



Signatures of nonspecific motor inhibition during response preparation

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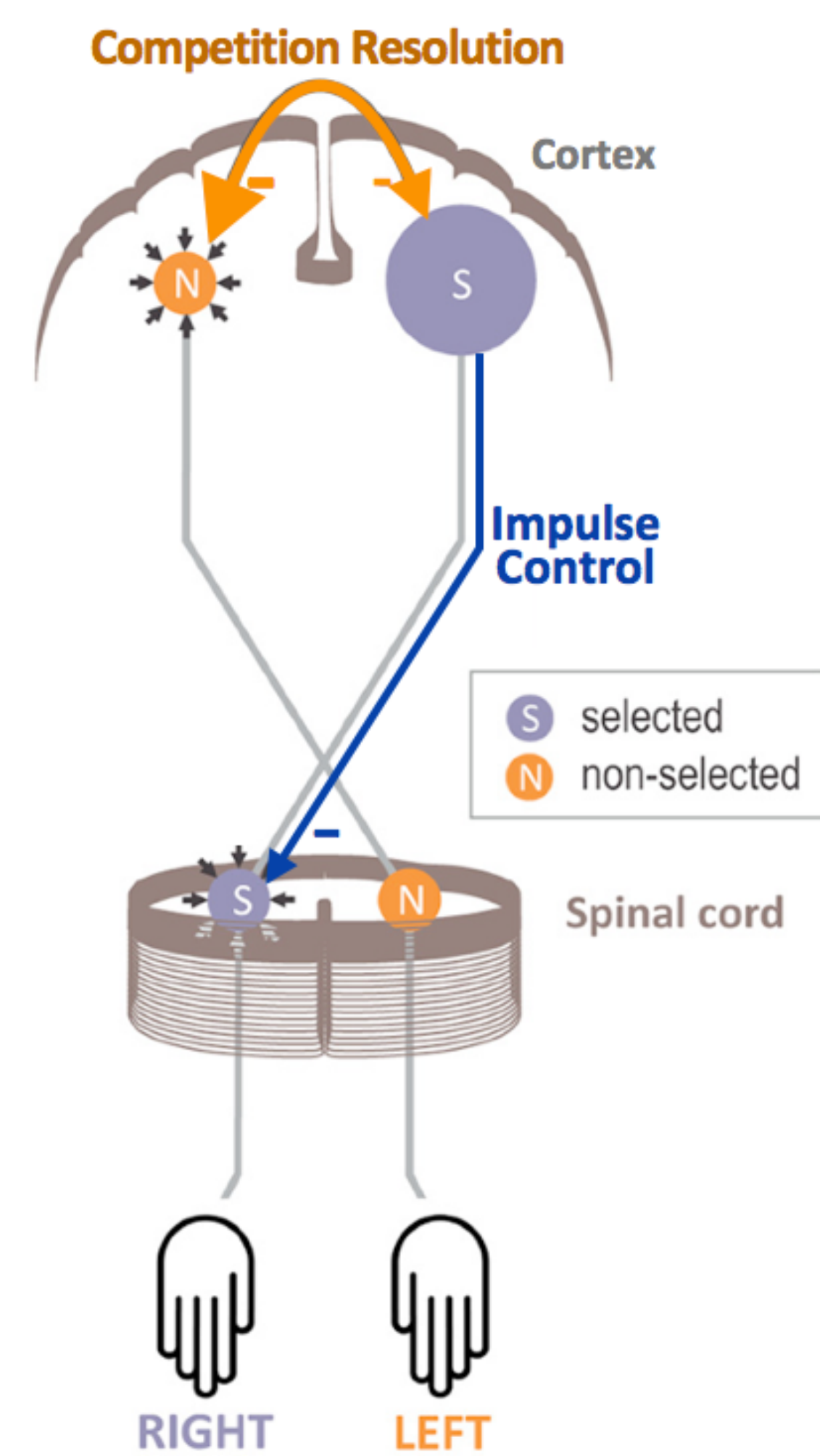


Introduction

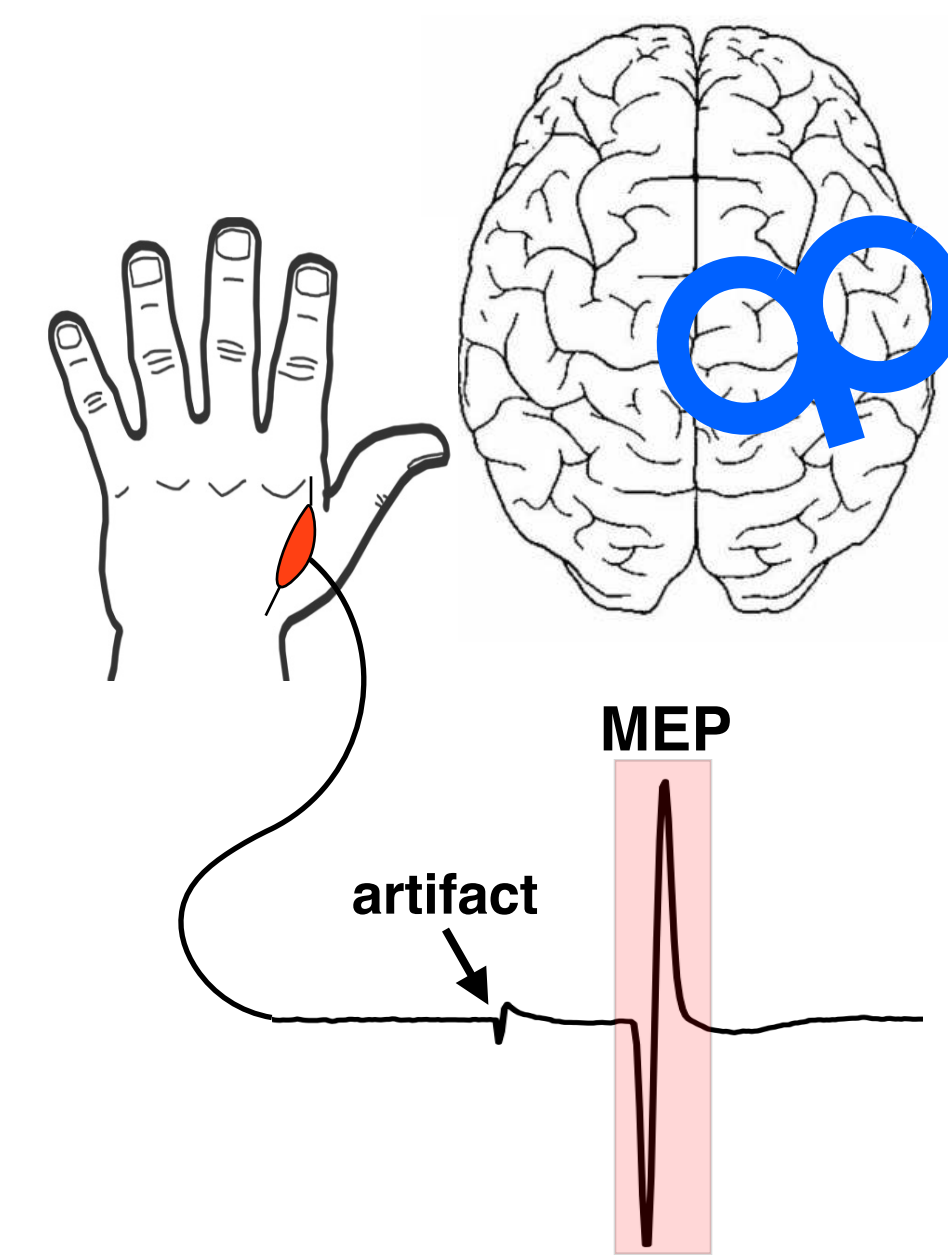
This study was designed to examine inhibitory brain mechanisms involved in the selection and initiation of volitional movement.

Two inhibitory mechanisms have been implicated in response preparation^{1,2}:

1. **Competition resolution** resolves competition between candidate responses
2. **Impulse control** prevents premature initiation of the selected response



This hypothesis predicts that preparatory inhibition is limited to task-relevant muscles. We test this hypothesis in the current study.

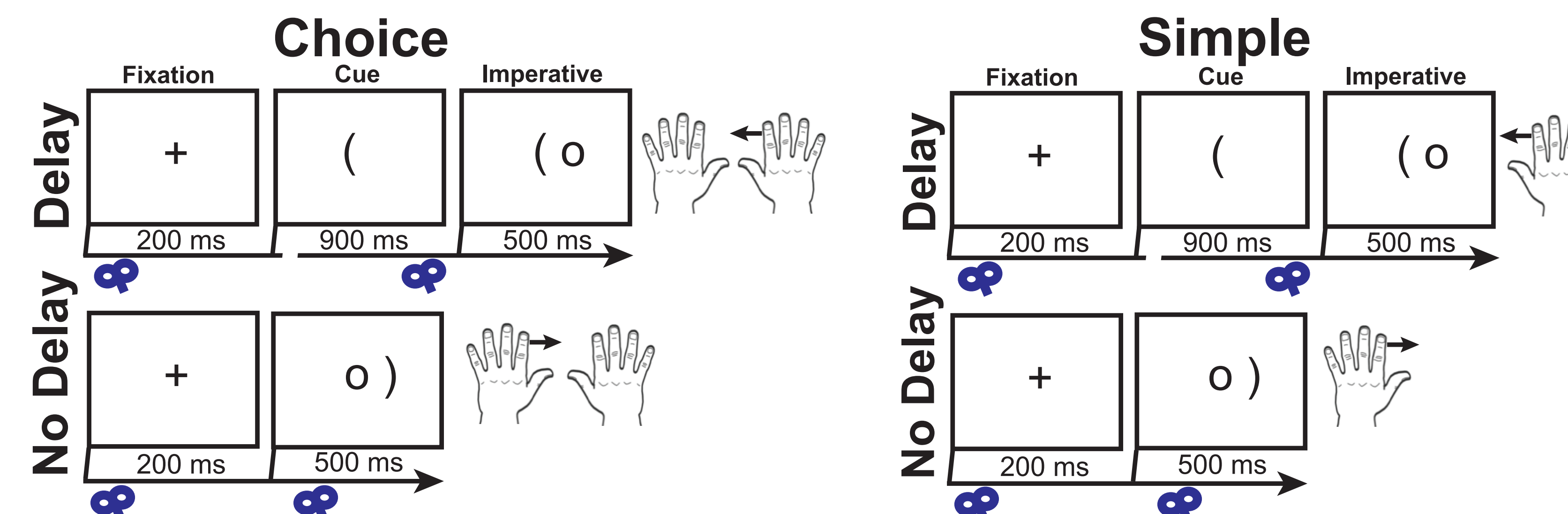


Transcranial magnetic stimulation (TMS) was used to measure motor evoked potentials (MEPs) from task-relevant and task-irrelevant muscles during the preparation of responses in choice and simple RT tasks.

We also assessed whether preparatory inhibition relates to anticipation of the TMS pulse or a decision about the imperative signal.

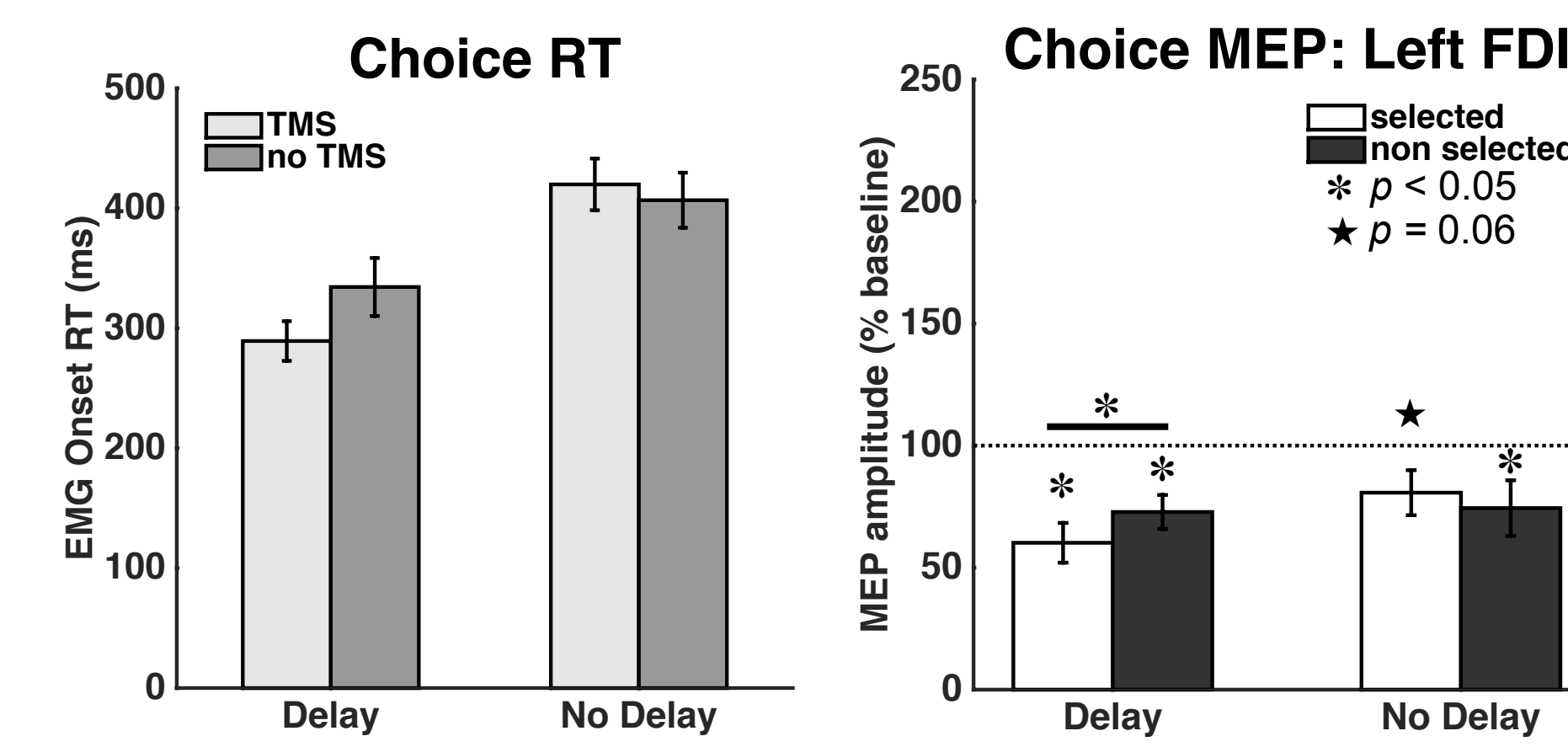
Experiment 1: Choice vs. Simple

Is there preparatory inhibition in the absence of a choice?

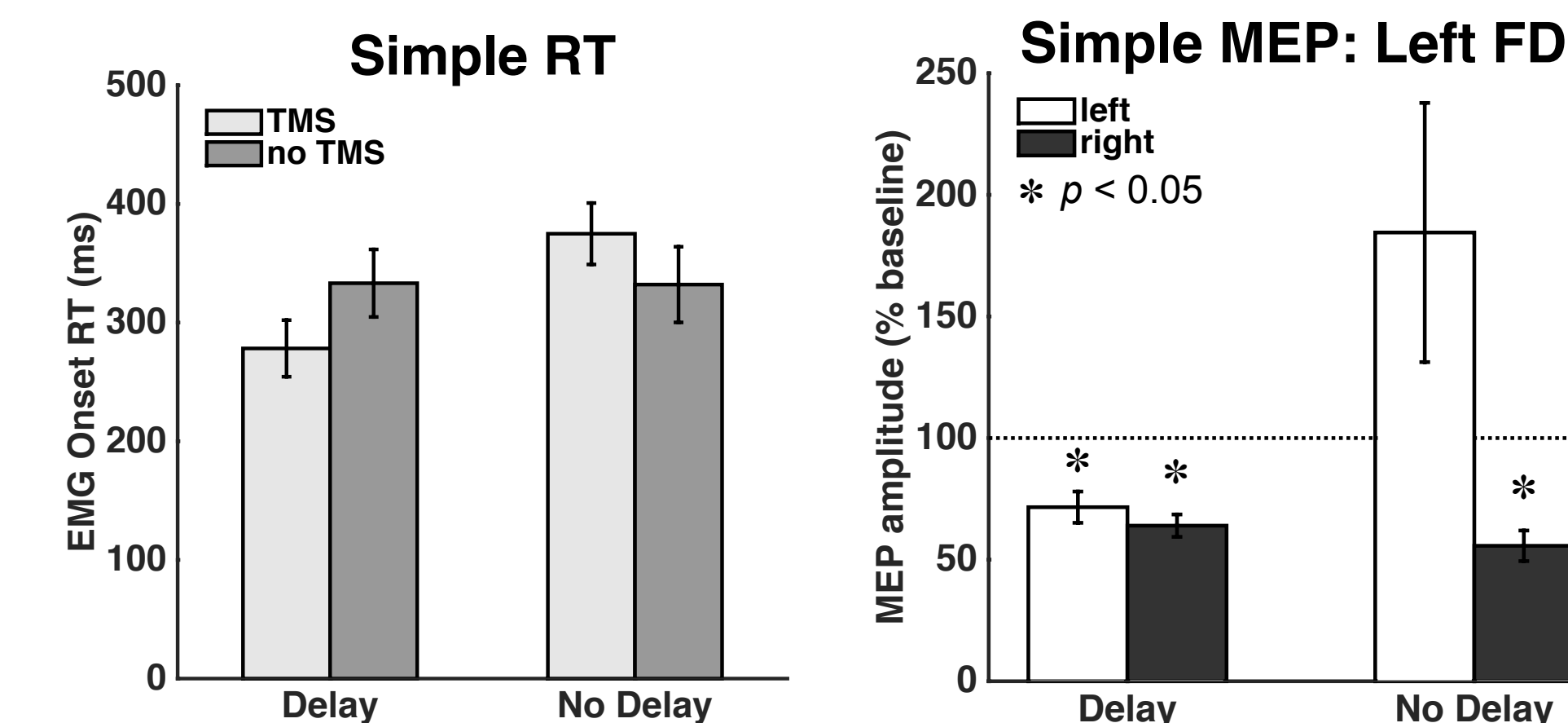


Cue indicated left or right hand response.

Response hand was fixed for each block of trials.



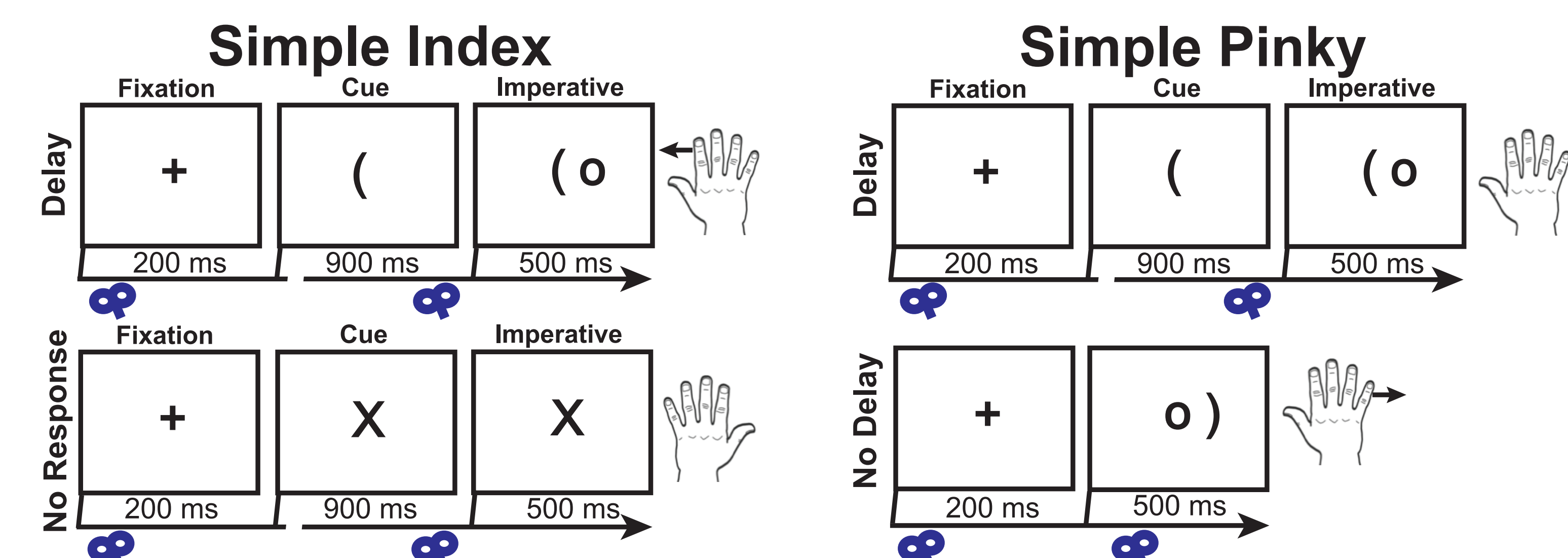
- Delay: Replication of preparatory inhibition effects.
- No Delay: Inhibition after imperative, even when muscle is agonist for forthcoming response.



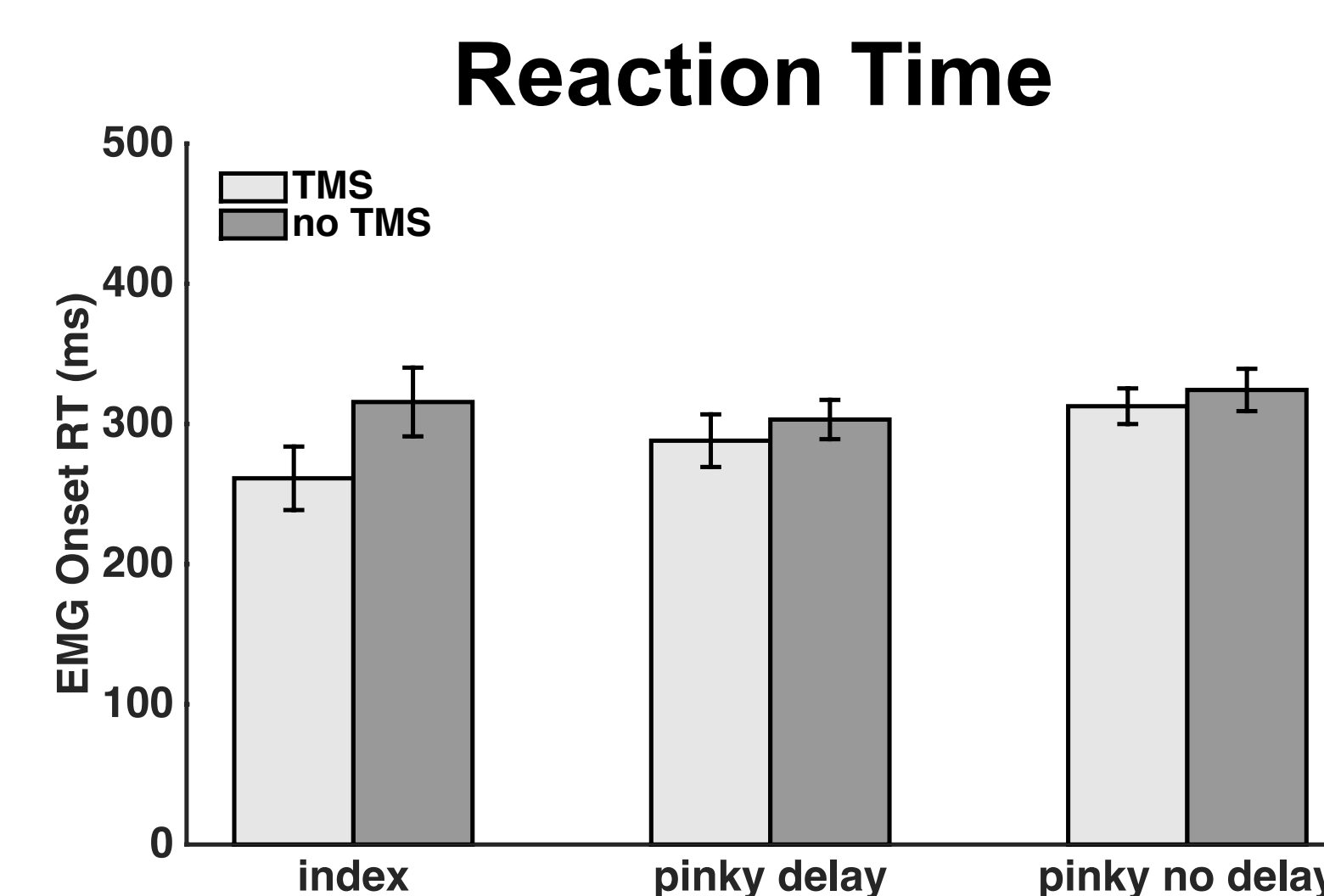
- Left No Delay: increase reflects recruitment of agonist.
- Right Delay: Unexpected suppression of left hand MEPs during the preparation of right hand responses.

Experiment 2: Task Relevancy & TMS Expectancy

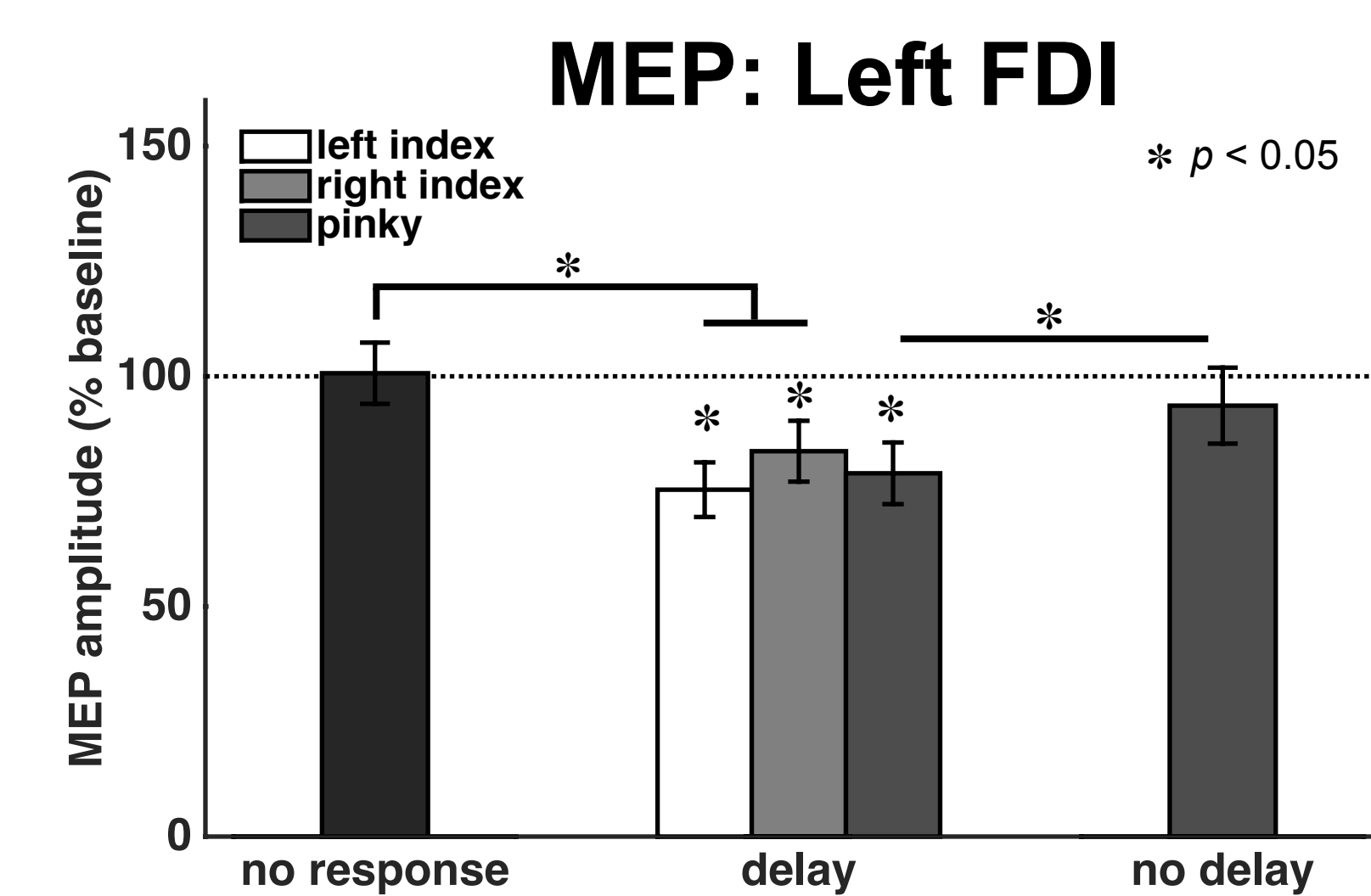
Is preparatory inhibition only detectable in homologous task-irrelevant muscles?



- MEPs in left FDI were probed when participants prepared left index, right index or right pinky responses (Simple RT only). We also included a right pinky, no delay block to assess effect on MEP when a non-homologous response is being initiated.
- "X" replaced the cue in a "no response" condition to test if inhibition reflects TMS expectancy.

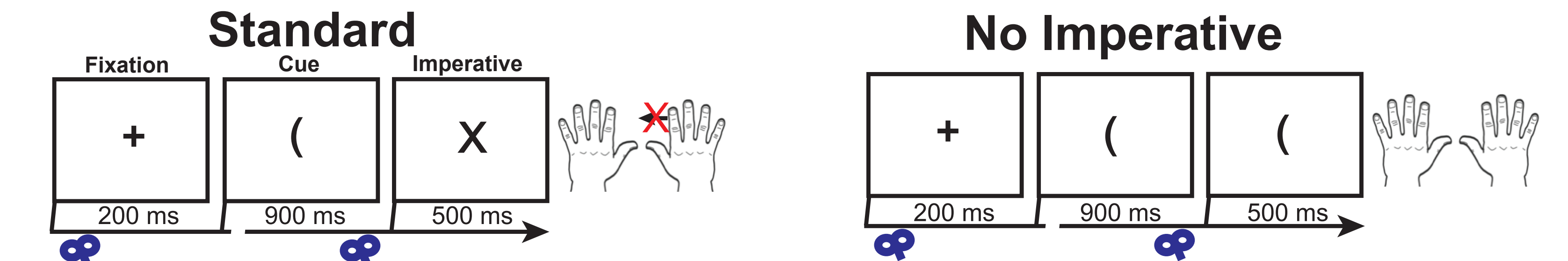


- Left FDI inhibition observed even when left hand was task-irrelevant in all delay conditions.
- Inhibition is not related to anticipation of TMS pulse (i.e., absent on no-response trials).

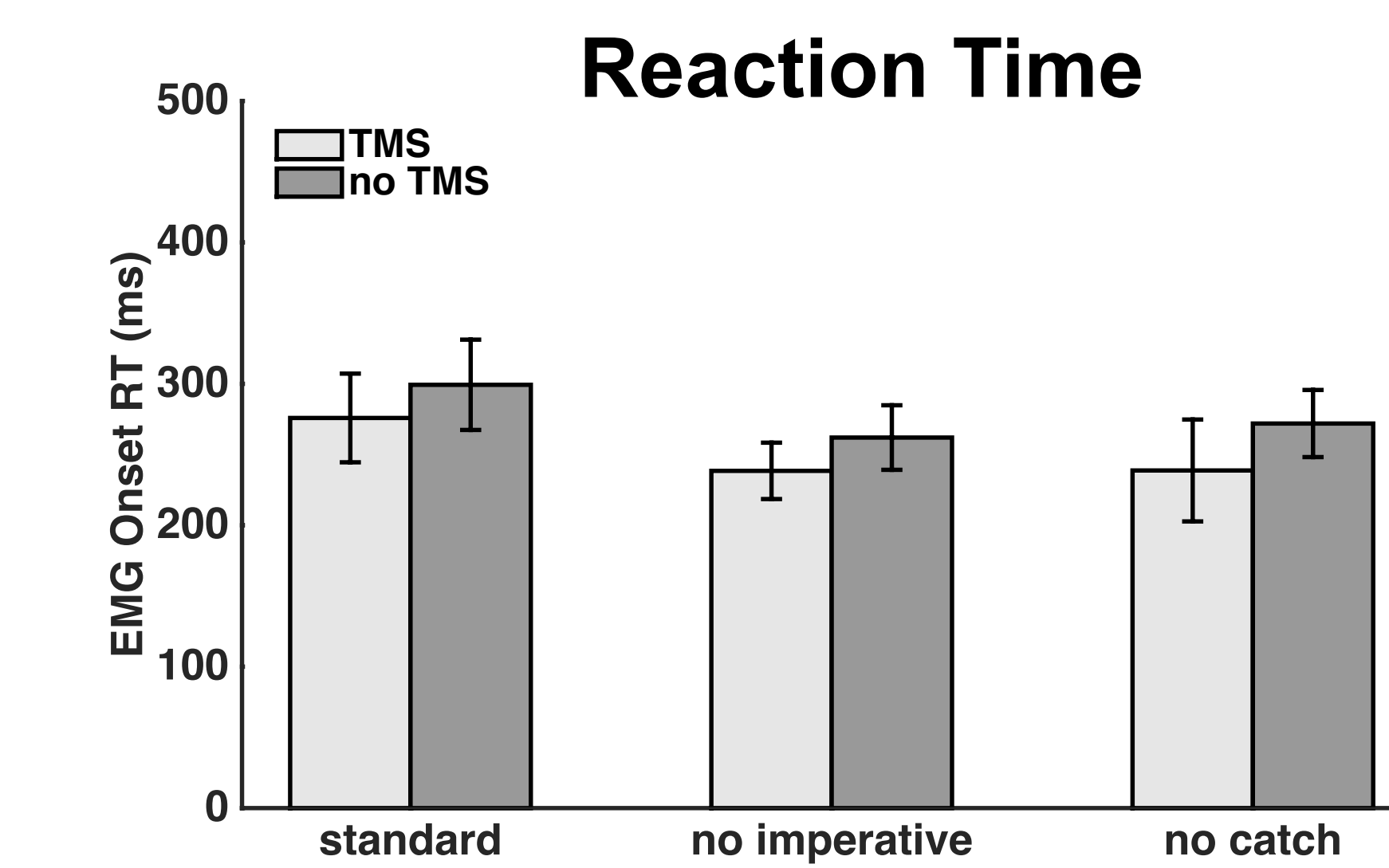


Experiment 3: Anticipatory Control

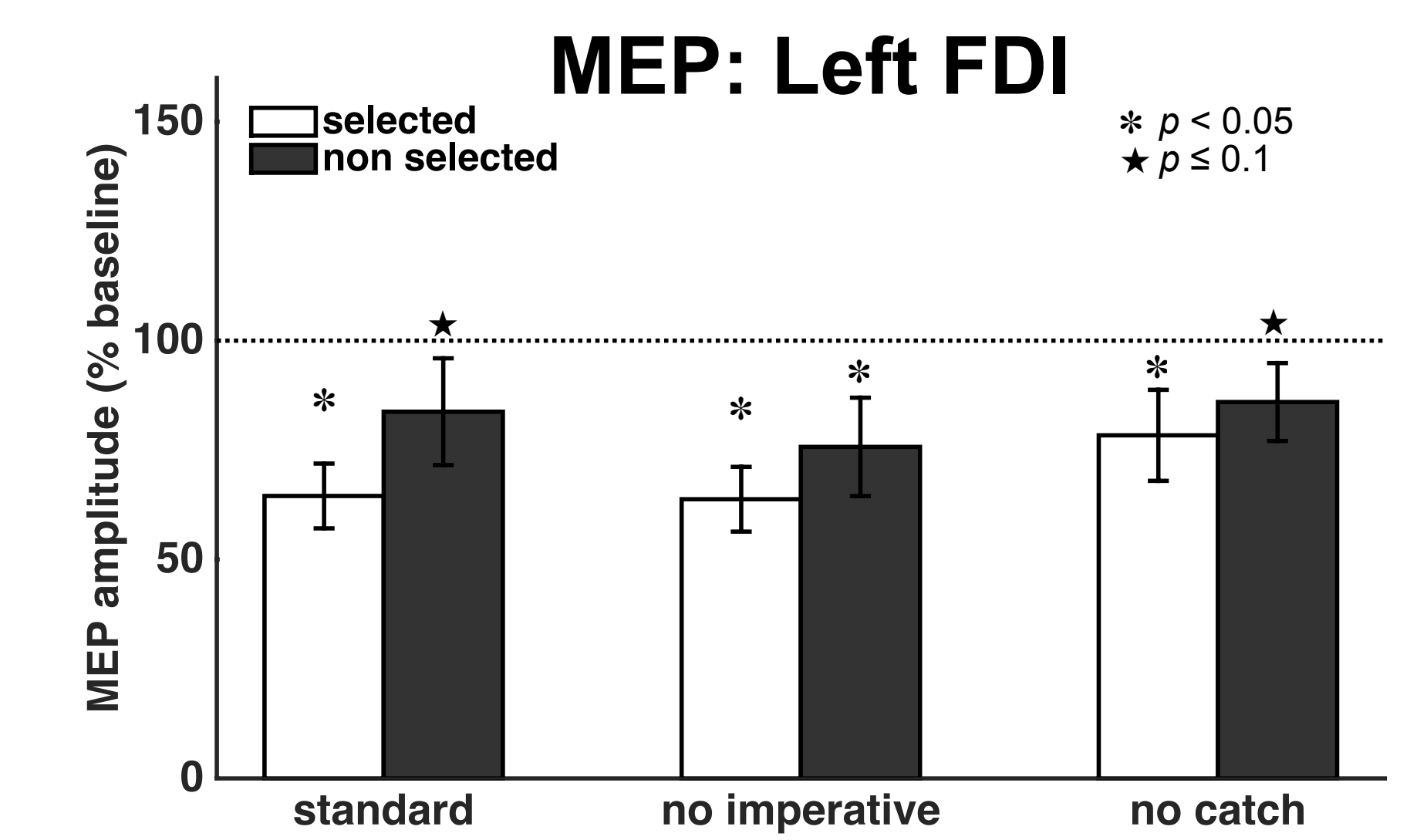
What is the impact of anticipatory control on preparatory inhibition?



- Standard: Imperative or Catch stimulus following cue.
- No Imperative: Catch trial indicated by absence of imperative.
- No Catch: Imperative presented on 100% of trials



- Inhibition was observed in the presence and absence of catch trials, with significantly greater inhibition in the selected than non selected hand.
- These results suggest that inhibition is a signature of response preparation and not a product of anticipatory control.



Results Summary

Experiment 1

- Preparatory inhibition was observed in both task-relevant and -irrelevant muscles.
- The degree of inhibition was similar in choice and simple response contexts.
- The homologous contralateral effector was inhibited 150 ms after the imperative.

Experiment 2

- There was no inhibition in the absence of response preparation, although participants could still anticipate TMS.
- A non-homologous contralateral effector was inhibited during response preparation, but not after the imperative.

Experiment 3

- Inhibition was present during response preparation even when there were no catch trials that would require canceling a prepared response.

Conclusions

The results suggest the operation of a non-specific inhibitory mechanism during the preparation of a speeded response. This inhibition is manifest in task-irrelevant muscles even in the absence of a choice, i.e. no competition.

This inhibitory mechanism 1) cannot be explained by anticipation of TMS, 2) is distinct from inter-hemispheric inhibition observed during response execution, and 3) is not related to anticipatory control.

It remains to be seen if the inhibition of task-irrelevant muscles reflects the operation of a generic inhibitory signal or spreading inhibition centered around a selected representation (see Labruna et al. poster NN15, right next door).