

Introduction

In our daily activities, we often need to withhold an automatic, habitual response in order to carry out a desired action. This ability to flexibly select among conflicting candidate responses to a stimulus is a key aspect of "Cognitive Control".

e.g. Stroop task Stroop (1935) Incongruent: red blue green yellow
Congruent: red blue green yellow

An influential theory suggests that a key component of cognitive control is a "conflict monitoring" process that detects conflicts between candidate responses and modifies response preparation accordingly. (Botvinick et al., 2001, 2004)

According to this theory, the behavioral hallmark of increase conflict monitoring is increased reaction time (RT) under higher level of conflict between candidate responses. Altering the frequency of congruent versus non-congruent trials influences RT (e.g. Logan & Zbrodoff, 1979).

This evidence is indirect, however. RT differences do not necessarily imply a difference in underlying processes of preparation.

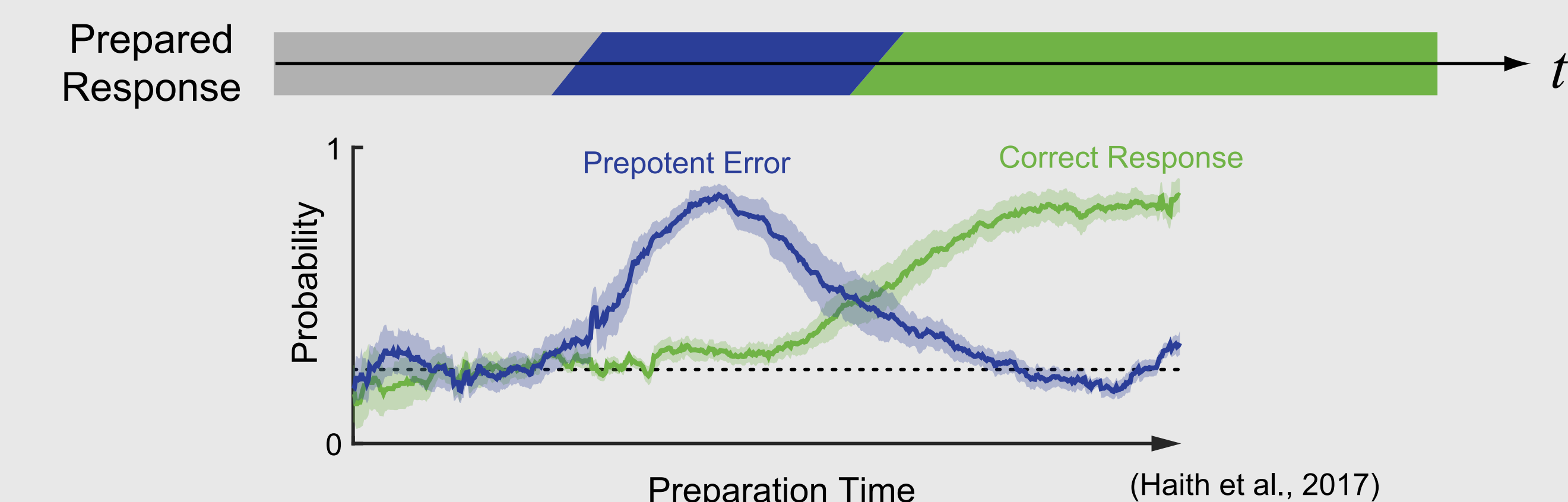
In deed, recent work in motor control has revealed that action preparation and action initiation are under independent control

(Haith et al., 2016).

A window on response preparation

Response preparation can be probed more directly using a forced-response paradigm (Ghez, 1998) to assess which responses are prepared at different times following stimulus presentation.

This approach has revealed that the pre-potent response is always but is later replaced by a more appropriate, deliberate response:



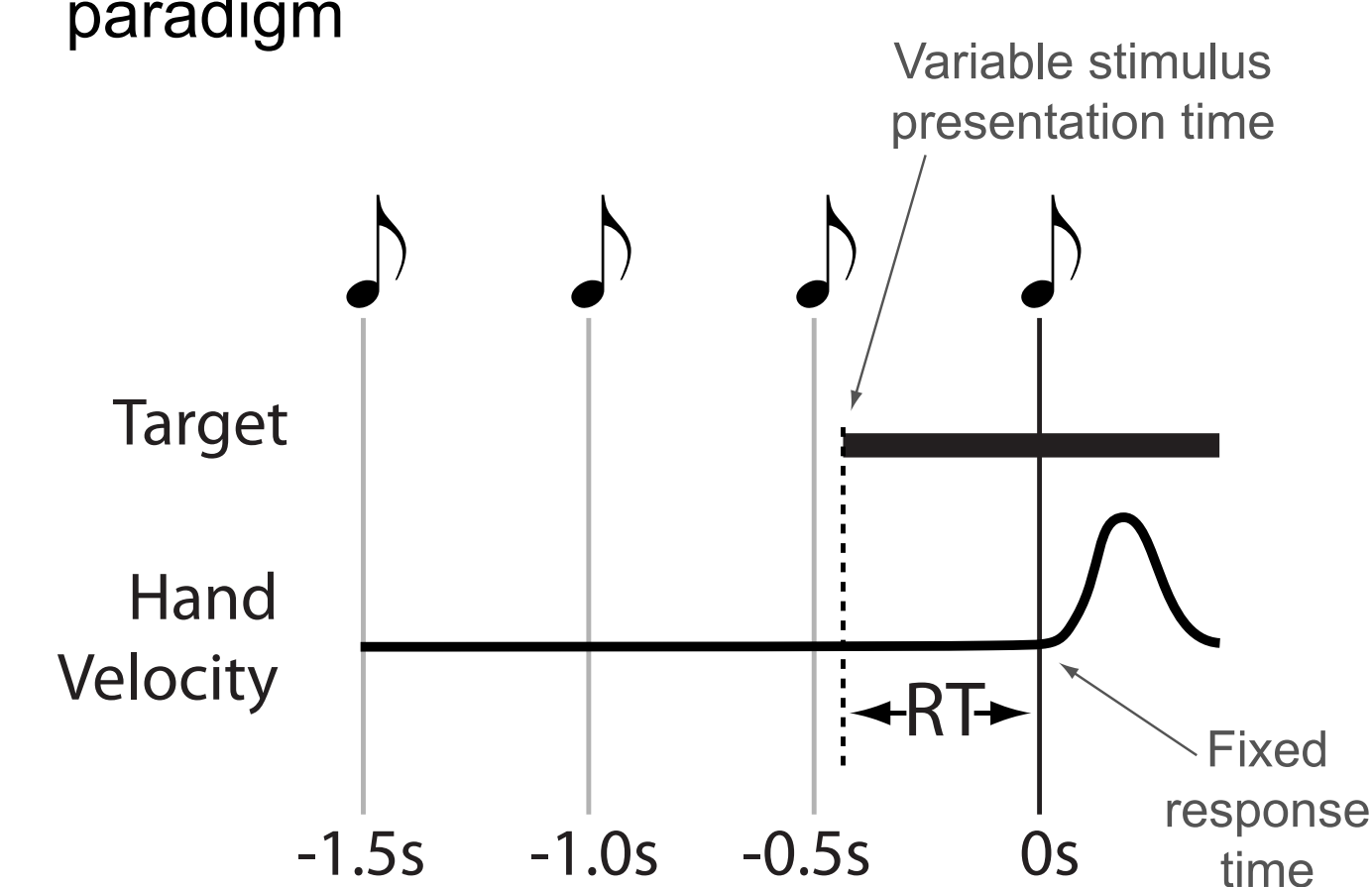
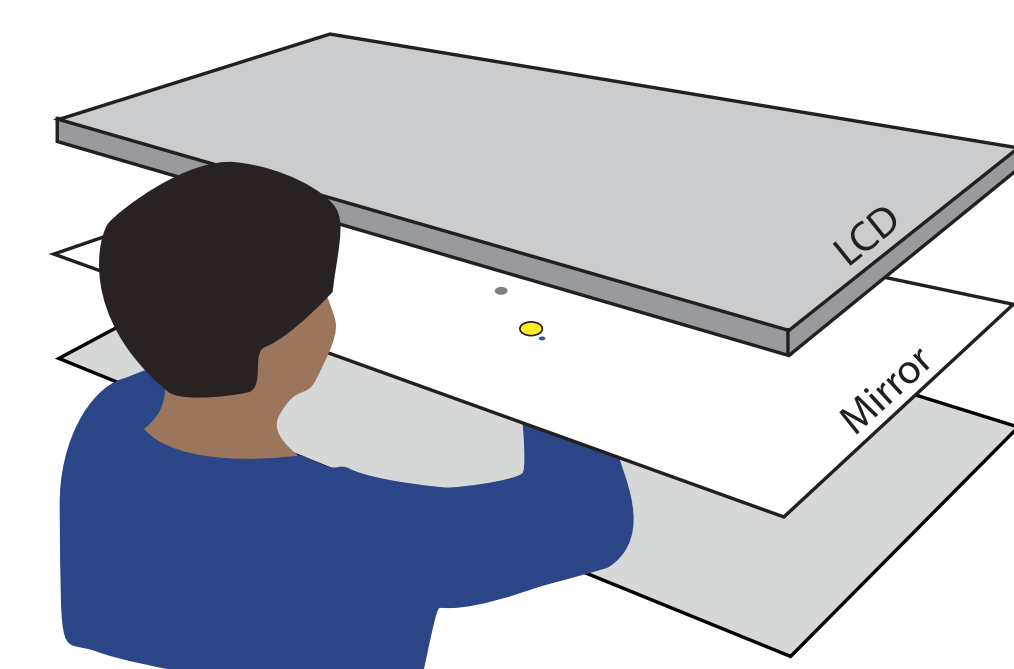
Here, we used this approach to more directly assess whether conflict context influences on response preparation, or just the timing of response initiation.

Approach

We examined movement preparation in a context of different levels of conflict imposed by frequency of congruency, in a reaching task between symbolic and spatial information cuing required movement direction

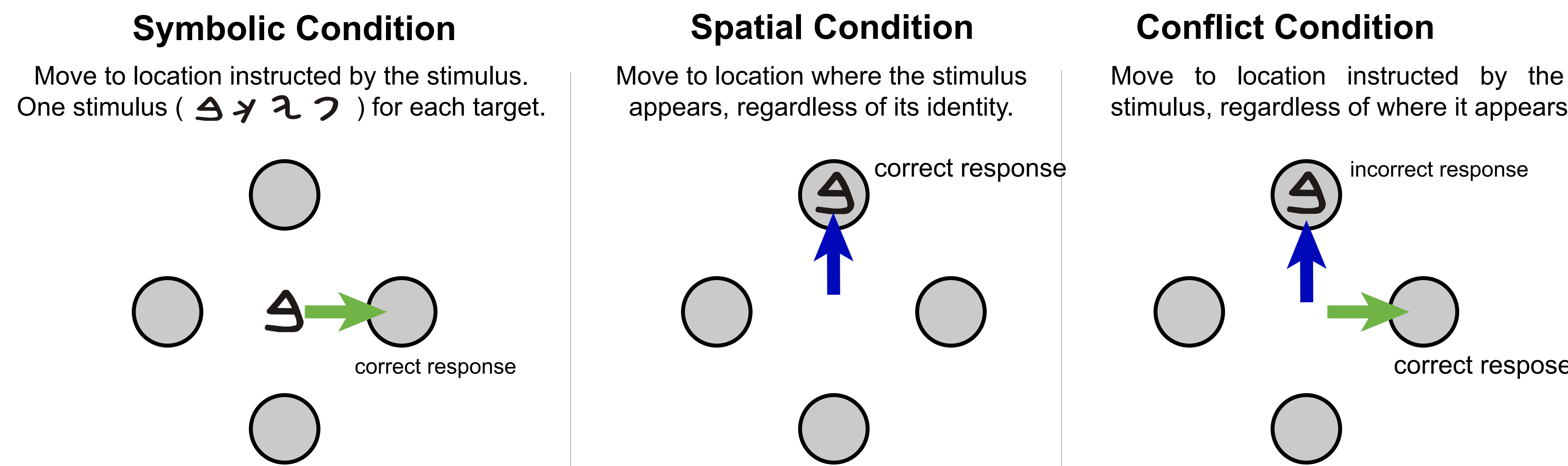
Planar reaching movements to one of four potential targets

Participants forced to respond at a range of preparation times using a timed response paradigm



Experimental design

Participants completed center-out reaching tasks in three conditions. Each task cued the required movement in a different way.

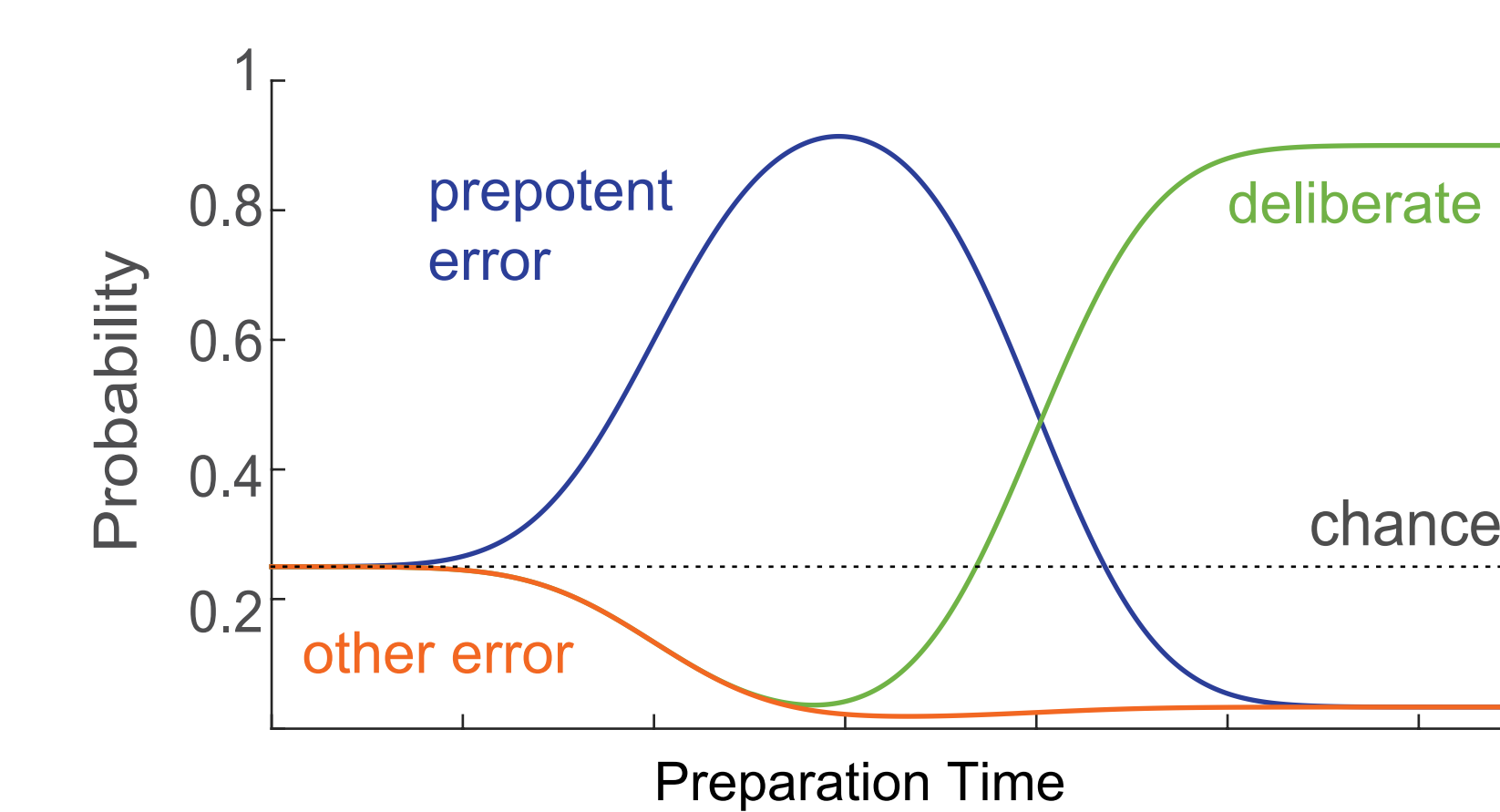


Group 1: training with with 0% congruency
Group 2: training with 50% congruency

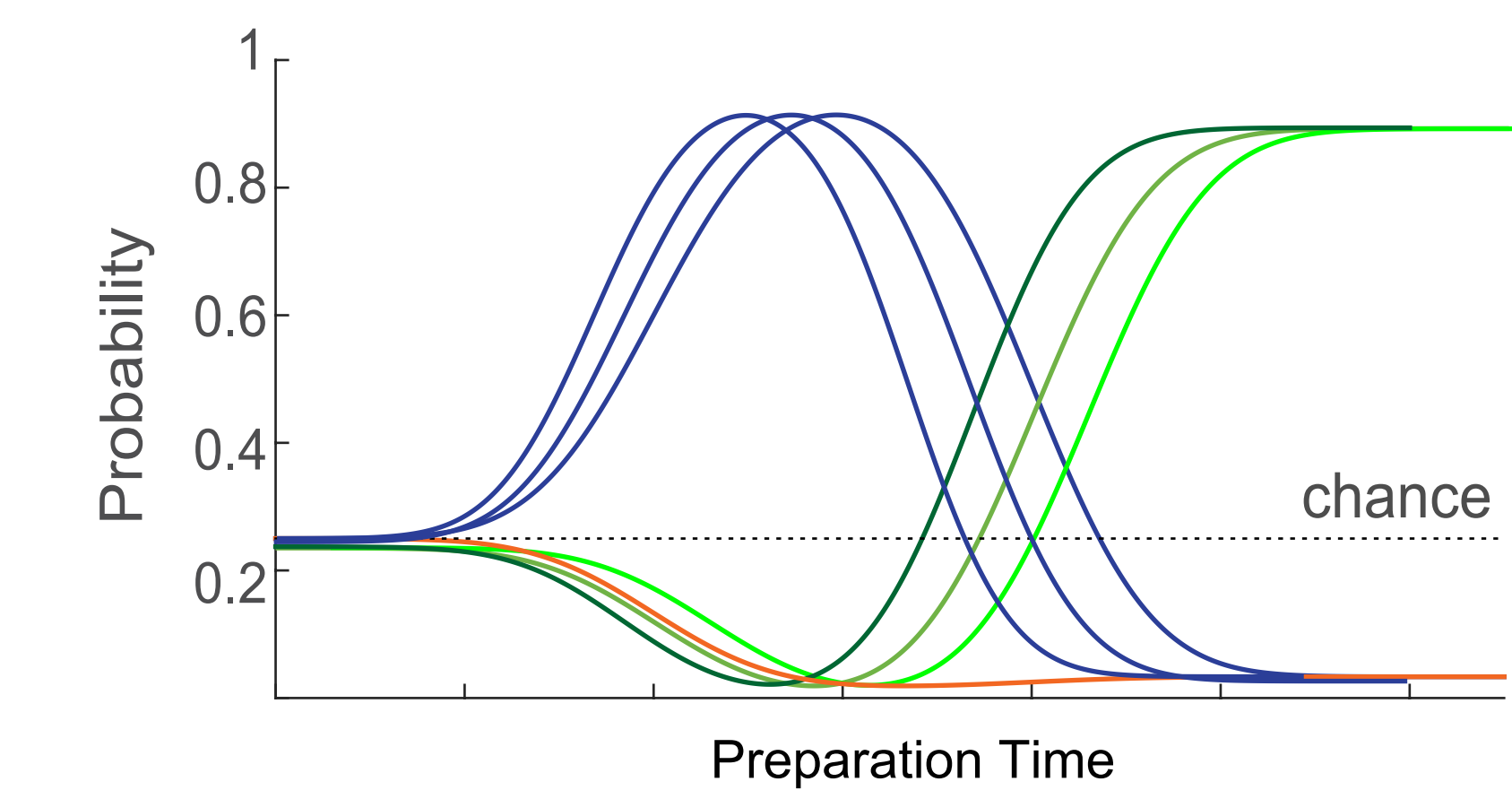
Free-RT Symbolic	72 trials	72 trials	
Free-RT Spatial	72 trials		
Free-RT Conflict (25% congruency)	72 trials	72 trials	
Forced-RT Conflict (25% congruency)	120 trials	120 trials	
Free-RT Conflict (0% congruency)	96 trials	96 trials	Group 1
Free-RT Conflict (50% congruency)	96 trials	96 trials	Group 2
Forced-RT Conflict (25% congruency)	120 trials	120 trials	

Predictions

Hypothesis 1: no change in action preparation after exposure of different frequency of congruency.



Hypothesis 2: context of congruency frequency accelerates (for 50% congruency) or slows (for 0% congruency) preparation.



Conclusions

Frequency of congruency in a spatial cognitive control task affected distributions of RTs in the Free-RT tasks, prolonging RTs when there were fewer congruent trials.

However, the Forced-RT task revealed that frequency of congruent trials did not change the dynamics of response preparation.

Our results suggest that frequency of conflict may selectively influence the timing of response initiation, instead of the action preparation process, questioning theories of cognitive control based on conflict monitoring.

References

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Results

