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Cognitive Flexibility: a translational magnetoencephalographic study

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Cognitive flexibility, enabling behavioral and cognitive adjustments to ever-changing environments is essential to survival. It is often examined using rule-learning and rule-switching paradigms. Current learning models often operate accurately in environments with few dimensions but fail to perform accurately in multidimensional settings such as our outer world. They also fail to account for moments of sudden insight shaping learning processes.
The employed multidimensional learning paradigm offers a solution as to how humans achieve a reduction of the multidimensional outer world by attention-modulated trial-by-trial testing for strategies as well as offering the employment of strategies as an explanation to moments of sudden insight occuring in learning. It further achieves to demonstrate that behavioral strategies are constituted by sequentially activated neural dynamics on a single subject-level, as well as showing strategies are differentially neurally encoded both on single- and cross-subject level. Strategies attending to the same stimulus are shown to share common whole-brain representation differentiating them from strategies attending to other stimuli. Participants were seen to be set on which strategy they would execute, and which stimulus dimension they would attend to preceding stimulus onset. This reflects the use of top-down attention in attention-modulated strategy use during learning.
The paradigm is validated both at the behavioral and neural level through the correlation with behavioral variables obtained during independent and validated neuropsychological testing of executive functioning (*CANTAB*). At the behavioral level, participants' performance in the rule-learning and switching task *IED* transferred to performance metrics in the employed paradigm. At the neural level, decoding accuracy of attentional strategies correlated with *OTS* and *SWM* performance parameters in the test-specific frontal sensor space. This notably underlines the employement of strategies as an efficient means of executive planning and task organization.
These findings validate the employed multidimensional rule-learning paradigm as an effective assessment of executive functions in learning. Together with rodent results, this paradigm is suited as a translational paradigm. The implication and importance of these questions stem from the number of neuropsychiatric disorders affected by cognitive inflexibility, with hope of a better understanding giving way to better prevention, diagnose and treatment for affected patients.