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Behind and beyond a shared definition of ecological rationality: A functional view of heuristics

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ABSTRACT

Observing human behavior in laboratories reveals time and again the undeniable influence of social components, even in the isolation of carefully designed experiments. Clearly, social and cultural constructs shape human cognition. The study of ecological rationality recognizes the importance of specifying these and other characteristics of the environment as a basis of cognition. In this paper, we compare the views of Vernon Smith and Gerd Gigerenzer, the founders of two leading research programs on ecological rationality, one in economics and one in psychology. Based on their written work and on interviews conducted by one of the authors, this article brings together for the first time the essence and principles of the study of ecological rationality in these two traditions. This conjoint presentation poses important questions and clarifies methodological challenges in the understanding of actual human behavior from experimental data. Smith sees ecological and constructivist rationality as two complementing versions of economic rationality, while Gigerenzer regards the study of fast-and-frugal heuristics as the appropriate scientific method for exploring real-world rationality. Drawing a connection between forms of rationality and emergence of experimental knowledge, we note that a theory of behavior cannot be deducted from observations alone. Establishing a theoretical framework for observed behavior starts with a search for norms that are sensitive to the context and content of the situation in which a choice is made. Studying the ecological rationality of heuristics, markets, and institutions reveals such norms.

A shared definition

Ecological rationality has been defined by Gigerenzer, Todd, and the ABC Research Group (1999) as the property of a heuristic: "A heuristic is ecologically rational to the degree that it is adapted to the structure of an environment." Vernon Smith, father of experimental economics, adopted this definition of ecological rationality and extended it to also include individuals, markets, and institutions (Smith, 2008; Smith was a student of Chamberlin, who began investigating market forces through classroom games in his Ph.D. classes at Harvard. See Holt (1999) for a review of the origins of experiments in economics classroom.). This shared notion of ecological rationality has been explored in their two research programs in complementing areas. Smith is concerned with "adaptations that occur within institutions, markets, management, social and other associations governed by informal or formal rule systems," where the unit under study is a group (all quotations in the text without a source are from the interviews conducted by one of the authors.). In contrast, Gigerenzer describes his goal as "developing testable models of fast-and-frugal heuristics," which are rules of thumb used by individuals as strategies in response to problems. The main goal of studying ecological rationality is to explore why and when a behavior is rational in its artificial, social, cultural, regulatory, or natural environment. Such exploration includes observing the actual behavior inside and outside labs, finding both deliberate and subconscious mechanisms that evoke certain behavior, and determining the rationale behind them.

This paper starts with a well-known experiment to illustrate the ecological aspect of practical rationality. Then, the discussion attends to forms of rationality and their respective roles in the emergence and understanding of behavior. A methodological discussion of what constitutes a reasonable rule (or strategy) and the way in which rules can be deducted from experimental exercises opens the floor to the conception of heuristics, which bridges the insights from Smith's and Gigerenzer's traditions. This paper is one piece of a patchwork leading to a satisficing

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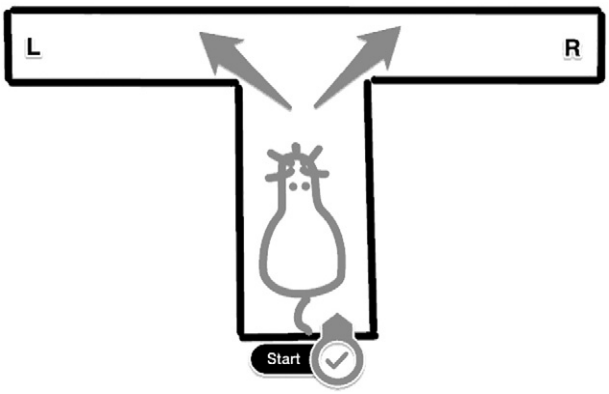

Fig. 1. The T-maze.

theoretical foundation for experimental and behavioral studies, studies that are focused on the actual process of human actions and pursue a formal yet empirically founded representation of rational decision-making. Here, satisficing, as defined by Herbert Simon, applies to both scientific inquiry and daily problem solving.

What is rational is where it is rational

Fig. 1 shows what is called a T-maze. Single and multiple T-mazes have been used to study mice's memory and their cognitive and special abilities. General results from these studies reveal an important connection between individual and collective rationality. In a typical experiment, a single mouse is placed at the starting point *S*. A reward (food) is placed randomly on the left side *L* 80% of the time and on the right side R the rest of the time. The mouse's optimal strategy would be to turn left (where food is mainly found) all the time. But what has been observed is a probability matching behavior: The mouse turns to *L* 80% of the time and to *R* 20% of the time. With this behavior, the chances of finding food are $.8 * .8 + .2 * .2 = 68\%$, which is less than the optimal (or the constructivist) chance of 80% by using the rational strategy. (In the next section, different forms of rationality, including constructivist rationality are defined.) We define all forms in the next section. A first simplistic conclusion from this study about mice in general might be that their limited cognitive abilities lead them to mimic the probability structure of the environment. And in turn, their less-than-rational behavior earns them a sub-optimal reward.

Assume that in the real world, every mouse followed the rational strategy maximizing pay-off. First, the spot with a higher possibility for finding food would become overcrowded. Second, none of the mice would have exploited the less plentiful (but nevertheless available) food resources elsewhere. It can be easily seen that such behavior would be wasteful and therefore irrational in the context of the natural habitat of the mice. Thus, the evolved capacity of reflecting on the probability structure of the environment (of which mimicking is a special case) when accessing natural resources is in fact socially rational. Observing a single mouse using its evolved capacity in the unnatural setting of an experiment that leads to sub-optimal rewards has no bearing whatsoever on the cognitive abilities of mice. Looking at the same problem from an environmental perspective reveals that there is a good reason for mice to have developed the ability to mimic the probability structure of their natural environment.

Using the rational benchmark of maximizing reward to evaluate mice's choices is misleading because it ignores how a particular situation relates to the natural habitat of the mice. This is an instance of using a norm that is blind to the experiential content of the situation. On the other hand, viewing this choice behavior in the context of an environment natural to mice leads to appreciating their motivation to survive by exploiting all available resources. The rationality of mice behavior can thus be better understood. Sensible norms of rationality reflect adaptation to environmental structures. They are content-sensitive. Mousavi and Gigerenzer (2011) offer this definition of content-sensitive norms: "Behavior must be evaluated against an ecological notion of rationality, which in turn requires constructing content-sensitive norms. In contrast to logical norms, which are content-blind in assuming the truth of syntax, content-sensitive norms reflect the actual goals and specifics of the situation. Ecological rationality is about the match of decision-making strategies to the structure of information in the environment. This match is a functional one, not a mirror image of the environment."

Rationality is bounded on the continuum of reasoning and inference

Smith (2008) speaks of two forms of rationality, constructivist and ecological: "The role of constructivism, or reason, is to provide variation, and the role of ecological process is to select the norms and institutions that serve the fitness needs of societies." There is a two-way road between constructivism and observations. Constructivism projects real-world rationality on a continuum of logical reasoning and statistical inference, a useful exercise that provides insight. The mistake is to take this projective model at face value and use its results as a benchmark to judge actual behavior in the world.

Constructivism in the sense of abstract modeling is motivated by observations in the world. This modeling is customarily performed in accordance with the assumption that rationality equals optimality. On the other hand, once an observation is made in the world or in the laboratory, one can ask whether it corresponds to a constructivist model of rationality. That is, one can use constructivism to reinterpret an observation or a puzzling phenomenon. In using constructivism to make sense of such phenomena, one is essentially asking: Is the puzzling phenomenon *rational* in the sense that it conforms to a solution concept of the model used to reconstruct it? Smith elaborates:

> David Hume said there are just three laws of human nature: the right of possession, its transference by consent, and the performance of promises. Where did he get that idea? He's looking around and sees that there is something that people call property rights. There is exchange. He is using constructivism, but he didn't make it up as a whole plot. He sees important characteristics of the society that he lives in, he's thinking: 'these must be important stable properties of any human system that works.' What he is in a way telling us in a little bit different form is that that's what the great religious *shalt not*'s are all about: Shall not kill, steal, and bear false witness. All these things have to do with some sort of an ancient emerged order that people must have tried to preserve in tradition because they saw that it had value in terms of stability, in terms of human betterment, in terms of values that are important to humans. Of course this is all long before (formal modelling was attempted).

Smith (2008) relates the distinction between ecological and constructivist rationality to "Simon's distinction between subjective and objective rationality, procedural and substantive rationality, and between people making 'good enough' satisfactory decisions and making optimal decisions… Both kinds of rationality have influenced the design and interpretation of experiments in economics."

Gigerenzer in turn distinguishes between unbounded and bounded views of rationality. Unbounded rationality assumes that more information and calculation is always better and that rational decision-makers are omniscient (know all there is to be known), omnipotent (are able to use all known information and calculate the best strategy), and omnipresent (keep preferences in the same order). For Gigerenzer,

> The term *bounded rationality* has unfortunately been taken to suggest a second-best strategy. For that reason, other terms such as *ecological rationality* and *social rationality* are often used in its place… Unbounded rationality still retains at least two meaningful roles in the study of human behavior. First, there are certain