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The cognitive economy: The probabilistic turn in psychology and human cognition

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Abstract: According to the foundations of economic theory, agents have stable and coherent "global" preferences that guide their choices among alternatives. However, people are constrained by information-processing and memory limitations and hence have a propensity to avoid cognitive load. We propose that this in turn will encourage them to respond to "local" preferences and goals influenced by context and memory representations.

One of the most significant current discussions in economics and psychology is about the (lack of) link between normative (what we should do, based on probability and logic) and descriptive theories (what we do) of decision making.

An obvious challenge for and advantage of good theory in decision making is that it is general, being able to account for both normative (rational) and descriptive psychological mechanisms and assumptions (Kusev et al. 2009). According to the foundation of economic theory, people have stable and coherent “global” preferences that guide their choices among alternatives varying in risk and reward. In all their variations and formulations, normative utility theory (von Neumann & Morgenstern 1947), and descriptive prospect theory (Kahneman & Tversky 1979; Tversky & Kahneman 1992) share this assumption (Kusev et al. 2009). However, a consistent claim from behavioral decision researchers is that, contrary to the assumptions of classical economics, preferences are not stable and inherent in individuals but are “locally” constructed “on the fly” and are strongly influenced by context and the available choice options (e.g., Kusev et al. 2009; 2012a; 2012b; Slovic 1995). For example, the preference reversal phenomenon (Lichtenstein & Slovic 1971; 1973) suggests that no stable pattern of preference underlies even basic choices; in other words, consistent trade-offs between lotteries with different probabilities and values are not made. Accordingly, we shall present some evidence for violations of the classical probability framework, inspired by existing research in judgment and decision making, and also review plausible sources for understanding human decision making: specifically simplicity in human information processing, based on local decision making goals and strategies.

Theorists in cognitive science achieve general theoretical propositions, based on the following assumptions: (1) the cognitive systems solve problems, optimally, given environmental and processing constrains (Anderson 1990; 1991); therefore, the objective is to understand the structure of the problem from the point of view of cognitive systems and (2) cognitive goals determine choice behavior: when a general cognitive goal is intractable, a more specific cognitive goal, relevant to achieving the general goal, may be tractable (Oaksford & Chater 2007; 2009). For example, all local goals are assumed to be relevant to more general goals, such as maximizing expected utility. The observation that the local goals may be optimized as surrogates for the larger aims of the cognitive system raises another important question about the use of rational models of human cognition. Specifically, Oaksford and Chater (2007; 2009) propose that optimality is not the same as rationality. The fact that a model involves optimization does not necessarily imply a rational model; rationality requires that local goals are (1) relevant to general goals and (2) reasonable. Here we make a very simple assumption about how and whether the cognitive system optimizes. We assume that the cognitive system simplifies and adopts “local” goals, and that these goals will be influenced by contextual and memory representations. Accordingly, we argue, strengthening such an account could provide a challenge to classical probability approach.

Whereas some phenomena in judgment and decision making systematically violate basic probabilities rules – classic examples include the conjunction fallacy

(Tversky & Kahneman 1983), the disjunction effect (Tversky & Shafir 1992), the subadditivity principle (e.g., Tversky & Koehler 1994), and the preference reversal phenomenon (Lichtenstein & Slovic 1971; 1973; Slovic 1995) – the simplicity framework suggested in this commentary argues that people are constrained by information-processing and memory limitations, and hence have a propensity to avoid cognitive load. Research in judgment and decision making demonstrates that by focusing on local goals (e.g., the representativeness heuristic) people may violate principles of classical probability theory (e.g., fallacies in which specific conditions are assumed to be more probable than a single general one). For example, the *independence* assumption states that the occurrence of one event makes it neither more nor less probable that the other occurs; examples of violation include the conjunction fallacy (Tversky & Kahneman 1983), the disjunction effect (Tversky & Shafir 1992), and the familiarity bias (e.g., Fox & Levav 2000; Tversky & Koehler 1994). One plausible account for these effects, as an alternative to *classical logic, classical probability*, and the *classical information-processing paradigm,* is *quantum probability theory* (Busemeyer & Wang 2007; Busemeyer et al. 2006; 2011; target article – sections 1 and 2). These authors argue that the "classical" view forces highly restrictive assumptions on the representation of the complex cognitive system. In particular, they suggest that (1) the brain is a complex information-processing system with a large number of unobservable states, (2) the brain is highly sensitive to context and, finally, (3) the measurements that we obtain from the brain are noisy and subject to uncertainty. Pothos & Busemeyer (P&B) show that quantum probability

theory allows the modeling of decision-making phenomena (e.g., the conjunction fallacy and violations of the sure-thing principle), going beyond classical probability theory. This is because quantum probability theory can account for context- and order-dependence of human behavior.

We conclude that the cognitive system is likely to respond to “local” goals (that might be tractable) influenced by memory representations and context that may be indicative of probability and frequency judgments. Therefore, in contrast to classical probability theory, quantum probability theory has the potential to account for context- and order-dependent behavior that is indicative of human propensity to adopt local goals. Moreover, there is mounting evidence for this type of behavior and simple mechanisms ruling human behavior (Kusev et al. 2011). Therefore, quantum probability has the potential to account for cognitive economy in many domains of human cognition.

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