Evidence for Context-Sensitive Adjustments in Cognitive Flexibility

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BACKGROUND

- Neither "cognitive flexibility" nor "cognitive stability" are inherently beneficial. Adaptive behavior requires the ability to adjust cognitive flexibility according to environmental demand.

- **How we make these adjustments, and under what circumstances, is not completely understood**

Existing Research

- Previous study[1] found that switch cost *decreases* when the proportion of switch trials in a task *increases*
  - Only when participants do not have enough time to prepare for upcoming task based on cue (short CSI)

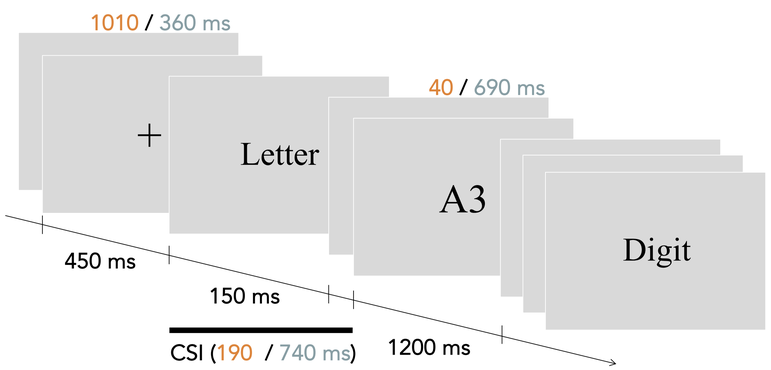
Experiment Questions

- **Exp 1:** Replicate previous study[1] with added exp controls
- **Exp 2:** Does the switch proportion effect remain when participants cannot prepare for "that other task"?
- **Exp 3:** Does the switch proportion effect generalize to an unbiased third task with neutral task associations?

EXP1 Methods

Cued Task Switching Procedure (N = 40)

- 31 trials x 18 blocks
- Trial Type: Switch v. Repeat
- Switch Proportion (3): 30%, 50%, & 70%
- CSI Type (2): Short & Long



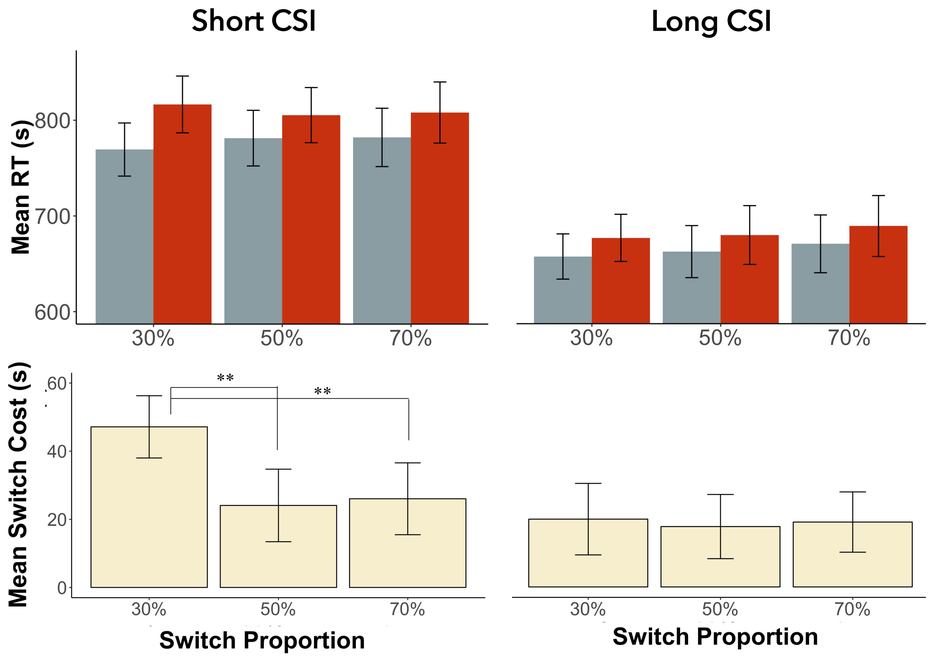
- Letter: Vowel or Consonant?
- Digit: Odd or Even?

- Controlled for cue-repetition

EXP 1 Results

2 (Trial Type) x 3 (Switch Proportion) x 2 (CSI) ANOVA

- Trial Type: F(1,39) = 83.8, p < .001, ges = .02
- CSI Type: F(1,39) = 316.26, p < .001, ges = .31
- Trial Type x Switch Proportion: F(2, 78) = 4.61, p = .013, ges = .0009
- Trial Type x Switch Proportion x CSI Type: F(2,78) = 4.11, p = 0.02, ges = .0007



Switch cost decreases with increasing switch proportion when CSI is short and participants do not have enough time to prepare prepare for the upcoming task based on cue.

Future Directions

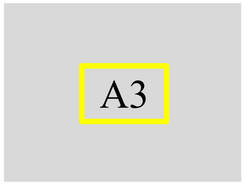
- EEG/ERP
  - Frontal theta oscillations changes during pre-cue period[2]
- fMRI
  - MVPA analysis to decode task context (switch proportion) from frontoparietal activity patterns[3]
  - RSA to access trial by trial changes[3]

EXP 2: Three Tasks

Does the switch proportion effect hold when switching between three tasks?

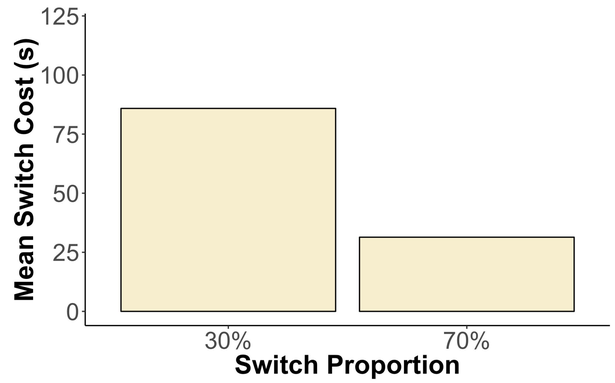
Cued Task-Switching Procedure

- 31 trials x 10 blocks
- Switch Proportion: 30% & 70%
- 200 ms CSI
- Letter, digit, and color tasks



Color: Warm or cold?

Pilot Results (N = 4)



EXP 3: Unbiased Third Task

Does the switch proportion effect generalize to a task that is equally likely to be a switch trial as it is a repeat trial?

Procedure

- 30% switch condition (21:9)
  - Task A & B: 8 switch, 2 repeats
  - Task C: 5 switch, 5 repeats
- 70% switch condition (reverse 30%)

References

1. Monsell, Stephen, and Guy A. Mizon. "Can the Task-Cuing Paradigm Measure an Endogenous Task-Set Reconfiguration Process?" *Journal of Experimental Psychology: Human Perception and Performance* 32, no. 3 (June 2006): 493–516. https://doi.org/10.1037/0096-1523.32.3.493.
2. Cooper, Patrick S., Frini Karayanidis, Montana McKewen, Samuel McLellan-Hall, Aaron S. W. Wong, Patrick Skippen, and James F. Cavanagh. "Frontal Theta Predicts Specific Cognitive Control-Induced Behavioural Changes beyond General Reaction Time Slowing." *NeuroImage* 189 (April 1, 2019): 130–40. https://doi.org/10.1016/j.neuroimage.2019.01.022.
3. Qiao, Lei, Lijie Zhang, Antao Chen, and Tobias Egner. "Dynamic Trial-by-Trial Recoding of Task-Set Representations in the Frontoparietal Cortex Mediates Behavioral Flexibility." *The Journal of Neuroscience* 37, no. 45 (November 8, 2017): 11037–50. https://doi.org/10.1523/JNEUROSCI.0935-17.2017.