*Erasmus Journal for Philosophy and Economics,*
*Volume 15, Issue 2,*
*Winter 2022, pp. aa–aa.*
*https://doi.org/10.23941/ejpe.v15i2.703*

# Review of Ralph Hertwig, Timothy J. Pleskac, and Thorsten Pachur's *Taming Uncertainty*. Cambridge, MA: MIT Press, 2019, xvii + 469 pp.

JAMES D. GRAYOT
*Universidade do Porto*

It's difficult to overstate the significance of uncertainty within the history of human thought. From Pyrrhonian skepticism to Cartesian anxiety, quantum mechanics to predictive processing, uncertainty is the spark that ignites doubt and innovation. It is in attempt to cope with uncertainty that philosophers and scientists share a common goal. Nowhere is this better demonstrated than in the study of rational decision-making.

Taming Uncertainty (TU) represents the forefront of decision science under uncertainty. Authored by Ralph Hertwig, Timothy Pleskac, and Thorsten Pachur, along with various members[1] of the Center for Adaptive Rationality (Max Planck Institute of Human Development, Berlin), the 18-chapter volume is an interdisciplinary work of staggering achievement, integrating cutting-edge research from cognitive and social psychology, behavioral economics, and evolutionary biology. Those familiar with the Center (which is home to the Adaptive Behavior and Cognition [ABC] group, directed by renowned psychologist, Gerd Gigerenzer) will have a good idea of what TU is all about. For those uninitiated, this review will provide a crash course in the movement known as 'ecological rationality' and its newest developments.

Unlike formal investigations of uncertainty in economics and decision theory (Knight [1921] 2002; Savage 1972; Gilboa 2009), TU is deeply embedded in the tradition of Herbert Simon's theory of *bounded rationality* (1955, 1982). Among other things, Simon emphasized that: (i) humans are cognitively, and hence computationally, limited; but (ii) despite these limitations, ordinary persons are still capable of (sometimes remarkable) feats of judgment and reasoning; So, (iii) the science of decision-making ought to be grounded in the empirical (psychological) investigation of these limitations and how persons overcome them. To this end, Simon

[1] For information about the members of the Center for Adaptive Rationality, visit: https://www.mpib-berlin.mpg.de/research/research-centers/adaptive-rationality/people.

posited that successful decision-making often involves the use of simple *heuristics*—i.e., problem-solving behaviors that reduce the burden of computing optimal outcomes. Decision heuristics are thus frequently described as 'short-cuts' and 'rules of thumb'.

Following Simon, the formal (empirical) study of decision heuristics and their manifold practical applications has transformed how we understand human rationality—this is largely thanks to Gigerenzer and ABC researchers (see, e.g., Gigerenzer and Todd 1999; Todd and Gigerenzer 2007; Hertwig and Hoffrage 2013). In addition to refining and expanding the list of simple ('fast and frugal') heuristics, Gigerenzer has been instrumental in advancing the theory that humans are, in general, *ecologically rational*, that is, rational with respect to the repertoire of strategies they can deploy to meet choice-task demands. Central to the theory of ecological rationality is the belief that humans possess an 'adaptive toolbox'—i.e., an assortment of cognitive and behavioral tools for navigating uncertainty and making 'smart' decisions. The toolbox metaphor is important because it illustrates that different tasks call for different tools (heuristics) to make appropriate judgments and decisions. It is this positive spin on our cognitive limitations that sets ecological rationality apart from other mainstream theories of rationality which treat humans as inherently irrational and unsuited to complex reasoning (cf. Gilovich, Griffin, and Kahneman 2002; Kahneman 2003).

How does ecological rationality relate to (taming) uncertainty? If Gigerenzer's adaptive toolbox represents the first systematic approach to theorizing about how humans cope with uncertainty by utilizing fast and frugal heuristics, then TU represents the next stage of scientific development: not only does it expand the contents of the adaptive toolbox to include new environmental and social heuristics, but it offers compelling new insights about the socio-material basis and evolutionary origins of ecological rationality.

TU is loosely organized around four themes: the *heuristic mind*, the *exploring mind*, the *social mind*, and the *unfinished mind*. Chapters 2–6 (the heuristic mind) lay the groundwork for the book by revisiting the idea that simple heuristics are often as accurate as traditional maximization procedures for reasoning about choice when objective information, e.g., risk probabilities or statistics about world events, isn't available. Chapter 2 uses simulations to demonstrate how simple heuristics, such as the

'equiprobable heuristic' and 'natural-mean heuristic', outperform expected utility theory when estimating the value of choice outcomes.[2] Chapters 3 and 4 reflect on how these sorts of heuristics exploit environmental structures to overcome complexity. Chapter 3 presents the 'risk-reward heuristic' as a prime example of ecological inference-making in the absence of objective information.[3] Chapter 4 extends this idea to non-decision-theoretic contexts, where uncertainty is amplified by real world contingencies and messiness. Both chapters appeal to the view that one's personal network and implicit understanding of social structures can provide a useful basis for making estimations and reasoning about issues of public relevance.

Chapters 7–11 (the exploring mind) constitute a major contribution of the volume. While it is known that simple heuristics have immense inferential value, it is still not well understood what grounds or explains their accuracy or appropriateness for different tasks. This is where the significance of *search* and *learning* procedures come into play for expanding the adaptive toolbox. Chapters 7 and 8 investigate what has come to be known as the 'description-experience gap'. The gap refers to the observed difference in choice behavior among subjects who are given full information, e.g., probabilities of choice outcomes, versus those who have no prior information and must learn from experience alone. The key insight of these chapters is that traditional decision-theory can't account for search procedures that enable persons to make accurate inferences and decisions in situations of incomplete information. Chapter 9 applies the insights of the description-experience gap to the study of intertemporal choice, and it makes the case that irrational time preferences are, in fact, rational when viewed as adaptive responses to uncertain futures. Chapter 10 makes a similar case for understanding impulsive choice phenomena. Chapter 11 closes the section by reflecting on the nature of strategy selection, drawing a distinction between 'rule-based' and 'exemplar-based' heuristics for navigating new environments.

[2] The equiprobable heuristic calculates the arithmetic mean of all outcomes within each option and chooses the option with the highest mean. The natural-mean heuristic calculates the average of all outcomes sampled per option and divides the average by the number of sampled outcomes. It chooses the payoff distribution with the highest average outcome. For more information on these heuristics and other useful heuristics, see (30).

[3] The risk-reward heuristic recommends that, when the probability of winning is unknown, infer that it is equal to the costs of the gamble (G) divided by the value of the prize (P). See Pleskac & Hertwig (2014) for more information.

Chapters 12–14 (the social mind), demonstrate the value of search and learning heuristics for reasoning in social contexts and, in particular, how they can be harnessed for strategizing in competitive situations. Chapter 12 looks at how 'environmental uncertainty' interacts with 'strategic uncertainty' when there is competition between individuals. The chapter explores several game-theoretic scenarios to argue that an ecological approach to uncertain decision-making will need to be sensitive to different forms of competition. These will be contingent upon factors like prior experience, familiarity with competitors and conspecifics, and availability of information. Chapter 13 considers the vices and virtues of aggregation heuristics, i.e., heuristics for managing large groups of agents. It defends two strategies, or 'crowd rules', that improve standard readings of the 'wisdom of the crowd': (rule 1) when in doubt, aggregate more rather than fewer judgments; (rule 2) instead of trying to understand the environment, use experience to adapt to it—and become more selective if the environment calls for it. Chapter 14 continues the focus on aggregation heuristics, venturing several 'pedestrian heuristics' to help manage problems that emerge in dense populations, such as car accidents and bottlenecks. Complex systems analysis reveals that monitoring for, e.g., 'frequency of body contacts' and 'stop-and-go waves' can be used to maintain crowd safety and create more efficient trafficking systems in a less computationally demanding way.

Chapters 15–17 (the unfinished mind) close out the book by reflecting on the evolutionary and developmental trajectory of the adaptive toolbox. Chapter 15 uses *computational evolution*—the simulated modeling of evolutionary processes with artificial (virtual) organisms—to investigate how human evolution (might) have favored the selection of adaptive decision-making traits. Among other things, the authors found that the virtual agents of their models went from producing random behaviors to executing strategies that enhanced their fitness to survive. Chapters 16 and 17 return to the present to investigate how cognitive development shapes adaptive decision-making through maturity. Chapter 16 investigates how adolescents deal with uncertainty in different age groups and promotes an ecological framework for interpreting and intervening in impulsive and imprudent teen behavior. Chapter 17 continues this line of inquiry to understand which mechanisms cause changes in risk-taking behaviors as humans age. It argues that because risk preferences are an expression of one's uncertainty about future prospects, such preferences are better un-

derstood as forms of heuristic reasoning. This has the following implication: while popular social psychological research tends to favor the generalization that risk-taking behavior declines with age, risk preferences are *variant* across changing socio-environmental landscapes.

This brings to a close my summary of the book's content. Yet, for all its promise, there are aspects of TU I found puzzling. The first issue concerns how the authors depict the ecological basis of cognition. Hertwig, Pleskac, and Pachur begin the volume by claiming that "our vision of the mind is not that of an optimizing prediction machine" (23), a reference to Andy Clark's *Surfing Uncertainty* (2015). In contrast to Clark, they argue that the mind is like a 'good mechanic' in that it "learns to select a tool that can address the problem at hand, repurposes existing tools when necessary, and designs new ones using the available evolved capacities of the human mind, such as recognition, emotions, and perspective taking" (23). While the book takes great pains to demonstrate the importance of the body and socio-material environment for supporting reasoning and decision-making strategies, there is virtually no engagement with the philosophical or cognitive scientific literature on the embodiment or extension of human cognition. To put this into perspective, *embodied cognition* posits that intelligent behavior is not merely causally dependent on a physical body but is constituted by skilled bodily actions—from perception and motor control to higher thinking and reasoning, cognition is fundamentally integrated with an organism's body (Shapiro 2010; Varela, Thompson and Rosch 2017). *Extended cognition* takes this perspective a step further by positing that many forms of thinking and reasoning are not only enhanced by bodily skills but are refined and transformed through the use of social and technological artifacts outside the human body (Clark and Chalmers 1998; Clark 2008; Menary 2010).

TU's failure to engage with the philosophical literature on embodied and extended cognition is unfortunate, not just because there are deep theoretical ties between ecological rationality and adaptive decision-making (Arnau et al. 2014; Mastrogiorgio and Petracca 2016)—exploring these ties would have provided useful explanatory support and nuance in explicating the value of heuristics for overcoming uncertainty—but also because decision researchers still don't fully comprehend the role of the human body and the environment in modelling and explaining adaptive decision-making. On the one hand, the 'cognitive' science of ecological rationality is still relatively young and so is not to be blamed for not hav-

ing all the answers. Yet, it is also evident from reading TU that the 'cognitive' science of ecological rationality remains ill-defined with respect to its ontological and metaphysical commitments about the human mind vis-à-vis the body and the environment. As such, it seems to me the editors have missed a pivotal opportunity to better define the cognitive foundations of ecological rationality with respect to these commitments.[4]

The second issue is less philosophically disconcerting, though it builds on the previous inquiry. One of the principle aims of TU is to understand how individuals subjectively assess and respond to the environmental information they are given (this applies to both implicit and explicit information). Yet, for all its focus on how persons utilize search and learning heuristics to overcome uncertainty, there is surprisingly little discussion of the psychological concept of *framing* with respect to how individuals subjectively interpret information. This is odd. Afterall, supporters of ecological rationality readily admit that the tools of the adaptive toolbox are both the causes of and solutions to cognitive limitations. It would have been interesting to see how researchers draw a distinction between *adaptive response* and *subjective interpretation* of the same information. I suspect the topic was avoided in part because the concept of framing is typically cast negatively, being associated with perceptual biases and suboptimal decision-making (Kahneman and Frederick 2007). This obviously runs contrary to the theme of TU, which is that the human mind appears quite rational once we adopt an ecological perspective. It's a shame this topic wasn't discussed more explicitly as there is clearly a need to investigate the positive aspects of framing in the study of rational decision-making (Bermúdez 2020).

In sum, there's no doubt that TU will inspire readers across disciplines, especially those who have interests in the behavioral foundations of human rationality. Although one would benefit from having exposure to economic and/or decision-theoretic research and debates about bounded rationality, such a background is not necessary to appreciate the book's many merits. Hertwig, Pleskac, and Pachur have done a remarkable job not only in promoting ecological rationality as a worthy alternative to the heuristics and biases tradition (cf. Kahneman 2003, Kahneman and Frederick 2007), but they have presented a clear and comprehensive overview of the adaptive toolbox and its many practical applications.

[4] Since the publication of Taming Uncertainty, there have been a few attempts to determine in how far ecological rationality is, or should be seen as, committed to embodied and extended cognition (Gallese et al. 2020; Petracca 2021). These represent exciting developments in the cross-disciplinary study of adaptive decision-making.

## REFERENCES


Arnau, E., Ayala, S., and Stu Arnau, Eric, Saray Ayala, and Thomas Sturm. 2014. "Cognitive Externalism Meets Bounded Rationality." *Philosophical Psychology* 27 (1): 50–64.

Bermúdez, José Luis. 2020. *Frame It Again: New Tools for Rational Decision-Making*. Cambridge: Cambridge University Press.

Clark, Andy. 2008. *Supersizing the Mind: Embodiment, Action, and Cognitive Extension*. New York, NY: Oxford University Press.

Clark, Andy. 2015. *Surfing Uncertainty: Prediction, Action, and the Embodied Mind*. New York, NY: Oxford University Press.

Clark, Andy, and David Chalmers. 1998. "The Extended Mind." *Analysis* 58, (1): 7–19.

Gallese, Vittorio, Antonio Mastrogiorgio, Enrico Petracca, and Riccardo Viale. 2020. "Embodied Bounded Rationality." In *Routledge Handbook of Bounded Rationality*, edited by Riccardo Viale, 377–390. Abingdon: Routledge.

Gigerenzer, Gerd. 2021. "Embodied Heuristics." *Frontiers in Psychology,* 12.

Gigerenzer, Gerd, and Peter M. Todd. 1999. "Fast and Frugal Heuristics: The Adaptive Toolbox." In *Simple Heuristics that Make Us Smart,* edited by Gerd Gigerenzer, and Peter M. Todd, 3–34. New York, NY: Oxford University Press.

Gilboa, Itzhak. 2009. *Theory of Decision Under Uncertainty*. New York, NY: Cambridge University Press.

Gilovich, Thomas, Dale Griffin, and Daniel Kahneman, eds. 2002. *Heuristics and Biases: The Psychology of Intuitive Judgment*. New York, NY: Cambridge University Press.

Hertwig, Ralph Ed, and Ulrich Ed Hoffrage. 2013. *Simple Heuristics in a Social World*. New York, NY: Oxford University Press.

Kahneman, Daniel. 2003. "Maps of Bounded Rationality: Psychology for Behavioral Economics." *American Economic Review* 93 (5): 1449–1475.

Kahneman, Daniel, and Shane Frederick. 2007. "Frames and Brains: Elicitation and Control of Response Tendencies." *Trends in Cognitive Sciences* 11 (2): 45–46.

Knight, Frank, H. (1921) 2002. *Risk, Uncertainty and Profit*. Reprint, Washington, DC: Beard Books.

Mastrogiorgio, Antonio, and Enrico Petracca. 2016. "Embodying Rationality." In *Model-Based Reasoning in Science and Technology*, edited by Lorenzo Magnani, and Claudia Casadio, 219–237. Cham: Springer.

Menary, Richard, ed. 2010. *The Extended Mind*. Cambridge, MA: MIT Press.

Petracca, Enrico. 2021. "Embodying Bounded Rationality: From Embodied Bounded Rationality to Embodied Rationality." *Frontiers in Psychology* 12.

Pleskac, Timothy J., and Ralph Hertwig. 2014. "Ecologically Rational Choice and the Structure of the Environment." *Journal of Experimental Psychology: General* 143 (5): 2000–2019.

Savage, Leonard J. 1972. *The Foundations of Statistics*. 2nd edition. New York, NY: Dover Publications, Inc.

Shapiro, Lawrence. 2010. *Embodied Cognition*. London: Routledge.

Simon, Herbert A. 1955. "A Behavioral Model of Rational Choice." *The Quarterly Journal of Economics* 69 (1): 99–118.

Simon, Herbert A. 1982. *Models of Bounded Rationality: Vol. 3. Empirically Grounded Economic Reason*. Cambridge, MA: MIT Press.

Todd, Peter M, and Gerd Gigerenzer. 2007. "Environments that Make Us Smart: Ecological Rationality." *Current Directions in Psychological Science* 16 (3): 167–171.

Varela, Francisco J., Evan Thompson, and Eleanor Rosch. 2017. *The Embodied Mind, Revised Edition: Cognitive Science and Human Experience*. Cambridge, MA: MIT Press.

**James Grayot** is a postdoctoral researcher in the Mind, Language, and Action group (MLAG) of the Instituto de Filosofia, Universidade do Porto. James' research is situated at the intersection of philosophy of science and philosophical psychology, with special emphasis on decision modelling in the cognitive and behavioral sciences. He holds a Ph.D. in Philosophy from Erasmus Institute for Philosophy and Economics (EIPE) at Erasmus University Rotterdam.
Contact e-mail: <james.grayot@gmail.com>