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NEUROSCIENCE AND PHYSIOLOGY SEMINAR SERIES

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"Instructive Influence of Motor Cortex on Muscle Activity During Ethological Motor Behavior."

The primary motor cortex (M1) has expanded significantly across mammalian evolution, yet many behaviors persist after M1 disruption, challenging its perceived role in driving movement. Historically, studies have focused on highly constrained, stereotyped movements, leaving M1's role in natural behavior poorly understood. Funded by a DP2 award, we addressed this using a new paradigm where mice perform naturalistic climbing across unpredictable terrain. By combining rapid optogenetic inactivation, muscle recordings, and a novel statistical framework, we measured M1's direct influence on limb muscles. We found that M1 inactivation affects muscles only at specific activity states, with varying magnitudes. Contrary to existing views, this reveals that M1 instructs muscle activity patterns during naturalistic climbing. This influence primarily involves activating certain muscles rather than just correcting errors, contradicting prominent hypotheses. Large-scale multielectrode recordings indicated that M1's instructive influence relies on activity patterns distinct from those previously examined. Our unpublished results now show this instructive influence is present across a broad range of ethological behaviors. Collectively, these results overturn long-held assumptions, indicating that the persistence of behavior following M1 disruption has belied its broad involvement in natural movement.

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