Environmentally-induced changes in midfrontal theta power modulate maladaptive decision-making

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Résumé

In many situations, choices require the selection of actions based on the expected value (i.e., the probability of obtaining a reward) associated with each option. This process allows humans and animals to learn optimal decision-making strategies, i.e., strategies that maximize gains and minimize losses. Recently, it has been demonstrated that environmental cues can interfere with this adaptive process, biasing people towards maladaptive (or, suboptimal) choices. Nevertheless, the neurophysiological mechanisms of this phenomenon are still largely unknown. We hypothesize that this maladaptive bias reflects a failure of cognitive control over motivational processes. More specifically, the presence of an environmental cue associated with a suboptimal choice can provoke a cognitive conflict that might be solved either in favor of the optimal or the suboptimal decision-making strategy. Accordingly, our study tested whether widely used oscillatory (i.e., midfrontal theta activity) markers of cognitive control can predict the ability to adaptively overcome (or not) maladaptive bias in a Pavlovian-to-Instrumental Transfer paradigm. Specifically, participants learned an optimal decision-making strategy through instrumental learning, which consisted of allocating more choices to a richer option (i.e., an option that was paired with a reward in 70% of trials) as compared to a poorer option (i.e., an option that was paired with a different but equally motivational reward in 30% of trials). Then, Pavlovian cues predictive of the two rewards were introduced during decision-making, and their ability to alter the optimal decision-making strategy, unbalancing choice in favour of the predicted option, was tested, while EEG was continuously recorded. Our results confirm our hypotheses and advance comprehension of the causes of maladaptive decision-making and its neural correlates, providing crucial insights into possible clinical implications, such as addiction or risk-taking behavior.

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