



Binding of Abstract Control Parameters in Task Switching

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Introduction

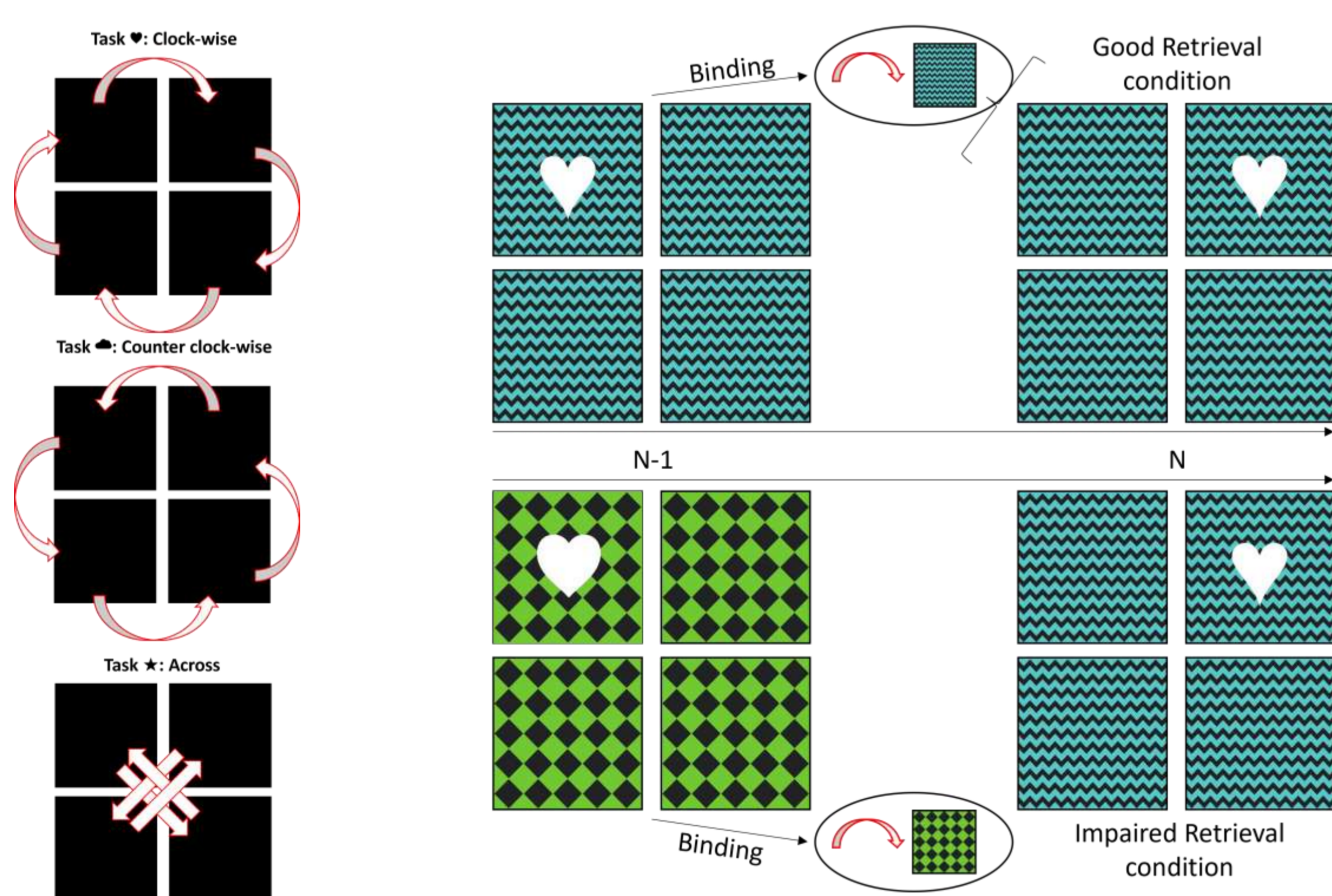
Binding theories assume that components of an active task set become bound to the currently experienced context. However, while previous task switching studies focused on the effect of response retrieval, our aim was to investigate whether also more abstract task set components can be bound and retrieved. To be more specific, we tested whether control parameters translating stimulus input into appropriate motor output without relying on specific response codes, can be bound to a visual context and retrieved upon re-encountering this context.

Methods and Hypothesis

Two experiments ($N_{\text{exp 1}} = 45$; $N_{\text{exp 2}} = 104$).

In each trial, participants performed one of three spatial operation tasks while encountering one of three background patterns. Task and context transitions were pseudorandomized (repetitions_{exp1} 50 %; repetitions_{exp2} = 33 %).

Each trial had a starting box and a goal box (which depended on the task cue). The goal box of the previous trial, always became the starting box of the current trial. Therefore, no response repetitions were possible.



Expected binding effect:

Larger switch costs ($RT_{\text{task change}} - RT_{\text{task repetition}}$) in context repetition sequences than in context change sequences.

Analysis and Results

RM-ANOVA on reaction times (RT) with factors *task transition* x *context transition*.

Exp. 1:

Main effect *task transition*, $F(1, 44) = 382.43$, $p < .001$, $\eta^2 = .897$.

Main effect *context transition*, $F(1, 44) = 25.84$, $p < .001$, $\eta^2 = .370$.

Two-way interaction, $F(1, 44) = 16.25$, $p < .001$, $\eta^2 = .270$.

→ Switch Costs_{context repetitions} (131 ms) > Switch Costs_{context changes} (109 ms).

Exp. 2

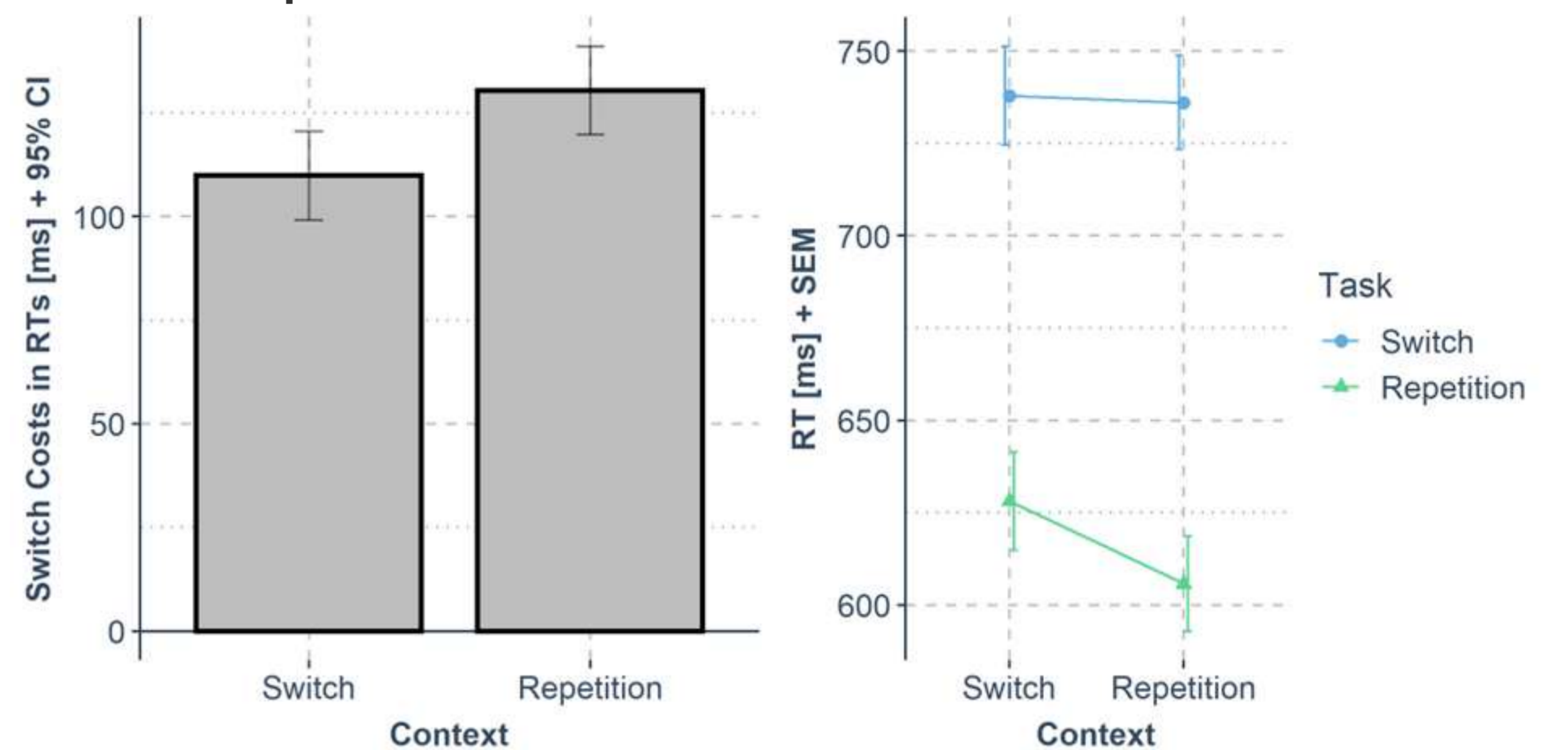
Main effect *task transition*, $F(1, 103) = 188.43$, $p < .001$, $\eta^2 = .647$.

Main effect *context transition*, $F(1, 103) = 10.03$, $p = .002$, $\eta^2 = .089$.

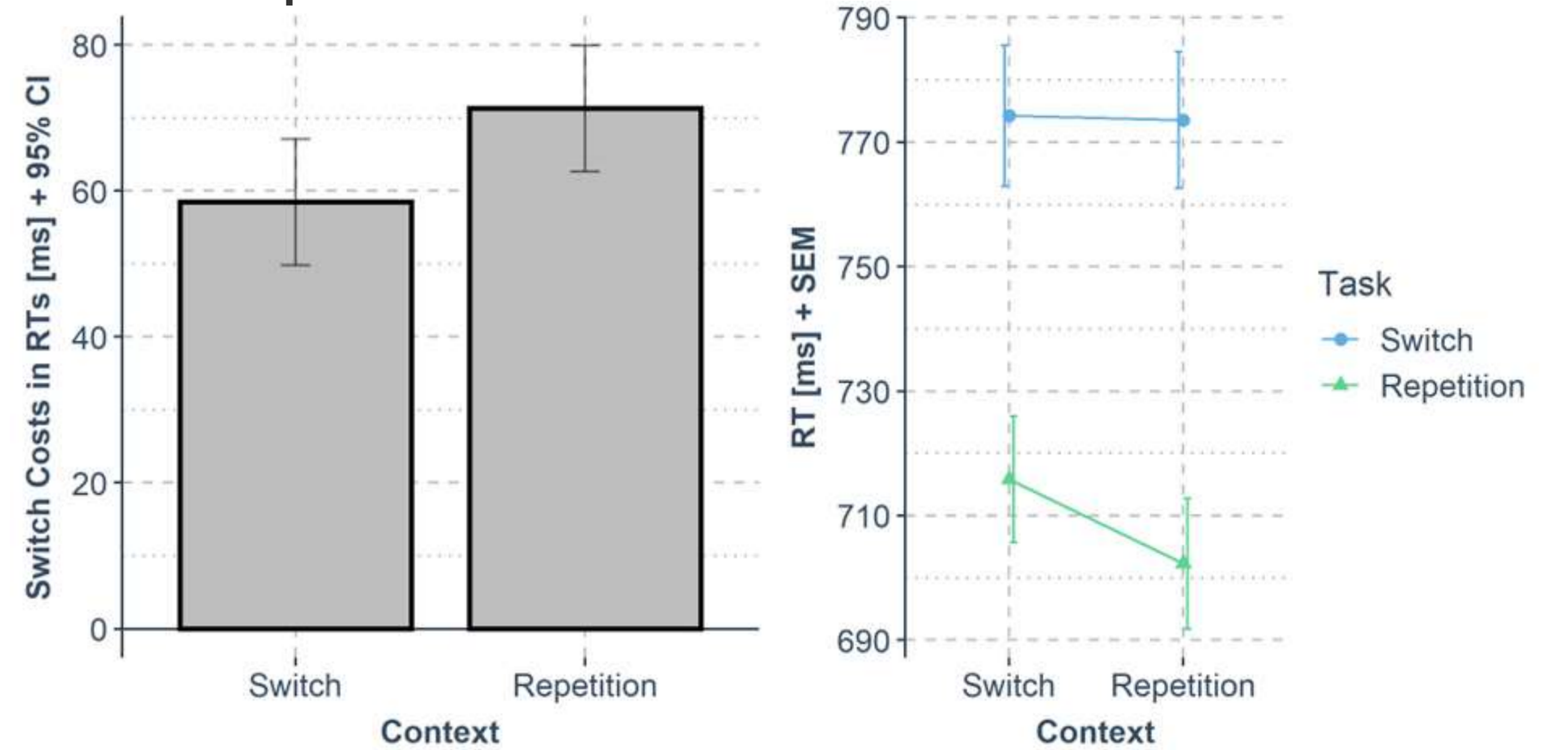
Two-way interaction, $F(1, 103) = 8.61$, $p < .001$, $\eta^2 = .077$.

→ Switch Costs_{context repetitions} (72 ms) > Switch Costs_{context changes} (58 ms).

Results Exp. 1



Results Exp. 2



Discussion

In two experiments, we confirmed the hypothesis that abstract control parameters that translate the stimulus input (task cue and spatial setup) into an appropriate response can be bound to a visual context and retrieved if the context repeats.

Critically, we controlled for the influence of response retrieval generalizing earlier findings on the topic of binding effects in task switching (e. g., Koch, Frings, & Schuch, 2018; Schuch & Keppeler, 2022).

Two alternative explanations for the observed effect seem feasible:

First, task cue repetitions could contribute to this effect, either through encoding benefits when all stimuli repeat or through stimulus-stimulus bindings between task cue and context. Second, assuming that participants were biased towards expecting task repetitions context changes might induce a „novelty“ response associated with similar neural processes like task updating and error processing (Barcelo et al., 2006; Wessel et al., 2012).

Literature

- Barcelo, F., Escera, C., Corral, M. J., & Periáñez, J. A. (2006). Task switching and novelty processing activate a common neural network for cognitive control. *Journal of Cognitive Neuroscience*, 18(10), 1734–1748. <https://doi.org/10.1162/jocn.2006.18.10.1734>
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- Schuch, S., & Keppeler, E. (2022). N-2 Repetition Costs in Task Switching: Task Inhibition or Interference Between Task Episodes? *Journal of Cognition*, 5(1), 48. <https://doi.org/10.5334/joc.244>
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