

Dynamic task representations induced by evolving task uncertainty: an fMRI study

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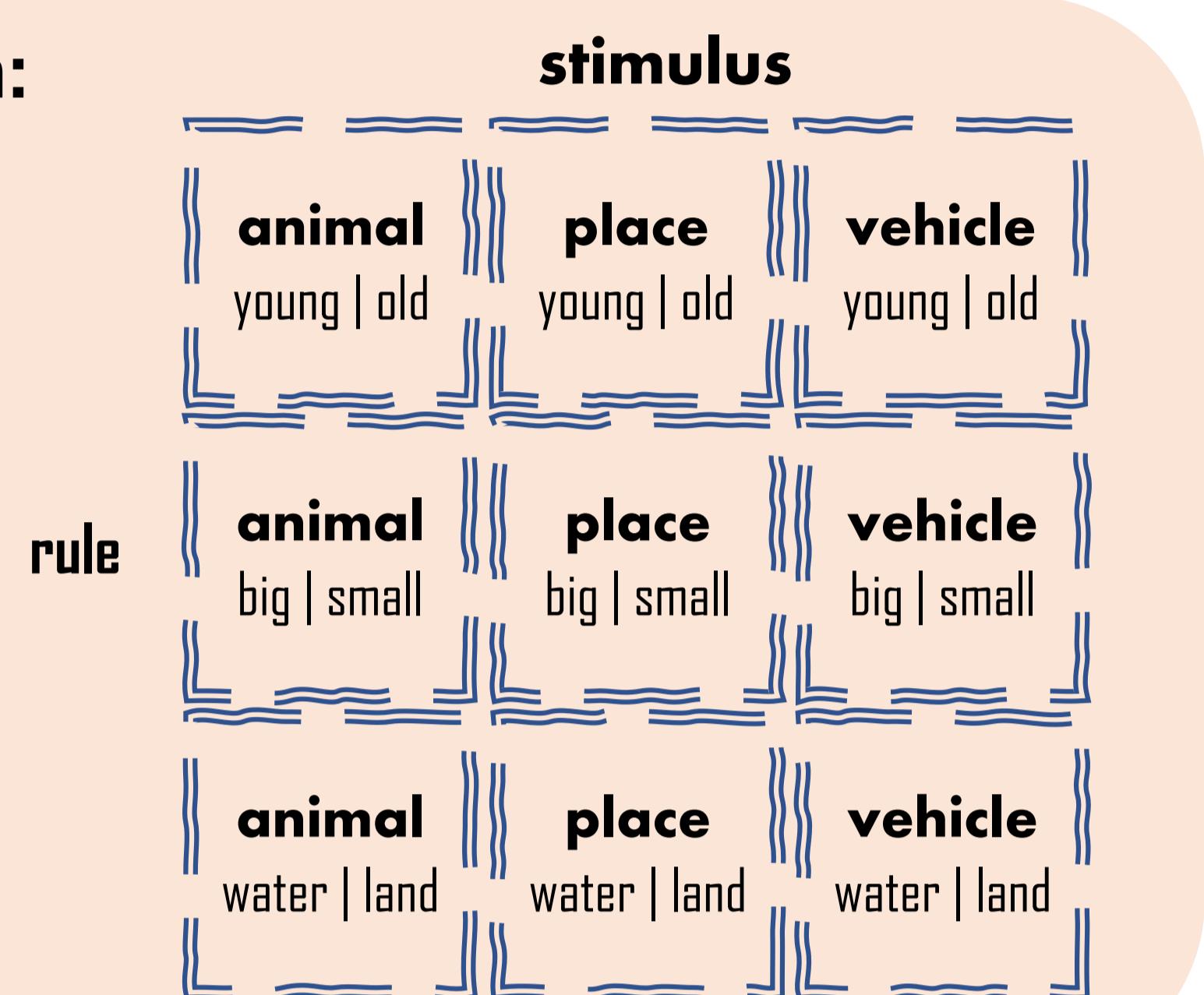
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Background:

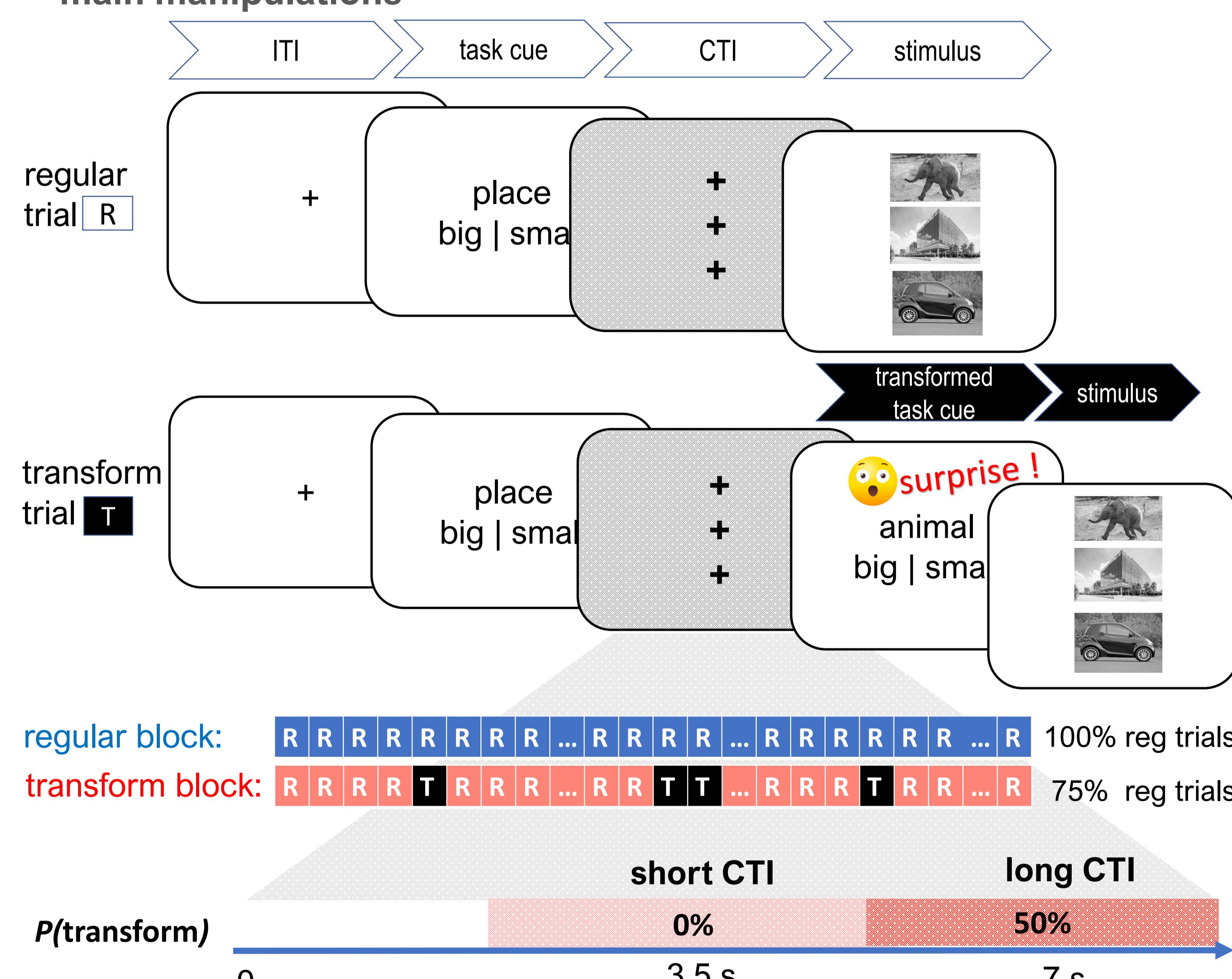
- One of the hallmarks of humans' cognitive flexibility regards the ability to dynamically adjust and control our intentions and actions.
- We previously demonstrated that people can dynamically adjust task preparation when the to-be-performed task varied in uncertainty (Chai et al., 2023).
- In the current fMRI study, we aimed to further elucidate the neural mechanisms underlying these dynamics in task control.

Task transformation paradigm: image categorization

- 9 different tasks were created by factorially combining 2 task dimensions: **stimulus** and **rule**.
- For each trial, participants need to perform a image categorization task according to the preceding task cue.

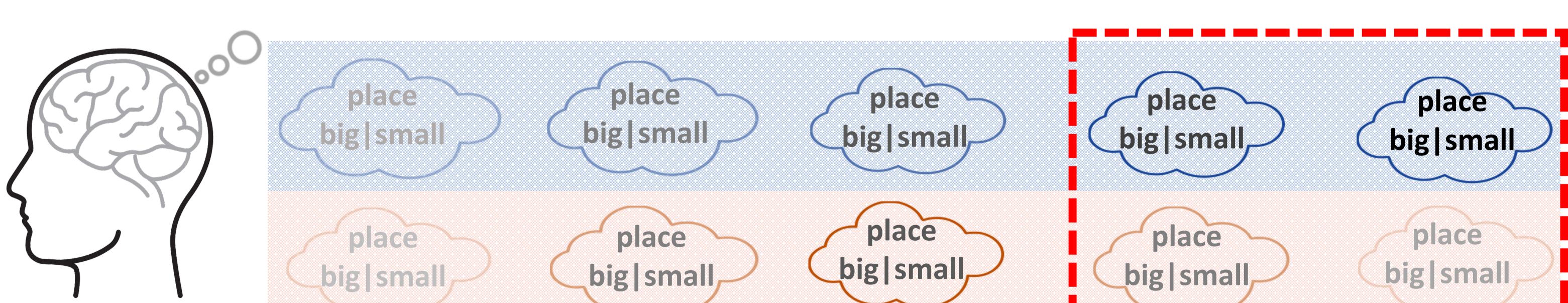


Task transformation paradigm: main manipulations



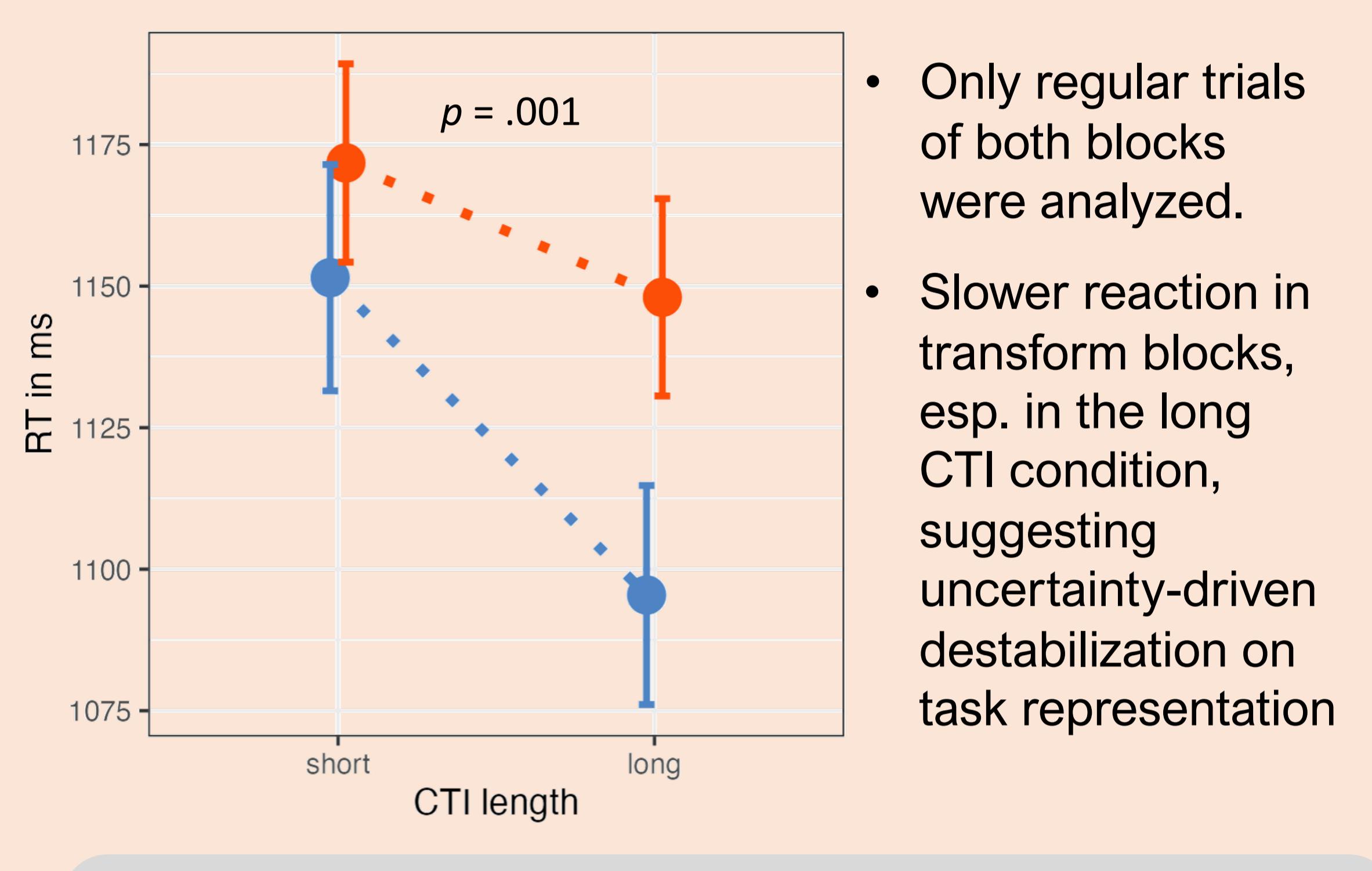
Neural hypothesis:

The evolving task uncertainty would require dynamic regulation regarding the strength of task representations in order to facilitate flexible goal setting in the transform blocks.

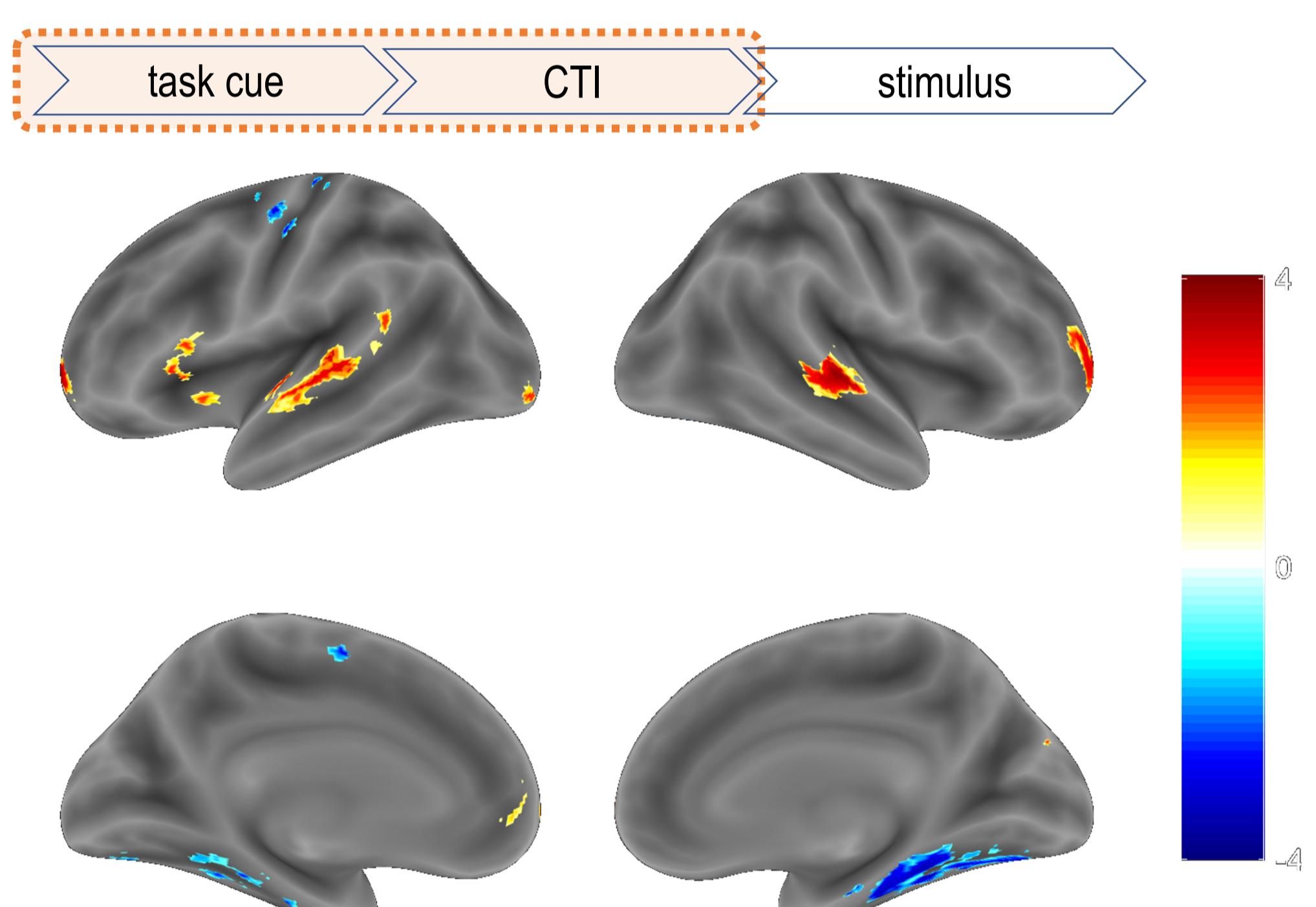


Preliminary Results:

Behavioral:



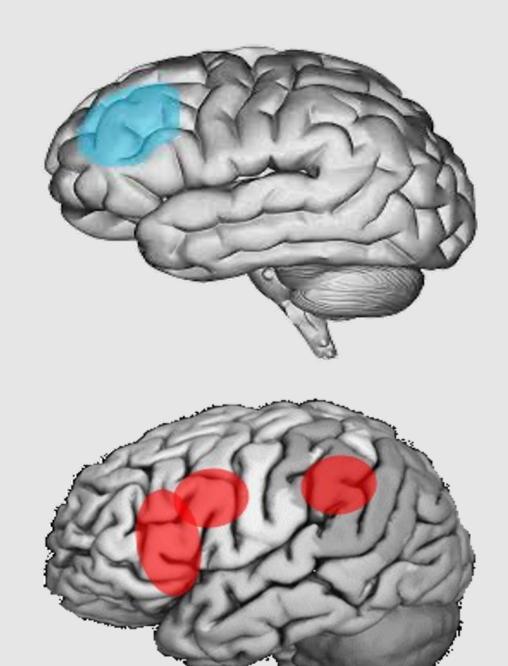
fMRI:



- 43 participants went through 2 scanning sessions;
- Modelled the sustained activity during task cue encoding and task preparation;
- Focused on the interaction between block type (transform vs. regular) and CTI length (long vs. short);
- Transform condition showed heightened activity in frontopolar cortex and superior temporal regions, suggesting the need of managing competing goals (either transform or not) .
- Regular condition showed enhanced activity in parahippocampal and fusiform gyrus, demonstrating stronger category specific task representation when the to-be-performed task was certain.

Next step:

- Unveiling the neural dynamics during task preparation using finite impulse response (FIR) model;
- Conducting MVPA to further examine the strength of neural representation :
 - Neural decoding to quantify the integrity of task relevant information;
 - Representational similarity analysis(RSA) to quantity the overall noisiness of task representation



References:

- Chai, M., Holroyd, C., Brass, M., & Braem, S. (2023). Dynamic changes in task preparation in a multi-task environment: The task transformation paradigm. *PsyArXiv*.



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