

A Comparison of Widespread Motor Inhibition during Movement Preparation and Stopping

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Introduction

Corticospinal activity is inhibited during the preparation of actions and during stopping.

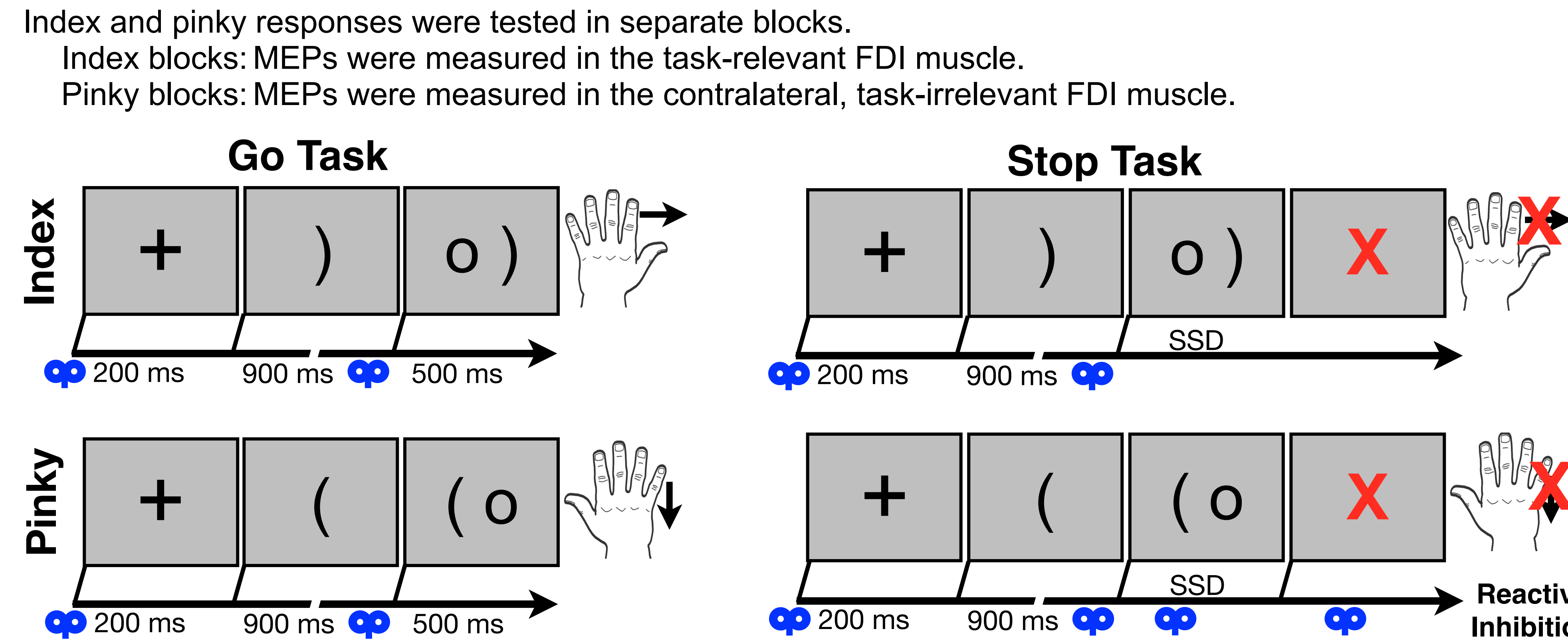
These signatures of preparatory and reactive inhibition are detectable in resting muscles that are irrelevant to the task^{1,2}.

Stopping is associated with cortico-basal ganglia circuits, whereas, to date, preparatory inhibition has been associated with transcortical circuits.

We examined the relationships between signatures of preparatory and reactive inhibition.

Transcranial magnetic stimulation (TMS) over right motor cortex was used to elicit motor evoked potentials (MEPs) from the left first dorsal interosseous (FDI) muscle during task performance.

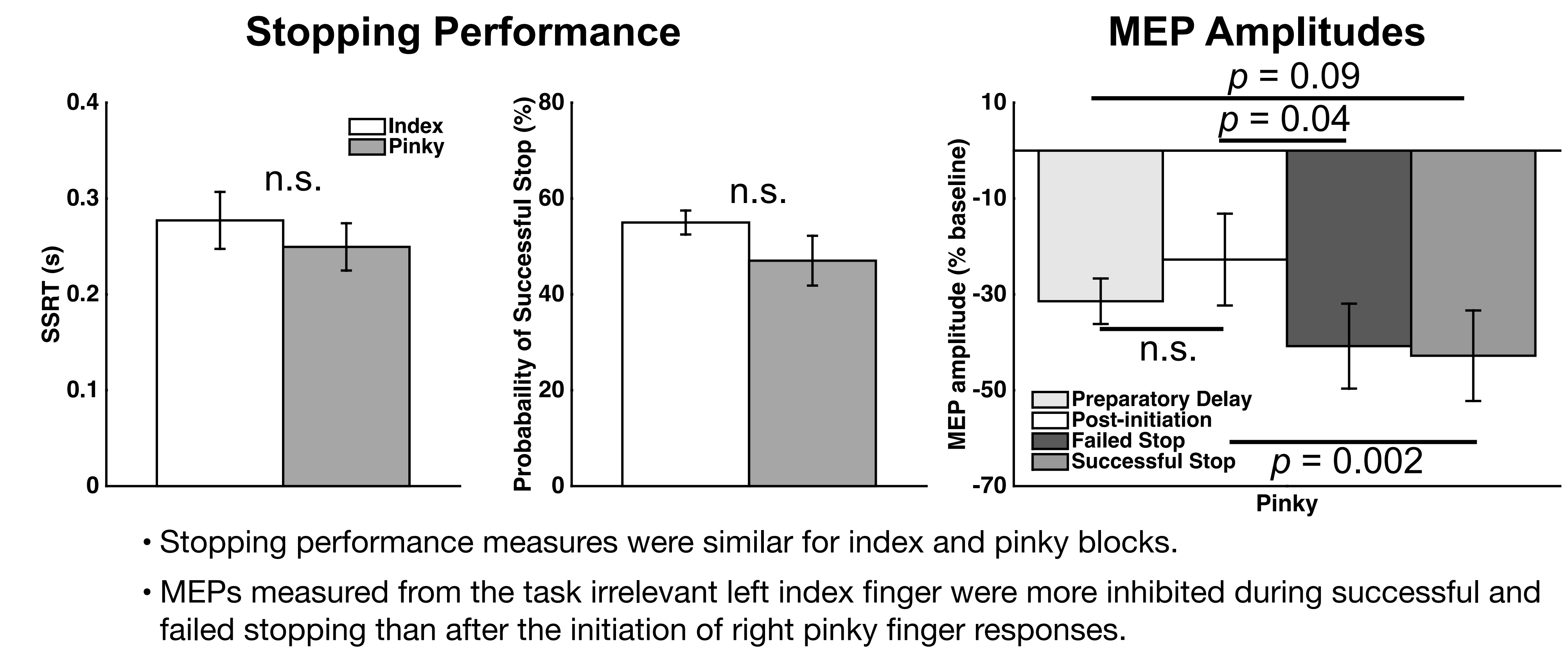
Task Design



Preparatory: MEPS measured 800 ms after the cue, relative to baseline.

Post-initiation: MEPs measured 150 ms post-imperative.
 Reactive: MEPs measured 150 ms post-stop signal
 Post-initiation and reactive only measured for pinky blocks.
 SSD adjusted dynamically to maintain ~50% stopping success rate.

Reactive Inhibition During Stopping

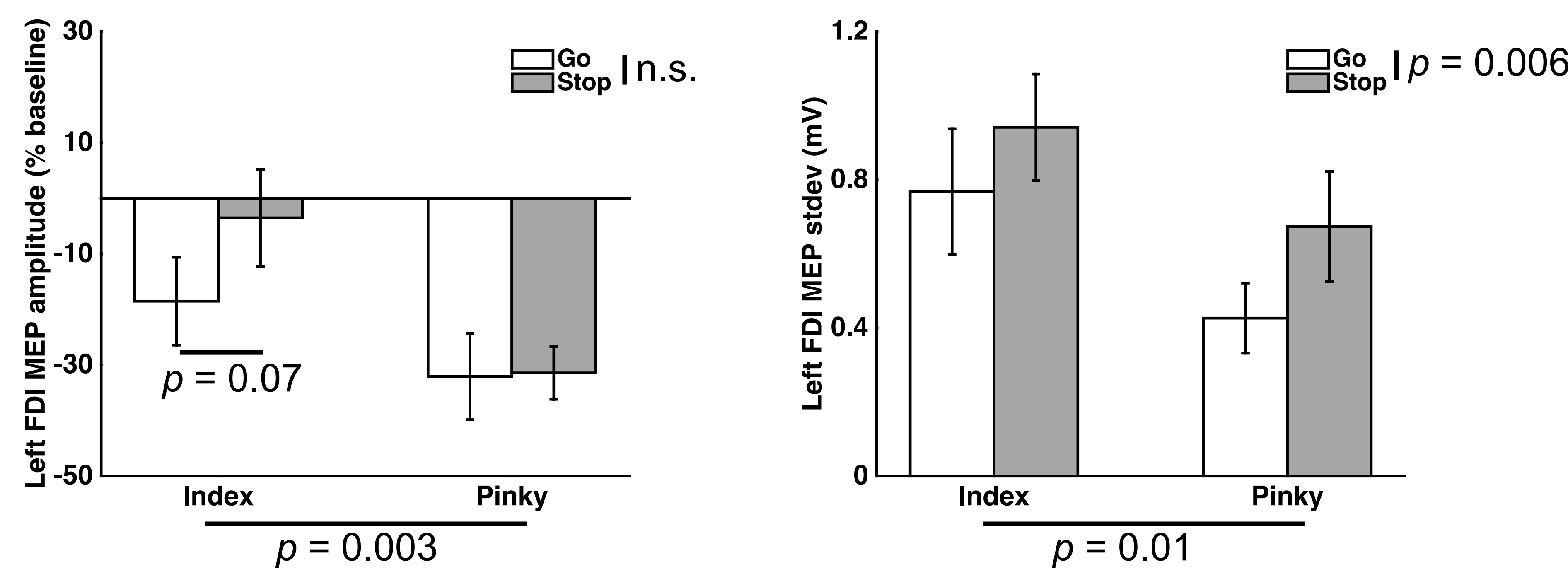


- Stopping performance measures were similar for index and pinky blocks.
- MEPs measured from the task irrelevant left index finger were more inhibited during successful and failed stopping than after the initiation of right pinky finger responses.

Going vs. Stopping Comparisons

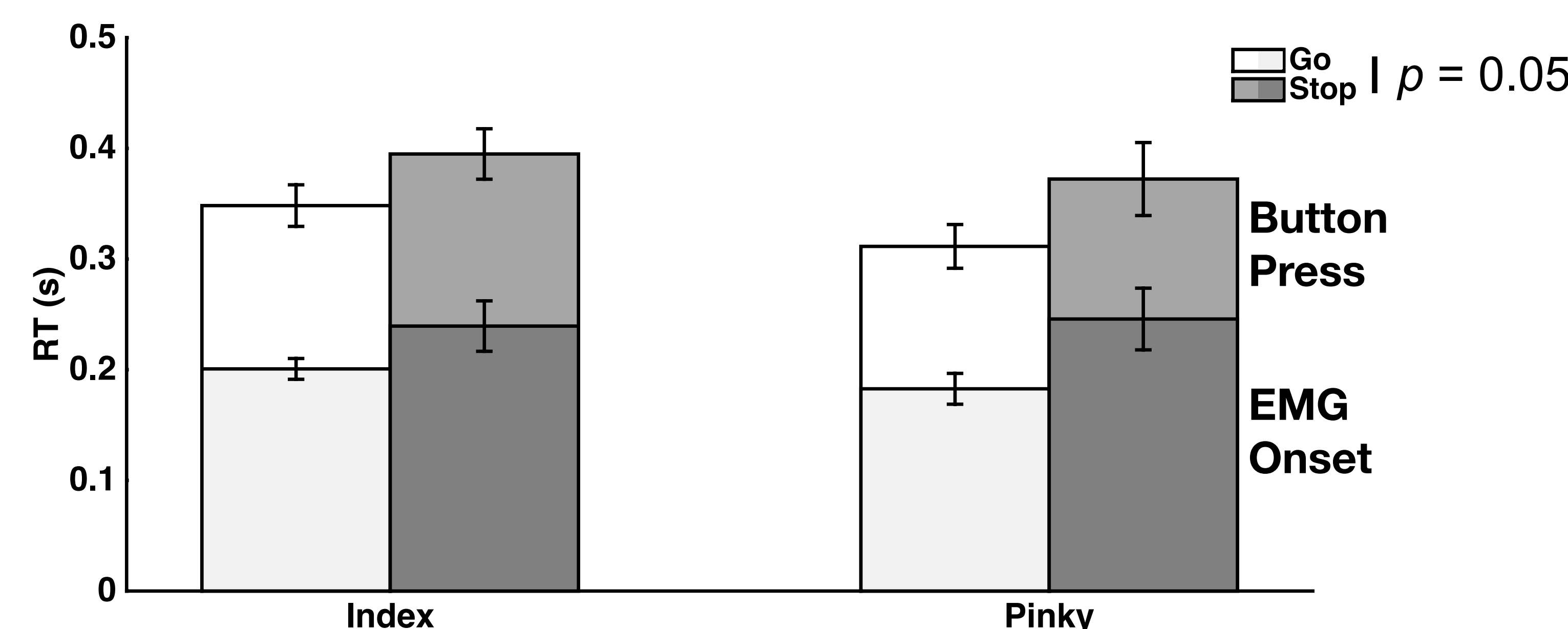
Anticipation of Stopping Influences MEPs & RTs

Preparatory Delay MEPs



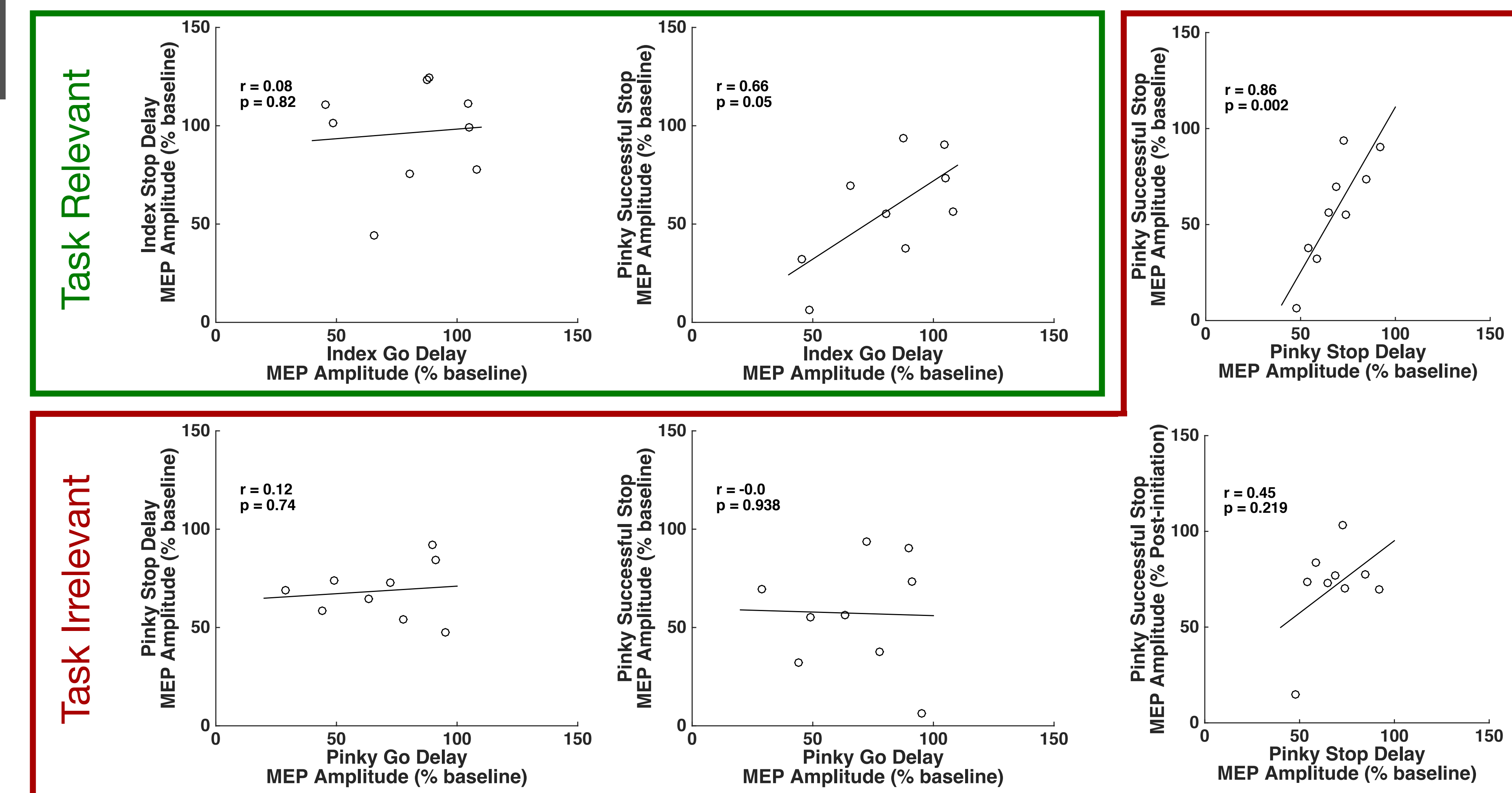
- Go Task:
 - Inhibition was observed late in the preparatory period, consistent with previous studies.
- Stop Task:
 - Inhibition was absent when the FDI was relevant to the task.
 - Inhibition was present when the FDI was irrelevant to the task.
- MEPs were more variable during Stop Task and when the FDI was task relevant.

Reaction Times (trials without TMS)



- RTs were slower on the Stop Task compared to the Go Task.
- Participants may have deferred preparation on stop blocks or been conservative in initiating a response in anticipation of a possible stop signal.
- Deferred preparation would be consistent with the absence of preparatory inhibition on Stop trials.

Is preparatory inhibition correlated between tasks? Are preparatory and reactive inhibition correlated between blocks? Within the same task block?



- The level of preparatory inhibition was not correlated between task conditions.
- Inhibition during stopping correlated with preparatory inhibition in a task relevant index finger.
- Inhibition during stopping correlated with preparatory inhibition in a task irrelevant index finger only when acquired within the same task block and relative to a common baseline.

Conclusions

Preparatory inhibition of a task relevant effector tended to decrease in the context of stopping.

Corticospinal excitability was more variable during response preparation in the context of stopping. This was evident for both task relevant and task irrelevant muscles.

These results suggest corticospinal excitability during response preparation is influenced by anticipation of stopping.

Preparatory inhibition was not correlated between Go and Stop tasks.

Only weak evidence suggests reactive inhibition is correlated with preparatory inhibition.

1. Badry, R., Mima, T., Aso, T., Nakatsuka, M., Abe, M., Fathi, D., et al. (2009). Suppression of human cortico-motoneuronal excitability during the Stop-signal task. *Clinical Neurophysiology*, 120(9), 1717–1723.
 2. Greenhouse, I., Sias, A., Labruna, L., & Ivry, R. B. (2015). Nonspecific Inhibition of the Motor System during Response Preparation. *The Journal of Neuroscience*, 35(30), 10675–10684.