# Propagating spatiotemporal patterning in motor cortex during movement initiation and execution

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## Abstract

Voluntary movement initiation involves the modulations of large groups of neurons in the primary motor cortex (M1). Yet, similar modulations occur during movement planning when no movement occurs. Here, we show that a sequential spatio-temporal pattern of excitability propagates across M1 prior to the movement initiation in one of two oppositely oriented directions along the rostro-caudal axis. Using spatiotemporal patterns of intracortical microstimulation, we find that reaction time increases significantly when stimulation is delivered against but not with the natural propagation direction suggesting that movement initiation requires a precise recruitment pattern in M1. Functional connections among M1 units emerge at movement onset that are oriented along the same rostro-caudal axis but not during movement planning. Finally, we show that beta amplitude profiles can more accurately decode muscle activity when these patterns conform to the natural propagating patterns. These findings provide the first causal evidence that large-scale, propagating patterns of cortical excitability and activity are behaviorally relevant and may be a necessary component of movement initiation. We also will present some preliminary findings that propagating patterns of activity in the high gamma frequency range carry information about movement execution.