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Managing Intuition I.: Why does intuition need to be educated?

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Abstract: Imagine that human intuition suggests the same good solution to everyone in every situation, or imagine that intuitive decisions are always much worse than conscious thinking. In these cases educating intuition would not have much use. In reality, however, intuition has its powers and perils, it can guide us to genuine creativity or can lead us astray from any sensible logic. Intuition is neither a hidden mystical sense, nor a curse upon human thinking. It is – if managed well – a potential to complement our limited conscious thinking, to lower the risk of errors in our decision-making, or to deal with complex problems in an uncertain world. To achieve this, all we need is to learn which of our intuitions are erroneous, and how to improve them.

Keywords: experience-based learning, implicit/explicit knowledge, intuition.

1. What is intuition and what is it not?

Intuition is an inevitable part of almost all decisions and judgments, it is one of the sources of our knowledge. Inherited either from evolutionary history or acquired from personal experience, this knowledge suggests certain beliefs, interpretations or predictions about the world. In contrast to conscious reasoning, intuitive responses reach conscious awareness with little apparent effort from a consciously unavailable knowledge (Dienes & Perner, 1999).

Speed and confidence are often associated with intuition, however, these are not necessary correlates (Hogarth, 2001). Intuition can be an impression building up gradually, often in conflict with our conscious thoughts abandoning us in consequent puzzlement.

Insight is similar, but not the same as intuition. Insight is the sudden realisation of a solution that was already known, but a different perspective or cue was needed to retrieve it. Whereas, intuition is a function of the cognitive system that processes environmental information in an automatic way and builds up behavioural preferences before reaching consciousness (Polanyi, 1964; Reber et al., 2007).

2. Can intuition ever be better than conscious thinking?

Although common belief and numerous popular books (e.g., Claxton, 1997; Gigerenzer, 2007; Gladwell, 2005; Myers, 2002) propagate the prevailing power of intuitive thinking, firm scientific evidence show that our most frequent decisional mistakes are rooted in the systematic biases

of our intuitions (Kahneman & Tversky, 1979). Conscious, analytical thinking has the advantage of its verifiable nature. An explicit reasoning provides more security over our judgments for, in theory, it is based on facts and available memory along with testable steps in its argument. In practice, however, this ideal state is rarely the case. In most everyday situations we are constrained to make decisions based on incomplete or noisy information under limited time. In these cases we have to guess or to rely on previous experience or general knowledge. The well known limitations of our attention -a conscious working place - provides access only to a small amount of information to be processed in consciousness (Miyake & Shah, 1999). However, it is assumed that a parallel automatic system of the brain also processes information in a distributed, less costly way (Sloman, 1996).

Intuition, therefore, is, on the one hand, based on a broader automatic processing which builds in several aspects of our experiential knowledge, but, on the other hand, it is not always reliable. At this point, our questions arise: "Is there a way to decide which of our intuitions are reliable?" and "Is there a way to improve our intuitions?". Recent work in scientific psychology suggests a confident 'yes' to both questions. To understand the argument behind these suggestions, first, we have to step back and analyse what makes the difference between good and bad intuition.

3. Where does intuition come from?

Our intuitive knowledge is partly based on our natural reactions, a functionally important inheritance of our evolutionary past (e.g. our perception of emotion) (Damasio, 1996). The acquired part of our intuition comes from either well-practised explicit knowledge that became automatic (expertise) or from experience. Widely accepted explicit knowledge easily becomes common-sense, intuitively obvious today and non-sense 'tomorrow' (Frantz, 2005). Experience-based learning provides a dynamic and critical part of our intuition. It is dynamic because we are constantly processing information about the frequencies of events in our environment and we build up connections about the perceived relatedness of the objects we meet. It is critical, because the inherent strengths and weaknesses of intuition are rooted in the validity of the learning environment (Hogarth, 2001).

In experience-based learning, we learn automatically from observing connections between our actions and feedbacks from the environment. This is a very powerful way of learning, but it does not necessarily teach us the right lessons (Hogarth, 2001). To understand when learning is valid and when it creates false beliefs, first, we should understand the general structure of how we learn from experience.

According to the works of Robin Hogarth (e.g., 2001, 2008), there are two main variables that affect the quality of our learning from experience: the quality of feedback and the consequence of errors. If the feedback of our (or others') actions is noisy, delayed, probabilistic or irrelevant then the quality of the learning is poorer than when it is fast and accurate. A lenient environment provides approximate, but risk-free, feedback on accuracy. Learning will not be erroneous, but it will not be accurate either. An exacting environment can teach us much, but the knowledge will not be necessarily relevant to our aims. Table 1. demonstrates some examples for each of these categories.

Consequence of errors		Quality of feedback: Relevant	Quality of feedback: Irrelevant
	Exacting	Relevant-exacting	Irrelevant-exacting
	Lenient	Relevant-lenient	Irrelevant-lenient

Table 1. The learning structure in experience-based learning. (based on Hogarth, 2001, pp. 88.)

Relevant-exacting: A professional golf player receives immediate and highly accurate (exacting) feedback during training. The acquired knowledge will be valid, precisely what was aimed for (relevant).

Irrelevant-exacting: Here the feedback can be dangerously misleading. The example can be the infamous physician from the early 20th century who believed to diagnose patients from tongue shape and texture by touching them with his fingers. The patients spent weeks in the infected ward going through the procedure again and again until they eventually got infected with the typhoid fever. The physician got strongly reinforced that his intuitive skill was right (Thomas, 1983).

Relevant-lenient: For instance, in the case of walking down a corridor you do not have to be very precise with your steps, it is enough to keep the direction, your errors cannot be too costly (Hogarth, 2001).

Irrelevant-lenient: In the case of most superstitious behaviour learning may be invalid, but you do not realise it, because it has no real effect on you: for example, not crossing the street after seeing a black cat. This false belief is mostly harmless, but can also lead to unfounded confidence.

4. When is better to use intuition than conscious analysis?

To identify when our intuition gives advantageous advice to us, first, we should see how the feedback that we learn from can be misleading. By experience-based learning, intuition constantly and automatically gathers information about connections in the world. This effortless way of learning has its cost since in experience-based learning we can learn only from what we see, the system cannot utilise something that was not observed (Hogarth, 2001). However, for valid learning quite often we should know about what we do not see. To understand the importance of this caveat, consider the following example. A sales manager wants to motivate her sales staff to improve performance. Anytime performance decreases she sends a blaming note to the individual. She most often notices an increase in the sales next time. Experience-based learning builds up her knowledge about the connection between the action and the outcome, supporting the original hypothesis of the manager that blaming is motivating. Her intuition will suggest blaming anytime she notices a decline in performance (Hogarth, 2001).

The manager motivates her sales staff by	*Performance*	
	increase	decrease
Sending a blaming note	a	b
Using other means	c	d

Table 2. The environmental structure of experience-based learning in the example of motivating sales staff (based on Hogarth, 2001, pp. 84., 123-125.)

This intuition will, however, be biased by two serious fallacies. One peril of this knowledge is that using other means was never tested. For valid learning she should compare a/(a+b) and c/(c+d) (Table 2.). She never tested any cases of c, although there might be much more effective means to help increase performance than blaming

(e.g., sending them to intuition training). On the other hand, the observed connection might be an illusory correlation (Chapman & Chapman, 1969). If, in reality, sales are affected mainly by random events, they will follow the probabilistic phenomena called *regression towards the mean*. According to this, in most of the cases performance will increase after a decay (Kahneman & Tversky, 1973). Blaming has maybe nothing to do with future performance.

The learning structure of the environment is, therefore, what determines whether the knowledge that we obtain in it is valid or not. Hogarth (2001) calls these *wicked* and *kind* learning environments. We learn the right lessons only in kind environments. Misleadingly, confidence in our intuition does not reflect the difference, we can be just as confident in our knowledge learned in wicked as in kind learning environments. To be aware of this bias and to correct it is the central point in how to educate intuition.

When making everyday decisions, people mostly process information and make a decision in quasi-rational ways, somewhere in a cognitive continuum between pure intuition and pure rational analysis (Hammond et al., 1987). Furthermore, the demands of the tasks differ along this continuum as well. Therefore, the validity of the decision also depends on the match between the demands of the task and the applied cognitive style. Empirical studies show that at some tasks we are better with intuition (e.g., emotion recognition: Halberstadt, 2005; perceptual training: Melcher & Schooler, 2004; basketball prediction: Halberstadt & Levine, 1999). Compare, for example, two tasks: estimating your tax for the coming year and choosing between women to marry. Whereas you could work out both problems analytically and intuitively as well, still, the tasks call for different ways of thinking, although making mistakes could bring similarly serious consequences.

A further question is how accurate intuition needs to be. To assess the accuracy of judgment is not always that straightforward. The few studies in the scientific literature (e.g., Kleinmuntz, 1990; Sawyer, 1966) show that analytical methods, on average, bring about more accurate and more reliable predictions than human judges – provided with the same information. Due to motivational and cognitive limitations, humans, on average, cannot outperform well-built models, and they are not perfectly consistent either. Still, when the environment is changing or too complex models may turn out to be less reliable and human judgment can be more flexible and more adaptive. In general, researchers find the composition of statistical models with human judgments to be more accurate then either of them alone (e.g., Blattberg & Hoch, 1990).

In conclusion, rational analysis, if available, is ideally more expedient, but intuition can be beneficially used if it was acquired in a 'kind' learning environment and if the given situation requires a decision with speed, flexibility and creativity. In these cases our risk that we take mostly is to be 'approximately right' with human intuition or 'precisely wrong' with statistical models.

When we are confident in our decisions we find it intuitively obvious that they are correct. However, as we must see, intuitive impressions are not obviously right. Our aim in the Intuitive Project is to analyse intuition and to develop a training program for active decision makers on how to avoid the perils of these gut feelings and how to utilise their powers. This concise summary of the previous thoughts and studies of intuition should provide a theoretical basis for those who wish to base the answers to these questions on more than their intuitions.

Invited Peer Commentary

Comments on the Target article

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The effective use of either rational analysis or intuition is related to the type of learning environment and whether the decision requires speed, flexibility and creativity. However, it may also be interesting to look at when it is appropriate to switch between modes. For example, a speech and language therapist has a large battery of tests she could administer before making a diagnosis on a patient. She could continue administering tests until analytically she was almost certain she was right. However, in practice, continuing to administer tests has costs in terms of staff time and the number of patients who can be seen. Ideally, the therapist should stop giving tests as soon as she can be confident in her diagnosis, that is when she is practically certain. It could be argued that this point is reached when the costs of continuing to administer tests outweighs the benefits of having a more analytically secure basis for judgment. Now even using the same tests in the same order experts tend to be readier to reach a diagnosis than many trainees, who would rather give an extra test or two 'just to be sure.' Now is the decision about when to move from an analytical mode itself an intuitive decision.

Eraut (2004) argues that shortage of time forces people to adopt a more intuitive approach, and intuitive routines developed by experience enable people to do things more quickly. So the expert feels confident in her diagnosis, she is practically certain. Now two questions arise – can this process of reaching an intuitive feeling of confidence be speeded up and when might be appropriate to adopt a different approach to decision-making. First, the use of vicarious learning resources in the form of re-usable video-clips of students discussing clinical reasoning issues with other students or with a tutor have been shown to be helpful in developing clinical reasoning skills (Howarth et al., 2007). In that case, might it not be helpful to develop similar dialogue-based resources around students and experts talking about when to trust that intuitive feeling as a basis for confidence. Secondly, it may be equally helpful to say something about the circumstances when and how often it might be appropriate to check whether intuition is providing a reliable guide to diagnosis. Eraut (2004) argues that a third type of reasoning may play a role in this respect: deliberative reasoning can be used as a basis of reflection on the whole decision-making process, including through the explicit review of value considerations.

Intuition and Creative Cognition

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The idea that intuition can be educated is certainly intriguing. One potential arena in which the educating intuition paradigm could be applied is within the domain of creative cognition. The approach investigates the fundamental cognitive processes, such as conceptual combination, analogical mapping, and insight that play a role in creative thought (Finke, Ward, & Smith, 1992; Ward, Smith, & Finke, 1999). One such process that deserves more attention is intuition and its role in creative cognition.

In spirit with the approach of the target paper to determine when to rely on intuition and when to rely on analysis, it would be a worthy research program to determine when in the creative cognition process to rely on intuition and when to rely on analysis. According to the Geneplore model (Finke et al., 1992), creative products are the result of two interacting phases of thought. In the first phase, the generative stage, a wide net of ideas is cast, and various potential ideas are produced. In the next stage, the exploratory stage, the ideas that are considered to have the most potential are developed. These two phases are thought to be interactive and cyclical.

A related concept to intuition is implicit learning (Lieberman, 2000). Implicit learning is the acquisition of knowledge that takes place without our intent and conscious awareness (Reber, 1993). As mentioned in the target article, our intuitive knowledge is partly a result of experience. It indeed has been argued that intuition is the subjective feeling of knowledge that is the result of an implicit learning experience (Lieberman, 2000; Reber, 1989).

It is my belief that it is of uttermost importance that implicit learning is allowed to take place during the generative stage of creative cognition. The hallmark cognitive process of this stage is implicit learning. It is in the very beginning stages of idea generation, in which every idea should be considered, and automatic associations should not be hindered from being formed. Then, in the exploratory stage, one can shift gears to analysis to work out the implications and make the abstract idea(s) more practical. Therefore, during the generative stage analysis should not hinder the generation of ideas, and intuition should be harnessed to access the result of the implicit learning process.

Intuition also plays an important role in deciding which ideas to pursue. Experts have more accurate intuitions as to which ideas will be worthy to pursue, and which ones are likely to flop. To the extent that these intuitions are helpful in distinguishing between potential ideas, these "creative intuitions" can, and should, be educated.

In sum, a promising research directory may be to educate intuitions in creative cognition. I laude the efforts of the Implicit Laboratory Association in determining the conditions where intuition is best suited for the task, and the conditions when it is best to use analysis. I think such an effort could also be applied to further an understanding of how people come up with the inventive ideas that change the world in a positive direction.

Accuracy of Intuition Depends on Experience and Problem Complexity

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Intuition is rooted in experience. The accuracy of intuitions depends not only on the characteristics of the learning environment (Hogarth, 2001), but also on factors such as the experience of the decision maker and the complexity of the problem. For example, if an individual has acquired a great deal of experience in a domain, then that individual is likely to have superior intuitions to those with less experience. Klein's (1998) work with expert fire-fighters and nurses has shown the superiority of expert intuitive judgment under conditions of uncertainty. In such

cases, decisions must be made extremely quickly and consequences carry high stakes. For these experts, deliberate analysis is not possible nor is it optimal.

Recent empirical work has challenged the assumption that expertise and intuition accuracy share a linear relationship. In a study of undergraduates solving everyday problems related to college life, students in their first few weeks of college performed slightly better when using intuition relative to analysis (Pretz, 2008). Conversely, experts in college problem solving (trained residential assistants) performed worse when they trusted their intuition than when they used analysis. This counterintuitive set of findings can be explained by Baylor's (2001) U-shaped theory about the relationship between experience and intuition. Baylor argues that both novices and experts excel when trusting intuition, but that intermediate experts perform better when trusting analysis. The most experienced and trained college students are not yet experts by the 10-year standard of the field and would therefore qualify as intermediate experts. Intuition may be beneficial not only to experts but also to those with minimal experience in a field. Novices who attempt analysis may focus on misleading information which results in worse solutions than if they made a holistic intuitive judgment.

Another factor that affects the appropriateness of intuition is problem complexity. Hogarth (2005) predicted that relatively simpler problems would be better solved via analysis, but that for the most complex problems, intuition would be superior. Dijksterhuis and Nordgren's (2006) Unconscious Thought Theory makes a similar case for the benefit of intuition for complex problems, and is supported by empirical work (Dijksterhuis, 2004). This benefit of intuition has been documented in other paradigms as well, including process-control tasks of Berry and Broadbent (1988) and the Piagetian Balance Scale Task (Pretz & Zimmerman, 2007). Converging evidence from these paradigms has shown that an intuitive, implicit approach facilitates the induction of relatively non-salient, complex rules, whereas a more analytical, explicit approach is better for relatively salient, simpler rules.

Intuition has a reputation in the cognitive literature as a simplistic heuristic which leads to bias and error, with the notable exception of the critiques provided by Gigerenzer (2007). As we gain an increasingly nuanced understanding of implicit cognition, we must re-examine the construct as an aspect of implicit processing. The field has provided tantalizing evidence that implicit cognition is not only pervasive, but also adaptive. Our task is to better understand conditions under which intuitions are more accurate than analytical approaches.

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