The neuroscience and psychophysiology of experience-based decisions: an introduct...

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Experience-based decisions can be defined as decisions emanating from direct or vicarious reinforcements that were received in the past. For example, in a typical setting a person initially faces blank buttons and needs to press any of them without prior information concerning the selection outcomes. Upon pressing a button the participant receives monetary outcomes (e. g., “ you won $5”) and then, based on this experience, makes another selection. Quite often hundreds of trials of this sort are administered. The outcomes of the two alternatives are usually sampled from different payoff distributions (e. g., a button producing a fixed payoff of $5 could be contrasted with a button producing risky payoff, such as wining $9 or $1 with equal likelihood). This allows examining the decision response to different incentive structures without explicit information concerning their statistical properties.

The current Research Topic aims to integrate various works in this area that have been conducted in Decision science and Neuroscience. The study of experience-based decisions has recently revealed some robust regularities that differ from how people make decisions based on descriptions (i. e., where the participants have full information about the outcome distributions but no feedback). For example, people were found to underweight small probability events in experience-based decisions, while overweighting them in decisions based on descriptions. This is now commonly referred to as the description-experience gap (Hertwig and Erev, 2009). In parallel to the recent advancement in Decision Science, neuroscientists have for a long while used the experience-based decisions paradigm for analyzing brain-behavior interactions. For example, phenomena such as the feedback-based

Error-Related Negativity (fERN) in event-related potentials (Gehring and Willoughby, 2002) and the role of non-declarative knowledge in selecting advantageously were discovered using experience-based tasks. The goal of the current Research Topic was to combine these two disciplinary sources concerning experience-based decisions.

As expected, several works in this Research Topic explored the “ underweighting rare event” tendency. Zhang and Maloney (2012) propose a logit model for this tendency as well as some other robust biases, and also suggest that the underweighting tendency may be driven by basic properties of neural transmission. Upton et al. (2012) propose that underweighting rare events may underlie some of the differences found between neuropsychological populations and controls in complex tasks such as the Iowa Gambling task. By contrast Glöckner et al. (2012) do not replicate the underweighting phenomena in decisions from sampling both in behavior as well as in eye point of gaze. Finally, Nevo and Erev (2012) investigate the immediate aftermath of a rare event and highlight a phenomenon whereby surprising events trigger a change in the participants’ response.

Other authors focused on the issue of consistent preferences in experience-based tasks. Yechiam and Telpaz (2011) demonstrate consistency between tonic (at rest) arousal and risk taking, and show that it is more prominent in tasks with losses. In an important critique, Marchiori and Elqayam (2012) present some boundaries for consistency in risk taking. Ert (2012) retorts by arguing that most of these boundaries have been demonstrated in decisions from description, while in experience-based decisions consistency of individual differences is more robust. Relating to this, Warren and Holroyd (2012) show that the rapid fERN phenomena, which demarcates the rapid frontal cortical sensitivity to negative/positive outcomes, is larger in a condition involving active learning similar to an experience-based task, than in a condition involving passive learning.

Wang et al. (2012) examine the issue of whether choices in an experience-based task are guided by unconscious motivations, as evidenced by advantageous choices in the absence of conscious awareness of the difference between outcomes. Their results suggest a role for unconscious motivations. Such findings are very often interpreted as denoting dual processes or systems. Investigating the influence of dual processes, Hawes et al. (2012) focus on cognitive strategies in a complex decision task and their neural correlates, and their result demonstrate a combination of bottom-up experience-based learning and abstract learning. Sela et al. (2012) focus on an inhibition-related dual process and show that weak transcranial stimulation in the left hemisphere has the ability to affect risk taking, stressing the role of balance between theta activity in the two hemispheres. Finally, Warren and Holroyd (2012) propose two neuromodulatory systems in learning and decision making but stress the context-specific nature of the conditions for the activation of these two systems. For instance, changing the task context from gender to color provided sufficient conditions for differentially activating the two systems.

Finally, several authors examined the effect of social versus private environments, a research area often addressed by both decision and neuroscience models. Grygolec et al. (2012) show that in an experience-based task both the striatal and behavioral response to risk greatly differs in a social versus private setting. Investigating a similar domain, de Bruijn and von Rhein (2012) find that the context in which a person makes a decision with other people greatly determines how others' payoffs are perceived and the frontal mechanisms activated upon them. In a related work, Fahrenfort et al. (2012) show that sharing in a public good game prompts activation of neural systems associated with reward (striatum), but also empathy (anterior insular cortex and anterior cingulate cortex). Finally, Marchiori and Warglien's (2011) study demonstrates that a neurally inspired model can explain changes in participants' responses to different social dilemmas.

We believe that the current Research Topic led to some transfusion of ideas between the two disciplinary sources of Decision science and Neuroscience in key issues related to experience-based decisions (though see our concluding paper for some gaps that remain unresolved). Reflecting on one emergent theme, it appears that brain-behavior relations are quite unstable and may form or unform in different contexts. Contexts that facilitate the relation between frontal processes and behavior, and have been discussed in this Research Topic, include the availability of active choice, feedback, and losses. This sheds light on why experience-based tasks, which typically include these three components, are quite often used in neuropsychological assessment batteries for evaluating brain dysfunctions.

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