An Essay Concerning Human Decisions

Zoltán Baracskai*[1] *and Viktor Dörfler*[2]*, [1] *Doctoral School of Regional Sciences and Business Administration, Széchenyi István University, Győr, Hungary, Email: baracskai.zoltan@sze.hu;* [2] *Management Science Department, University of Strathclyde Business School, Glasgow, United Kingdom, Email: viktor.dorfler@strath.ac.uk*

Received 2 August 2017; Revised 14 September; Accepted 19 September 2017

Copyright ©2017 Zoltán Baracskai and Viktor Dörfler. This is an open access article distributed under the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Available online 2 August 2017 at www.atlas-journal.org, doi: 10.22545/2017/00088

Based on decades of combined experience in teaching, observing and working with decision makers, we realized that the praxis of decision making as well as our own approach has always been transdisciplinary. Therefore in this paper we offer a transdisciplinary model of decision making at three levels of reality, namely model, method and tool. We conduct our inquiry in the realm of human-social studies, and argue that in this realm we need to transcend the traditional hard sciences and include a soft approach. Along the way we examine the concept of transdisciplinarity within human-social studies, and introduce the concept of meta-knowledge. Examining the research and teaching of decision making on this basis, we suggest that 'coffeehouse philosophers' should teach about decision making, bringing in practicing decision makers whom they interview, while students will need to go through a process of 'bootstrap learning' figuring out their decision problems.

Keywords*:* Decision making, transdisciplinarity, meta-knowledge.

1 Introduction

> *" If the human brain were so simple that we could understand it, we would be so simple that we couldn't."*
>
> **Emerson M. Pugh**[1]

Paraphrasing John Locke's [1] book title, in this essay we speculate about how people make decisions. We, the authors of this essay, have been teaching about decisions for several decades, primarily in business schools, but also as guest teachers in medical, sport, engineering, psychology, and law schools. This essay is a personal take on the way we perceive decisions and teach about decision making, as well as how we realized, with hindsight, that our approach has always been transdisciplinary. However, this is not only a 'l'art pour l'art' musings on decisions – although it started as such. We view this essay as a nuanced conceptual starting point, necessary for a future empirical study.

[1] Quoted in 'The Biological Origin of Human Values' by George Edgin Pugh (1977). Author's note: Quote from my father around 1938. Biologist Lyall Watson, described it as "the Catch-22 of the biology of consciousness."

When talking about decisions we implicitly talk about thinking, and therefore knowledge. More precisely, we are interested in fast (intuitive) decisions [2], and the knowledge required for it. We base our conceptualization of knowledge on Polányi's notions of 'personal knowledge' [3] and 'tacit knowing' [4]. Instead of engaging with the scholarly endeavors since Polnyi's foundational work, we go back to the original work in which we build our approach directly. From this basis, we explore the scientific approach to knowledge, and argue that if we want to achieve a rich picture of knowledge, we need a more open approach than that which the dogmatic view of positivist science would allow. A proper scientific account of knowledge must be to some extent unscientific.

The reason for this is the following: Ignoring tacit knowledge leads to such a limited view that it loses touch with reality. In turn, tacit knowledge cannot be meaningfully examined within a purely positivist framework. As a mathematician friend of ours, who works in psychology, said: 'No one who attempts to analyze the unconscious has actually understood it.' In essence, if it could be analyzed, it would not be unconscious. Paraphrasing this maxim, our starting assertion is that tacit knowing cannot be analyzed. In positivist science, analyzing means taking apart, modelling in the algorithmic sense, and describing as a well-structured process, which cannot be done with tacit knowledge. This does not mean, however, that we cannot theorize about the nature of tacit knowing, examine the purpose for which it can be useful, when, and particularly whose tacit knowing to trust.

As with any discussion on the topic of tacit knowledge, our argument in this essay is also somewhat unscientific. The reason is that we want to bring together several highly complex concepts, and we believe that aiming for the intuitive understanding of the readers, using a personal account, is more fruitful than listing who said what. And we believe that "[t]oo many definitions kill rigor, which is why poetic knowledge is more rigorous than scientific knowledge" [5]. Therefore we do not offer a traditional literature review, covering a historical overview of the significant milestones of the scholarly decision literature [e.g. 6; 7; 8; 9; 10; 11; 12; 13; 14] and a review of what can be considered up-to-date [such as 15; 16; 17; 18]. Instead, here we offer a picture based on our personal histories, which is necessarily subjective and partial. Similarly to the way mathematicians often elaborate several lemmas that are subsequently brought together in the main argument, we take a triple detour following the initial exploration of the concept of knowledge. In the first detour, we elaborate a view according to which it is an imperative to include the 'soft side'. In the second detour, we use the example of Einstein, as reported by Polányi, to demonstrate the necessity of what we call meta-knowledge. In the third detour, we introduce our view of transdisciplinarity. Finally, we bring these three approaches together to elaborate our new model of decision making. In our concluding remarks, we present our personal view of decisions and of teaching about decisions.

2 A Philosophical Detour: Towards a Soft Approach

We start with a personal example of a chain of master-apprentice relationships [3; 19; 20]. Zoltn Baracskai (the first named author) started his journey as a scholar in 1979, when his master told him to read Polányi's book 'Personal Knowledge'. Zoltán then gave the same book to Viktor Dörfler (the second named author), Viktor to his apprentice who then gave it to his apprentice. We don't want to suggest that Zoltáns master and the apprentice of Viktor's apprentice made the same sense of Polnyi's work. However, all of us realized that it makes no sense trying to dissect tacit knowledge, trying to find its constituents, or model it. In this essay tacit knowledge is the fixed point, using which, in Archimedes' words, we try to move the world – i.e. to understand decision making better.

We studied the philosophy of science with Kuhn [21; 22], Popper [23; 24] and Feyerabend [25; 26], and will continue studying such esteemed thinkers. However, their works were of limited help, as we dedicated our lives, as scholars, to the research within the soft scope, namely within the human-social studies, while the major works in philosophy of science refer to the hard sciences. The concept of science (scientific knowledge) is controversial, as it is impossible to divorce scientific knowledge from other forms of knowledge. Why? Because, according to Polnyi's famous dictum, all knowledge is rooted in the tacit dimension:

While tacit knowledge can be possessed by

ISSN: 1949-0569 online, ©2017 TheATLAS

> *itself, explicit knowledge must rely on being tacitly understood and applied. Hence all knowledge is either tacit or rooted in tacit knowledge. A wholly explicit knowledge is unthinkable.* [27]

Dogmatic scientists sometimes argue that only positivist science qualifies as science, basing their argument on the use of they refer to as the 'scientific method'. And, as Heisenberg says:

> *Confidence in the scientific method and in rational thinking replaced all other safeguards of the human mind.* [28]

However, even the hardest of sciences, physics, cannot be fully locked into the positivist box anymore. To talk about knowledge in the strictly positivist framework, we would need to derive a conceptualization of knowledge from matter, as in a strictly positivist science everything has to be derived from matter. As Schrödinger warns us, with reference to consciousness:

> *All this is pure fantasy, as irrefutable as it is unprovable, and thus of no value for knowledge.* [29]

Physics actually seems to be doing somewhat better than the human and social studies in abandoning some obsolete requirements of the scientific enterprise. There have been numerous physicists recently (e.g. Geoffrey Chew, David Bohm, Robert B. Laughlin) transgressing the positivist boundaries in an attempt to broaden their horizons. Scholars in the human-social studies far too often try to copy an obsolete world of physics; this is the essence of what von Hayek [30; 31; 32] refers to as 'scientism'. While we do not intend to offer a different demarcation or classification between science and non-science here, we suggest that a non-positivist or even anti-positivist perspective needs to be included in studying decision making. To represent this 'other side', we bring in Bourdieu's [33] sociological approach.

Umberto Eco pictures scientists becoming, like monks in a monastery, isolated from the 'real world', occasionally maybe visiting it, but living and working separately from it. Bourdieu [33] explains this through the mathematization of science, which helped hard sciences, and particularly physics, in gradually achieving considerable autonomy, but at the same time, being a mathematician became an entry-barrier to science, drawing a line between professionals and amateurs, and then between insiders and outsiders. Unfortunately, this also led to a severe reduction of the readership, as reading science books or papers started to mean reading equations: after a while, only insiders were able to read what other insiders wrote. In the soft knowledge domains in general and in decision making in particular, a similar tendency can be observed and we believe that this can lead to catastrophic consequences; what Cathy O'Neil[2] calls 'weapons of math destruction' in her TED Talk.

In hard sciences, a lot can be achieved looking at the world from the outside. When designing a machine, we do not need to become cogs in order to understand how the machine works. To understand atomic interactions we do not need to become quarks. In the human-social studies, we cannot avoid being humans nor being social. If we separate ourselves from the world of humans, lock ourselves into a monastery, we cannot understand that world. This, however, leads to an interesting and very tricky situation in teaching. For example, should practicing decision makers teach about decision making? No, they shouldn't, as they cannot teach (there may be exceptions but those are rare). Should we therefore get the highest ranked academics (assuming that they are excellent teachers) to teach about decision making? There is also a serious limitation to this; in pursuing such academic careers, academics then remove themselves from the praxis of decision making. They can teach, but they cannot reflect on the praxis as they are not part of it. So who should teach about decision making and how? We are searching for an answer to this question for several decades, and this paradox drives out exploration in this paper.

The Universal Truth, the ideal of fully objective science[3], is not an external entity that we are approaching, but a complex system of partial and subjective truths. We do not need to give up our subjectivity trying to be governed by an externally given objective truth, but we need to embrace our subjectivity and pursue it, in order to create a universal truth that emerges from the synergistic assembly of all which is partial and subjective. We could even

[2] https://www.ted.com/talks/cathy_o_neil_the_era_of_blind_faith_in_big_data_must_end

[3] Our assertion only applies to the idea of the objective Universal Truth in science; the idea of spiritual Universal Truth is outwith the scope of this inquiry.

ISSN: 1949-0569 online, ©2017 TheATLAS

say that this is our interpretation of Popper's [23] conceptualization of inter-subjectivity, which he offers as a replacement for the notion of objectivity. This is hard enough to do in the hard sciences, but in the human-social studies it is many times harder. The reason is that any human-social inquiry needs to make itself also part of its own inquiry [cf 33]. And this is also the point where, for the first time since antiquity, human-social studies can advance beyond the hard sciences and become the example that the hard sciences may follow. This is why we could say with reference to hard sciences that it is not exactly true that we do not need to become cogs and quarks. Heisenberg recognized that "in the drama of existence we are ourselves both players and spectators". Although hard sciences can still progress without accepting this, their pursuit of science will come to halt, and they will need to accept it eventually. It is up to us in the human-social studies to do the pioneering work, as we cannot progress if we detach ourselves from our subject of inquiry, as that would mean detaching ourselves from ourselves.

3 A Methodological Detour: Meta-Knowledge-Approach

We start with a story of the experimental implications of Einstein's theory of relativity, and Polányi's [34] analysis of this remarkable case of Einstein's intuition. The particular experiment in case is the Michelson-Morley experiment that established that a light source would never overtake a beam sent out by it. Importantly, the Michelson-Morley experiment was conducted earlier than Einstein developed his conceptualization of relativity. In his autobiography, Einstein offered an account according to which he intuitively recognized the nature of light. This was without being familiar with the experimental results of Michelson and Morley where Einstein made the same assumption from the start. It was assumed that Einstein must have known of the experiment and his conceptualization of relativity was the way of providing the conceptual framing for the experimental results. In contrast, Polányi argues that:

> *[...] when Einstein extended his vision to the universe and included the case of a light source emitting a beam, he could make sense of what he then faced only by seeing it in such a way that the beam was never overtaken, however slightly, by its source. This is what he meant by saying that he knew intuitively that this was in fact the case.* [34]

According to Polányi this vision led Einstein to the conceptualization of relativity, which does explain the Michelson-Morley experiment but, contradictory to the general belief, is not based on it. What we find in this story is what we tentatively label meta-knowledge. There is a small problem with this label: it may be read as 'knowledge about knowledge'. This is not what we mean here. What we refer to with the 'meta-' is a very high level of abstraction, something that we can call meta-level. At a high level of abstraction, where the details of reality dissolve, such knowledge loses direct touch with reality. However, it can be 'concretized' by zooming into reality, and in this 'concretization' the meta-knowledge can take radically different forms. For instance, it may take the form of some knowledge with reference to one reality and some different knowledge with reference to some other reality. For this reason, meta-knowledge does not consist of concepts but of meta-concepts, which are extremely high-density essences of many concepts. This is why we discussed great thinkers in the above examples: those who see the totality of their disciplines possess meta-knowledge and develop meta-concepts. Usually there are no words corresponding to meta-concepts, therefore the great thinkers often communicate their meta-knowledge in the form of metaphors, which is another reason to use the 'meta' label.

Meta-knowledge is heavily tacit. This meta-knowledge, and its tacit nature, is what enables the greatest thinkers to demonstrate sometimes almost supernatural abilities, which may at times present as "extra-sensory perception" or "acts of precognition or apparent clairvoyance" [35]. We would risk the assertion that every single great breakthrough in science has been achieved in this way, even when the story is not as striking as the one about Einstein.

Meta-knowledge, in contrast with low-level (i.e. closer to reality) well-structured concepts, cannot be directly transferred. If great thinkers teach, they will not attempt to transfer their meta-knowledge. They are the only ones who can apply their own meta-knowledge. Yet, through metaphors, and/or larger metaphoric narratives called parables, great thinkers can 'send' meta-concepts that the talented learners can 'receive', reinterpreting the meta-concepts their

own way, and develop their own meta-knowledge. When learners receive a meta-concept from a discipline that is not their native discipline, they will not magically become 'masters' of the new discipline, but they will be able to grasp some of its essence. Talented learners can use the deep insight embedded in the meta-knowledge to enrich their own knowledge of their own discipline.

We can learn one further thing about the nature of meta-knowledge from Einstein's story. Intuitively apprehending the experimental facts, from which he had no prior knowledge, was not possible whilst remaining within the discipline of physics; Einstein had to transcend the disciplinary boundaries. We use this as an illustration, as a justification but not a verification, that the disciplinary boundaries must be transcended for the highest achievements. This led us to consider Nicolescu's conceptualization of transdisciplinarity.

4 A Conceptual Detour: Towards a Transdisciplinary Approach

We know that the initial framing of transdisciplinarity can be traced back to Piaget [36], but it was Nicolescu [e.g. 37] who developed it into a full conceptualization. Henceforth when we use the term 'transdisciplinarity', we refer to Nicolescu's conceptualization. Interestingly, or perhaps quite understandably, Nicolescu transcended his own discipline of quantum physics the same way as the above mentioned scientists. He is also comfortable in the realms of philosophy, art and religion. Now we try to work out how this conceptualization of transdisciplinarity can work in the human-social studies, whether we see any limitations or barriers, and what we can learn from this attempt. There were numerous applications of transdisciplinarity to particular problems in human-social studies, but here we are interested in the overall knowledge domain not in a particular problem. Before applying transdisciplinarity as a lens for our inquiry, we need to explain how we understand Nicolescu's conceptualization.

Before we discovered Nicolescu's [38; 39; 40] work we constantly tried to position ourselves within multi- and/or interdisciplinarity and we were constantly dissatisfied with what these two concepts could offer. We did not yet know that our approach was, and has always been, transdisciplinary. Here, we want to explain the subtle but significant differences multi-, inter- and transdisciplinarity using a powerful metaphor, which Nicolescu [41] used in his seminar talk. In this metaphor, disciplines are represented by birds in their cages.

A mono-disciplinary approach is when we only have one bird in one cage. This bird, remaining in its cage, observes reality outside its cage, the room that represents the problem area, through the grid of the cage. Looking at this picture from the *outside* it is perfectly clear that what this bird sees is necessarily partial, subjective and distorted. However, from *within* the cage this cannot be seen; the bird can think that it observes reality as it is. If we bring in further birds of different species, each of them in its own cage, we can have a *multidisciplinary* approach. Each bird sees its mono-disciplinary picture but they 'talk' to each other. As the name suggests, it is a multiplication of mono-disciplinary approaches, which presents a far richer picture than what mono-disciplinarity can offer. Still, it has severe limitations. Each observation refers to the complete picture of what each bird can see and, as they belong to different species, their knowledge backgrounds, approaches, ontological and epistemological stances, and also songs (professional jargons) are different. Ultimately, such observations can lead to cacophony of songs, i.e. immensely complicated (but not complex) mutually incompatible results. If we are outside the cages, we will probably leave the room, since all we can hear is immense noise. Most importantly, the birds are still in cages, meaning that we are still bound by disciplinarity.

Interdisciplinarity usually involves fewer birds. Suppose, we temporarily bring over one bird of other species into the cage of another bird from a different species. The host bird will learn a bit of the songs of the guest birds. It may not learn the songs very well, but enough to get something new from them. This can be a new concept, an approach, but most probably a method and/or a tool. For example, a psychologist host bird may borrow a statistical method from a mathematician guest bird, and a harmony concept from a musical guest bird. We don't have a definite answer to the question of whether the adopted method and the new concept will result in a displacement of original concepts [42] in the host bird's original discipline. We believe the answer depends on the docility of the host bird. An interdisciplinary inquiry is not as noisy as the multidisciplinary one; it is somewhat more complex

ISSN: 1949-0569 online, ©2017 TheATLAS

and less complicated. It can lead to meaningful results within the cage of the host bird. The Sword of Damocles of interdisciplinary research is that the presumptions behind the borrowed methods, concepts, etc. may not be synchronized with the background knowledge of the host bird. It is possible that there are hidden irreconcilable inconsistencies. However, if the host bird is docile and learns the songs of the guest birds well, the quality of such inquiry can be excellent. Still, the notion of interdisciplinarity is very limited, since the birds remain in cages. However, the docility and second-language knowledge of the host bird can expand the cage.

Now, let's open the cage doors, and let the birds fly outside of their limited habitats. This new setup brings us into *transdisciplinarity*. The birds are freely flying beyond their cages, although most of them will probably choose to return to their cages sooner or later in order to eat and rest. We are all most comfortable within our own disciplines, but many of us also find our disciplines limiting, and even boring at times. Some of us may even fall in love with the second-language songs so much that we keep whistling them after our guests return home. Bourdieu, Nicolescu, and Einstein are excellent examples of this phenomenon. The greatest thing about transdisciplinarity is that it goes beyond the disciplinary boundaries *in principle*, not only beyond the boundary of a particular discipline. Transdisciplinarity does not just allow us to visit a different cage; it gives us an opportunity to create new knowledge in the no man's land between cages. Such knowledge may achieve immensely high complexity but should not be very complicated. The birds now seem to be perfectly in tune, as they are together in the space between the cages, and we hear one beautiful, harmonious, polyphonic song.

Teaching about decisions has been multidisciplinary for a long time, and it still is. In business schools operational researchers build quantitative models based on linear programming (and its recent advances) or statistics and probability theory. In schools of psychology, cognitive psychologists focus on the role of memory and biases, while others detail aspects of personality and motivation. Some economists calculate expected utility functions, while other economists who are better mathematicians build simulated models based on game theory. Operational researchers, psychologists and economists rarely talk to each other or use each other's work. In contrast to teaching, decision *research* has predominantly been interdisciplinary. We could list the previous examples of operational researchers, psychologists and economists; the difference would be that there is some interaction. Sometimes a tool, a method or a concept is borrowed, occasionally a model or another form of result is lent. These disciplines, and some additional ones, such as artificial intelligence, social psychology and philosophy, meet around a problem domain that is currently known as 'cognitive sciences'. This is a very good label, as it signifies the multiplicity of disciplines. However, the *reality* of decisions has always been transdisciplinary. Thus, being engaged with practicing decision makers, our approach has become transdisciplinary as well – only we did not know what it was called.

Transdisciplinarity offers some methodological guidelines for scholars. Following these guidelines, we distinguish between various levels of reality, similarly to Russell's logical types [43]. On each level of reality, bivalent logic may be valid; however, transdisciplinary also transcends bivalent logic. This means that something and the opposite of something can hold true at the same time. Using the notations of logic this means that something can be $\boldsymbol{A}$ and $\boldsymbol{non\text{-}A}$ at the same time; Nicolescu call this third possibility T, the 'hidden third'. $\mathbf{T}$ is obtained by the synthesis of $\boldsymbol{A}$ and $\boldsymbol{non\text{-}A}$, as Fichte [44] did in his thesis-antithesis-synthesis cycle[4], and this is what we can see in the Taoist tradition of Yin and Yang. This synthesis enables moving between the levels of reality.

Now, after introducing our soft approach at a philosophical level, meta-knowledge at a methodological level and transdisciplinarity at a conceptual level we are ready to introduce our new model of decision making.

5 A New Model: The Realities of Decision Making

After this triple detour, in this section we finally outline our main point: a new model of decision making. Based on decades of combined experience in teaching, observing and working with decision makers, we realized something very important. It is

[4]Typically but incorrectly attributed to Hegel's dialectic. Although Hegel did not introduce or use the triad of thesis-antithesis-synthesis, transcending dichotomies is an important aspect of Hegel's idealism.

Table 1: Levels of Reality of Decision Making

		Model	Method	Tool
Observed	A	rule-following	MCDA	BI
	Non-A	misbehaving	intuition	expert system
	T	cognition	complex order	SmArt tool
Observer	A	Homo Calculator	algorithm	(big) data analytics
	Non-A	Homo Ludens	non- or quasi-algorithmic	knowledge engineering
	T	Homo Sapiens	complex system	experience mining(?)

impossible to support decisions; we can only support decision makers. In order to portray decision making as we see it, we use a transdisciplinary lens, so that we can observe the decision maker as birds flying freely between the cages. At the core of decision making we focus on meta-knowledge, which we argue is necessarily tacit. And we bring in the soft approach, as the antithesis of the hard, to achieve a synthesis in order to move between the realities, that is, levels of reality which thus becomes more nuanced.

Therefore, for the sake of our exploratory thinking presented here, we describe decision making with the following three levels of reality:

1. Model of the decision maker's behavior.
2. Method used to support the decision maker.
3. Tool we use to implement the support of the decision maker.

On each of these levels, we distinguish the observer and the observed, and for each of them provide the ***A***, ***non-A*** and ***T*** the following way (see Table 1):

At the model-level, the decision maker (in a particular decision situation) can be a *rule-follower* (***A***) or a misbehaver (***non-A***). The notion of the rule-follower is linked to March's [45] concept of 'appropriate action', according to which decision makers do what is expected from them. That is they follow the rules, not only the standardized procedures, but also the expected behavior. In contrast, those who misbehave [18] demonstrate notorious neglect of not only expected behavior, but often also of the standardized procedures. As behavioral patterns, the two (***A*** and ***non-A***) can be considered mutually exclusive: those who follow the rules do not misbehave, and those who misbehave do not follow the rules. However, the two contradictory behavioral patterns can be synthesized in a more complex cognition (***T***). The decision maker using both hard and soft approaches knows the rules and follows them when necessary and/or useful, but also knows which rules can be broken under which conditions and how often. Such decision maker will demonstrate both rule-following as well as misbehaving behavioral patterns. In observing the decision maker we can see a Homo Calculator (***A***), the person who mainly does mental accounting [18]. Or a Homo Ludens (***non-A***), a playing man, who is playful and curious like a child, who allows her-/himself to admire the worlds wonders. As a synthesis, we can see a Homo Sapiens (***T***), a wise man, who finds the harmony between playing and calculating. Such a decision maker measures what can be measured, calculates what can be calculated, but does not force measuring and calculating on things that cannot be measured and calculated. This is when (s)he uses her/his imagination.

At the method-level, the rule-following decision maker uses a variant of*MCDA* (multi-criteria decision analysis), nearly always in a quantitative mode (***A***). The misbehaving decision maker, in contrast, uses *intuition* as a 'method' [14], they refer to their gut feel, hunch, overall experience, etc. (***non-A***). Indeed, only experienced decision makers should use their intuition [46]. The synthesis of the two methods we call '*complex order*' (***T***). This signifies both that this order cannot be reduced to a simple one or several simple ones (which would only be complicated but not complex), and also that it is multidimensional. Intuition and well-structured analysis are not only side-by-side but also hand-in-hand; it may involve intuitive reinterpretation of the analytical findings as well as new analysis based on a hunch, etc. [cf 47; 48] As observers, we see the Homo Calculator using *algorithms* (***A***), in the sense of fol-

lowing recipes, assuming that these are eternally and universally valid, and they are often surprised why the recipe does not work. In contrast, what the Homo Ludens does is often *non-algorithmic* or, at least, *quasi-algorithmic* (***non-A***). Non-algorithmic here means that it appears arbitrary to us, we cannot detect any series of logical steps. Quasi-algorithmic, in turn, means that we may see shorter or longer sequences of steps, but not an overall designed process, the steps may go now this way then another way. As a synthesis (***T***), we can observe a *complex system*, as in Boulding's [49] levels 7-8 (human and social) of systemic complexity, including emergent phenomena that cannot be reduced to the level of the thermostat (level 3).

At the tool-level, the rule-following decision maker, who adopted an MCDA method uses some form of BI (business intelligence), to implement the method, not necessarily knowing what the chosen BI-tool does (***A***). In contrast, misbehaving decision makers, who use their intuition, usually feel that they don't need a tool. However, they also often feel that they benefit from a good conversation with someone who can be a partner in this, such as a good coach. Nevertheless, there is one type of tool that can be useful in supporting such thinking: *expert systems* (***non-A***). Expert systems can help organize the thinking of such decision makers in a transparent way, which can be particularly useful for explaining the hidden logic behind their intuitions. Synthesizing these two tools we get what we call *SmArt decision tools* (***T***). Making both the 'S' and the 'A' capital signifies that this is as much 'Art' as 'Smart'; it incorporates both analysis and soft approaches, such as expert systems. As yet we have conceptualized the SmArt Tool, but we must admit the tool does not currently exist. Observing the tools decision makers use, we can see that the Homo Calculator, who follows algorithms, relies on data analytics, which is increasingly taking the form of big data analytics (***A***). This shift towards big data analytics is unfortunate, as it is based on the conviction that the way to improve data analysis is through analyzing more data, rather than by doing more thinking. We refer to this phenomenon as 'big data – small insight'. The Homo Ludens with her/his non- and quasi-algorithmic methods can be supported through *knowledge engineering* (***non-A***). Knowledge engineers are a special kind of facilitators, who build expert systems by acquiring knowledge from the decision makers and organizing this knowledge into knowledge bases. Finally, synthesizing [big] data analytics with knowledge engineering will require a new concept. One possibility would be something that we tentatively call experience mining (***T***), which is a way of finding and adapting relevant experience to the current decision problem. Many aspects of the way experience mining will work are yet unclear. This is what we signify with the '?' symbol (Table 1). We do not know yet what the process will look like that incorporates both [big] data analytics and knowledge engineering. First, we will need to create a SmArt tool, so that we can then develop the process for using it. We have some ideas about what this process could be, but the development of the tool does not follow a prior design of a well-structured process. Cars were not developed after the process of driving and traffic system were designed; arguably cars, driving and traffic systems all would be very different today, if the latter were designed first. Furthermore, once we can get rid of the question mark, regardless of whether we end up with experience mining or another new concept, we may be able to recognize the next level of reality.

This is how we see decision making today, using the lens of transdisciplinarity based on Nicolescu's conceptualization. These are the three levels of reality that we can see. Based on the '?' in the final cell of Table 1, we also see a few things about the possible fourth level of reality, which will inform the way we teach about fast decisions tomorrow. For example, we see that tomorrow's decision makers are Shallows [50], whose attention needs to jump after a very short time (approximately 15 minutes at most) even when they are doing something exceptionally exciting, such as listening to a good teacher.

6 Concluding Remarks: Teaching about Fast Decisions Tomorrow

We believe that our audience tomorrow will be Shallows. In addition, we have argued that neither the teacher nor the practitioner are really suitable to teach about decision making. So, who should be teaching, what should they be teaching, and how, when it comes to decision making?

The 'what' here consists of two parts; both covered in this essay. First, the topics should be along the lines of our table, or an alternative view of decisions. The particular topics are not important, what matters is that they are fresh and based on a coherent

'big picture' of decision making; what the teacher sees 'then and there' [cf 'egocentric particulars' in 51]. This is primarily important from the viewpoint of credibility: if we teach something other than what we believe in then it will be perceived as inauthentic by students. However, it is also important in the sense of not delivering outdated knowledge, as the world of decision making is changing too fast. Second, the topic should be delivered in the form of meta-knowledge. This is, again, important for two reasons. On the one hand, meta-knowledge is more applicable to different real-life situations. If we could elaborate in detail what works in a particular decision situation, this would only work in that single situation, nowhere else. Meta-knowledge, as showcased earlier, can take different shapes in different real-life situations. On the other hand, in any classroom where we have practitioners, we will have people with a wide variety of knowledge backgrounds only meta-knowledge can transcend the limitations of existing knowledge variety.

The most appropriate person to teach decision making could be described through the metaphor of the 'coffeehouse philosopher'. By this we mean a person who speculates about the big questions of the human condition, the universe, love, and similar important topics, while sitting in the coffeehouse and watching people as they go about their real lives. The coffeehouse philosopher is not embedded in the real world of practicing decision makers, but is also not completely removed from it. Ideally this would be a wise person who started to figure out something important – it does not really matter what that 'important something' is. However, the coffeehouse philosopher should not do this teaching alone. There should be guests, practicing decision makers whom the coffeehouse philosopher will interview live in front of the students. If this works well, both the coffeehouse philosopher as well as the practicing decision maker will produce meta-knowledge for the students.

This brings us to the 'how' of teaching. We believe in storytelling. Stories work much better than dry, abstract models, for a number of reasons. Our students, who are Shallows and practitioners themselves, will find it easier to relate to stories than to abstract models and thus achieve an intuitive understanding. Also, good stories are much easier to remember. At least two types of stories should be told in our classroom: metaphoric parables by the coffeehouse philosopher and real-life stories of concrete experience by the practicing decision makers.

Finally, we need to separate teaching from learning rather than assuming that learners learn what teachers teach. Our starting point here is that our Shallow practitioner students have decisions they need to make, and that we cannot provide them with the solution, because we are not part of the specific context, and even if we could, it would be of extremely limited use for the next decision they need to make. We call the mode in which we can help them *bootstrap learning*. We derive the conceptualization of bootstrap learning from Popper's [24] tentative problem solving process. Popper initially conceptualized the process as interpreting the earlier mentioned 'dialectic triad' (thesis-antithesis-synthesis) as a trial and error-elimination process. In doing so, he identified the following schema:

$$P1 - TT - EE - P2$$

Where P1 and P2 stand for problems (in our case there is a decision that need to be made), TT stands for a tentative theory (through which the decision situation is interpreted) and EE stands for error elimination (something we are unhappy about in the TT). It is important to note that in the later revisions of this idea Popper emphasized that *any* of the three components could be a legitimate starting point of the tentative problem solving process (in the initial version that starting point was the P1 problem). In our bootstrap learning this would mean that the meta-knowledge can connect to any of the three components, changing how the learners see them. So the meta-knowledge can help the learners see any of the P, TT, EE differently than before receiving the meta-knowledge. However, the meta-knowledge does not provide them with a solution, only with some ammunition, using which they can bootstrap themselves from the problem situation. In future decision situations, our students will re-use some of the meta-knowledge the same way to make fast (intuitive) decisions. In this sense, in bootstrap learning it becomes very explicit that what is taught and what is learned are two different things.

In conclusion we want to remark that we do not think that this is what the teaching about fast (intuitive) decisions will look like in the future; this is only how we see future teaching about fast (intuitive) decisions today. There are countless unforeseen and unforeseeable circumstances, political agendas, new

technologies, societal changes, etc. that will lead to a different reality tomorrow. However, this is what we work towards today, and even if the world will be different tomorrow than the tomorrow we envision today, we will be closer to the reality of tomorrow than those who work on assumptions which were outdated yesterday. We have the ***A*** of tomorrow today, there will be a ***non-A*** that we don't know about yet, and there will be a ***hidden third*** version of tomorrow emerging on a new level of reality. Therefore, tomorrow we will rethink again what and how to teach about decisions. We will continue wandering at the mystery of decision making, as:

> *The fairest thing we can experience is the mysterious. It is the fundamental emotion which stands at the cradle of true art and true science. He who knows it not and can no longer wonder, no longer feel amazement, is as good as dead, a snuffed-out candle. [52]*

References

[1] Locke, J. (1690/1959). *An essay concerning human understanding*, (Vol. 1). New York, NY: Dover Publications.

[2] Kahneman, D. (2011). *Thinking, fast and slow*. London, UK: Penguin Books.

[3] Polányi, M. (1962/2002). *Personal knowledge: Towards a post-critical philosophy*. London, UK: Routledge.

[4] Polányi, M. (1966/1983). The tacit dimension. Gloucester, MA: Peter Smith.

[5] Nicolescu, B. (2016). *Hidden third*. New York, NY: Quantum Prose.

[6] Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, 69(1), 99-118.

[7] Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review*, 63(2), 129-138. DOI: 10.1037/h0042769

[8] Tversky, A., & Kahneman, D. (1974, September 27, 1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124-1131. DOI: 10.1126/science.185.4157.1124

[9] Knight, F. H. (1921/2006). *Risk, uncertainty and profit*: Cosmio Classics.

[10] Hammond, J. S., Keeney, R. L., & Raiffa, H. (1998). The hidden traps in decision making. *Harvard Business Review*, 76(5), 47-58.

[11] Kahneman, D., Slovic, P., & Tversky, A. (1982). Judgment under uncertainty : *Heuristics and biases*. New York, NY: Cambridge University Press.

[12] March, J. G. (1994). *Primer on decision making: How decisions happen*. New York, NY: Free Press.

[13] Simon, H. A. (1947). *Administrative behavior: A study of decision-making processes in administrative organization* (1st ed.). New York, NY: Macmillan. DOI: 10.2307/1884852

[14] Barnard, C. I. (1938/1968). *The functions of the executive*. Cambridge, MA: Harvard University Press.

[15] Taleb, N. N. (2008). *The black swan: The impact of the highly improbable*. London, UK: Penguin Books.

[16] Iyengar, S. S. (2011). *The art of choosing: The decisions we make everyday - what they say about us and how we can improve them*. London, UK: Little, Brown Book Group.

[17] Slovic, P., & Västfjäll, D. (2010). Affect, moral intuition, and risk. *Psychological Inquiry: An International Journal for the Advancement of Psychological Theory,* 21(4), 387 - 398. DOI: 10.1080/1047840X.2010.521119

[18] Thaler, R. H. (2015). *Misbehaving: The making of behavioral economics*. New York, NY: W.W. Norton.

[19] Stierand, M. (2015). Developing creativity in practice: Explorations with world-renowned chefs. *Management Learning*, 46(5), 598-617. DOI: 10.1177/1350507614560302.

[20] Dörfler, V., & Eden, C. (2017). *Becoming a nobel laureate: Patterns of a journey to the highest level of expertise*. Paper presented at the AoM 2017: 77th Annual Meeting of the Academy of Management, Atlanta, GA. http://www.researchgate.net/publication/319373590

[21] Kuhn, T. S. (1962/1996). *The structure of scientific revolutions* (3rd ed.). Chicago, IL: The University of Chicago Press.

[22] Kuhn, T. S. (2000). *The road since structure: Philosophical essays, 1970-1993, with an autobiographical interview*. Chicago, IL: University of Chicago Press.

[23] Popper, K. R. (1968/2004). *The logic of scientific discovery* (2nd ed.). London, UK: Routledge.

[24] Popper, K. R. (1974/2005). *Unended quest: An intellectual autobiography*. London, UK: Routledge.

[25] Feyerabend, P. K. (1993/2002). *Against method* (3rd ed.). London, UK: Verso.

[26] Feyerabend, P. K. (1987/2002). *Farewell to reason.* New York, NY: Verso.

[27] Polányi, M. (1966). The logic of tacit inference. *Philosophy,* 41(155), 1-18. DOI: 10.1017/S0031819100066110

[28] Heisenberg, W. (1962/2000). *Physics and philosophy: The revolution in modern science.* London, UK: Penguin Books.

[29] Schrödinger, E. (1958). Mind and matter. In E. Schrödinger (Ed.), What is life? With mind and matter and autobiographical sketches (pp. 91-164). Cambridge: Cambridge University Press.

[30] von Hayek, F. A. (1942). Scientism and the study of society. Part i. *Economica*, 9(35), 267-291. DOI: 10.2307/2549540.

[31] von Hayek, F. A. (1943). Scientism and the study of society. Part ii. *Economica*, 10(37), 34-63. DOI: 10.2307/2549653.

[32] von Hayek, F. A. (1944). Scientism and the study of society. Part iii. *Economica*, 11(41), 27-39. DOI: 10.2307/2549942.

[33] Bourdieu, P. (2004). *Science of science and reflexivity.* Cambridge, UK: Polity Press.

[34] Polányi, M. (1969). The creative imagination. *Psychological Issues*, 6(2), 53-91.

[35] Polányi, M. (1946). *Science, faith and society.* London, UK: Oxford University Press.

[36] Piaget, J. (1972). L'épistémologie des relations interdisciplinaires. In L. Apostel, G. Berger, A. Briggs & G. Michaud (Eds.), Interdisciplinarity: Problems of teaching and research in universities ; based on the results of a seminar on interdisciplinarity in universities organised by ceri in collaboration with the french ministry of education at the university of nice (france) september 7th - 12th, 1970: OECD.

[37] Nicolescu, B. (2015). From modernity to cosmodernity: *Science, culture, and spirituality.* Albany, NY: State University of New York Press.

[38] Nicolescu, B. (2002). *Manifesto of transdisciplinarity.* Albany, NY: State University of New York Press.

[39] Nicolescu, B. (2010). Methodology of transdisciplinarity: Levels of reality, logic of the included middle and complexity. *Transdisciplinary Journal of Engineering & Science,* 1(1), 19-38.

[40] Nicolescu, B. (2014). Methodology of transdisciplinarity. *World Futures*, 70(3-4), 186-199. DOI: 10.1080/02604027.2014.934631.

[41] Nicolescu, B. (2016). Transdisciplinarity (lecture). Budapest, Hungary.

[42] Schön, D. A. (2001). *Displacement of concepts.* London, UK: Routledge.

[43] Bateson, G. (1980). *Mind and nature: A necessary unity.* New York, NY: Bantam Books.

[44] Fichte, J. G. (1993). *Fichte: Early philosophical writings* (D. Breazeale Ed.). Ithaca, NY: Cornell University Press.

[45] March, J. G. (1991). How decisions happen in organizations. *HumanComputer Interaction*, 6(2), 95-117. DOI: 10.1207/s15327051hci0602_1.

[46] Kahneman, D., & Klein, G. (2009). Conditions for intuitive expertise: A failure to disagree. *American Psychologist*, 64(6), 515-526. DOI: 10.1037/a0016755.

[47] Bergson, H. (1911). *Creative evolution.* New York, NY: Henry Holt and Company.

[48] Bergson, H. (1946/1992). *The creative mind: An introduction to metaphysics.* New York, NY: Citadel Press.

[49] Boulding, K. E. (1985). *The world as a total system.* Beverly Hills, CA: Sage Publications.

[50] Carr, N. (2011). *The shallows: What the internet is doing to our brains.* New York, NY: W. W. Norton & Company.

[51] Russell, B. A. (1948/2003). *Human knowledge: Its scope and limits.* London, UK: Routledge.

[52] Einstein, A. (1956/1984). *The world as i see it.* New York, NY: Kensington Publishing.

Zoltán Baracskai is an Associate Professor at the Széchenyi István University, Györ, Hungary and holds part-time and visiting professorial positions at several universities in Hungary, Croatia, Bosnia and Romania. He also works as an independent executive coach in these countries. His research is focused on decision making, leadership, creative problem solving and on supporting

decision makers and creative problem solvers with coaching and knowledge-based expert systems. He has written 25 books and 100+ conference and journal papers on these topics. Zoltán, with his team, developed the Doctus knowledge-based expert system shell to support executive decision takers and he conducted 100+ consultancy projects where decision support was provided using Doctus and worked on many of these as a knowledge engineer. Over the last few decades Zoltán designed a dozen postgraduate schools and degree courses.

Viktor Dörfler is a Senior Lecturer in Information & Knowledge Management at the University of Strathclyde Business School, Glasgow, UK. His research is focused on two interrelated areas: the first covers modelling personal knowledge, learning and cognition in organizational context; the second covers knowledge-based expert systems, in particular the Doctus [http://www.doctuskbs.com/] knowledge-based expert system shell. His most recent research into cognitive complexity has seen Viktor interview 17 Nobel Laureates. He has written 2 books, 7 book chapters, 20+ journal papers, and 100+ conference papers in these areas. He also worked as an independent software development consultant and as a knowledge engineer. Viktor is a dedicated and passionate teacher. He designed and delivered two MOOCs; the first titled 'Understanding Modern Business & Organisations ' [https://www.futurelearn.com/courses/understanding-modern-business-and-organisations], and the second titled 'Understanding Information & Technology Today' [https://www.futurelearn.com/courses/information-and-technology].