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Over the past two decades, the study of the neural mechanisms of decision-making has flourished. A distinctive and valuable aspect of this research is that it has adopted a strongly inter-disciplinary flavor: theories, constructs and experimental methods are borrowed, as they prove useful, from a variety of disciplines including psychology, economics, cognitive and behavioral neuroscience, as well as computer science and artificial intelligence. Ideas and challenges have also come from the study of behavioral ecology, and applications in understanding financial and consumer decision making. This emerging field has attracted a variety of labels to capture its essence and coalesce efforts, most prominently the terms 'neuroeconomics' or 'decision neuroscience' [1,2].

This issue of the Current Opinion of Behavioral Sciences brings together contributions which form a group portrait of the breadth of questions and methods currently being pursued in the field. Our attempt at breadth in coverage across the various topics necessitates a compromise in the depth to which each individual topic can be addressed. We have typically invited a single set of authors to address each relevant topic, rather than seeking multiple discussions of a smaller number of themes. As the term 'opinion' in the journal's title allows, the special issue is not designed to provide thorough encyclopedic coverage of all points of view. The issue simply takes stock of some domains and highlights areas of future exploration over the next decade.

A major question that has been posed both from within as well as from outside the field is the impact that insight into the neural mechanisms of decision-making might have on its contributing disciplines. This question is particularly interesting for economics, which has traditionally been happily disinterested about whether and how hypothesized choice optimization is carried out biologically [3,4]. Given this tradition, can neuroeconomics findings help to build new theories in economics, or just impose constraints on existing theories? Krajbich and Dean give a positive answer, by identifying specific areas in which they contend findings from neuroeconomics can usefully impact on economic theory. Taking a different perspective, Bossaerts and Murawski, trace a lineage of ideas and findings from behavioral economics to neuroeconomics and ultimately to decision neuroscience. They espouse the perspective that rather than exclusively using economic theory as a lens to understand the brain, insights from the study of the neural basis of decision making can and should be used to construct novel theories of decision-making, without being restricted by constraints of existing theories.

A challenge in this new inter-disciplinary area is that researchers coming from different disciplines tend to invoke different terminology, use different experimental approaches, and sometimes focus on distinct questions. As the field matures, it could be argued that it is desirable that we find a common language and elucidate commonalities in the tools we are using and questions that are being posed. For instance, researchers coming from an economic perspective might use concepts such as 'decision utility' or 'experienced utility' to describe decision-making variables, while those coming from a more animal learning theory perspective might use terms such as stimulus-outcome associations and 'learned outcome values' to describe constructs which are at least partly overlapping with what the economists are talking about. In this issue Padoa-Schioppa and Schoenbaum attempt to bridge the gap between economics-based approaches to the study of decision-making and learning theory based approaches. As you will see, there is much they can agree on, and those issues on which agreement is less forthcoming might potentially identify fruitful areas for further research from both perspectives.

Another major theme in neuroeconomics over the past decade has concerned an attempt to characterize the neural mechanisms underlying decision-making under risk. In particular, a key discovery has been the finding of neural signals corresponding to the risk present in a particular decision option in the brain during decision-making, distinct from other variables such as its expected value or outcome probability [5,6]. Knutson and Huettel summarize this literature, and propose the existence of a 'risk matrix' in the brain that may underpin the capacity to make decisions under risk.

A classical set of findings from behavioral economics is the existence of a number of context-dependent violations of rational choice behavior that can pose challenges to classical normative decision theories from economics [7]. Specifically, patterns of choice (e.g. 'decoy effects') are inconsistent with the idea that separate choice objects have object-specific utility which is invariant to what other choices are being compared. It is now becoming increasingly clear that value signals in a number of places in the brain are not encoded in an absolute manner that is invariant as to the context, but instead are encoded in a context-dependent manner: Value signals are modulated as a function of the relative value of other options in the choice set. An intriguing hypothesis is that such relative value codes may potentially account for at least some of the context-dependent violations of rational choice that have been observed in the behavioral literature. Louie *et al.* describe some context-dependent choice biases and provide an interpretation of the relationship between such biases and adaptive value coding in the brain.

Perhaps the single greatest success story in the investigation of the neural basis of value-based decision-making over the past two decades has been the discovery that the phasic activity of dopamine neurons in the midbrain, measured by single-unit recording of spike rates, appears to encode prediction errors from a class of formal computational models called reinforcement learning [8]. Schultz *et al.* review recent literature suggesting a role for dopamine prediction errors in tracking subjective value or utility.

Understanding how the brain learns to select actions on the basis of past reinforcement has grown as a result of the initial evidence that the dopamine encodes reward prediction errors. However, little attention has up until now been paid to how the brain represents features or states of more complicated decision problems, such as in decisions involving many possible choices, with a sequence of follow-on decisions and consequences. Botvinick *et al.* focus on the principles of how these representations could be efficiently coded in the brain.

They suggest that representations could potentially exploit the natural statistics of how relevant decision variables are encoded in decision-making problems encountered in everyday life. Gershman *et al.* consider how the brain might perform inference in order to discover the (often hidden) structure of a decision problem. Here they focus on the problem of inferring the hidden cause of a particular outcome across different contexts in classical conditioning.

Another influential theme in the past decade has been the hypothesis that mammalian choice behavior is the result of an interaction between a number of independent systems that use different computational strategies for making decisions. Two systems for which there is substantial distinct evidence are a model-free habitual system and a more effortful, computationally intensive goal-directed system [9,10]. An on-going question in the literature is how the interactions between these different systems are controlled. Balleine *et al.* propose that action selection is controlled in a hierarchical manner: goal-directed actions at the top of the hierarchy are used to drive selection of lower level action chunks. Those lower level chunks can be described as habitual, since one component action in the chunk automatically triggers the next action in a type of cascade. Continuing on the multiple interacting systems theme, Shohamy and Daw also consider the important role that a hippocampal dependent memory system might play in decision-making. They suggest that stored memories might be used in one of two ways to guide decisions: in either a retrospective or prospective manner.

Researchers studying the neural basis of decision making have also borrowed constructs and paradigms from the fields of behavioral ecology and ethology. The approach to decision making in these fields is properly situated in evolutionary context and related to naturalistic real-world behaviors that animals need to perform in order to