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Preparing to act follows Bayesian inference rules

Friday, September 12, 2025 6:00 PM (10 minutes)

Introduction
Predictive brain theories suggest that the brain builds internal models to anticipate sensory inputs. Recent findings show that such models influence early sensory representations, shaping perceptual outcomes. Here, we hypothesized that this integration process extends along the cortical hierarchy, reaching the motor system. Specifically, we propose that cortico-spinal excitability (CSE) is modulated in anticipation of actions consistent with prior expectations, reflecting preparatory activation of congruent motor representations.

Methods
Sixty-two participants performed a probabilistic discrimination task while receiving bilateral single-pulse TMS over the primary motor cortices (M1s). Motor-evoked potentials were recorded to assess CSE associated with prior-congruent versus incongruent actions, separately encoded by the two hands.

Results
Prior information modulated CSE before movement execution, primarily through suppression of M1 activity coding for prior-incongruent actions. This motor modulation reflected the behavioral bias introduced by prior cues, supporting a link between motor preparation and decision-making. Notably, we identified substantial interindividual variability in prior-driven CSE modulation, revealing two distinct predictive strategies: believers, who strongly relied on priors and showed selective CSE tuning, and empiricists, who downplayed priors and exhibited more balanced excitability. These differences were associated with individual cognitive traits:believers had higher schizotypal, whereas empiricists showed stronger autistic-like traits.

Discussion
Our findings demonstrate that predictive models shape not only perception but also action readiness, as reflected in CSE dynamics. Moreover, CSE modulation offers a physiological marker for individual differences in predictive processing, shaped by subclinical cognitive phenotypes. This work highlights the motor system as a key site for integrating expectations into decision behavior.

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