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Working Paper**Author(s):**

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Publication date:

2022-07-29

Permanent link:

<https://doi.org/10.3929/ethz-b-000578934>

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Originally published in:

OSF Preprints, <https://doi.org/10.31219/osf.io/evjd6>

EMBRACING THE INTUITIVE-ANALYTICAL PARADOX?

HOW INTUITIVE AND ANALYTICAL DECISION-MAKING DRIVE PARADOXES IN SIMPLE AND COMPLEX ENVIRONMENTS

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The idea

Dual process theories build on the notion that we make decisions based on two dissimilar but complementary decision-making styles: intuitive-reflexive (i.e., automatic, experiential, and effortless) and analytical-reflective (i.e., intentional, rational, and effortful). These two types have been discussed extensively in the academic discourse (e.g., Epstein et al. 1996; Hodgkinson & Sadler-Smith, 2018; Jung et al., 2016; Kahneman & Frederick, 2012; Wang et al., 2017) and paraphrased in the field of politics.¹ Scholars have shared many characteristics and definitions of those two thinking styles (e.g., Dane & Pratt, 2012; King & Clark, 2002; Rosen, Shuffler, & Salas, 2010; Salas, Rosen, & DiazGranados, 2012); we follow the view that intuition reflects a skill at using subconscious information for conscious decision making (Lufityanto et al., 2016). However, dual process theories face challenges and require scrutiny of how the two decision-making styles interact in different environments while exploring the source of responsibility for decision paradoxes in managerial and organizational contexts (Dane & Pratt, 2012). For instance, analytical decision making does not guarantee rational decisions; conversely, intuitive decision making does not automatically produce irrational ones (Grayot, 2020).

Under the expected utility theory, we pursue axioms of rationality with a static set of rules and preferences to make decisions that maximize benefit (Fishburn, 1984; Karmarkar, 1978; Payne, 1973; Shapiro, 1956; von Neumann & Morgenstern, 2007). Paradoxes are contradictory interconnected elements that exist at the same and over time (Smith & Lewis, 2011). Because analytical and intuitive decision-making styles have long been regarded as uncorrelated constructs (e.g., Hochberg & Brunswik, 1957; Simon, 1955; Wang et al., 2017) and, in particular, because there is no fixed neural architecture for making decisions intuitively or analytically (Osman, 2004; Keren & Schul, 2009), those dual processes presuppose “either/or” tradeoffs resolved by either intuitive or analytical thinking styles. In this context there is an ongoing discourse how both decision making systems interact—sequentially or in parallel—whereas there is not enough empirical proof to validate one or the other interaction (Hodgkinson & Sadler-Smith, 2018). Controversial, because literature for intuitive decision making and its measurement is significantly lagging the rational literature stream, it might be misleading that intuition is less reliable as it has been used as explain away decision anomalies due to lacking evidence (Keren, 2013; Buturovic & Tasic, 2015; Grayot, 2020). Thus, we propose an intuitive-analytical paradox which consists of

¹ See <http://www2.econ.iastate.edu/classes/econ502/tesfatsion/Solow.StateOfMacro.CongressionalTestimony.July2010.pdf>

tensions that are resilient to resolution but key to unlocking the positive potential of those (Cameron & Quinn, 1988; Smith & Lewis, 2011). For instance, paradox mindsets can help individuals leverage them to improve job performance and innovation (Miron-Spektor, Ingram, Keller, Smith, & Lewis, 2018) as well as innovative work behavior (Liu, Xu, & Zhang, 2020). Practical examples have been provided by a leading carmaker which used paradoxes to increase revenue (Takeuchi, Osono, & Shimizu, 2008). Paradoxes are also at the heart of successful brands (Heracleous, 2013).

Overall, there is as yet no overview nor debate in the managerial and organizational context of which paradox is predominantly caused by which decision-making style and under which environmental conditions. We still do not know whether intuitive or analytical decision making is responsible for specific paradoxes and whether one decision-making style has more potential to use the paradox to result in better decisions. Similarly, discussion of paradoxes in an intuitively and analytically balanced context is missing in the literature (Banuri, Dercon, & Gauri, 2019). Intuition is underrepresentative which makes it difficult for future research across disciplines and decision makers to understand holistic decision making in an ever more complex and uncertain world.

In discussions of the nature of decision making, paradoxes are often mentioned under uncertainty (Dasgupta et al., 2015; Ellis & Dix, 2015; Rudolph et al., 2009). For instance, the Cognitive Reflection Test – which represents a pure rational probability problem – measures a person's tendency to override an incorrect heuristic response (Frederick, 2005). This test has been criticized that it is a valid measure of cognitive reflective but not of intuitive thinking – it is uncorrelated to metacognitive skills (Pennycook et al., 2016). This test reflects “simple” conditions solved based on static mathematical rules, an environment in favor for rational thinking but “hostile” for intuitive thinking. Furthermore, a recent study stressed that managers are more likely to see employee working for a higher purpose as better people in general. For instance, the “halo effect” shapes managers’ (mis)perceptions assuming that calling-oriented employees are better performers (Cho & Jiang, 2021). Such calling-oriented employees might be better performers in complex environments but not in simple ones, in line with Jackson's (1996) work on halo-accuracy paradox. Furthermore, this paradox can be trained to decrease halo and increase accuracy as discussed by a meta-analysis (Woehr & Huffcutt, 1994).

Managers and entrepreneurs often employ intuition for crucial, complex, and nonroutine (strategic) decisions for their companies (Hodgkinson & Sadler-Smith, 2018). In the same vein, a complex environment is successful investing since stock prices are difficult to forecast. Recently neuroscientists explored neural evidence, that certain brain activity forecasts stock price movement even when choice behavior did not follow (Stallen, Borg, & Knutson, 2021). By demonstrating that unconscious neural activity indicates stock price movement although conscious decision behavior does not follow, we might imply a complex environment for successful intuitive decision making. Another example is provided by Piaget’s experimental evidence with children in which age controls the elicitation of the mode of decision making. Children were tasked with choosing the bag with the largest number of sweets. Below seven-year-old children use non-analytic intuitive global estimation methods and succeed better than children aged seven or older who rely on analytical counting the sweets (or trying to count the sweets in the bags). In the absence of our comprehensive knowledge of intuition, which leads to a lack of control of our analytical mind (Schlottmann & Wilkening, 2012), paradoxically, we claim that at the mercy of circumstances complex decision environments stimulate inaccuracies in analytical decision making and vice

versa simple decision environments facilitate inaccuracies in intuitive decision making. As a consequence, the following research questions are posed: *To what extent is unconscious intuitive decision-making in complex and uncertain conditions more accurate than conscious analytical decision-making? Is – paradoxically – analytical thinking more successful when making simple decisions and intuitive thinking when deciding in complex environments?*

From the vast literature on decision making, we will choose the most relevant papers related to decision making paradoxes in managerial and organizational contexts feasible to categorize them in simple and complex environments. In this regard we build on the quantum prospect probability which is of dual nature, combining the objective prospect utility factor and the subjective and unconscious attraction factor for the decision maker which is subject to decision maker's behavior (Yukalov & Sornette, 2010; 2011; 2014a; 2014; 2018; Favre, Wittwer, Heinimann, Yukalov, & Sornette, 2016). As such, the paradox overview with a focus on decision making in managerial and organizational contexts envisaged in our study will not only help us understand the current state of cognitive processing paradoxes in greater detail and which decision-making style is largely responsible for which paradox based on their decision environment but also suggest new experimental paths to outsmart specific paradoxes to our advantage in managerial and organizational situations. The fact that in complex situations intuitive decision making is paradoxically more accurate than analytical decision making and vice versa means we are able to acknowledge an “intuitive-analytical paradox” as a crucial influence on decisions.

Despite growing efforts across disciplines (Hodgkinson & Sadler-Smith, 2018; Pretz et al., 2014), methodological limitations focusing on self-reporting techniques and experiments flawed by small sample sizes lacking in practical relevance (e.g., Lufityanto et al., 2016) mean that far too little is known about which paradoxes arise in either rational or intuitive decision making. Additionally, we do not know the roots of those paradoxes in either decision-making style. No research has yet categorized cognitive paradoxes in those two styles, which are defined as uncorrelated according to the latest meta-studies (e.g., Alaybek, et al., 2021; Phillips et al., 2016; Wang et al., 2017) according to their decision nature. By taking the paradoxes of intuitive and rational decision making into account, we will not only be more able to develop effective and creative methods to take advantage of those but also identify research gaps and future research work required on specify paradoxes. To understand how decision paradoxes can be used to our advantage, we first need to understand which form of decision nature is predominately responsible. Despite the importance of and growing interest in this subject, an overview of this topic remains lacking. As such this work will deliver certain decision characteristics crucial to increase decision accuracy.

The fundamental idea of this paper is to analyze the body of work studying the contexts in which decision nature—*simple or complex*—and decision paradoxes have been discussed, taking both intuition and analysis into balanced consideration. We follow the research stream based on the dual natures studied in complex systems, whose dynamics and structures result from an interplay between those two² (Sornette, 2005) to manage both known unknowns and unknown unknowns we face (Sornette & Cauwels, 2020). This article thus contributes to the growing body of research related to the far-reaching impact of nonconscious and conscious cognitive processes in the workplace. Its primary objective is to offer an overview of intuition and analysis contexts in

² See the resources on the endo-exo concept at <https://emeritus.er.ethz.ch/media/essays/origins.html>

which paradoxes have been studied. We synthesize recent advances to provoke a reconsideration of how to outsmart paradoxes, whether intuitively or analytically.

The audience for the article

The academic discussion requires a fuller exploration of which paradoxes are generated by intuitive or analytical decision making and how to use them to our advantage; this article is thus directed to readers with an interest in reasoning, judgment, and decision making and their broad implications. We aim to help bridge cognitive gaps across disciplines and address several audiences.

First, policymakers and executives are increasingly using choices to guide people toward better decisions in the workplace (Beshears & Gino, 2015) and improve employees' decisions (Bowles, 2009). There are tools to outsmart paradoxes (Burmeister & Schade, 2007; Soll et al., 2015) that are expected to support policymakers when implementing default decision making for others, which is known as nudging. This requires them to understand the multiple and interconnected contexts of a diverse set of paradoxes and their related decision nature. Our overview will support policymakers in designing responsible approaches to default decision making.

Second, the work will also be of interest to educators in general and those in management and psychology in particular. If we become more aware of the natural roots of paradoxes, we will be more able to outsmart them. For instance, boosting intuitive decision making can be achieved through repetition (Myers, 2007), improved with practice over time (Lufityanto et al. 2016), and facilitated on a nonconscious basis (Raio et al., 2012). Furthermore, selective training weakens pre-existing paradoxes (Woehr & Huffcutt, 1994) for which we do not see any exploitation opportunity for our advantage. An overview of paradoxes, their role in intuitive and analytical decision making, and how to use them to our advantage in one decision-making style will inspire educators to employ their creativity to design new training tools for managerial and entrepreneurial paths.

Thirdly, Hodgkinson and Sadler-Smith (2018) explored the dynamic nature of intuitive and analytical decision making and stressed that, especially in management and organizational contexts, intuition plays a crucial but traditionally underestimated role in decision making. Thus, this article aims to inspire researchers to pay particular attention to balancing intuitive and analytical decision making when exploring new paths for decision making by humans supported by artificial intelligence.

Finally, we also aim at a larger audience. Overall, relying entirely on an analytical decision-making style refers to an attempt to find optimal but not robust and resilient solutions for societal problems. Given the growing complexity and uncertainty in crucial systems like finance and economics, constant (computational) optimization could lead to misleading and even incorrect models that could contribute to crises and disasters. In the context of Darwinian fitness, nature provides perfect examples and models for robust and resilient solutions. For instance, the human brain represents a low-energy form of computation. Although the brain is not optimized like a computer, it operates in a highly effective and efficient manner when its energy consumption is considered (Levy & Calvert, 2021). Moreover, destroying even a significant proportion of neurons can result in only minor impacts on brain function (Gage, 2002; Götz & Huttner, 2005). On the other hand, if even a single transistor is removed from computer, it is often completely useless. Constant optimization with a focus on conscious analytical approaches, processed by computers and/or only one part of the brain, represents a fundamental mistake of modern societies that could

lead to more fragility and disasters in the long run, which are the polar opposite of what was intended.

The importance of the idea

Research regarding decision-making procedures (Miller, 2007; Zhang & Cueto, 2017) shows that we make irrational and poor decisions under conditions of complexity and uncertainty, which will be hallmarks of tomorrow's workplaces in which humanity is endogenously creating uncertainty in a society aiming at zero-risk (Sornette & Cauwels, 2020). Analytical, logical, and rational procedures decrease the difficulty of making a given decision by distilling data down to the single aspect that is crucial to adopting a specific position (Dijksterhuis, 2004). Information and data are used to reduce uncertainty in decision making (Duncan, 1972). By exploring intuitive and rational decision making with a balanced viewpoint, we will not merely enrich our understanding of which paradoxes are rooted in which type of environment; we will also be able to develop effective methods to boost effective decision making in future contexts that are sure to become more and more uncertain and complex by taking the potential paradoxes in algorithmic fair decision-making tools into account, an issue that has begun to receive scholarly attention (Courtland, 2018; Starr, 2020a).

A moderate amount of research has focused on paradoxes during decision making in organizations (e.g., Miron-Spektor, Ingram, Keller, Smith, & Lewis, 2018), but we are not aware of which decision-making style serves as the primary source for which paradox and how to exploit them for our benefit. Decision making takes place in ever more novel situations of an increasingly complex and uncertain nature. Practitioners in leading roles regularly refer to "intuition" as an important reason for their successes (Hodgkinson & Sadler-Smith, 2018). Because of our cognitive capacity, we often just "know" which decisions are correct and act accordingly, even though we are not able to justify or explain why in our own words (Kahneman, 2011). Although simplifying heuristics can jeopardize our decisions (Tversky & Kahneman, 1974), research has shown how intuition leads to successful decisions (Burmeister & Schade, 2007; Kanze et al., 2018). Thus, in some contexts, intuition does not have to lead to irrational decisions (Artinger et al., 2015; Brandstätter et al., 2006; Burmeister & Schade, 2007; Gigerenzer & Goldstein, 1996; Goldstein & Gigerenzer, 2002; McCarthy et al., 1993). With the increasing interest in dual process theories, intuition has received more attention as a source of inspiration and imagination to create social and economic value (Mitchell et al., 2005). However, research into intuitive and rational decision making and their interplay remains significantly lagging; indeed, such exploration is almost non-existent. Our novel approach toward the categorization between decision nature (simple vs. complex) and decision-making style (intuitive vs. analytical) opens up new directions for future research.

The importance of our idea is further exemplified by the testimony to the US congress in 2010 of economist Nobel prize winner Robert Solow³, in which he made the point that every proposition (and by extension any decision) should pass the "smell test", that is, does it really "make sense"? This emphasizes the importance of using "good sense" and by extension "guts feeling" (after all, we have approximately 500 millions neurons around our guts, constituting the enteric nervous system (Mayer, 2012)). In other words, rigorous analytical approaches should be complemented by the use of the "smell sense", i.e. a qualitative rough appreciation and feeling that "this is about right". This raises many interesting avenues of investigation to understand the role of unconscious

³ <http://www2.econ.iastate.edu/classes/econ502/tesfatsion/Solow.StateOfMacro.CongressionalTestimony.July2010.pdf>

processes in decision making, such as those activated in the cerebellum, the brain part where 10000-hours based expertise is stored. We suggest to map the dual role of analytical decision making versus intuition to the dual role of analytical reasoning versus smell sense (or good sense):

conscious analytical thinking \Leftrightarrow rational computational optimisation
intuition \Leftrightarrow gut feeling, good sense, “smell sense”

To be clear, conscious analytical decision making amounts to finding optimal solutions (which are often fragile to changes of circumstances and/or to domino effects resulting from too strong coupling between optimized sub-structures).

As an illustration, given a context of significant uncertainty like in finance and economics, the optimizing rational economists have developed theories and models that have nothing to say to guide decisions of policy makers that have felt completely abandoned during times of crises. As a case in point, Jean-Claude Trichet, the Chairman of the European Central Bank at the time of the great financial crisis, complained: “as a policymaker during the crisis, I found the available [economic and financial] models of limited help. In fact, I would go further: in the face of the crisis, we felt abandoned by conventional tools.”⁴ It has been argued that the great financial crisis is in part the result of the focus on rational optimization rather than on good-sense heuristics (Sornette and Cauwels, 2014). For instance, biological organisms are viable and resilient because biological evolution selects for redundant resilient solutions to shape biological bodies such as the brain. The brain is not optimized like a computer but is very good at consuming very little energy (30 W, a small lamp bulb) while 10% or more of our neurons can be removed with no noticeable impact on performance. Remove one transistor of a (optimized) computer and it ceases functioning.

We thus suggest to explore the rational-intuition duality in the broader context of the relative value of rational optimization that pervades modern thinking and our technological world on the one hand and of robust good-sense approaches based on intuition, gut-feeling and good sense, on the other hand.

Communication of the idea

The article’s structure is as follows. After an introduction, the paradoxes relevant to intuitive and analytical decision making in managerial and organizational contexts are outlined. In this regard, background information with definitions and related work is provided. For instance, there is a glossary of key terms and a table of studies of paradoxes with descriptions, examples, and evidence of the paradoxes important for managerial and organizational contexts. We build on well-established definitions of decision-making styles from Epstein (1991), Epstein et al. (1996), Jung, Baynes, and Beebe (2016), and Wang et al. (2017). The existing perspective and limitations will be discussed. We will introduce our new perspective regarding the simple versus complex phenomenon and the implication for existing perspective and future research. The article evaluates the most pertinent recent conceptual academic discussions and enhancements of the relevant paradoxes and which cognitive processing type is responsible for particular failures (e.g., Evans, 2007; Evans & Stanovich, 2013).

In this process, our new perspective and arguments will be enriched with some empirical evidence to support them. Taking advantage of a practical how-to guide for quantum decision theory (Favre et al., 2016) and studies how to resolve paradoxes of human decision making

⁴ <https://www.ecb.europa.eu/press/key/date/2010/html/sp101118.en.html>

(Yukalov & Sornette, 2009; 2010; 2011a; 2011b) the article also applies the latest bibliometric software tools such as VOSviewer and CitNetExplorer to present vast bibliometric maps of multidimensional scaling (van Eck & Waltman, 2009, 2017). To categorize the most influential work regarding paradoxes in decision making in simple and complex environments, this work uses the latest scientific visualization tools to highlight key peer review publications dedicated to both intuitive and analytical research streams that are relevant for paradoxes under investigation. It also draws the reader's attention to crucial elements across different disciplines.

Each paradox is described, evidence of each related to its simple or complex decision nature is discussed, and the dominant intuitive and analytical decision-making style is highlighted. Furthermore, the visualized maps of the intuitive and analytical literature related to the paradoxes are explored, and their theoretical and practical significance for managerial and organizational contexts are appraised in depth. The challenges of the research and its implications for future studies are discussed. Our work will conclude with final reflections, limitations, and recommendations for a future multidisciplinary agenda.

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