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Distributed encoding of action-mediated outco consistent population dynamics during goal-di

European Neuroscience Institute Göttingen (ENI-G)

Anticipating the outcomes of actions is central to goal-directed behaviour, but how such expectations are encoded across the brain during ongoing movement remains unclear. To address this, we recorded spiking activity from cortical and subcortical regions using multiple Neuropixels probes simultaneously in head-fixed mice performing a water-reaching task. We found that distributed neural population dynamics were strongly modulated by the availability of reward beyond their encoding of forelimb kinematics. Principal component analysis revealed conserved population dynamics across brain regions and sessions that depended on reach amplitude and reward availability. Generalized linear models revealed outcome-related encoding within region-specific population dynamics, in addition to kinematic encoding, with the strongest outcome signals expressed in frontal cortico-thalamic regions. Unsupervised cluster analysis further identified outcome-encoding subpopulations that were enriched in frontal cortices and disproportionally contributed to the shared global latent dynamics. Together, these findings demonstrate that action-mediated outcome expectations are encoded in movement-related population dynamics that are shaped by functional clusters of neurons across the brain.

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