Judgment and Decision-Making

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Evaluations or estimates (*judgments*) inform the intention to pursue a course of action among alternatives (*decision-making*). All of the behavioral sciences – economics, biology, and psychology – have made JDM a focus of substantial research. However, JDM has been variously characterized in multiple disciplines and has lacked overarching theoretical integration (Mishra, 2014). Evolutionary theory offers such a point of overarching integration. Because all organisms are necessarily products of natural selection, all behavior must be (at least in part) a manifestation of evolutionary pressures (whether positive, negative, or neutral).

In the following, we first summarize theoretical work suggesting that JDM research requires an overarching normative approach (guided by evolutionary theory) and further requires explication of universal currency of decision-making (proxies of biological fitness). Second, we outline that JDM mechanisms must be calibrated around ecological rationality: Decision mechanisms should be fast, frugal, and sensitive to historical and recurrent environmental pressures. Third, we provide examples of how an evolutionary approach can shed light on key topics in the JDM field.

Evolutionary Theory and the Currency of JDM

Normative theories are concerned with quantifying what organisms *ought* to do in a particular situation. In contrast, descriptive theories involve a bottom-up approach based on empirical observations of actual behavior. Descriptive theories are typically constructed from apparent violations of normative theories, and are concerned with describing *what* organisms actually do. In evolutionary parlance, normative theories are concerned with functional explanations for behavior, whereas descriptive theories are concerned with proximate explanations for behavior (Scott-Philips, Dickins, & West, 2011). Both normative and descriptive theories are integral to understanding JDM processes and outcomes given that quantifying both function and mechanism are essential to fully understanding the etiology of any behavior.

The first (and arguably most influential) normative theory of decision-making is *expected utility theory* (EUT), which was developed in the field of economics (Friedman & Savage, 1952). EUT posits that decision-makers seek to maximize *utility*, which is a measure of happiness, gratification, or satisfaction derived from a behavior. Although EUT has been, and continues to be, extremely influential, the currency of utility is vague and has typically been operationalized only at the proximate level (Mishra, 2014). In contrast to normative economic theories of decision-making, normative biological theories of decision-making (e.g., optimal foraging theory, risk-sensitivity theory) do not suffer from the problem of vague quantification of a currency of utility. Rather, biological theories explicitly codify that decisions are made around the currency of fitness (Stephens & Krebs, 1986).

Humans and non-human animals are products of evolution by natural selection, and should therefore have cognition shaped by sensitivity to inclusive fitness (that is, the differential reproductive success of self and kin; Hamilton, 1964). In humans, however, the pursuit of fitness is not direct; rather, people make decisions based on *proxies of fitness*, which are outcomes that are (or have been) historically statistically associated with reproductive success (Mishra, 2014; Mishra et al., 2016). Positive proxies of fitness include access to material resources, mates, status, and positive reputations, among others. JDM should therefore reflect sensitivity to proxies of fitness. Quantification of proxies of fitness as the central currency in decision-making has two key virtues. First, such a currency is not as vague as utility. It can be explicitly quantified, measured, and empirically examined. Second, this currency is derived directly from evolutionary theory, and therefore grounds any understanding of JDM in a broader overarching explanatory framework.

Ecological Rationality and Mechanisms of Decision-Making

Normative approaches to JDM have focused on understanding "rational" or "optimal" decision-making (i.e., seeking to maximize or optimize a particular currency). Key pushback against the idea of "optimal" decision-making in economics came in the form of the descriptive "heuristics-and-biases" program of research, which quantified the various ways that actual human decision-making countered the predictions of EUT.

Proponents of the heuristics-and-biases program argued that human reasoning is prone to systematic errors (*biases*; Tversky & Kahneman, 1974). However, this tradition treats biases as failures of a flawed mind. By contrast, evolutionary theory suggests that while biases may appear to be "irrational" at first glance, they may actually be part of a cognitive system designed to maximize proxies of fitness (reviewed in Haselton et al., 2009). Given the fundamental constraints of cognitive processing – it takes time, energy, and effort to collect information, and almost every real-world decision is made under some constraint of uncertainty or incomplete information – it is necessarily the case that JDM mechanisms must be "bounded". Most decision-making is characterized by satisficing, which involves seeking outcomes that are "good enough" to meet one's needs (versus optimal; Simon, 1956).

Fast-and-frugal heuristics are simple satisficing cognitive "rules of thumb" that can be simply applied to a wide range of situations. Such heuristics are time, knowledge, and computationally efficient (Gigerenzer & Gaissmaier, 2011). However, to be effective, fast-and-frugal heuristics must be well-fitted to the environment of decision making. In this sense, fast-and-frugal decision-making reflects *ecological rationality*, which describes robust fit between cognitive decision mechanisms calibrated to recurrent structures of regularly encountered environments (Todd & Gigerenzer, 2012). The use of heuristics may not always be "rational" in the context of modern environments. However, some heuristics can be considered adaptively rational in that they reflect fit to recurrent past (rather than present) ecologies.

Evolution-minded theorists have posited that human bias occur for three reasons (see *Bias* entry). First, fast-and-frugal heuristics can be prone to breakdowns in reasoning in systematic ways. Second, humans may have become prone to bias because they developed a preference for errors that impose lower fitness costs. Third, some instances of bias may be an artifact of environments incompatible with the evolved mind (reviewed in Haselton et al. 2009). Together, this theorizing and research suggests that people make satisficing decisions in accordance with an account of bounded rationality, and that people's JDM mechanisms reflect ecological and adaptive rationality.

Applying Evolutionary Theory to JDM Problems

An evolutionary perspective suggests that JDM is centered around maximizing proxies of fitness, and JDM mechanisms must reflect bounded and ecological rationality. In the following, we provide examples of how an evolutionary approach can shed light on several commonly studied topics in JDM.

Judgments and cognitive biases. Canonical mainstream understanding of cognitive biases is that they represent systematic errors as a consequence of deviation from "rational" normative judgments. However, many of these supposedly "irrational" biases reflect evolutionary architecture. For example, the *primacy effect* and *recency effect* describe people's tendency to overweight initial and recent events (respectively) in memory. The *availability heuristic* describes the tendency to overweight salient events in memory. *Attentional bias* describes people's tendency to differentially attend to recurrent thoughts. The *base rate fallacy* describes people's tendency to ignore base rates and focus on salient anecdotes.

The list of cognitive biases that have been identified is very large. However, a common thread emerges: most biases involve overweighting salient events in memory, independent of how statistically likely they are. Such biases are obviously ecologically rational: particularly hazardous, dangerous, or important events *should* be overweighted so as to prevent negative fitness outcomes. Ecologically rational judgment mechanisms (especially regarding risk assessment) should overweight salient threats in order to motivate appropriate behavior. In this sense, cognitive biases reflect deep evolutionary logic (an argument made persuasively elsewhere; e.g., Haselton, Nettle, & Murray, in press)

Risk and uncertainty. Risk and uncertainty are inherent properties of essentially every decision. Risk is payoff or outcome variance (Mishra, 2014; Mishra et al., 2016). Uncertainty occurs when decisions involve unknown outcomes (by contrast, risk canonically involves choice only among known outcomes; Volz & Gigerenzer, 2012). There are few "real-world" (i.e., non-laboratory) decisions that do not involve uncertainty. It has thus been argued that uncertainty can be considered a form of immeasurable risk, and that decision mechanisms must be sensitive to (and potentially integrate) risk and uncertainty (Volz & Gigerenzer, 2012).

How do people make decisions around risk (and uncertainty?). The recently proposed *relative state model* suggests that there are two pathways to risk-taking: need-based and ability-based (Mishra et al., 2016). Need-based risk-taking is a product of competitive disadvantage, consistent with risk-sensitivity theory (which posits that decision-makers seek risk when unable to meet their needs with low variance options). Those who are competitively disadvantaged (i.e., far from a desired goal) thus up-regulate risk-taking. This pathway is inclusive of such widely documented empirical phenomena as the young male syndrome (Wilson & Daly, 1985), which describes increased risk-propensity among young males who are competitively. By contrast, ability-based risk-taking is a product of an assessment of competitive advantage, where people engage in risk-taking when they possess abilities or traits that increase the expected value of risk-taking and/or have signaling value (e.g., Sell, Tooby, & Cosmides, 2009). The relative state model provides an evolutionary account of why both competitively advantaged and disadvantaged individuals engage in (differential) patterns of risk-taking, offering clarification of longstanding arguments about domain-specificity and generality of risk-taking.

Framing and loss aversion. One of the most renowned findings in the JDM literature is that decision-makers are risk-prone when facing losses and risk-averse when facing gains (summarized in highly influential *prospect theory*; Kahneman & Tversky, 1979). Evolutionary theory offers a normative explanation for these findings. Experiencing a loss may bring an organism to the threshold of not being able to reproduce or survive (Hurly, 2003). As a consequence, organisms should elevate risk in the face of losses because risk-taking might represent the only way to potentially avoid such dire biological outcomes (consistent with risk-sensitivity theory; McDermott, Fowler, & Smirnov, 2008).

Temporal discounting. Human and non-human animals engage in temporal discounting: the active preference of smaller, immediate rewards over larger, distal rewards. A large literature suggests that degree of temporal discounting is dependent on an individual's perceived time horizon. Those who perceive themselves to have short time horizons (e.g., shorter life expectancy) are substantially more likely to engage in temporal discounting (Daly & Wilson, 2005). Such behavior is often interpreted as irrational (why choose outcomes with lower expected values?). However, viewed through an evolutionary lens temporal discounting makes adaptive sense. Individuals who do not anticipate that tomorrow is guaranteed choose options that are available today, especially when making decisions about behaviors related to proxies of fitness (e.g., Krupp, 2012).

Perceived time horizons are associated with individual differences in life history orientation, which range from “fast” (comprising a constellation of impulsive, present-oriented behaviors) to “slow” (comprising a constellation of patient, future-oriented behaviors). Substantial research has shown that individuals who exhibit “fast” life histories typically have experienced developmental and/or environmental conditions that cue short time horizons (e.g., high extrinsic mortality, low life expectancy, parental absence, abuse; reviewed in Mishra & Lalumière, 2008).

The four broad areas summarized above represent some of the core areas of research and knowledge in JDM. An evolutionary framework offers an integrative, normative understanding of behaviors in all of these areas in that it (a) grounds currencies of decision-making in concrete and quantifiable proxies of fitness, (b) offers an ecologically rational account of decision-making mechanisms, and (c) has broad explanatory power and scope.

References

Daly, M., & Wilson, M. (2005). Carpe diem: Adaptation and devaluing the future. *The Quarterly Review of Biology*, *80*, 55-60.

Friedman, M. & Savage, L. J. (1952). The expected utility hypothesis and the measurability of utility. *Journal of Political Economy*, *60*, 463-374.

Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision-making. *Annual Review of Psychology*, *62*, 451-482.

Hamilton, W. D. (1964). The genetical evolution of social behaviour. *Journal of Theoretical Biology*, *7*, 1-16.

Haselton, M. G., Bryant, G. A., Wilke, A., Frederick, D. A., Galperin, A., Frankenhuis, W. E., & Moore, T. (2009). Adaptive rationality: An evolutionary perspective on cognitive bias. *Social Cognition*, *27*, 733-763.

Haselton, M. G., Nettle, D., & Murray, D. R. (in press). The evolution of cognitive bias. In D. M. Buss (Ed.), *The Handbook of Evolutionary Psychology (2nd ed.).* New Jersey: Wiley.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, *47*, 313-327.

Krupp, D. B. (2012). Marital, reproductive, and educational behaviors covary with life expectancy. *Archives of Sexual Behavior*, *41*, 1409-1414.

McDermott, R., Fowler, J. H., & Smirnov, O. (2008). On the evolutionary origin of prospect theory preferences. *The Journal of Politics*, *70*, 335-350.

Mishra, S. (2014). Decision-making under risk: Integrating perspectives from biology, economics, and psychology. *Personality and Social Psychology Review*, *18*, 280-307.

Mishra, S., Barclay, P., & Sparks, A. (in press). The relative state model: Integrating need-based and ability-based pathways to risk-taking. *Personality and Social Psychology Review*.

Mishra, S., & Lalumière, M. L. (2008). Risk taking, antisocial behavior, and life histories. In J. Duntley & T. K. Shackelford (Eds.), *Evolutionary forensic psychology: Darwinian foundations of crime and law* (pp. 176-197). New York: Oxford University Press.

Scott-Phillips, T.C., Dickins, T.E., & West, S.A. (2011). Evolutionary theory and the ultimate-proximate distinction in the human behavioral sciences. *Perspectives on Psychological Science*, *6*, 38-47.

Sell, A., Tooby, J., & Cosmides, L. (2009). Formidability and the logic of human anger. *Proceedings of the National Academy of Sciences USA*, *106*, 15073-15078.

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review*, *63*, 129-138.

Stephens, D. W., & Krebs, J. R. (1986). *Foraging theory*. Princeton: Princeton University Press.

Todd, P. M., & Gigerenzer, G. (2012). *Ecological rationality: Intelligence in the world*. Oxford University Press.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*, 1124-1131.

Volz, K. G., & Gigerenzer, G. (2012). Cognitive processes in decisions under risk are not the same as in decisions under uncertainty. *Frontiers in Neuroscience*, *6*:105.