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Interdisciplinary Perspectives on Decision Making

Introduction

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In October 2006, a group of young PhD students and postdocs from all over Europe followed the call of the German Volkswagen foundation to convene in Berlin and discuss their common research interests. The Volkswagen initiative, called the "European Platform for Life Sciences, Mind Sciences, and the Humanities" (www.volkswagenstiftung.de/funding/off-the-beaten-track/european-platform-for-life-sciences-mind-sciences-and-the-humanities.html) aims to promote the networking and interaction of young academics doing research at the interface between the cognitive neurosciences, humanities, and social sciences. The initiative is genuinely multidisciplinary, and the participants' backgrounds range from psychology and philosophy through psychiatry, engineering, mathematics, and neuroscience to economics and social science.

At the inaugural meeting, participants split up into smaller groups, one of which was based on a shared scientific interest in decision-making. About half of the contributors to this special issue participated in that group. Even though we had opportunities for several days to discuss our views of what decision-making is, requires, and involves, we failed to come to a consensus, and we disagreed even on the very definition of our research topic. Despite our dissent, we quickly realized that the divergence in our ideas and methodological approaches was anything but a disadvantage, and that there is potentially much to gain from an intensified interaction. But we also appreciated that a first necessary step was to collect the different views and perspectives on decision making and locate them within a common context. Thus, the idea for this special issue was born.

As the title suggests, the core purpose of this issue is to gather interdisciplinary perspectives on decision making. We strongly emphasize the interdisciplinarity and, even though this issue obviously contains articles from both emerging and well-established disciplines, we particularly encouraged less conventional synergies—for example, between philosophy and psychiatry, or systems engineering and psychology. A further aim is to bridge the gap between junior academics and internationally recognized senior scientists (although we acknowledge that some of the senior people are actually also still quite junior in "absolute" terms). We therefore aspired to an equal balance between contributions from as yet less established and those from well-known authors. Finally, we hope to promote an improved interaction between yet (more or less) isolated disciplines, and to stimulate more cooperative future research among the various disciplines.

As a starting point, we asked every contributor to provide us with his/her own view of decision making. Their answers illustrate the divergent perspectives of the different fields on the science of decision making, and the protagonists' expectations thereof. Representatives of the economists' fraction, for example, emphasized the stochastic nature of choice as a natural link between economic models and cognitive and neuroscience theories of decision. They also stressed the "as if" flavor of economic decision models ("as if" models are theories that predict choice without any claim that it spells out how exactly choice comes about). This was mirrored by the behavioral ecologists' definition, according to which a decision occurs whenever an animal produces one action in the face of alternatives, regardless of the mechanism through which this happens. However, the economists also stressed that the intensified collaboration between psychology and neuroscience confirmed that individuals indeed make decisions as predicted by economic and ethological theory. In additon, the same collaboration has also changed the prescriptive approach in the direction of a more process-based approach by showing that elements of some "as if" decision models appear to be encoded in the human and nonhuman primate brain.

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Congruent with this alleged process-oriented approach, the neuroscientists' views focused less on the prescription of choice, but more on probing the actual process of decision making. In particular, key issues involve how the brain trades off rewards against costs, how it weighs the different choice alternatives, and how it evaluates the predicted outcomes. Moreover, it is essential to understand the dynamics of the processes with which the available alternatives are assessed and weighed, on the basis of learned and immediate sources of information.

Philosophical notions emphasized the intention to act as an essential component of a decision. In this view, the core process of decision making would be that of forming the intention to perform one of several available actions, and then eventually performing this intentional action. The psychologists' and psychiatrists' views were also process based, but more diverse. Some definitions took on a more economic flavor and viewed decision making as the continuous process of matching internal preferences with available choice options or evaluating options in relation to a given decision criterion. In contrast, other definitions focused more on the conflict of choice-underlying motives, and viewed decision making as the process of balancing conflicting motives under restricted conditions of time and resources, resulting in the selection of a course of action. Yet other notions highlighted the multiplicity of processes leading to the initiation of an appropriate action in a given situation and the social aspect of choice, because everyday decisions rarely occur in a social vacuum.

Despite their differences, all the definitions held the common view that decision making consists of the selection of one out of several alternative courses of action. Even though the mutual agreement on this very basic classification is not very astonishing, it is interesting to note that only one of the definitions included a clear demarcation between decision-related processes and other processes. Such delineation is not self-evident. Even rods and cones in the retina have the (limited) freedom to respond in one way or another to a photon, but this would hardly be called a decision. Thus, there may be no clear agreement about what actions do *not* involve a decision—for example, physiological responses, reflexes, or habitual or random action selection. Maybe this is because one is left with the further problem of defining such exclusion criteria as soon as they are invoked.

The author who was concerned with exclusion criteria mentioned the following: The difficulties in finding precise exclusion criteria may arise from introspection (or from a dominant psychological view). For example, pulling a foot from the fire may not qualify as a decision if viewed from an introspective or psychological perspective, but it might if viewed from an evolutionary or developmental perspective. Introspection and psychology suggest that "decisions" are flexible and stochastic, and less stereotypical than would be expected from a purely reflexive evolutionary and developmental mechanism. The latter processes may indeed be "decisions" per se, but it is important to remember that there may or may not be mechanistic differences between these flexible "decisions" and more stereotypical "decisions" such as pulling one's foot from the fire. We simply do not yet know.

The distinct approaches to the definition of decision making are reflected in the wide array of contributions to the present special issue. They include such diverse topics as computational approaches to learning and decision making (Dayan & Daw, pp. 429–453), a framework inspired by systems engineering that adds a systems-theoretical twist to the study of decision making (Scherbaum, Dshemuchadse, & Kalis, pp. 454–474), and an ethological analysis of animal foraging from a behavioral ecological perspective (Stephens, pp. 475–484). Moreover, this issue also contains novel approaches from economics and neuroeconomics regarding how to investigate distinct conceptualizations of utility (d'Acremont & Bossaerts, pp. 363–374) and an assessment of what such distinctions entail (Glimcher, pp. 348–354). Other articles review the currently contemplated question of whether decisions are based on one or two systems. In the single-system view, decision making is a distributed nonhierarchical process, whereas in the dual-systems view, decisions are the product of an emotional, automatic system and a cognitive, controlled system (Rustichini, pp. 355–362). Other contributions discuss the neuronal correlates of trading off reward magnitude, probability, and effort (Floresco, St. Onge, Ghods-Sharifi, & Winstanley, pp. 375–389) and compare the functions of the anterior cingulate and orbitofrontal cortex in social and emotional decision processes (Rudebeck, Bannerman, & Rushworth, pp. 485–497). The more philosophical contributions provide an investigation of the role of conceptual representations in human and animal decision making (Shea, Krug, & Tobler, pp. 418–428), investigate the commonalities of irrationality as discussed in philosophy and clinical impairments of decision making as studied in psychiatry (Kalis, Mojzisch, Schweizer, & Kaiser, pp. 402–417), and combine views from ethics, economics, psychology, and neuroscience into an interdisciplinary perspective on how moral utility may affect decision making (Tobler, Kalis, & Kalenscher, pp. 390–401). Finally, the role of time in decision making is also considered (Klapproth, pp. 509–524), and the ways in which social factors affect human and animal decision making are reviewed (Mojzisch & Krug, pp. 498–508).

Several of the articles suggest interesting future directions that could be pursued. For example, Mojzisch and Krug (pp. 498–508) focus on the neuronal correlates of social influence. They note that although the psychology of social influence has a research tradition of more than 50 years, this field's interdisciplinary cross-talk with neuroscience has only just begun. An open question is whether social influence affects primarily sensory, perceptual, or higher order components of the decision process. To address this question, the authors propose a perceptual decision experiment in nonhuman primates, during which one primate makes a perceptual decision after having observed the decision of another primate given the same sensory input. Another example for future investigation concerns distinct but related concepts of value from finance and microeconomic theory,

as introduced by Glimcher (pp. 348–354) and further elaborated by d'Acremont and Bossaerts (pp. 363–374). It is currently not clear whether the brain uses the concepts suggested by microeconomics, by finance, or both to compute the value of choice options. D'Acremont and Bossaerts suggest a neuroscientific experiment on how to disentangle these concepts. Philosophical and economic contributions also point out the necessity and importance of theoretical and conceptual clarifications for such an interdisciplinary endeavor (e.g., Kalis et al., pp. 402–417; Rustichini, pp. 355–362; Shea et al., pp. 418–428). Often only such theoretical advances can allow meaningful interpretations of empirical findings, and they are absolutely essential for interdisciplinary research, where conceptual pitfalls and differential use of the same scientific terms loom in many corners. Conversely, only experimental work will allow us to find out whether proposed theoretical terms have a meaningful empirical basis.

Finding a common terminology will be beneficial for the interdisciplinary study of decision making. For example, the term *rationality* is used in economics (cf. d'Acremont & Bossaerts, pp. 363–374; Glimcher, pp. 348–354), ethology (Stephens, pp. 475–484), and philosophy (Kalis et al., pp. 402–417) to characterize a certain type of decision making. However, even though these fields' different conceptions of rationality overlap in part, they sometimes assume quite dramatically divergent connotations. Particularly the philosophical approach to analyzing the meaning of concepts such as rational action could enrich existing theories in economics, biology and psychology and might stimulate new research in neuroscience (cf. Kalis et al., pp. 402–417).

Even though interdisciplinarity is a fashionable, almost overstretched word in science today, we think that the reality of cross-disciplinary interactions is much more sobering, and communication between different disciplines is still sparse at best. The articles in this special issue suggest that it *is* possible to bridge the gap between such diverse fields as systems engineering, computational modeling, mathematics, behavioral ecology, ethics, general philosophy, and, of course, neuroscience and psychology. We hope to have moved a step forward in the right direction, and trust that this special issue will foster a more vivid and intense interaction among all people interested in understanding how the brain makes decisions.

As a concluding note, we should like to express our great thankfulness to Deanna Barch and the rest of the *CABN* team for making this special issue possible, trusting us with our editorial work, and providing the best possible support.

REFERENCES

d'Acremont, M., & Bossaerts, P. (2008). Neurobiological studies of risk assessment: A comparison of expected utility and mean–variance approaches. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 363-374.

Dayan, P., & Daw, N. D. (2008). Decision theory, reinforcement learning, and the brain. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 429-453.

Floresco, S. B., St. Onge, J. R., Ghods-Sharifi, S., & Winstanley, C. A. (2008). Cortico-limbic-striatal circuits subserving different forms of cost–benefit decision making. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 375-389.

Glimcher, P. W. (2008). Understanding risk: A guide for the perplexed. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 348-354.

Kalis, A., Mojzisch, A., Schweizer, T. S., & Kaiser, S. (2008). Weakness of will, akrasia, and the neuropsychiatry of decision making: An interdisciplinary perspective. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 402-417.

Klapproth, F. (2008). Time and decision making in humans. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 509-524.

Mojzisch, A., & Krug, K. (2008). Cells, circuits, and choices: Social influences on perceptual decision making. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 498-508.

Rudebeck, P. H., Bannerman, D. M., & Rushworth, M. F. S. (2008). The contribution of distinct subregions of the ventromedial frontal cortex to emotion, social behavior, and decision making. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 485-497.

Rustichini, A. (2008). Dual or unitary system? Two alternative models of decision making. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 355-362.

Scherbaum, S., Dshemuchadse, M., & Kalis, A. (2008). Making decisions with a continuous mind. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 454-474.

Shea, N., Krug, K., & Tobler, P. N. (2008). Conceptual representations in goal-directed decision making. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 418-428.

Stephens, D. W. (2008). Decision ecology: Foraging and the ecology of animal decision making. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 475-484.

Tobler, P. N., Kalis, A., & Kalenscher, T. (2008). The role of moral utility in decision making: An interdisciplinary framework. *Cognitive, Affective, & Behavioral Neuroscience*, **8**, 390-401.