fMTP: A Unifying Computational Framework of Temporal Preparation across Time Scales

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Abstract

Temporal preparation is influenced by factors across a range of time scales, from effects of the previous trial to learning effects throughout entire experiments. Theories on temporal preparation thus far have failed to offer a complete account of these effects. We present the formal multiple trace theory of temporal preparation (fMTP), a computational framework that integrates theories on time perception, motor planning, and associative learning. At fMTP's core lies Hebbian, associative learning between a layer of time cells and a motor layer. Its preparatory state is governed by the automatically retrieval of traces formed in the past. We show that fMTP, with only this single implicit learning mechanism, accounts for behavioral phenomena across a range of time scales that previously have been considered to be the result of distinct processes. Furthermore, for experimental setups where the predictions of existing accounts and fMTP differ, the data aligns with our model.