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Educating Intuition: A Challenge for the 21st Century

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Imagine that you are interviewing a candidate for a job. On paper, the candidate seems perfect: excellent qualifications, past experience that is relevant to the job, good letters of reference, and so on. The candidate also answers your questions well. However, during the interview you sense there is something about the candidate that makes you uneasy. Although you cannot identify its source, you have a distinct sensation that it would be a mistake to hire this person. What do you do? Do you ignore your feelings and try to analyze the hiring decision in a strictly "rational" manner? Or do you trust your feelings and use these as a way of identifying a "reason" not to hire the candidate?

Now imagine that you are buying a house. Much of your decision undoubtedly rests on reasons that you can articulate to others. The house is located in a pleasant neighborhood at a convenient distance from your work and, perhaps, your childrens' schools. You are going to be able to afford the mortgage payments (although perhaps with difficulty) and, possibly, you are close enough to some friends and family. However, there is another factor that is difficult to explain. At some fundamental level, you simply like the house. Of course, you may tell people that you like the house, and even attempt to explain why, but once again it is difficult to articulate the feelings that are so important to your decision.

As both these examples illustrate, the decisions we take in life are not all governed by seemingly rational processes that we can make explicit to others. Instead, many decisions that we take, including important decisions, are heavily influenced by sensations or feelings that are not under our conscious control. What then are these feelings? Where do they come from? And, as supposedly rational decision makers, should we allow these feelings to influence our decisions? Finally, should these feelings be encouraged? Are there ways in which we might train ourselves to have the "right kinds" of feelings?

The purpose of this opuscle is to explore these questions. To do so, I first summarize current research that attests to people being able to make decisions in two modes of thought, one of which can be conceptualized as "analytical," the other as "intuitive." For reasons to be explained, I refer to these as the *deliberate* and *tacit* systems, respectively. I next explore the origins of what we call people's intuition (which operates within the tacit system). Whereas there is little doubt that some intuitions are genetic in origin, I emphasize the enormous role played by learning. In particular, the effects of different kinds of feedback are seen to be critical in that they condition the extent to which intuitions are or can be functional. As a prelude to thinking about how to "educate" the tacit system of thought, I then present a framework to show how the tacit and deliberate systems interact and share the work of thinking. Finally, I suggest seven guidelines for educating intuition and conclude that, because intuitive processes are so important in our daily lives, the task of educating them is critical. Fortunately, the ability to do this well is now within the scope of scientific knowledge.

The two modes of thought

Over the last two decades, researchers from many areas of psychology have been converging on the notion that people can make decisions in two quite distinct ways or "modes of thought." At one level, this is an idea that goes back to antiquity and can be summarized loosely by describing decisions as being affected by intuition, on the one hand, and analysis, on the other. Indeed, as the above examples illustrate, you don't need to be a social scientist to recognize that you can experience conflict between intuition and analysis. The contribution of the recent work, however, has been to make these ideas more explicit and to provide a framework within which the questions enumerated above can be answered.

The key to understanding the two modes of thought is to recognize that all human activity involves some form of information processing. However, this information processing can occur at two levels; and, whereas we are conscious (i.e., aware) of one level, we are not conscious of the other. Moreover, attention – or the ability to process information consciously – is limited. Indeed, Herbert Simon, the late Nobel laureate in Economic Sciences made much of the notion that attention is the scarcest of economic resources.[1]

To illustrate these ideas, imagine the following scenario. Pau, an 11-month old child is beginning to learn to walk. Pau's uncle Josep knows this and encourages Pau to walk to him from the other side of the room. To do so, Pau first levers himself into a standing position by using an armchair, and then starts making slow, tentative steps in the direction of Josep who beckons him with outstretched arms. Pau makes good but unsteady progress across the room. However, Pau's mother suddenly enters the room and, seeing her son walking unaided, cannot but help saying "Pau" in a fairly loud voice. What happens and why?

On hearing his mother say his name, Pau falls down. The reason is simple. As an 11-month old child who is learning to walk, Pau is concentrating all his attention on the act of walking. The effort of processing the information from his mother saying his name is just too much. Pau does not have enough mental capacity to keep his balance while walking as well as handling his mother saying his name. On the other hand, as Pau grows and learns to walk he will soon be able to walk and carry out conversations at the same time. Basically, the effortful, deliberate process that Pau uses to walk as an 11-month old child will become automated through practice such that walking will no longer require much conscious attention.[2]

This example illustrates the two modes of thought and emphasizes the fact that whereas one requires attention, and is therefore effortful, the other does not. In addition, the example shows that processes that initially consume mental effort (attention) can become automated over time so that they subsequently cease to require effort. I have illustrated this point here by using a physical example of how the attention

needed to walk diminshes as the person becomes more familiar with the task. However, this process of automatization does not just apply to physical activities such as walking. It applies equally to many of the mental processes that we use to navigate the vagaries of everyday life. Indeed, in a recent review, social psychologist John Bargh wrote,

> *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…*[3]

To distinguish the two modes of thought, I refer to one as the *tacit* system, and the other as the *deliberate* system. The tacit system consists of all processes that occur tacitly or automatically, i.e., without use of conscious attention. In the deliberate system, on the other hand, outcomes are effortful; they require deliberation and attention. To illustrate, for the 11-month old Pau, walking requires use of the deliberate system. When he is older, however, the act of walking will be delegated to the tacit system even though some deliberate system resources may be used while walking to control the process, e.g., to avoid bumping into objects or people. Similarly, as suggested by the quote from Bargh above, we may initially learn to "read" people's facial expressions in a deliberate manner. However, our subsequent reactions are typically tacit processes and may induce actions that we cannot explain.

A key feature of the tacit system is that people lack insight into the processes that produce outcomes. At 11 months, Pau is quite conscious of the effort he needs to expend in the act of walking as well as the movements he needs to initiate. By the time he goes to kindergarten, however, Pau will not only walk without "thinking" but, in addition, he will have lost all insight into what is involved in the act of walking which, for him, has now become an intuitive process.[4] Indeed, one way of describing tacit processes is to say that these result in intuitions. That is, "the essence of intuitive responses is *that they are reached with little apparent effort, and typically without conscious awareness. They involve little or no conscious deliberation.*"[5] Table 1 lists different characteristics of the tacit and deliberate systems.

As should be apparent, the fact that many of our cognitive processes are or become automated is very advantageous. If we had to engage in deliberate thought for all actions we take, few of us would ever leave our beds in the morning! There is just tremendous efficiency in being able to handle many everyday decision making tasks in an automated manner. The costs, of course, are that – from time to time – we should spend some time thinking deliberately about decisions and, secondly, precisely because we do so much in tacit mode we are unaware of why we take certain actions (stimulated perhaps by the manner in which questions are asked) and the nature of the habits we develop for taking decisions (avoiding, for example, difficult trade-offs). I shall elaborate on these issues further below.

Table 1
Characteristics of the two modes of thought

Tacit	Deliberate

• Triggered automatically
• Effortless
• Speedy
• Confidence inducing (but not always)
• Sensitive to context
• Lacks conscious awareness
• Produces "approximate" responses
• Reactive
	• Deliberative
	• Requires effort
	• Can be
	  • controlled, guided
	  • made explicit
	  • abstract
	  • rule governed
	  • precise
	• Proactive

The origins of intuition

It is important to emphasize that the tacit system involves responses that are innate, on the one hand, and learned, on the other. In particular, many physical reactions are innate. For example, if a small puff of cold air is directed toward your eye, your eyelid will shut automatically. In addition, many processes in the body react to changes in external temperature, the length of time since you last ate, and so on. At one level, the reader might think that these types of reactions have little or nothing to do with decision making. However, in assessing effects on actions taken, it is often difficult to separate the contributions of innate physical processes, on the one hand, and learned responses, on the other.

For example, in experiments on perception, people have been asked to identify words that are flashed very briefly in front of them on a screen. Responses have then been compared between people who differ in hunger (i.e., have or have not eaten recently). Hungry respondents identify many more food-related words than the others.[6] Similarly, when under stress, people automatically narrow their focus of attention which, if it permits them to access the appropriate information, can lead to good decisions. On the other hand, narrowing the focus of attention can lead to excluding important information such that decision quality is decreased.[7] Clearly, in both of these examples there are complex interactions between innate physical processes and behaviours people have learned.

The notion that many intuitions are innate has attracted much attention. I think that there are several strands of evidence that speak to this issue and that are important for understanding the practical dilemmas outlined at the outset of this paper. Most of this relates to learning or how humans come to see connections – between events, objects, and even concepts.

First, it is a mistake to believe that people learn all types of connections with equal facility. The connections between some events are acquired with incredible rapidity whereas others require considerable reinforcement. For example, in a famous experiment, an eminent investigator showed that it was possible to condition an 11-month old boy to become afraid of a white rat, a rabbit, and a dog when these were paired with a startling noise. However, a subsequent attempt to replicate this experiment failed when conventional objects, such as blocks of wood and cloth curtains, were paired with the startling noise.[8] More generally, much evidence now exists

that shows that humans are differentially "prepared" to learn different connections in the environment.[9] It is easy, for example, for humans to acquire fear reactions to snakes, wild animals, and heights. However, it is much more difficult to learn to be afraid of X-rays or carbon monoxide both of which are far more frequent in modern life than snakes and wild animals.

Second, studies of children – and even infants – reveal the use of mechanisms for reasoning that have an inborn quality. For example, 7-month old children are quite capable of inferring linguistic rules from speech when tested on their ability to perceive patterns in nonsense syllables. And children also seem to have well-developed mental algorithms for detecting causal relations in the environment, e.g., by being attentive to temporal order, the significance of contiguity in time and space, and so on.[10] Some researchers go as far as to argue that people are born with a core of *initial knowledge* that allows them to understand much about the environments into which they are born and which then becomes the core around which their more adult understanding of the world develops. Thus, they are born with the recognition that, unlike inanimate objects, animate objects need not be in direct contact for one to influence the other. On the other hand, this view has been challenged by stating that instead of being born with "knowledge," we are endowed instead with "highly constrained mechanisms" that guide reasoning.[11] To use the common metaphor of the computer as a mind, this argument suggests that our "operating systems" are constructed in ways that limit how we process information and thus reason.

Above I have summarized evidence that some cognitive responses within the tacit system are part of our genetic endowment and, in this sense, our genetic makeup does play a role in our intuitive way of making decisions. In addition, many basic mechanisms that we use in thinking are clearly inherited. However, irrespective of the position taken on the role of genotype in intuition, few can doubt the important role played by learning – and thus the environment – in the acquisition of intuition. It is to this topic of learning that I now turn.

Learning takes place within both the tacit and deliberate systems. Deliberate system learning is effortful. It is the kind of learning that occurs when you deliberately study a text, do some calculations, or even learn specific vocabulary words in a foreign language. And indeed, deliberate system learning followed by much practice can lead to intuitive behaviour (see above). The beauty of tacit learning, however, is that it requires little or no effort and occurs constantly without our conscious awareness.

One stunning example of this phenomenon is provided by studies that demonstrate how effectively humans store in memory frequencies of events as well as levels of covariations between events in an automatic manner. As an example, think back on some of your recent experiences. For example, how many movies have you seen in the last six months? Alternatively, how many people did you see in the street on your way home from work yesterday? How many of these people were old? Although people can only give approximate estimates to these kinds of questions, the evidence suggests that they are quite accurate. The intriguing point is that people are able to make these estimates by interrogating their memory systems and yet, at the time the events actually occurred, they had no idea that they

would be asked these questions on a subsequent occasion. In other words, we record much statistical information about our environments as a matter of course and without any specific goals to do so.

A second line of research has examined people's ability to learn quite complex phenomena in laboratory settings through a process of interaction. For example, in one experimental task, participants are required to observe abstract sequences of events (e.g., strings of letters generated by so-called artificial grammars) and to infer the underlying rules of the system. The significant finding from these experiments is that, long before people are able to articulate how they think the system works, they are able to act as though they understand it. Moreover, when people are explicitly instructed to try and learn how the system works – i.e., in deliberate mode – they are not as successful in gaining an understanding as when they interact with the system in more passive, tacit mode.[12]

The tacit learning described above applies to our ability to understand the causal and statistical structure of our environments. However, tacit system learning also plays a fundamental role in both the preferences and values that people acquire in life. And, as must be obvious, these play a critical role in the kinds of intuitive decisions that we make. To illustrate this point, consider the following question. What kind of music do you like?

Clearly, music is not appreciated universally but most people can express preferences for some kinds of music over others, for example, jazz over classical, for Mozart over Mahler, and so on. But what is the source of these preferences? Do people systematically sample different kinds of music and then rationally decide which they prefer? The answer to this question is resoundingly negative.

Instead, I believe that the answer to the source of people's preferences can be traced to a phenomenon known as the *mere exposure effect*. This principle, initially discovered in the 1960s, simply holds that people acquire positive affect (or "learn to like") stimuli that they encounter frequently in their environments provided that these are not experienced negatively.[13] Thus, mere exposure leads to liking. In other words, people like the music to which they have been exposed and which has not been tinged with negative consequences. It is experience that leads to preferences.[14]

Although the mere exposure effect was first demonstrated in rigorous experimental fashion involving, inter alia, preferences for words and variations in Chinese characters, its implications are far reaching. At an anecdotal level, for example, consider how many people have strong positive affect for the locations where they grew up as children even if, when returning to visit such places as adults, they admit that they are quite ugly.

Society, however, has understood the implications of the mere exposure effect for years before it was "discovered" by psychologists. Two striking examples are provided by processes of acculturation and advertising. People acquire knowledge of the cultural rules and values of the societies in which they live largely through a process of osmosis or tacit learning. Not only do people learn how to behave appropriately in the societies in which they grow up but they also learn to like these societies (provided they have not been castigated by them). As to advertising, there is little doubt that mere exposure and familiarity with the names of products leads to positive affect. The power of advertising is not just one of communicating information about products and services (that can be thought of as cognitive in nature). Its power lies mainly in creating positive feelings. Indeed, perhaps the ultimate example of this is provided by top clothing brands. Customers are so happy to buy these products that they feel good about sporting the brand's logo on their clothes thereby further increasing the power of the tacit message that supports the brand.

The point I wish to emphasize here is that we are always learning and being influenced through the processes of our tacit systems. Moreover, we are typically unaware of these effects and, more importantly, how they affect the quality of the decisions we take on an intuitive basis. It is to this issue that I now turn.

The importance of feedback

Two processes lie at the heart of our automatic, tacit learning: first, is the observation of connections between objects or events; the second is feedback that reinforces observed connections. Fortunately, this is a system that works very well for many things that we need to do in everyday life (which presumably is why evolution led to this system). However, two types of bias can have deleterious effects on the validity of the knowledge generated by the system. The first is bias in the sampling of connections between events; the second is bias (often absence) of feedback.

To illustrate the first, reconsider processes of acculturation discussed above. By growing up in your native culture you are clearly exposed to connections that are valid for behaving appropriately in that culture. However, and as most who have lived abroad realize, the implicit rules you have absorbed from your own culture are not necessarily valid in others.

Deficiencies in feedback are probably the greatest barrier to acquiring effective intuitions. We learn automatically, but we are not necessarily aware of whether experience has been a good teacher. Consider two quite different jobs and the validity of the intuitions they are likely to develop. One is a meteorologist who makes weather forecasts on a daily basis. The other is a physician in the emergency room of a busy urban hospital.

The meteorologist is well-placed to develop accurate intuitions. She has much knowledge about how weather systems develop as well as access to much current information on which she can base her forecasts; she also receives accurate and timely feedback on the accuracy of her forecasts.

The physician in the emergency room also has much relevant knowledge; however, he must make speedy decisions and will not always receive adequate feedback.[15] Indeed, the typical feedback he receives is short term: how the patient responds to his immediate actions. It is rare that the physician ever really finds out what happened to the patients he treated within a longer, and perhaps more relevant time frame. Some patients simply go home after treatment and never return to the hospital; others are cared for in different departments of the hospital, and so on. Moreover, there is another important difference between the meteorologist and the physician. When the meteorologist makes a forecast, this does not affect the weather and thus the feedback that she receives. On the other hand, when the physician

makes his diagnosis, he acts on it. This, in turn, affects the patient and thus the short-term feedback that the physician receives.

Clearly, the key to developing "good" intuitions is to be in a decision making environment that provides accurate and timely feedback. To the extent that the domain in which you are active is what I call "kind," i.e., provides accurate and timely feedback, you are likely to develop accurate intuitions. However, if your domain of activity is "wicked," i.e., feedback is missing or biased, you will have reason to question the validity of your intuitions.

Above, I quoted the extreme cases of the meteorologist and emergency room physician. But, how "kind" or "wicked" is the decision making domain of, for example, business executives? Recently, I undertook a study to illuminate this issue with 24 executives who had been studying at two management education centers in Europe.[16] This "convenience" sample of managers, who ranged in age from 30 to 45, had jobs in quite different industries in some 5 different countries. For periods of time varying between 4 and 10 working days, the managers consented to complete small questionnaires about their current decision making activities when they received SMS messages on their mobile telephones that were sent at random moments (4 or 5 times per day). The managers were asked to describe (briefly) the last decision they had taken and, inter alia, answered questions about feedback: Would they receive feedback on their decisions and if so, when, and in what form?

Apparently, these managers received or expected to receive feedback for about 65% of their decisions. Moreover, whereas some of the feedback they received was immediate, most was not and was often quite delayed (some 35% of feedback would only be received after a week). Closer analysis also revealed that a significant proportion of the feedback they described was not informative.

Clearly, it is difficult to tell whether these data are representative. However, I believe that most executives would tell you – at an anecdotal level, at least – that the feedback they receive from taking decisions in their jobs is far from perfect.

To summarize, I claim that two modes of thought are involved in human decision making. One mode, the deliberate, is effortful. It consumes our limited resources of attention. The second mode, the tacit, operates automatically in an apparently "cost free" manner and is triggered into action by stimuli that we meet in the environment. It is also the system that develops our long-term memory by recording many features of our interactions with the world. I now examine the interactions between the two systems in greater detail.

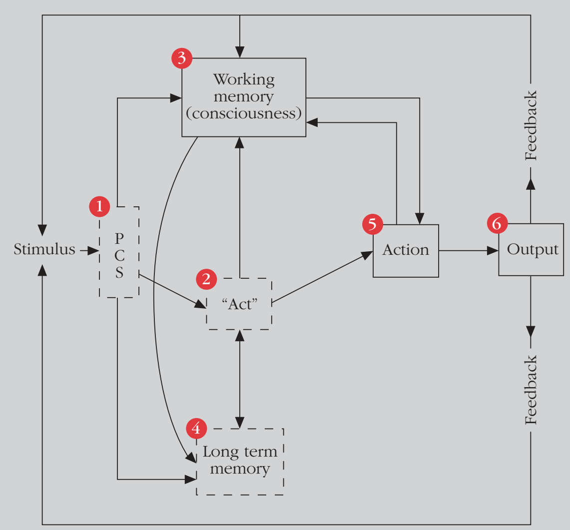
The interaction of the tacit and deliberate systems

Figure 1 illustrates the interconnections between the tacit and deliberate systems.[17] 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 person and third parties.

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 person, 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). Consider what happens in three types of cases.

Figure 1
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.

In the first, 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, frequencies, and feelings. As stated above, it requires neither effort nor intention and, yet, the information stored can be subsequently recalled when needed, even for tasks that were never imagined.

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 involves 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 walking along a crowded street. Here you are involved in a continuous stream of actions and yet pay only a minimum of attention. An interesting feature of this case is that our actions frequently precede our understanding of why we 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.[18]

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, reading a book or solving an analytical puzzle. Moreover, the deliberate system can overrule outputs of the tacit system provided action has not already taken place. An example is the way we suppress 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. On the contrary, we can learn – through our deliberate systems – to censor these feelings. 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 on demand. It is rarely "shut down" completely and 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 systems operate together.

Discussion of Figure 1 would be incomplete without considering the effects of feedback and understanding 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 1 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.

Educating our intuition

In many ways, our intuition is the product of our idiosyncratic experiences as we journey through life. Moreover, the quality of our intuitions depends heavily on these interactions and can be thought of on two dimensions.

One dimension is the domain or content of our intuitions. Because it is acquired empirically, intuition is necessarily limited to the domain in which it was acquired. Thus, one may gain many intuitions in, say, the game of chess by playing a lot of chess. However, these intuitions would not be invoked (or perhaps even be useful) for other tasks such as, for example, performing medical diagnoses.

The second dimension is the quality of the intuitions as measured by accuracy in making predictions or advantages gained in making decisions. Intuitions can only be as "good" as the experience on which they have been built. If they have been acquired in *kind* environments (i.e., characterized by accurate and timely feedback), they are liable to be valid. However, intuitions acquired in *wicked* environments should be treated with suspicion.

One view of intuition in any domain is that "people have either got it or not got it." I believe that this statement is true as a description of a momentary state. However, I also believe it is a mistake to let your haphazard experiences with the environment determine the stock of intuitions that you possess. On the contrary, I believe that people can and should manage their experiences in order to educate their intuition. After all, if you have an automatic system for making decisions, why not make sure that it is based on appropriate inputs and is making the right decisions for you?

To achieve this, it is important for people to realize that they can provide direction to their activities in order to "educate" their intuition in productive ways. Indeed, I believe that developing means of doing this represents an important challenge – and opportunity – for social science. As has been demonstrated on numerous occasions, the mere fact that we possess technology for helping decision and policy making does not guarantee good decisions. The complexity of real-world decision making often precludes building complete analytical models and decision and policy makers typically cannot avoid relying on their intuitions. Consider, for example, complex decisions such as changing interest rates, large capital expenditures, energy policy, and so on. To make a start on this endeavour, I recently formulated seven guidelines that I believe could be important in helping people educate their intuition. At the present time, these cannot be considered scientifically validated proposals but more by way of hypotheses garnered from an extensive review of literature. I now summarize these guidelines.[19]

The first guideline builds on the fact that our intuitions are constantly being formed by the environments in which we find ourselves. Thus, to develop our intuitions appropriately we should deliberately *select and/or create our environments*. Thus, for example, if we wish to develop good intuitive skills in financial analysis, we should seek to work with people who are the best in this area. At one level, this is simply an application of learning by apprenticeship. What it shows, however, is the potential power of the apprenticeship model. In many cases, apprentices do not learn by being told what to do; instead, they learn by observing their masters. In general, the principle here is to think about the environment in which one is currently acquiring intuitions and to ask how well suited it is for the task. Can the experience be changed or improved to maximize effective tacit learning?

The second guideline explicitly recognizes the importance of feedback and is, simply, *seek feedback*. As noted previously, feedback is frequently distorted or missing in many professional situations. However, often many things could be done to mitigate the negative effects of this situation. Consider the emergency room physician discussed above. True, it is not possible for him to obtain feedback on all cases he treats. But, what he can do, is some intelligent sampling of outcomes by following up on a subset of patients. Similarly, I believe that several

of the executives described in the study on feedback (above) could improve the quality of their learning by, first, explicitly paying more attention to feedback they could receive, and second, by learning what kind of feedback they should seek in the first place.

The third guideline I propose is to *impose "circuit breakers*." Let me explain. One implication of the model illustrated in Figure 1 is that much behaviour occurs automatically and has been enacted before people are consciously aware of what they have done. Whereas this is functional in many cases, it may not always be in the person's best interests. For example, there are instances where reacting on an emotional impulse (e.g., anger) leads to undesirable outcomes. One therefore needs to "break the circuit" of subconscious, automatic behaviour and allow the deliberate system time to control your reactions. Clearly, people do learn to control their anger in many situations. In like manner, I claim, we need to learn to recognize other potentially damaging situations – perhaps in commercial negotiations – and learn to maintain control over our "natural" tendencies to react. In many cases, this is similar to what has become known as "emotional intelligence" and can be learned (although it may need coaching by a third party).

The fourth guideline is to *acknowledge emotions* – treat emotions as data! The key idea here is to recognize that in many situations our emotional systems are providing us with information that may contain wisdom we cannot articulate. Consider, for example, the job interview situation discussed at the beginning of this paper. You feel uneasy about the candidate but cannot explain why. Whatever you finally decide to do, my suggestion is to treat your feelings as data, i.e., in the same way as other information you have gathered. Because these emotional data are difficult to calibrate, it might be advantageous to discuss your feelings with others. Did your colleagues also have uneasy feelings about the candidate? The point is that our emotional systems do provide important information. They are particularly likely to be accurate in telling us what we like and do not like (recall the mere exposure effect) and, although imperfect, can be an important input into our decision making.

The fifth guideline is to suggest an openness to *explore connections*. By this I mean the following. One of the most important dimensions of tacit thinking is the automatic ability to see similarities. When, for example, we see different versions of our signatures, it is simple to spot the similarities. In like manner, it is easy for us to say whether members of the same family are or are not similar to each other in physical appearance even though there may be disagreement about this. More generally, it is well known that the ability to perceive similarities between situations, mechanisms, processes and so on, lies at the heart of much effective problem solving and creative work. Many creative solutions and innovations in our human-made or artificial world owe their origin to analogous processes in the natural world or even other human-made environments. Thus, to the extent that we can build on our ability to see similarities, the more likely we are to reach interesting hypotheses and conclusions. For example, imagine that you are an executive in the banking industry. Now, ask yourself what similarities you see between how customers could be treated in your bank and how they are treated in, say, other industries as different as first-class hotels, fast-food outlets, or hairdressers. What are the similarities? Could

these be used to design better ways to service customers?

The sixth guideline is to *accept conflict in choice*. The notion here is that we all know that choice involves trade-offs (e.g., how much delay in delivery are you willing to accept for an increase in quality?) However, it has also been well-established that people seek to avoid trade-offs when making choices. Trade-offs are hard to execute from a cognitive viewpoint and sometimes difficult to accept emotionally (e.g., how much are you willing to save by reducing accident insurance coverage for a loved one?). As a result, much literature attests to the fact that tacit choice processes typically reach “satisfactory” choices without confronting trade-offs.[20] However, this can also lead to dysfunctional outcomes that should be avoided. In short, we need circuit breakers (see above) to alert us to face trade-offs instead of taking the “easier” choice that springs to our attention.

The seventh guideline is to *make scientific method intuitive*. As everybody knows, it is difficult to acquire valid knowledge through experience. However, the “rules” of scientific method contain many useful suggestions: take care in how you make observations (separate facts from conclusions); generate different hypotheses; find ways of testing your hypotheses; and so on. The key idea here is to learn these rules so well that you can execute the appropriate steps without having to think what these should be. In other words, you have educated your problem solving intuition to work according to the best known principles.

Clearly, people cannot be expected to transform their environments and thinking skills overnight. By following the above guidelines, however, I believe that there is every chance that people can educate their intuitions in two important ways. First, by choosing the right environments they can ensure that the content of their intuitions is appropriate to the tasks they face. And second, by working on the guidelines they can develop habits of thought that will be more effective in dealing with their decision making tasks.

A goal for future research

In an uncertain world, we can never guarantee that all our decisions will be "correct." On the other hand, by using and developing better processes for making decisions, we can guarantee that we will be making better decisions "on average." In this paper, I have outlined a model that involves two modes of thought – the tacit (intuitive) and deliberate (analytic) systems. To be effective decision makers, we need to be able to deploy both systems appropriately.

To date, much research has been devoted to developing tools that help the deliberate system structure and solve decision problems. This is as it should be. Moreover, I fully support the efforts involved in teaching people how to use these analytical tools in the deliberate mode. At the same time, I believe that attention should also be directed toward aiding the tacit system because this undoubtedly accounts for most of our decision making activity. Fortunately, scientific knowledge about how we think – and particularly about how we use our tacit systems – has now reached the point where we can systematically develop means to educate our intuitions. Interestingly, over 200 years ago, David Hume, the great Scottish philosopher, wrote "Reason is, and ought to be, the slave of the passions, and can never pretend to any office other than to serve and obey them." We are now in a position to turn Hume's insight into an effective reality.

Notes

(1) *See, e.g., H. A. Simon (1996).* The Sciences of the Artificial *(3rd ed.). Cambridge, MA: MIT Press.*

(2) *Note, however, that even as adults similar phenomena can occur. Imagine, for example, that you are walking down a street with a friend who tells you about a really good idea. When this happens, many people stop walking. Indeed, the idea is so good that it "stops you dead in your tracks."*

(3) *J.A. Bargh (1996). Automaticity in Social Psychology. In E. T. Higgins & A. W. Kruglanski (Eds.),* Social psychology: Handbook of Basic Principles. *New York: Guilford, p. 169.*

(4) *As another example, consider ski instructors. They typically learn to ski as children and do so "naturally." But to become ski instructors as young adults, they need to follow courses that teach them what is involved in skiing so that they can, in turn, explain this process to novices.*

(5) *R. M. Hogarth (2001).* Educating Intuition. *Chicago, IL: The University of Chicago Press, p.14.*

(6) *W. N. Dember (1960).* The Psychology of Perception. *New York: Holt.*

(7) *K. R. Hammond (2000).* Judgments Under Stress. *New York, NY: Oxford University Press.*

(8) *J. B. Watson & R. Rayner (1920). Conditioned emotional reactions.* Journal of Experimental Psychology*, 3, 1-14; and E. Bregman (1934). An attempt to modify the emotional attitude of infants by the conditioned response technique.* Journal of Genetic Psychology*, 45, 169-198.*

(9) *M. E. P. Seligman (1970). On the generality of laws of learning.* Psychological Review*, 77, 406-418.*

(10) *G. F. Marcus, S. Vijayan, S. Bandi Rao, & P. M. Vishton (1999). Rule learning by seven-month-old infants.* Science*, 283, 77-80; and T. R. Shultz (1982). Rules of causal attribution.* Monographs of the Society for Research in Child Development*, 47, 1-51.*

(11) *E. Spelke (1994). Initial knowledge: Six suggestions.* Cognition*, 50, 431-445; and R. Baillargeon (1994). How do infants learn about the physical world?* Current Directions in Psychological Science*, 3, 133-140.*

(12) *A. S. Reber (1989). Implicit learning and tacit knowledge.* Journal of Experimental Psychology: General*, 118, 219-235.*

(13) *R. B. Zajonc (1968). Attitudinal effects of mere exposure.* Journal of Personality and Social Psychology Monograph Supplement*, 9 (2, Pt.2), 1-27.*

(14) *This statement is quite heretical from the standpoint of most economists. Economists typically assume that preferences are fixed and used by people to select between different experiences. Instead, I maintain that people develop preferences through experience and then use those preferences to select further experiences. This is clearly a far more complex and dynamic story than the orthodox view.*

(15) *This example is based on talking to emergency room physicians at a large urban hospital.*

(16) *R. M. Hogarth (2003).* Is confidence in decisions related to feedback? Evidence – and lack of evidence – from random samples of real-world managerial behavior. *Working paper, Universitat Pompeu Fabra, Department of Economics and Business.*

(17) *See Hogarth, op. cit., Ch.6.*

(18) *J. A. Bargh & T. L. Chartrand (1999). The unbearable automaticity of being.* American Psychologist*, 54, 462-479.*

(19) *See Hogarth,* op. cit.*, Chs.6 & 7.*

(20) *G. Gigerenzer, P. M. Todd, & the ABC Research Group (1999).* Simple heuristics that make us smart. *New York, NY: Oxford University Press.*

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