Lauri Järvilehto

"The Role of Intuition in Inquiry"

In: Ulf Zackariasson (Ed.) (2015). *Action, Belief and Inquiry—Pragmatist Perspectives on Science, Society and Religion* (pp. 250–259). Nordic Studies in Pragmatism 3. Helsinki: Nordic Pragmatism Network.

ISSN-L 1799-3954
ISSN 1799-3954
ISBN 978-952-67497-2-3

Nordic Pragmatism Network,
Helsinki 2015

www.nordprag.org

The Role of Intuition in Inquiry

Lauri Järvilehto
Aalto University

1. Introduction

On June 20th, 1879, the philosopher Charles Sanders Peirce took a river boat to attend a conference in New York. On the boat, Peirce's overcoat was stolen, along with an expensive watch. To apprehend the thief, Peirce rounded up the entire service personnel on the boat. On nothing more than a hunch, he soon identified a man he believed had stolen the watch. He could not, however, persuade the man to confess.

Shortly after the ship had landed at a dock, Peirce hastened to the Pinkerton agency to report the crime. He gave a detailed description of his suspect. The Pinkerton detective assigned to the case, however, identified a different suspect, whom he followed but who turned out to be innocent. Later, it was discovered that the person Peirce had identified was, indeed, the person who had stolen the watch. The property was recovered, and the culprit tried. Peirce's hunch was vindicated (Sebeok & Sebeok, 1981).

What was at work when Peirce identified the thief in the first place? Peirce himself maintained that *guesswork* has an important role in carrying out inquiry (Peirce, MS 629; Sebeok & Sebeok, 1981). Mere guessing, however, amounts often to not very viable results. While in some cases, guessing seems to work better than mere chance, there are cases where guesswork is delimited by prejudice or mere ignorance. What are then the grounds for following hunches?

The concept of *intuition* is something of a philosophical conundrum. While the idea of immediate apprehension or immediate insight has been a central subject of debate in philosophy for centuries, its nature is still shrouded in mystery. What makes some guesses work better than others? And why are some people better at guessing than others? It is my

intention in this paper to shed light to this peculiar capacity of the human mind, and its role in carrying out inquiry.

2. Two Types of Intuition

Intuition has perplexed thinkers throughout millennia. There have been various explanations to what just occurs to us out of the blue "gut feelings." Roughly, the positions on intuition can be divided into two categories.

The first use of intuition was made famous by Immanuel Kant. This is the notion of *immediate apprehension*. The second use has gained popularity especially since early 20th century, and concerns *immediate insight*. This is the idea of viable insight that is generated independently of conscious inference. Let us call these two types of intuition apprehensive intuition and generative intuition, respectively.

Kant's idea is relevant in particular to formation of knowledge, in particular his notion of *a priori knowledge*. Kant argued that we can arrive at an understanding of the truth of some statements just by thinking (Kant, 1998). This understanding is rooted in the immediate apprehension, or the intuitive capacity of the human mind. The notion bears some resemblance to Descartes' idea of clear and distinct ideas: ideas that just *seem* to be true to us, no matter what.

In this paper, however, I will mostly focus on the second type of intuition. This is the type of intuition that is exemplified by the story about Peirce above. Somehow it seems that some people possess a Sherlock Holmes-like capacity of drawing immediate insight from no apparent inference. But up till the recent years, the nature of this mechanism has been unknown.[1]

In order to shed light on the mystery of this intuition, I will, however, need to sidetrack for a moment to recent findings in cognitive psychology and neuroscience. While empirical, these findings will lend considerable argumentative support for the notion of intuitive insight defended below.

3. Intuition and the dual-processing theory of thought

In recent years, the psychologist Jonathan Evans, among others, has proposed a theory called the dual-processing theory of thought (e.g. Evans,

[1] For a more in-depth comparison of apprehensive and generative intuition, see (Järvilehto, 2015).

2003; 2009; Stanovich, 2004; 2009; Kahneman, 2011; Evans & Stanovich, 2013). Evans argues that the human mind consists of two Systems, called System 1 and System 2:

> Dual-process theories of thinking and reasoning quite literally propose the presence of two minds in one brain. The stream of consciousness that broadly corresponds to System 2 thinking is massively supplemented by a whole set of autonomous subsystems in System 1 that post only their final products into consciousness and compete directly for control of our inferences, decisions and actions
>
> Evans 2003, 458.

System 1 is evolutionarily speaking old. Humans share it with most "higher" animals and it concerns for the most part non-conscious processing. That is to say, System 1 is the seat of instinct, emotion and intuition. System 1 has a very high capacity and can process many streams of information in parallel. Most of System 1 processes take, however, place unknown to the cognitive agent.

System 2 is, evolutionally speaking, new, and it is typical only to humans and some more "advanced" primates. It concerns the conscious processing of the agent. System 2 is the seat of logical and analytical reasoning. Its processing capacity is very limited compared to System 1, and it can typically process information only serially.

System 2 is constrained by the limitations of working memory, discovered already in the 1950's by George Miller (1956). Miller argued that a person can consciously process only about seven items of information at a time. This number has since been corrected downwards, and the consensus of present day memory researchers is that System 2 can only process about three to five items at a time (Dietrich, 2004).

Manfred Zimmermann argued that human conscious capacity is only around 40 bits per second. (Zimmermann, 1989.) If we suppose that a working memory chunk (an item of information) takes about 8 bits to encode, as with computers, Zimmermann's study comes close to most working memory research: about five units at a time.

Zimmermann, however, also proposed measuring the non-conscious processing capacity of the human brain. Extrapolating from the structure of the nervous system and the channel capacity of the various human senses, Zimmermann ended up hypothesizing that the non-conscious processing capacity of the human mind is a whopping 11.2 *million* bits per second. In other words, the parallel processing capacity of System 1 is capable of processing almost 1.5 million items of information at one time.

It should, of course, be noted that such results are highly speculative: no direct measurement of the human non-conscious capacity can be carried out as of this moment.

Proponents of the unconscious theory of thought, Ap Djiksterhuis and Loran Nordgren argue also that a considerable body of research suggests that the discrepancy between the conscious and non-conscious processing capacity is considerably large (Djiksterhuis & Nordgren, 2006). A great majority of the information processing carried out by an individual happens non-consciously.

Prominent researcher in social psychology focused on non-conscious thought, John Bargh argues with Tanya Chartrand that 95% of human activity happens non-consciously and automatically (Bargh & Chartrand, 1999). In terms of Zimmermann's research, the relationship of conscious to non-conscious capacity is a whopping $1/280\,000$ units per second.

While this capacity discrepancy is quite astounding, it cannot alone explain the viability of non-conscious thought. There must also exist some such structures in non-conscious processing as to enable the generation of *viable* insight. This viability can perhaps be explained by *neuroplasticity*: the brain's capacity to change its structure through experience and practice.

Donald Hebb proposed in the 1940's that repeated exercise should produce predictable changes in the brain (Hebb, 1949). This notion, now often referred to as "Hebbian learning," was demonstrated empirically in the Nobel prize-winning studies of Eric Kandel. In studying the nervous System of the *Aplysia* snail, Kandel demonstrated that by repeatedly simulating a neuron, synaptic growth is produced in connections to adjacent neurons (Kandel, 2006). To paraphrase, the nervous System of human beings changes with experience and practice.

In carrying out a vast meta-analysis of studies on talent, Anders Ericsson and his team found out that no world-class expert had put less than ten years of deliberate practice in their trade (Ericsson et al., 1993). As Ericsson later argued, it takes approximately 10 000 hours, or ten years, of deliberate practice in a domain to become expert in it (Ericsson et al., 2007). It takes, in other words, a considerable amount of time to generate the neural structures that produce viable results sufficiently well to warrant expertise in a domain.

In a study on the nature of intuitive insight, the organisational psychologists Erik Dane and Michael Pratt found out that the intuitive capacity to draw valuable insight was, indeed, domain-specific. People such as corpo-

rate executives and experts, who often trusted their "gut feelings" would fare no better than the layman when drawing insight in an area they were unfamiliar with (Dane & Pratt, 2007).

Intuition appears then to be a domain-specific capacity that is learned by deliberate practice. In carrying out exercises in a given domain, the neuronal structures relevant for producing viable results within that domain are strengthened on the grounds of the Hebbian principle. This in turn creates a better suited System 1 to produce results that are crucial to drawing non-conscious insight and to making fast viable decision within the scope of the given domain.

4. Intuition and Habit

The development of neural structures correlates directly with the pragmatic notion of *habit.* William James wrote already in 1890 presciently of the Hebbian principle: "When we look at living creatures from an outward point of view, one of the first things that strike us is that they are bundles of habits" (James 2007, 104).

Peirce described habits as follows:

> [a habit] denotes such a specialization, original or acquired, of the nature of a man, or an animal, or a vine, or a crystallizable chemical substance, or anything else, that he or it will behave, or always tend to behave, in a way describable in general terms upon every occasion (or upon a considerable proportion of the occasions) that may present itself of a generally describable character Peirce, 1934, § 538

Habits are identified by the results that they produce. Or more specifically, what they *would* produce, given the appropriate circumstances. To Peirce, this idea of the conditionality of habit was important. According to Peirce, "the identity of a habit depends on how it might lead us to act, not merely under such circumstances as are likely to arise, but under such as might possibly occur, no matter how improbable they may be. What the habit is depends on when and how it causes us to act." (Peirce, 1934, § 400).

The idea of acquiring habits by practice and repetition is also something central to Peirce's idea. He writes: "habits differ from dispositions in having been acquired as consequences of the principle [...] that multiple reiterated behavior of the same kind, under similar combinations of percepts and fancies, produces a tendency, the habit, actually to behave in a similar way under similar circumstances in the future."

(Peirce, 1998, 413). This notion comes, indeed, quite close to the idea of Hebbian learning.

Peirce's idea of habits as acquired structures is further developed by James. James, in fact, almost eerily predicted Hebb's idea in his magnum opus, *Principles of Psychology:*

> A path once traversed by a nerve-current might be expected to follow the law of most of the paths we know, and to be scooped out and made more permeable than before; and this ought to be repeated with each new passage of the current. Whatever obstructions may have kept it at first from being a path should then, little by little, and more and more, be swept out of the way, until at last it might become a natural drainage-channel James 2007, 108

Exercise and experience affect our neural structures, which in turns produces automated habits that function well in the environment where the experience has taken place. The nature of our habits is, in other words, determined by what we have experienced.

Thus intuition can be construed as a domain-specific capacity to generate viable insight that is based on non-conscious System 1 processes. At the root of intuition is experience and practice in a domain that generates the non-conscious ability to produce viable results in that domain.

5. Intuition and Inquiry

Why does a scientist entertain a given type of hypothesis rather than another? What, for example, caused Ernest Rutherford to argue, when he had discovered anomalies in J. J. Thomson's theory of the atom in his alpha ray experiments, that there was, in fact, a nucleus present within the cloud of electrons Thomson had postulated? Clearly, Rutherford's experimental results could have led him in innumerable alternative directions. Why, exactly, did Rutherford end up postulating the nucleus?

Peirce was skeptical about the existence of the Kantian-type intuition as immediate apprehension. He, as most American pragmatists, regarded the idea of self-evident knowledge with great suspicion. However, Peirce developed several notions that could be of use in understanding generative intuition.

Peirce argued that in addition to the traditional inferential modes of deduction (inferring particulars from laws) and induction (inferring laws from particulars), there is a third: *abduction*. In abductive inference, a hypothesis is first formed, which then acts like the law in deduction. If the

particulars inferred from the hypothesis are corroborated by experience, the abduction is considered valid.

In coming up with an abductive hypothesis, the role of *clues* is critical. But what drives the scientist to pay attention to just the right kinds of clues and to draw up a hypothesis on the grounds of them? This ambiguity in generating hypotheses has created a generous amount of criticisms towards the idea of abduction. Is any guess or viable hypothesis as good as the next? Or are there some demarcation criteria by which different hypotheses can be evaluated?

The dual-processing theory of thought offers us a credible account of how the abductive hypotheses are formed. In the light of what was argued above, the reason to both the acuity of the scientist and her forming of viable hypotheses lies in the highly sophisticated System 1 of the person.[2]

After having practiced and performed within a domain for years, the scientist has acquired a considerable amount of various skills relevant to that domain. Some of these skills pertain to being able to single out the relevant pieces of information from background noise. By carrying out experiments, the scientist has learned that certain kinds of results are significant, and certain other kinds are not. Likewise, the scientist has a wide knowledge of what has previously passed on as a viable hypothesis. Rutherford would have hardly found it viable to postulate a little green elf playing tennis with his alpha rays but to have a positively charged particle was, instead, perfectly in line of his acquired knowledge in his trade.

The available variety of different hypotheses for abductive inference is unlimited. But the available variety of *viable* hypotheses is scarce. Pure guesswork would amount to nothing more than just picking out one of the available hypotheses at random. Based on the acquired skills and the accustomisation of the scientists' System 1, a massive processing capacity for singling out the viable hypothesis based on earlier knowledge can take place. Intuition, therefore, plays a tremendously important role in discovery. And only once the intuitive capacity of System 1 has produced a viable hypothesis can the validity of the hypothesis be tested in terms of System 2 inference and conscious experimentation.

[2] For a more in-depth discussion on the critique and viability of abductions, see (Paavola, 2004).

6. Generative intuition and immediate apprehension

While I argued above that there are two kinds of intuition, I will tentatively offer here a potential future avenue of inquiry that might be pursued to bring these two kinds together. Namely, while at first it appears that apprehensive intuition is somehow different from generative intuition, it may be argued that both have grounds in the ontogenesis of the organism: in other words, in learning to function in a domain.

The idea of apprehensive intuition concerns knowledge, and in particular, knowledge of necessary truths. The Harvard pragmatist C. I. Lewis argued that such knowledge is generated by our application of concepts (Lewis, 1946). He furthermore held that concepts are subject to change both within a culture and as concerns the agent. (Järvilehto, 2011).

The intension, or the criterion of application, of a concept is subject to change. For example, after repeated encounters with hairy cats, having hair becomes an intensional criterion for the identification of cats. And if the present concept of the atom does not explain empirical evidence sufficiently well, a new criterion, such as having a nucleus, will eventually be added to it.

Thus Lewis' work could be used as a foundation to demonstrate that while generative intuition is based on domain-specific learned System 1 processes, also apprehensive intuition has its root in similar processes that is to say, learned conceptual structures.

I do not have the capacity to delve deeper into this convoluted issue; I have, however, elsewhere presented a deeper analysis of Lewis' System and its application in conceptual analysis and the resolution of a priori knowledge, which is highly compatible with the notion of intuition presented here.[3]

7. Conclusion

So how was "Peirce, the consulting detective", as the Sebeoks, alluding to Sherlock Holmes, so aptly put it, able to pick out the culprit? I can, of course, only speculate about which domain-specific skills were relevant for Peirce's feat. Two tentative answers may, however, be offered.

First, Peirce was, of course, a master of inference. Having practiced and developed logic in its many guises, Peirce had learned a considerable

[3] (Järvilehto, 2011); for a more detailed account of the relationships between apprehensive and generative intuition, see also (Järvilehto, 2015)

amount of thought processes relevant to logical inference both inductive, deductive and abductive. Given sufficient clues, Peirce may have simply been able to single out the most likely candidate to have perpetrated the crime. Also, Peirce's work on abduction must have given him an edge in knowing to look for the proper clues.

Second, Peirce was a true renaissance genius: a man proficient in a dozen or more specific traits. This gave him certainly an edge in singling out the various hypotheses available and to choose the most viable one.

Whatever the particular source of Peirce's expertise in the case of the river-boat, it is clear that human beings, time and again, have demonstrated the peculiar characteristic of coming up with correct answers without being able to consciously justify them.

I have argued that this capability must be more than guesswork, and that it must have a basis on what we now know about the functioning and the neural basis of the human mind. The intuitive capacity of the human being taps into the considerable domain-specific resources of the System 1 of the human mind, acquired by experience and deliberate practice. As in so many areas of life, also in the matters of intuition, practice makes perfect.

References

Bargh, J. A., & Chartrand, T. L. (1999). "The Unbearable Automaticity of Being". *American Psychologist* 54 (7), 462–479.

Dane, E., & Pratt, M. G. (2007). "Exploring Intuition and its Role in Managerial Decision Making". *Academy of Management Review* 32(1), 33–54.

Dietrich, A. (2004). "Neurocognitive mechanisms underlying the experience of flow". *Consciousness and Cognition* 13, 746–761.

Djiksterhuis, A., & Nordgren, L. F. (2006). "A Theory of Unconscious Thought". *Perspectives on Psychological Science* 1, 95–106.

Ericsson, K. A., Krampe, R. T., & Resch-Römer, C. (1993). "The Role of Deliberate Practice in the Acquisition of Expert Performance". *Psychological Review* 100(3), 363–406.

Ericsson, K. A., Prietula, M. J., & Cokely, E. T. (2007). "The Making of an Expert". *Harvard Business Review*, 18.

Evans, J. S. B. T. (2003). "In Two Minds: Dual-process Accounts of Reasoning". *Trends in Cognitive Sciences*, 7(10), 454–459.

Evans, J. S. B. T. (2009). "How many dual-process theories do we need? One, two, or many?" In J. S. B. T. Evans & K. Frankish (Eds.) *In two minds: Dual processes and beyond* (pp. 33–54). Oxford: Oxford University Press.

Evans, J. S. B. T., & Stanovich, K. (2013). "Dual Process Theories of Higher Cognition: Advancing the Debate". *Perspectives on Psychological Science* 8(3), 223–241.

Hebb, D. O. (1949). *The Organization of Behavior*. New York: Wiley & Sons.

James, W. (2007). *The Principles of Psychology* vol. 1. New York: Cosimo.

Järvilehto, L. (2011). *Pragmatic A Priori Knowledge. A Pragmatic Approach to the Nature and Object of What Can Be Known Independently of Experience*. Jyväskylä: University of Jyväskylä.

Järvilehto, L. (2015). *The Nature and Function of Intuitive Thought and Decision Making*. Berlin: Springer

Kahneman, D. (2011). *Thinking, Fast and Slow*. Kindle Edition.

Kandel, E. R. (2006). *In Search of Memory: The Emergence of a New Science of Mind*. New York: W. V. Norton & Co.

Kant, I. (1998). *Critique of Pure Reason* (Translated by P. Guyer & A. W. Wood). New York: Cambridge University Press.

Lewis, C. I. (1946). *An Analysis of Knowledge and Valuation*. La Salle, IL: The Open Court Publishing Company.

Miller, G. (1956). "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information". *Psychological Review* 63, 81–97.

Paavola, S. (2004). "Abduction as a Logic and Methodology of Discovery: The Importance of Strategies". *Foundation of Science*, 9, 267–283.

Peirce, C. S. (1934). *Collected Papers of Charles Sanders Peirce volume V: Pragmatism and Pragmaticism*. Edited by Charles Hartshorne and Paul Weiss. Cambridge, MA.: Harvard University Press.

Stanovich, K. (2004). *Robot's Rebellion: Finding Meaning in the Age of Darwin*. Chicago: University of Chicago Press.

Stanovich, K. (2009). "Distinguishing the reflective, algorithmic, and autonomous minds: Is it time for a tri-process theory?" In J. S. B. T. Evans & K. Frankish (Eds.) *In two minds: Dual processes and beyond* (pp. 55–88). Oxford: Oxford University Press.

Zimmermann, M. (1989). "The Nervous System in the Context of Information Theory". In R. F. Schmidt & G. Thews (Eds.) *Human Physiology* (pp. 166–173). Berlin: Springer-Verlag.