intuitive thought, at one extreme, to analytic thought, at the other. Moreover, he goes on to argue that people's judgments will tend to be more valid when there is a match between properties of the

task and the mode of thought employed. And indeed, in an important study involving experienced highway engineers whose task involved judging the safety of highways, Hammond and his collaborators provided evidence in support of this proposition (Hammond, Hamm, Grassia, & Pearson, 1987).

This concept of dual systems of thought has, as indicated above, become quite popular in different subdisciplines of psychology. Moreover, the essential feature that seems to distinguish the two systems is that of automaticity. One system requires effort, the other does not. Indeed, in the 1970s much interest was raised by work that emphasized how many basic psychological processes seem to be automated – from the acquisition of motor skills (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977) to the uncanny human ability to record and store the frequencies of events that we encounter in the environment (Hasher & Zacks, 1979; 1984). But by the 1990's, social psychologist John Bargh was able to point out that these phenomena are far more prevalent than had been previously imagined. He stated,

It was one thing for reading or driving or detecting digits to be automatic and autonomous, able to operate without our conscious control, as the early automaticity research had shown. But it was another thing entirely when our understandings and judgments of ourselves and others were found to be not fully intentional or under our control.....

.....by now there are very few research phenomena in social psychology that have not been shown to occur at least partly automatically. A person's affective reactions to another individual are often immediate and unconscious: Attitudes toward social and nonsocial objects alike become active without conscious reflection or purpose within a quarter of a second after encountering the object.....And the emotional content of facial expressions is picked up outside conscious awareness and intent to influence perceptions of the target individual... (Bargh, 1996, p. 169)

More recently, Wilson, Lindsey, and Schooler (2000) have published a two-system theory of attitudes in which they claim that people hold attitudes at two levels, one that is implicit, and the other explicit. Thus much of the literature that demonstrates lack of reliability in different measures of attitudes may, in fact, only reflect measurements of the different systems. Similarly, Kahneman and Frederick (2002) have revisited the topic of judgmental heuristics and biases from a 2- systems



perspective (see also Stanovich & West, 1998). And Haidt (2001) has analyzed moral judgments from both rational and “social intuitionist” perspectives. Finally, an exciting new field of research links findings from neuroscience with social psychology and also explicitly posits the existence of an automatic intuitive system of thought (Lieberman, 2000; Ochsner & Lieberman, 2001).

Defining intuition.

In an earlier summary (Hogarth, 2001), I have taken the view that, although the human organism can be characterized by many information-processing systems, it is helpful to consider it as having two systems for learning and doing (where the latter includes “thinking”). I have labeled these systems the *tacit* and the *deliberate* largely because the latter requires conscious effort whereas the former does not. Moreover, making an analogy with an iceberg, tacit thought is the part that lies below the surface (of consciousness) and to which we have quite limited access; deliberate thought, on the other hand, lies above the surface and can be made explicit. Also in keeping with this analogy, there is much more activity below the surface than above it.

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Insert Figure 1 about here  
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In Figure 1, I have listed a number of characteristics of the tacit and deliberate systems. As noted, the essential difference is one of cognitive effort. The tacit system is triggered effortlessly by stimuli that we encounter in the environment whereas deliberate thought is controlled. It should be noted that Figure 1 does not explicitly mention whether thought involves emotion or affect, dimensions that are often discussed in relation to intuition. The reason is that emotion or affect are typically triggered automatically by specific stimuli and, as such, are tacit system responses.

A further point concerns the extent to which tacit and deliberate actions involve learning or reflect response tendencies that are inherent. I take the position that some tacit response tendencies are inherent or at least “more inherent” than others (see e.g., Seligman, 1970 on *preparedness*) but that many (if not most) are learned. In many cases, responses that are initially learned through the deliberate system subsequently become automated and thus move from the deliberate to the tacit system. This is certainly true of many motor skills and I believe that most of us

underestimate how much it also applies to cognitive skills (see also Hogarth, 2001, pp. 78-81).

Finally, I have so far avoided actually defining intuition. To do so, I simply propose that “the essence of intuition or intuitive responses is that *they are reached with little apparent effort, and typically without conscious awareness. They involve little or no conscious deliberation*” (Hogarth, 2001, p. 14, emphasis in original). Intuitive responses are therefore outputs of the tacit system.

In the next section of this chapter, I outline a framework for integrating the roles played by tacit and deliberate thought. This framework has been developed to highlight how both systems work in tandem and to stress differences in how they operate. As will be seen, this – in turn – makes it easier to think about when intuitive or analytic thought will be more appropriate and also what can be done to improve the quality of intuitive thought. Of course, in many activities, it is difficult to separate the contributions of intuitive and deliberate thought and thus the presentation necessarily involves several simplifications.

#### A framework for integrating the two systems of thought.

Figure 2 illustrates the interconnections between the tacit and deliberate systems (see also Hogarth, 2001, Chapter 6). In this diagram, boxes with heavy lines indicate the deliberate system; boxes with dotted lines indicate functions of the tacit system. Actions and outcomes, the two right-hand boxes (numbers 5 and 6) denote events that can be observed in the environment by (in principle) both the organism and third parties.

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Insert Figure 2 about here  
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The diagram illustrates how the tacit and deliberate systems interact in the processing of a stimulus (shown on the left of the diagram). The stimulus can take several forms: it can be external to the organism, i.e., something that is seen, heard, or felt; it can also be internal; for example a thought may trigger other thoughts, and so on. A key assumption is that all stimuli are first processed *preconsciously* (by the preconscious screen – box 1). To facilitate the exposition, I consider what happens in three types of cases.

In the first case, information about stimuli are recorded without conscious awareness and stored for possible future use. This very basic process is at the heart of tacit learning and the accumulation of facts and frequencies that has now been so well documented in the literature (Hasher & Zacks, 1979; 1984). It requires neither effort nor intention and, yet, the information stored can be subsequently recalled when needed, even for tasks we would have never imagined. Thus, for example, whereas no effort is ever made to record how many times we have undertaken a certain action or seen something, we are still able to estimate the approximate frequency with relative ease and accuracy.

In the second case, actions appear automatically and bypass consciousness such that the person is only aware of an action after it has occurred: i.e., the chain from box 1 to box 5 does not involve box 3. A classic example is the case of reactions to fear-inducing stimuli. For example, you hear a loud noise and find that you have already moved to avoid what might have caused it before you realize what it is. Alternatively, consider your reactions when driving a motor car or walking along a crowded street. In both cases you take a continuous stream of actions and yet pay only a minimum of attention. An interesting feature of this case is that, especially in social situations, our actions precede our understanding of why we have acted in particular ways. In other words, we use outcomes to make sense – at a conscious level – of what we have just done – at a subconscious level (see, e.g., Bargh & Chartrand, 1999).

In the third case – of deliberate actions – consciousness plays an important role in what we do. People can use the deliberate system to concentrate on stimuli and to produce specific actions. Consider, for example, what happens when you read and solve an analytical puzzle or make up your mind to do something. Moreover, the deliberate system can overrule outputs of the tacit system provided action has not already taken place. An example of this is the way we overcome angry feelings. (Imagine that another motorist has taken advantage of your courtesy and stolen “your” parking space.) Clearly, we can all become angry for a variety of reasons. But this does not mean that we “must” act in accordance with the angry thoughts that suddenly appear in our consciousness.<sup>2</sup> On the contrary, we can learn – through our deliberate systems – to censor this kind of thought and behavior. (See also Langer, 1989.) People can also create intentions in consciousness and decide when and when not to let automatic processes take control. As a specific example, consider driving a car.

Typically, we decide where we want to go and then delegate many of the functions to automatic processing. However, we maintain sufficient attention on the task to be able to assume full control if necessary.

Attention in consciousness is limited and therefore costly. In the framework, I assume a *scarce resource* principle. The key idea is that because the deliberate system consumes limited resources, it is used sparingly. It is allocated to tasks that are deemed important at given moments but can be switched to other tasks as the situation demands. It is rarely “shut down” completely and often has a monitoring function. In most cases, the tacit system is our “default” and the deliberate system is invoked when either the tacit system cannot solve the problem at hand or the organism is making some conscious decision (for example, planning what to do). At any given time, however, both the tacit and deliberate will be operating together.

Discussion of the framework presented in Figure 2 would be incomplete without considering the effects of feedback and to understand how this interacts with characteristics of the environment. Whereas cognitive processes occur inside the head and are unobservable, actions and outputs (boxes 5 and 6) occur, for the most part, in the environment and can be observed by both the person and others. Indeed, as noted above, the interpretation of automatic actions often takes place after the fact. This is indicated in Figure 2 by the arrow that leads from action (box 5) to consciousness or working memory (box 3).

Feedback from the environment occurs because actions (box 5) lead to outcomes (box 6). For example, you turn the steering wheel while driving an automobile and the car adjusts direction in consequence. For most small actions, feedback is immediate and impacts both consciousness (box 3) and long-term memory (box 4). However, it is important to note that observed feedback becomes a stimulus that is subsequently processed by the preconscious screen (box 1). Thus, whereas its effect on working memory (box 3) can be direct (when the person is paying specific attention to the feedback), its effect on long-term memory is mediated by the preconscious screen.

Finally, your actions can affect the environment and, in effect, create their own feedback. Thus, the feedback from your own action (box 6) becomes the next stimulus to be processed by the preconscious screen (box 1). For instance, that fact that you smiled at an acquaintance, and the smile was reciprocated can affect your sense that the person really likes you. However, had you not smiled in the first place,

your acquaintance might not have smiled back and your automatic reaction would have been to infer less attraction.

### Three more factors

In addition to the framework presented in Figure 2, it is important stress three factors that also affect the relative functionality of tacit and deliberate responses. The first is that stimuli are not encountered and processed against what might be called a “blank slate.” Indeed, the state of the organism can play an important role when it encounters stimuli – I call these “field” or “set” effects. Second, the nature of the triggering stimulus – or task – may favor the use of either tacit or deliberate processes (as mentioned above) and this can interact with the demands of the task faced. And third, tacit and deliberate processes differ in the kind of information they typically use. I now consider each of these factors.

*The effects of “field” or “set.”* It is important to recognize that the state of the organism at a particular time and location can impact on how it reacts to a triggering stimulus. For example, many studies have shown that a person’s judgments and decisions can be affected by his or her physical state when a stimulus is encountered. The state of hunger, for example, has been shown to affect the words that people recognize from brief exposures (Dember, 1960). Similarly, variables such as health (including mental health), mood (e.g., positive or negative), and stress can all impact on how the triggering stimulus is perceived (see, e.g., Hammond, 2000; Isen, 1993).

Similarly, perception of the triggering stimulus will be affected by information that is accessible – or available – to the person when the stimulus is encountered, information that can be either “permanent” or “temporary” in nature. The source of permanent information is the level of knowledge or expertise that the person possesses relative to the triggering stimulus. Thus, for example, an expert in a given area will perceive a stimulus in that domain quite differently from a novice (see, e.g., Chase & Simon, 1973). More generally, a person’s familiarity with the domain will affect what knowledge is activated by the triggering event – see also below.

The temporary source is simply the information that, for whatever reason, happens to be accessible to the person when the stimulus is encountered. The importance of such temporary information has been amply demonstrated by the extensive use made of priming in psychological experiments. Even when people

know that recently processed information is irrelevant to their current judgments or actions, these can still be affected by such information (see, e.g., Tversky & Kahneman, 1974; Bargh & Chartrand, 1999). In other words, judgments and decisions can be affected by information that people have processed in the recent past and that is still accessible to them even though they may not be aware of this fact.

*The nature of the triggering stimulus.* The extent to which tacit or deliberate processes (or both) are activated will be affected by characteristics of the triggering stimulus. This notion was introduced and made operational through the concept of a task continuum in the paper by Hammond, Hamm, Grassia, and Pearson (1987) discussed above. Conceptually, the task continuum captures the idea that tasks can be ordered by their propensity to induce intuitive or analytic thought. In a related vein, I have proposed a *visualization hypothesis* whereby tasks are more likely to be processed in tacit (or intuitive) mode when their context and form promotes *visual* reasoning (Hogarth, 2001). For example, physics problems presented in visual forms (e.g., films, displays) induce more intuitive reasoning than when presented as abstract word-problems (see, e.g., Shanon, 1976; Kaiser, Proffitt, & Anderson, 1985; Kaiser, Proffitt, & McCloskey, 1985).

The same stimuli, however, will not necessarily be processed in tacit or deliberate manner by all people (see also above). Experts in specific disciplines (e.g., medicine, chess) are able to recognize particular stimuli as distinctive patterns (of symptoms or chess positions), thereby invoking tacit processes, whereas novices lack this ability and are required to process the information in slower, and more deliberate fashion (Ericsson & Lehmann, 1996). Relative familiarity or “expertise” with particular domains therefore affects the primary mode of thought that people apply to specific triggering stimuli.

A characteristic of tacit thought is that outputs are immediate and automatic. Thus, whether the person provides a deliberate response or not, I maintain that a tacit response is made to all stimuli whether expressed or not. In some cases, this tacit response may only be a vague feeling; at other times it could be quite precise. Note, however, that the tacit response is conditioned by both the nature of the triggering event and the state of the organism when this is encountered (i.e., the field or set).

*Types of cues and information.* When considering the differences between tacit and deliberate thought (or intuition and analysis), it is important to recognize that the kind of information used in the two modes typically differs on two dimensions. First, in tacit thought, information is *partial*; deliberate thought, on the other hand, usually involves *additional* information, i.e., information that is not present in the triggering stimulus. Second, cues used in tacit thought are *holistic* whereas in deliberate thought they are *unitary*. I now elaborate on these differences.<sup>3</sup>

In most cases, the tacit response will be based on what I call *partial information*. The key idea here is that tacit responses do not involve comprehensive consideration of all aspects of a judgment or decision but, instead, are sensitive to specific features of the triggering stimulus. For example, when someone responds intuitively to a stimulus by using the recognition (Goldstein & Gigerenzer, 2002) or affect heuristics (Slovic, Finucane, Peters, & MacGregor, 2002), the response is based on only part of the information that could be relevant to the issue at hand. For example, in a task investigated by Goldstein and Gigerenzer (2002), subjects are presented with the names of pairs of cities and asked which in each pair has the greater population. When the name of one city is recognized but the other is not, there is a strong tendency to guess that the city recognized has the larger population. There is no comprehensive evaluation of all the information that could be brought to bear on the problem.<sup>4</sup> Similarly, when a person chooses one garment over another because she “likes it more,” there is no pretense that all aspects of the choice have been considered.

In short, tacit processes are driven by information that is partial relative to the issue at hand. *Thus the validity of intuitive judgment depends critically on whether the partial information accessed is sufficient to make a valid judgment or decision in the situation.*

Contrary to tacit responses, deliberate responses typically involve the manipulation of information that is not just represented by the triggering event. For example, when deciding which garment to choose in deliberate mode, the person may also think about how other people will like it, for which occasions it will be suitable, and so on. Deliberation may also involve specific manipulation of the information presented in the triggering event, e.g., by explicitly deciding to weight some parts of the information more heavily than others. In deliberate thought, it is the validity of

what might be called *additional information* that is critical. In other words, deliberate thought typically involves adding/seeking information that is not evoked by the triggering event; tacit thought, on the other hand, represents a reaction to a subset of the information present in the triggering event. Both, however, are conditioned on the preceding background (field or set).

As noted above, it is important to emphasize that in many cases the deliberate response will be influenced by the tacit response and all that precedes it. In other words, people will always have some tacit response (however minimal) to any triggering event. The issue, of course, is whether – and the extent to which – this impacts the deliberate response. This is, of course, less likely to occur when the triggering event presents itself in a format that induces analytic thought and where the person both knows and can execute the appropriate formula. Imagine, for example, balancing your checkbook.

To examine further the distinctions between partial and additional information, it is instructive to consider two scenarios. The first involves estimating your purchases at the supermarket; the second is one of the so-called “base rate neglect” problems made famous by Kahneman and Tversky (1973). I start by considering the former.

Imagine you are at the checkout counter of your local supermarket and have just completed your purchase of groceries. To assess what you owe the supermarket, you rely on a deliberate process. You let the checkout clerk calculate the amount with an adding machine. As you are preparing to pay, the clerk announces the total of your bill, \$2,376.53. You are astounded. In fact, before being told the amount you had implicitly estimated that your bill would be around \$100 based on your past experiences of filling your shopping cart. Surely, there must be an error?

This situation illustrates several points. First, although a deliberate process was used to estimate the bill, you still made a tacit estimation – probably based on your memory for what a typical bill is and how full your shopping cart seemed to be. In other words, we don’t seem to be able to suppress the tacit response system. Second, in using your tacit system to estimate the bill, your “holistic” estimation was based on partial information, namely, you were “primed” for roughly what you thought your bill would be (based on past experiences) and you could also assess



“how full” your shopping cart was. Clearly, neither of these sources of partial information was sufficient in these circumstances to calculate the exact bill, but you could still use them to make an approximate estimate. Third, to calculate the correct amount, deliberate thought has to use additional information, in this case the rules of arithmetic (which, it should be noted, are not part of the triggering event). Note that in this particular case these rules were applied incorrectly (apparently the clerk misplaced a decimal in entering some data by hand). However, in these kinds of situations we typically accept the validity of this kind of additional information.

Now consider a classic illustration of base-rate neglect. Subjects are presented with a short description of Tom W. written by a psychologist when Tom was in his senior year at high school. Among other traits, Tom is described as intelligent, dull, and not very sociable. Subjects are then asked to estimate what kind of graduate studies Tom is following (Kahneman & Tversky, 1973). Despite recognizing that personality descriptions are not perfectly reliable, and knowing something about the distribution of graduate students in different areas of study, subjects state that there is a good chance that Tom W. is studying subjects such as computer or library science. In essence, these judgments reflect the representative (or similarity) heuristic. Subjects’ judgments are consistent with their stereotypes of students in different areas of graduate studies. They fail to take account of the lack of perfect reliability of the description and the distribution of students in different areas of study, i.e., the base rates.

From the viewpoint of this chapter, the tacit or intuitive judgment is based on partial information that, in this case, is not sufficient to answer the question correctly. In fact, it misleads the subjects. They fail to consider additional information – about base rates – and to use this (in deliberate fashion) to moderate their initial judgments.

In short, when tacit thought is used, partial information can vary as to whether it is an accurate indicator of a criterion (yes, in the supermarket scenario; no, in the case of Tom W.). And when deliberate thought is used, additional information can be valid if it is both appropriate and applied correctly (as failed to happen in the supermarket scenario).

*Holistic versus unitary cues.* Intuitive judgments are often described as being “holistic” because they give people the impression that they have considered the

stimulus as a “whole.” This might seem to contradict the discussion above about how tacit responses involve partial information. However, I do not believe there is a contradiction. It is, of course, true that in any given case people may see the “whole stimulus” but their tacit reaction is sensitive to only part of it. For example, consider the process by which people make judgments by recognition or similarity. These processes operate quickly and automatically but are driven by only parts of the actual stimuli. Judgments of similarity between two objects, for example, are heavily dependent on features that are common to both objects (see, e.g., Tversky, 1977). Recognition works by attending to part but not all of a stimulus (imagine, for example, recognizing a friend or relative whom you have not seen for some time).

It is useful to distinguish between what I call *holistic* and *unitary* cues. To explain this distinction, imagine again the problem of estimating your grocery bill at the end of your weekly visit to the supermarket. Using the deliberate response system, you could simply sum the cost of all the items purchased.

But imagine instead, that you estimate your purchases tacitly. Clearly, this would involve looking at part of the information (i.e., partial information) and extrapolating from this in some manner. To do so, however, you could look at either unitary or holistic cues. In the present case, the unitary cues would be the costs of each of the items purchased. Thus, for example, you might choose to extrapolate your week’s purchases by seeing what you paid for orange juice this week, or perhaps for bread. In other words, since each of these items contributes to the total, each has some validity in predicting that total. With many items, of course, some items would be more valid than others for estimating the total and you may even have some feeling for this.

On the other hand, you could use what I call a holistic cue. This would not involve paying attention to one or, say, two of the unitary cues but, instead, would focus on another variable that would give a rough indication of the total amount of your purchases. In this case, imagine that the cue you use is “how full” your shopping cart seems to be relative to the typical level of your purchases. Thus assume that this week the cart seems a bit fuller (perhaps 10%) than usual. In this case you estimate your purchases as being a bit higher than usual, e.g., roughly 1.1 times your typical bill.

Note the difference between unitary and holistic cues. The unitary cue stands on its own. It is precise and independent of the other cues although it may be correlated with them. It is the kind of cue that would be used as a variable in a deliberate or analytic model of the process. The holistic cue, on the other hand, is approximate, and based on an impression of the whole. It is, however, still partial information because it does not take account of *all* the information in the triggering stimulus. Moreover, it will not provide a precise answer to the question.

At one level, holistic cues may be thought of as providing patterns that allow people to recognize certain stimuli – and in many cases, this can be true. For example, the stereotypic features of Tom W. (discussed above) can be thought of as providing a pattern that people recognize. (See also the description of the famous “Linda” in the feminist bank-clerk scenario, Tversky & Kahneman, 1983). Moreover, as elegantly elaborated by Garner (1970), a feature of “good” patterns is that their stimulus configurations contain much redundancy such that people do not attribute alternative meanings to what they see. Nor are they cued to seek additional information to resolve any ambiguity. Thus, it is not hard to understand why people exhibit such strong confidence in their intuitions when these are based on recognizing “good” patterns. By these comments, I do not mean to equate the notions of holistic cues and patterns but simply to emphasize that holistic cues can be based on such patterns.

The manner in which unitary and holistic cues are processed characterizes the distinction between tacit and deliberate thought. The processing of unitary cues – one at a time – and finding a way to aggregate them is the epitome of deliberate thought (see also below). In tacit processes, on the other hand, holistic cues are processed speedily and without apparent effort.

### The role of learning

Above I discussed the importance of feedback and this naturally leads to the topic of learning. The fact that we learn so many things in a tacit manner clearly has an important impact on the “quality” of our intuitions (Reber, 1989; 1993). In Hogarth (2001), I develop the notion that tacit learning can take place in environments that can be described as *kind* or *wicked*. Kind and wicked environments are distinguished by the degree to which people receive accurate feedback on their

judgments and actions. In kind environments, people receive timely and veridical feedback; in wicked environments, they do not. This distinction follows the analysis of learning situations originally developed by Einhorn and Hogarth (1978) which showed that, even in fairly simple tasks, the feedback people receive on their judgments can be distorted by many factors including the very actions that they themselves take. For example, the fact that you take a particular action can prevent you from learning about possible outcomes associated with the actions you did not take.

The key point is that the accuracy and timeliness of feedback affects the quality of the intuitions we acquire through tacit learning processes. You cannot learn from feedback you do not receive and – as shown by Einhorn and Hogarth (1978) – some feedback may simply act to increase confidence in erroneous beliefs. In short, the quality of intuition is highly dependent on whether it was acquired in kind or wicked environments. I shall return to this issue below.

#### On the relative validities of tacit and deliberate processes

For several decades now, there has been much interest in the topic of whether people are “good” or “bad” at making judgments and decisions. Moreover, the focus of this work has concentrated mainly on what might be called “natural” judgments and decisions in situations where people are required to make fairly rapid responses and do not benefit from computational aids. In some cases, participants in such experiments have little experience with the types of questions asked; in others they have considerable experience. In addition, several studies have examined decision making in quite realistic situations involving experienced participants and even high incentives. Proponents of both the “good” and “bad” viewpoints can point to evidence that bolster their positions.

Several explanations for good and bad performance have been offered in the literature. Some researchers emphasize the role of individual variables such as experience and training in specific types of problems (e.g., Klein, 1998). Other explanations involve the role of incentives (cf. Camerer & Hogarth, 1999), the manner in which problems are presented (e.g., the use of frequencies as opposed to probabilities, Gigerenzer & Hoffrage, 1995, whether tasks are continuous or discrete, e.g., Hogarth 1981, and so on), and even the extent to which people tend to solve

problems in an analytic mode as opposed to a more intuitive one (see, e.g., Stanovich & West, 1998). However, once again, it is not too hard to find evidence that conflicts with all of these explanations.

It is tempting to consider this mass of literature within the context of two systems that can produce different responses assigning “good” responses to one system and “bad” responses to the other. However, I believe a more fruitful approach involves trying to specify the relative advantages and disadvantages of both systems. I therefore first specify relative advantages and disadvantages of the two modes of thought in general terms. Second, I discuss some of the empirical evidence that bears on the topic of the conditions under which the systems are differentially valid. And third, I present a scheme for clarifying these conditions and which can be used for future research.

To motivate discussion of the relative validities of tacit and deliberate thought, reconsider the problem described above of estimating your grocery bill at the checkout counter. The deliberate process uses *unitary* cues and can be represented by a formula,

$$\text{Grocery bill} = \sum_{i=1}^k w_i x_i \text{'s, } i = 1, \dots, k. \quad (1)$$

where the  $x_i$ 's represent the prices of the  $k$  items that you bought (these are the unitary cues) and, in this case, the  $w_i$ 's are all equal to 1.

Note that what is required in the deliberate approach is to: (1) identify and define the variables or unitary cues (in this case, each of the products); (2) define a relevant measure for each variable (the prices of the products); and (3) determine a rule for aggregating the information from the preceding step. Clearly, in this case, one would simply follow the rules of arithmetic but one could imagine other cases involving deliberate thought where you would choose to give different weights to the  $w_i$ 's and/or use another algorithm for aggregating the information, e.g., a multiplicative as opposed to additive rule.

This example shows both the strengths and weaknesses of the deliberate process. If you define the appropriate variables and measures and use the “right formula” correctly, your solution will match the criterion. However, the success of the method depends on executing *all* of these steps correctly. Thus, if you are simply adding a few figures to calculate, say, the cost of a few purchases, you can probably

be confident in the outcome of your deliberation. However, to the extent that the situation is less well defined, the probability of success will be lower.

Now consider how one might model the tacit process in the checkout counter example. As suggested above, this could be described by an anchoring-and-adjustment model where the person simply adjusts the typical or average weekly bill at the supermarket by a variable that expresses “how full” the shopping cart is relative to usual, e.g.,

$$\text{Tacit estimate of grocery bill} = ? \cdot z \quad (2)$$

where  $z$  represents the typical or average grocery bill and  $?$  indicates your tacit estimate of how full the shopping cart is relative to its usual level. There are several noteworthy features of this process. First, it is simple to execute (“fast and frugal” in the sense described by Gigerenzer, Todd et al., 1999). Second, it uses a variable that is likely to be strongly correlated with the criterion, i.e., grocery bills are positively correlated with the level of goods in shopping carts. And third, whereas the estimate is based on partial information, it does capture characteristics of the “total” problem (as noted above). By illustrating a case where a tacit process is likely to be effective, this example also emphasizes when tacit responses are likely to be ineffective, namely when the stimulus that triggered the response is not – by itself – a good predictor of the criterion (see also comments above).

In thinking about the validity of tacit system responses, we note that – in general terms – its two most important functions are to classify stimuli into appropriate categories (that can imply action or inaction) and to form expectations. Moreover, both of these tasks are conducted in environments that are more complicated than the organism and thus involve uncertainty. However, despite such uncertainty, the organism learns from feedback (from its own actions or observations) and not all actions it takes are irreversible. Two additional points to emphasize are, first, that the tacit system is “old” in evolutionary terms (see also Epstein, 1994, above); and second, people’s individual response tendencies have been shaped by the particular contingencies encountered in their lives.

The fact that the tacit system is old in evolutionary terms implies that it has specialized mechanisms for handling important tasks. Moreover, the system is sensitive to features of the environment that were important to survival in what is now

the distant past. Today, these features will vary in how suited they are for dealing with the demands of modern living.

The role of experience (or histories of contingencies encountered) is important because the response tendencies of the tacit system are shaped automatically by its specific past. Tacit system responses could involve histories involving many different amounts of past experience. As discussed above, however, the relation between confidence (based on amount of past experience) and validity of responses is not simple but mediated by the extent to which responses have been acquired in kind or wicked environments.

Given these characteristics and the uncertainty in the environment, what general response tendencies would we expect the tacit system to exhibit? First, note that the organism faces two kinds of errors in problems involving both classification and expectation (the relations between variables). Second, in general, the costs of both types of errors are not likely to be equal. In classification, failure to identify a danger is probably more costly – in the short run – than failure to identify a benefit (i.e., in the extreme failing to identify a predator can entail death; however, failing to identify a benefit would not be fatal in the short run). Similarly, when forming expectations, it is probably less costly to believe (erroneously) that a relation exists between two variables than to fail to recognize a relation that does exist. The point here is that, because of the complexity of the environment, discovering valid relations between variables can be quite difficult. Thus, falsely believing that a relation is valid will – in the short run – be less costly than failing to identify a valid relation (cf. Kareev, 1995).

Note that in the cases of both classification and expectation, I have specified that we are talking about short-term effects. The key here is that, when a choice is made on the basis of a classification or expectation, there will typically be some feedback. Thus, imagine an organism that takes a speedy fear-induced reaction to avoid being attacked by a predator. If there really is a predator, the action is justified. If not, the action taken is not necessarily costly; the organism survives and may even have learned something. Similarly, if an organism acts on a false expectation, it will typically receive some feedback; however, it will not receive any feedback if it fails to notice a relation between two variables.

Of course, it is important to point out that short-term response biases to specific classes of stimuli can be costly if they persist across time. Thus, it is dysfunctional to continue making fear-inspired reactions to the same type of stimuli if there is nothing to be feared; and continuing to act on false beliefs can have negative consequences (consider, for example, the old medical practice of blood-letting).

As a general consideration, therefore, one should expect tacit systems responses to be biased toward conservative responses in choice (i.e., classification) and particularly in the case of novel stimuli. With experience and accurate feedback, however, bias in response would be expected to reflect accurately the relative costs of the two kinds of errors. Similarly, with novel stimuli, one would also expect overestimates of the strengths of expectations (or the relations between variables) but that these would become more accurate with feedback (unless this too is biased).

Finally, note that, in psychology, the concept of validity is typically made operational by computing coefficients of correlation between cues and criteria. However, it is important to remember that when used in this way, the correlation assumes a squared error loss function and variables that can be measured on, at least, interval scales. This model is not always appropriate. Indeed, the validity of tacit responses can often be measured by simple binary categories, e.g., yes/no or go/no-go, and these categories can be quite broad. For example, in many situations, the speed of a tacit response can be important (e.g., when driving a car); in other situations, tacit responses are made in circumstances where corrective feedback can guide the person to an appropriate decision (e.g., in the process of social interactions or even when walking down a crowded street, see Hogarth, 1981). In some cases, when tacit responses are accompanied by fear the reaction is simply to take action that will avert potential danger. For example, Damasio (1994) argues that sensations experienced in the face of risk can help people make better decisions because they guide the choice process away from potentially dangerous alternatives (i.e., people's choice set is reduced to less risky alternatives).

#### Evidence on the relative validity of tacit and deliberate responses

A major problem in assessing the evidence relevant to this question is that few studies have been conducted with this issue specifically in mind. Moreover, few investigators provide any kinds of controls over whether people respond to problems in tacit or deliberate manners. Although studies can be classified in different ways, I



believe that eight different kinds of studies are relevant. These involve: (1) remarkable cognitive performance; (2) naïve understanding of natural phenomena; (3) studies of expertise; (4) clinical judgment; (5) deductive reasoning; (6) probabilistic thinking; (7) choice problems; and (8) specific tests of dual modes of thinking. By way of illustration, I now provide examples of studies in each of the eight categories.

1. *Remarkable cognitive performance.* The literature points to many examples of what might be called “remarkable” cognitive performance that require little to no effort and are thus intuitive. Consider, for instance, the operation of our perceptual system. Although it is true that, on occasion, we are subject to illusions, the vast majority of our perceptual judgments are accurate or, at least, accurate enough for us to navigate the vagaries of everyday life (cf. Brunswik, 1956). Moreover, people seem to have some understanding for factors that lead to illusions and can use their deliberate systems to correct these as needed. (Consider, for example, adjusting estimates of distance to an object according to environmental conditions are bright or hazy).

Several studies have demonstrated how attention to partial unbiased information can result in surprising accuracy of intuitive judgments. When running to catch a ball, for example, athletes appear to rely on an intuitive “gaze” heuristic<sup>5</sup> whereby they adjust the speed at which they are running to maintain a constant angle with the position of the ball in the air (McLeod & Dienes, 1996). Studies by Ambady and Rosenthal (1993) have demonstrated that students’ assessments of teaching ability can be fairly accurate when based solely on small samples of behaviors (video clips that last a few seconds or minutes). The notion here is that people can make accurate judgments on the basis of such “thin slices of behavior” under two conditions. First, these slices are good estimators; and second, people have learned what to look at. For example, it is unlikely that students use, say, the color of an instructor’s shoes to estimate who will or will not be a good teacher. Instead, they have learned to attend to other cues even though they may not be able to make these explicit.

2. *Naïve understanding of natural phenomena.* There is an intriguing field of research that looks at people’s naïve understanding of natural phenomena. Topics investigated have included how children acquire the concept that the world is not flat (Vosniadou & Brewer, 1992), assessing trajectories of moving objects (Kaiser, Proffitt, & McCloskey, 1985), judging where objects will fall when dropped as well

as predicting the order in which two objects that vary in weight will reach the ground if released simultaneously (Shanon, 1976; McCloskey, 1983).

The results of these studies clearly indicate that the manner in which people experience phenomena impacts their conceptions. Thus children – like many of our ancestors – do not “intuit” that the world is round. Instead, their experience of a flat world weighs heavily in their minds and the concept of a spherical world has to be integrated cognitively in a slow, deliberate manner. Similarly, when asked to make deliberate responses concerning the trajectories or relative speeds of moving bodies, many people give erroneous responses that are consistent with old – and now discredited – physical theories (the implication being that, based solely on experience, people develop theories that are similar to those of our ancestors). Interestingly, however, these responses increase dramatically in accuracy when people have had explicit instruction in the underlying physical principles. Even more interesting, however, from our viewpoint is that in some experiments subjects were shown films showing different trajectories that moving objects could take and asked which were anomalous. Results indicated that people could recognize which were and which were not anomalous trajectories (i.e., using their tacit knowledge) but that attempts to answer the same questions by using deliberate reasoning resulted in many more errors (Shanon, 1976).

Taken together, these studies illustrate the importance of how we perceive and experience the world. In *wicked* environments (e.g., the seemingly flat world), we may acquire erroneous intuitions. However, in other cases our tacit systems may learn to recognize the differences between authentic and artificial stimuli even though we cannot articulate differences correctly when reasoning in deliberate manner.

3. *Studies of expertise.* There have been many studies of expertise (see, e.g., Ericsson & Charness, 1994; Ericsson & Lehmann, 1996; Ericsson & Smith, 1991; Shanteau & Stewart, 1992). From our perspective, there are several key findings.

First, expertise is limited to domains and is only acquired through exposure to and activity within specific domains. Thus, because someone is an expert in one domain (e.g., chess) does not mean that she will be an expert in another domain (e.g., medicine) unless she has also had considerable experience in the latter.

Second, outstanding performance in any domain takes years of dedication. Moreover, high performers have typically followed demanding regimes of deliberate practice and benefited from good teachers.

Third, there is – curiously – less relation between expertise and predictive ability in many areas of activity than one might imagine (Camerer & Johnson, 1991). However, this finding may be more indicative of the nature of the uncertain environments in which experts operate than due to a lack of “expertise” per se. Consider, for example, the random nature of movements of the stock market.

Fourth, experts and novices process information in different ways. Experts acquire habits that allow them to process more information than novices. They learn, for example, how to counteract limitations in short-term memory and to “chunk” information more effectively. They also use different problem-solving strategies. Novices tend first to identify a specific goal and then work backward through the details to determine a solution – making much use of deliberate thinking. Experts, on the other hand, rely more on tacit processes. They tend first to take in the details of the problems they face, and then determine (by recognizing patterns and similarities) a general framework that allows them to explore possible solutions. Not surprisingly, experts solve problems faster than novices.

4. *Clinical judgment.* There are many tasks involving predictions or evaluations where people could also resort to deliberative methods such as simple linear models. Consider, for example, predicting success in graduate school or bank loan failures. The evidence in this area is overwhelming. If you only allow people to use the same information that is provided to simple models, models (or deliberative processes) predict better than humans (Dawes, Faust, & Meehl, 1989).

There are, I believe, two reasons for this result. First, models are consistent in their application of rules whereas people are not. Second, in many of the situations studied in these tasks people do not receive good feedback. For example, in making a credit decision, the outcome may not be known to the lender for some time and/or the fact that the lender did or did not make the loan could by itself affect the outcome. Interestingly, whereas it is true that models predict more accurately than people in almost all of these kinds of situations, it is also the case that the predictive ability of models is not high.

On the other hand, it is also true that there are many areas where unaided “clinical” judgment of humans is seen to be effective. This is the case, for example, in several situations involving weather forecasting (cf. Murphy & Winkler, 1984), as well as in aspects of clinical judgment (Garb, 1998). But again, these are mainly

situations where people have received accurate feedback, i.e., learning environments have been *kind*.

5. *Deductive reasoning*. Many studies have examined people's ability to reason in appropriate deductive fashion when dealing with problems that involve testing rules of the form *if p then q* (Wason, 1966). Basically, the result is that when problems are presented in somewhat abstract form (e.g., involving relations between cards), people fail to solve the problem correctly even when trying hard in deliberate fashion. However, when problems with the same logical structure are presented in the context of situations with which people are familiar, they are able to make appropriate responses (Wason & Johnson-Laird, 1972).

Although these results have been given different interpretations, I believe that the key issue is that familiar contexts appeal to people's tacit knowledge and that this allows them to access an answer without much effort and, in this case, an answer that happens to be correct. In other words, the abstract form of the problem cannot be answered in this way and, because people do not necessarily have the deliberate knowledge necessary to solve the problem correctly, they fail to do so when forced to rely mainly on their deliberate mode of thought.

6. *Probabilistic thinking*. Similar mechanisms can be found in the literature on probabilistic reasoning. Consider again the Tom W. problem discussed above (Kahneman & Tversky, 1973). Here the context of the problem allows people to classify Tom in a stereotypic kind of way and to generate a tacit response. However, in this case the tacit response is "incorrect."

Similarly, several investigators find differences in responses depending on whether people are presented with problems in the form of probabilities or frequencies. Most people, it seems, can relate to the meaning of frequencies and this can lead to more accurate responses (see, e.g., Fiedler, 1988; Gigerenzer & Hoffrage, 1995). On the other hand, frequencies can also trigger responses that would be difficult to justify on a normative basis (Kirkpatrick & Epstein, 1992; Denes-Raj & Epstein, 1994).

7. *Choice problems*. Two notions underlie some of the most interesting results in experimental work on choice over the last decades. The first is the idea that when problems are presented or "framed" in different ways, people change their responses in systematic ways (Kahneman & Tversky, 1979). Thus, people's natural choices simply reflect the manner in which problems have been presented to them. From our

viewpoint, however, it is not clear what conclusions to draw from these studies because it is uncertain which intuitive responses should be considered more valid.

The second idea is that, in making choices, people often seek to avoid making explicit trade-offs and thus the manner in which problems are presented to them can sometimes suggest – by appealing to tacit knowledge – what choices to take (see, e.g., Shafir, Simonson, & Tversky, 1993). Explicitly using trade-offs involves a high level of deliberate thought; avoiding trade-offs suggest the use of implicit arguments or rationales and is heavily dependent on tacit processes. It is fairly easy to construct specific cases where failure to confront trade-offs leads to suboptimal choices and this could suggest that deliberation should be preferred to tacit processes. However, we do not know enough about the total ecology of people’s choices to be able to make such a statement (cf., Hogarth, in preparation).

8. *Specific tests of dual modes of thinking.* A few studies have explicitly tested the relative validity of tacit and deliberate processes. In one study, Wilson and Schooler (1991) investigated the effect of introspection, in the form of providing explicit reasons, on the quality of choice. The question posed was whether people are better off trusting their initial feelings or taking time to reason deliberately.

Their paper makes the point that whereas people may have preferences for different options, they typically cannot explain why. That is, many of our preferences simply reflect the often-passive interactions we have had with our environments and may not be easy to justify, on reflection. However, in many choice situations, there are also salient and plausible reasons that people recognize as being relevant and, if they think explicitly about the choice, these reasons are likely to come to mind. The question is whether thinking explicitly about such reasons will change people’s preferences for the better.

In studies involving preferences, it is problematic to establish what is or is not “good.” Wilson and Schooler studied college students’ preferences for different brands of strawberry jam and college courses and, for both types of stimuli, used expert opinions as the criterion of “goodness.” Results showed that, in both studies, introspection – or making reasons explicit – led to inferior decisions relative to control subjects who had not engaged in introspection. According to Wilson and Schooler, thinking about the choice led the experimental subjects to consider reasons that were nonoptimal. Thus, had they not spent time in thinking, they would have responded in similar fashion to the control subjects whose initial preferences were

closer to the experts' opinions. In a further study, two groups of students evaluated several posters and were allowed to choose one to take home. One group was asked to introspect explicitly about their evaluations; the other was not. About three weeks later, the second group was found to be more satisfied with their choices (Wilson, Lisle, Schooler, Hodges, Klaaren & LaFleur, 1993).

Although studies such as these have been cited as examples of how intuition may be superior to analysis, care should be taken in generalizing. First, what the studies show is that deliberation affects and changes expressed preferences if subjects are unaware of the origin of those preferences (see also Wilson et al., 1993). However, other studies have shown that when people are aware of the origin of their initial preferences, these are less likely to be changed by thinking about reasons (Wilson, Kraft, & Dunn, 1989).

Second, decision aids that force people to be explicit about the reasons for their decisions have been shown to heighten satisfaction in choices relative to control groups that were not provided with aids (Kmett, Arkes, & Jones, 1999). Similarly, in the area of judgmental forecasting several studies have examined the validity of so-called "decomposition" methods in which people are required to split the prediction task into subtasks, make judgments about the parts, and then use a rule to aggregate the different judgments. Results show that decomposition methods are more accurate than directly estimating the outcome (MacGregor, 2002).

Third, McMackin and Slovic (2000) have recently both replicated Wilson and Schooler's results and emphasized the importance of understanding the joint effects of types of task and cognition emphasized Hammond (see above). Specifically, McMackin and Slovic asked subjects to make judgments in two tasks. One involved assessing how much people would like advertisements (an "intuitive" task). The second required estimates of uncertain facts such as the length of the Amazon River (an "analytical" task). There were two groups of subjects. One was just asked to answer the questions; the other was explicitly instructed to provide reasons for their answers. Results showed that, for the intuitive task (advertisements), providing reasons had a negative effect on performance thereby replicating Wilson and Schooler. On the other hand, generating reasons had a positive effect on performance in the uncertain facts task. Thus, McMackin and Slovic also replicated the results of Hammond et al. (1987) involving the interaction of type of cognition with type of

task, i.e., “intuition” was seen to be more valid in an “intuitive” task and “analysis in an “analytic” task.

Fourth, there is much evidence that, when requested to verbalize their thoughts, people shift to a more deliberate mode of information processing. What needs to be made clearer, however, is whether and when this leads to “better” outcomes (Schooler & Dougal, 1999). For example, when subjects engaged in problem solving are asked to verbalize their thoughts, there is evidence that this has deleterious effects on problems that require “insightful” solutions but not on more analytical problems. Verbalization, it seems, forces people to act in deliberate mode and cuts off access to tacit processes (Schooler, Ohlsson & Brooks, 1993). And yet, it is important in certain types of problem solving for people to access their subconscious. Similarly, recognition memory is highly dependent on the tacit system and can be less accurate if people are asked to make explicit use of the deliberate system through verbalization (Schooler & Engster-Schooler, 1990).

#### Intuition (tacit thought) or analysis (deliberation)?

Above, I have discussed the respective strengths and weaknesses of tacit and deliberate thought as well as evidence bearing on the issue of relative validity in different circumstances. Tacit thought is based on partial, holistic cues and its accuracy depends on the extent to which this information leads to biased responses. In addition, tacit thought typically involves approximate answers and thus, even when a series of tacit responses might be unbiased (in a statistical sense), specific responses will typically involve some error. As to deliberate thought, accuracy depends on the extent to which the person knows and is able to apply the “correct formula” (using unitary cues). Unlike the errors from tacit responses, errors in deliberate thought tend to have an “all or nothing” quality, i.e., there are typically no errors or large ones (recall the example of the checkout counter).

To assess whether tacit thought (intuition) or deliberation (analysis) is more or less likely to be accurate in a particular situation, it is illuminating to consider the trade-off between the bias and error implicit in tacit thought, on one hand, and the probability that a person will know and correctly apply the appropriate deliberate “formula,” on the other.

As noted above, there are many cases in which tacit responses are biased but where such biases are, in fact, functional (e.g., reactions to potential sources of

danger). Ignoring these kinds of cases, bias in tacit judgments and decisions will reflect the conditions in which response tendencies have been learned. Were these acquired in *kind* or *wicked* learning environments? Similarly, to what extent is the *partial* information on which tacit responses are based unbiased?

As to deliberate thought, one should ask what affects the probability that the person will know and apply the appropriate “formula” correctly. From the evidence reviewed above, two factors are critical. One is the manner in which the problem is presented, i.e., does this invite use of the appropriate formula? (See, e.g., Gigerenzer & Hoffrage, 1995.) The second factor (which may often be related to the first) is the complexity of the problem as presented. To summarize both these factors, therefore, I assume that the probability that a person will know and apply the appropriate deliberate formula correctly is a monotonic function of what I call the *analytical complexity* of the task. In other words, the greater the complexity a task exhibits in analytical terms (as measured, for example, by number of variables, types of functions, weighting schemes, and so on), the less likely it is that a person will both know the appropriate formula and apply it correctly. (Individuals can, of course, vary in the extent to which they perceive tasks as analytically complex.)

As an example, consider the experiment of McMackin and Slovic (2000) described above. From an analytical viewpoint, it is clearly a difficult task to judge whether people will like an advertisement. (Just what are the appropriate variables and how should they be measured and combined?) Thus, we would expect that an intuitive judgment based, perhaps, on how much the people just liked the advertisement themselves would be a more valid response (assuming little or no bias in response). Similarly, when asked the length of the Amazon River, it is probable that one’s first intuitive response could be biased by different sources of information. (What were the last distances in your mind?) Thus, thinking through different explicit reasons for one’s answer would not be too difficult analytically and could help improve the accuracy of the response.

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Insert Figure 3 about here  
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Figure 3 explores the trade-off between bias in tacit (intuitive) thought and the effects of analytical complexity in deliberate thought (analysis). It shows how the differential accuracy of the two modes of thought varies when tasks are characterized



by the extent to which they (a) induce different levels of bias in tacit thought and (b) are experienced as varying in analytical complexity. To simplify the discussion, I have considered three levels of each variable and thus nine types of situation. Bias is characterized by labels of “large,” “medium,” and “small/zero;” and analytical complexity is said to be “easy,” “moderate,” or “hard.” For the moment, I ignore individual differences (however, see below).

Consider cell 1, where bias is large but the level of analytical complexity is easy. Here deliberation is likely to be more accurate than tacit thought. An example is provided by the well-known Müller-Lyer illusion. A tacit judgment suggests that one line is larger than the other; however, the deliberate use of a ruler can demonstrate that both lines are the same length.

However, note that as analytical complexity increases, the differential accuracy between the two types of thought is predicted to decrease. In cell 2 – with moderate analytical complexity – deliberation is still preferable to tacit thought. (Imagine other optical illusions where people cannot use a simple analytical device such as a ruler to resolve uncertainty.)

In cell 3 – when analytical complexity becomes hard – it is not clear whether the errors of deliberate or tacit processes would be greater. Consider, for example, a person making a complicated investment in an area where she lacks prior experience. The person could be heavily biased by inappropriate prior experience and also lack the analytical ability to make the appropriate deliberate decision. However, it is not clear which error would be greater.

The interaction between bias and analytical complexity is most clearly illustrated in cells 4, 5, and 6 where bias is maintained at a “medium” level. When analytical complexity is easy, deliberate thought should be preferred to tacit. For example, a simple “base rate” task such as the “engineer-lawyer” problem (Kahneman & Tversky, 1973). This is not analytically complex (for most people) and even approximate use of the correct formula will be more accurate than the prototypical tacit response. However, as analytical complexity increases, tacit processes become progressively more accurate in a relative sense (cells 5 and 6), i.e., the increasing probability of making errors in analysis eventually outweighs the bias and error inherent in tacit responses.

Finally, consider cells 7, 8, and 9 where the bias from tacit thought is insignificant. For tasks that are easy in analytical complexity (cell 7), one should observe no accuracy differences between deliberate and tacit responses. An example might be adding two numbers explicitly (e.g.,  $2 + 2 = 4$ ) or simply recognizing the “pattern” that the sum of two particular numbers makes (e.g., 4 can be “seen” to result from 0 and 4, 1 and 3, and 2 and 2). However, for moderate and hard levels of analytical complexity (cells 8 and 9), tacit process responses are predicted to be more accurate.

The purpose of Figure 3 is to provide a framework for considering the conditions under which tacit (intuitive) or deliberate (analytic) thought is likely to be more valid. In summary, deliberate thought is predicted to be more accurate than tacit thought in cells 1, 2, and 4; intuitive thought is predicted to be more accurate than deliberate thought in cells 6, 8, and 9; no differences are predicted in cell 7; differences in cell 5 will be small; and no predictions seem possible for cell 3. Whereas this framework has not been empirically tested as such, it provides a means for classifying and thinking about studies that have been reported in the literature. Finally, one aspect not explicitly addressed here is the role of individual differences. Clearly people can vary in their susceptibility to bias in tacit thought (depending on their learning history), and certainly expertise affects the extent to which people perceive tasks as analytically complex. Thus this framework could also be used to predict when and where people with differential experience in specific domains would be advised to better trust their “analysis” or their “intuition.”

#### Toward more valid judgments and decisions

As this chapter shows, attempts to define the circumstances under which tacit (intuitive) or deliberate (analytic) judgments and decisions are likely to be more accurate raise a host of interesting psychological issues. On the one hand, it is necessary to have a holistic view of how tacit and deliberate processes interact; on the other hand, one also needs to specify much of the minute details of each system. By looking at the operation of both systems in tandem, one is struck by senses of both complexity and efficacy. The human system is complex. But it is also effective at handling a wide variety of different cognitive tasks.

And yet, although effective, we know that the human cognitive system is not perfect in the sense that people's judgments and decisions still involve errors that can not be attributed merely to random events in the environment. An important issue, therefore, is how to help people achieve their goals by making fewer errors and, indeed, a large part of our educational system is dedicated toward this objective. As educators, we spend much time teaching analytic methods designed to help people hone their capacity for deliberate thought. And, it could also be argued that when such reasoning is assimilated, people can learn to use some tools of analysis in tacit fashion. However, what is not done is to train people explicitly in how to develop their capacity for intuitive thought.

In Hogarth (2001, Chs. 6, 7, & 8), I provide a framework and many suggestions as to how people can develop their intuitive skills. Central to these ideas is the notion that our tacit systems are constantly honing our responses to the feedback we receive in the environments in which we operate (recall the discussion above on *kind* and *wicked* learning environments). Thus selecting appropriate learning environments and monitoring the kinds of feedback that we receive must rank high on the conditions that foster the acquisition of good intuitions. In addition, I believe that people need to be more aware of how often they allow themselves to take decisions automatically as opposed to exercising greater cognitive control (as elegantly discussed by Langer, 1989).

Greater awareness of the dual nature of thought can, by itself, lead to better use of our limited cognitive resources.

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## Figures

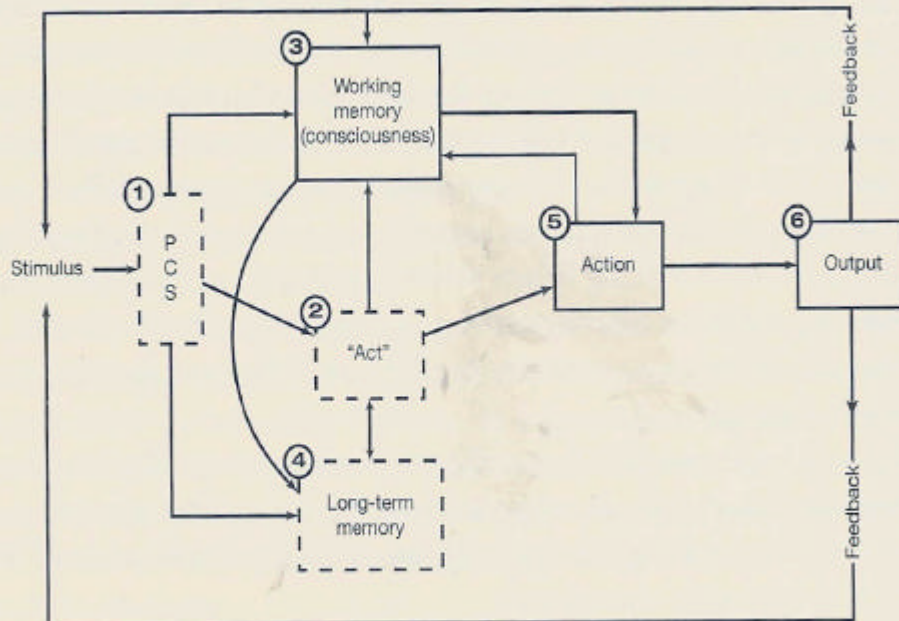
- Figure 1 Characteristics of the two modes of thought
- Figure 2 The deliberate and tacit systems. (From Hogarth, 2001, p.196)
- Figure 3 The relative accuracy of tacit and deliberate thought

Characteristics of the two modes of thought

<u>Tacit</u>	<u>Deliberate</u>
?? Triggered automatically	?? Deliberative
?? Effortless	?? Requires effort
?? Speedy	?? Can be
?? Confidence inducing (but not always)	○ controlled, guided
?? Sensitive to context	○ made explicit
?? Lacks conscious awareness	○ abstract
?? Produces “approximate” responses	○ rule governed
?? Reactive	○ precise
	?? Proactive

Figure 1

EXHIBIT 15 The deliberate and tacit systems



The stimulus is an "object" or a "thought." PCS = preconscious screen. The dotted lines indicate functions of the tacit system.

Figure 2

The relative accuracy of tacit and deliberate thought

		<u>Analytical complexity</u>		
		<u>Easy</u>	<u>Moderate</u>	<u>Hard</u>
<u>Bias and error implied by tacit processes</u>	<u>Large</u>	1 D > T	2 D > T	3 ?
	<u>Medium</u>	4 D > T	5 D ~ T	6 T > D
	<u>Small/zero</u>	7 D = T	8 T > D	9 T > D

- D > T means deliberate thought more accurate than tacit
- D ~ T means deliberate and tacit thought approximately equally accurate
- D = T means deliberate and tacit thought equally accurate
- T > D means tacit thought more accurate than deliberate

Figure 3

## Footnotes

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<sup>1</sup> As an example, consider the space probe recently launched by NASA that failed to meet its target because engineers were inconsistent in using the metric and imperial systems of measurement.

<sup>2</sup> Clearly the existence of roadrage indicates that not all people do learn to control their angry feelings.

<sup>3</sup> At first glance, it might seem contradictory that tacit thought is said to involve information that is both *partial* and *holistic*. As will be explained, however, there is no contradiction.

<sup>4</sup> Whereas the assumption being made here is that a tacit process is largely at work, it is also quite possible that some subjects use the “recognition heuristic” in a deliberate fashion. (Goldstein & Gigerenzer, 2002, do not investigate this issue in their paper.) However, it is undoubtedly the case that the act of recognizing one city in a pair (but not the other) is a tacit process.

<sup>5</sup> The term “gaze” heuristic is due to Gerd Gigerenzer (2001).