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Understanding psychiatric disease by capturing ecologically relevant features of learning and decision-making

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HighlightsTasks incorporating ecological features provide insights into learning and decision-making

- Distinct neural processes are recruited depending on the precise nature of the task
- Computational modelling can help dissect component processes in complex scenarios
- Psychiatric research may benefit from combining modelling with ecological tasks

ABSTRACT
Recent research in cognitive neuroscience has begun to uncover the processes underlying increasingly complex voluntary behaviours, including learning and decision-making. Partly this success has been possible by progressing from simple experimental tasks to paradigms that incorporate more ecological features. More specifically, the premise is that to understand cognitions and brain functions relevant for real life, we need to introduce some of the ecological challenges that we have evolved to solve. This often entails an increase in task complexity, which can be managed by using computational models to help parse complex behaviours into specific component mechanisms. Here we propose that using computational models with tasks that capture ecologically relevant learning and decision-making processes may provide a critical advantage for capturing the mechanisms underlying symptoms of disease in psychiatry. As a result, it may help develop mechanistic approaches towards diagnosis and treatment. We begin this review by mapping out the basic concepts and models of learning and decision-making. We then move on to consider specific challenges that emerge in realistic environments and describe how they can be captured by tasks. These include changes of context, uncertainty, reflexive/emotional biases, cost-benefit decision-making, and balancing exploration and exploitation. Where appropriate we highlight future or current links to psychiatry. We particularly draw examples from research on clinical depression, a disorder that greatly compromises motivated behaviours in real-life, but where simpler paradigms have yielded mixed results. Finally, we highlight several paradigms that could be used to help provide new insights into the mechanisms of psychiatric disease.

Keywords: reinforcement learning

- decision-making
- computational psychiatry