

Disentangling the roles of cue visibility and knowledge in learning cognitive control

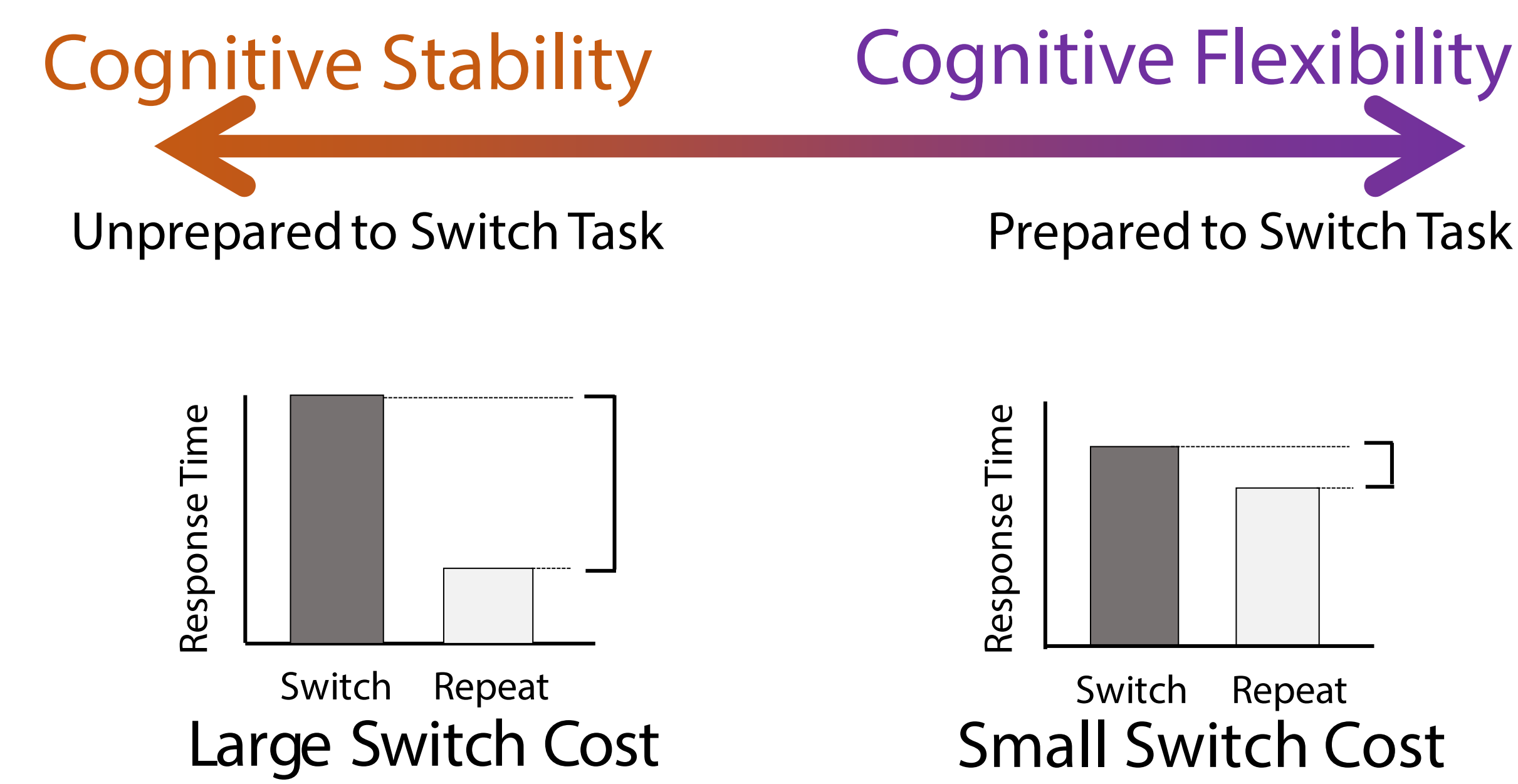
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Background: Subliminal Cueing of Control

Farooqui and Manly (2015, *Psych Sci*) raised the possibility that control-learning is more effective when cues of control demand are presented subliminally.



Our Design (<https://osf.io/7jfbp/>):

- Manipulate conscious cue perception & predictive cue knowledge independently
- 2x2 design with an overall 25:75 switch:repeat context, a task-switching paradigm with two predictive cues and one nonpredictive cue

	cue knowledge	
	1: implicit	2: explicit
cue visibility		
1: subliminal	subliminal, implicit (E1)	subliminal, explicit (E2)
2: supraliminal	supraliminal, implicit (E3)	supraliminal, explicit (E4)

Behavioral Prediction:

- Participants will use contextual cues to modulate control such that switch costs¹ will be reduced following predictive vs. nonpredictive cues^{2,3}.

Competing Hypotheses:

- If the conclusions from Farooqui & Manly (2015) were warranted, we should observe smaller switch costs for subliminal (E1-2) vs. supraliminal (E3-4) cueing^{4,5}.
- Traditional views on control, however, would predict the smallest switch costs under the supraliminal and explicit knowledge conditions (E4).
- Current theories of action control⁶ would predict the smallest switch costs under the implicit knowledge condition (E1, E3).
- If pre-emptive control operations⁷ can be prepared and triggered by the cues (“action-triggers”), we should observe smaller switch costs in E2-4 vs. E1.

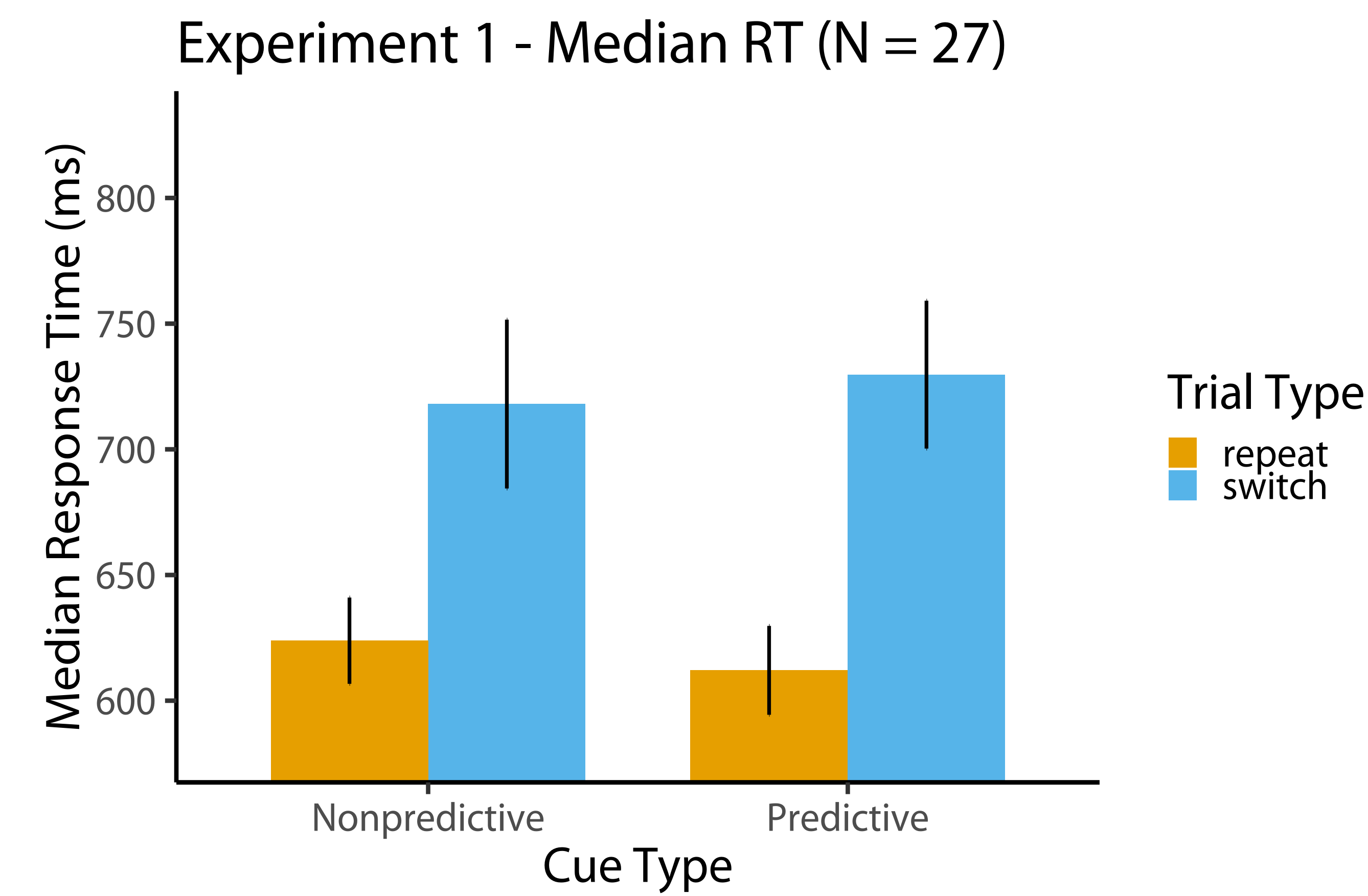
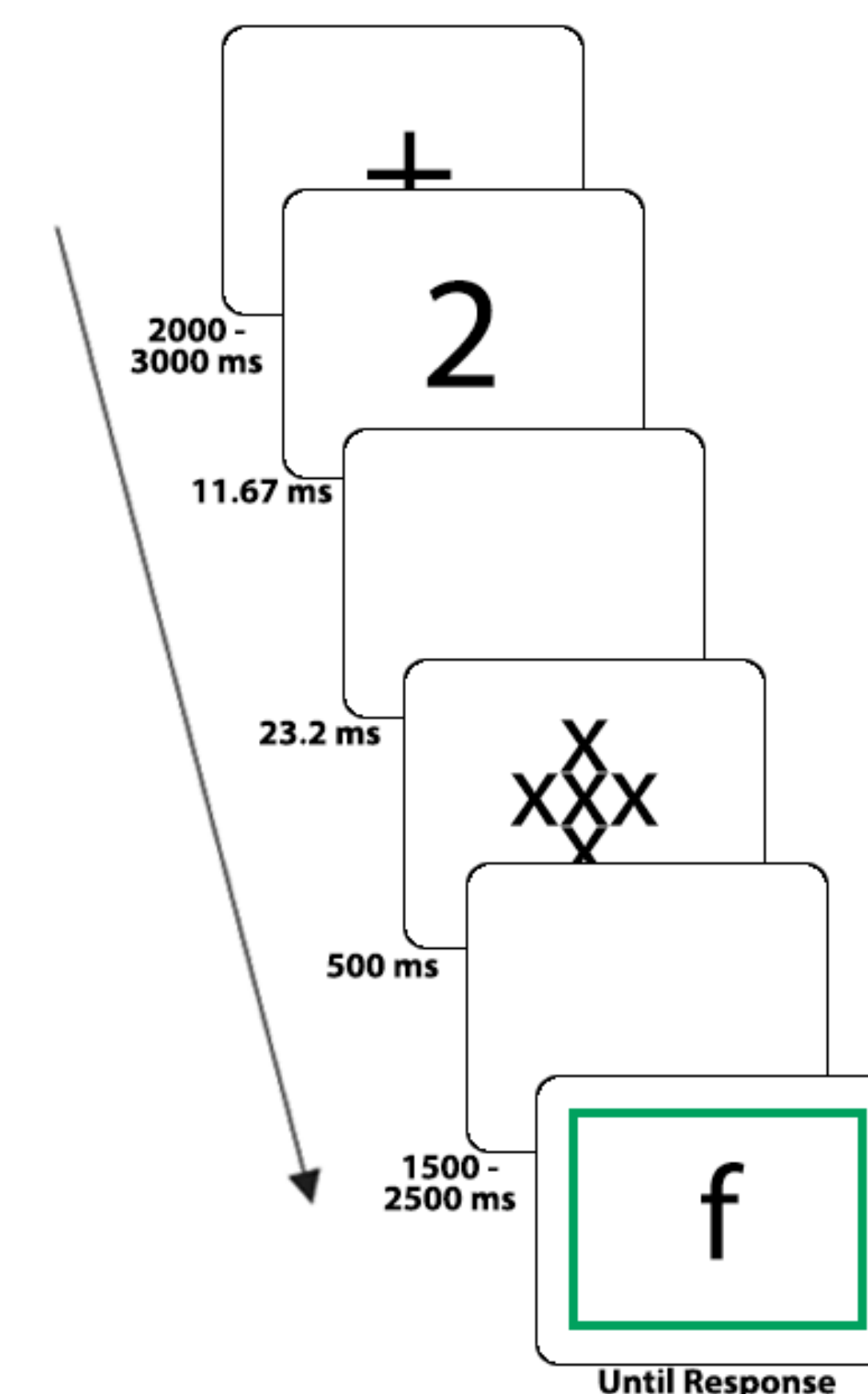
References:

¹Monsell (2003). *Trends in Cognitive Sciences*. ²Bugg & Crump (2012). *Frontiers in Psychology*. ³Abrahamse et al. (2016). *Psychological Bulletin*. ⁴van Gaal, De Lange, and Cohen (2012). *Frontiers in Human Neuroscience*. ⁵Kunde, Reuss, and Kiesel (2012). *Advances in Cognitive Psychology*. ⁶Hommel (2013). *Frontiers in Psychology*. ⁷Kunde, Kiesel, and Hoffmann (2003). *Cognition*.

Not Informed of Cues' Meanings

E1: Subliminal, Implicit

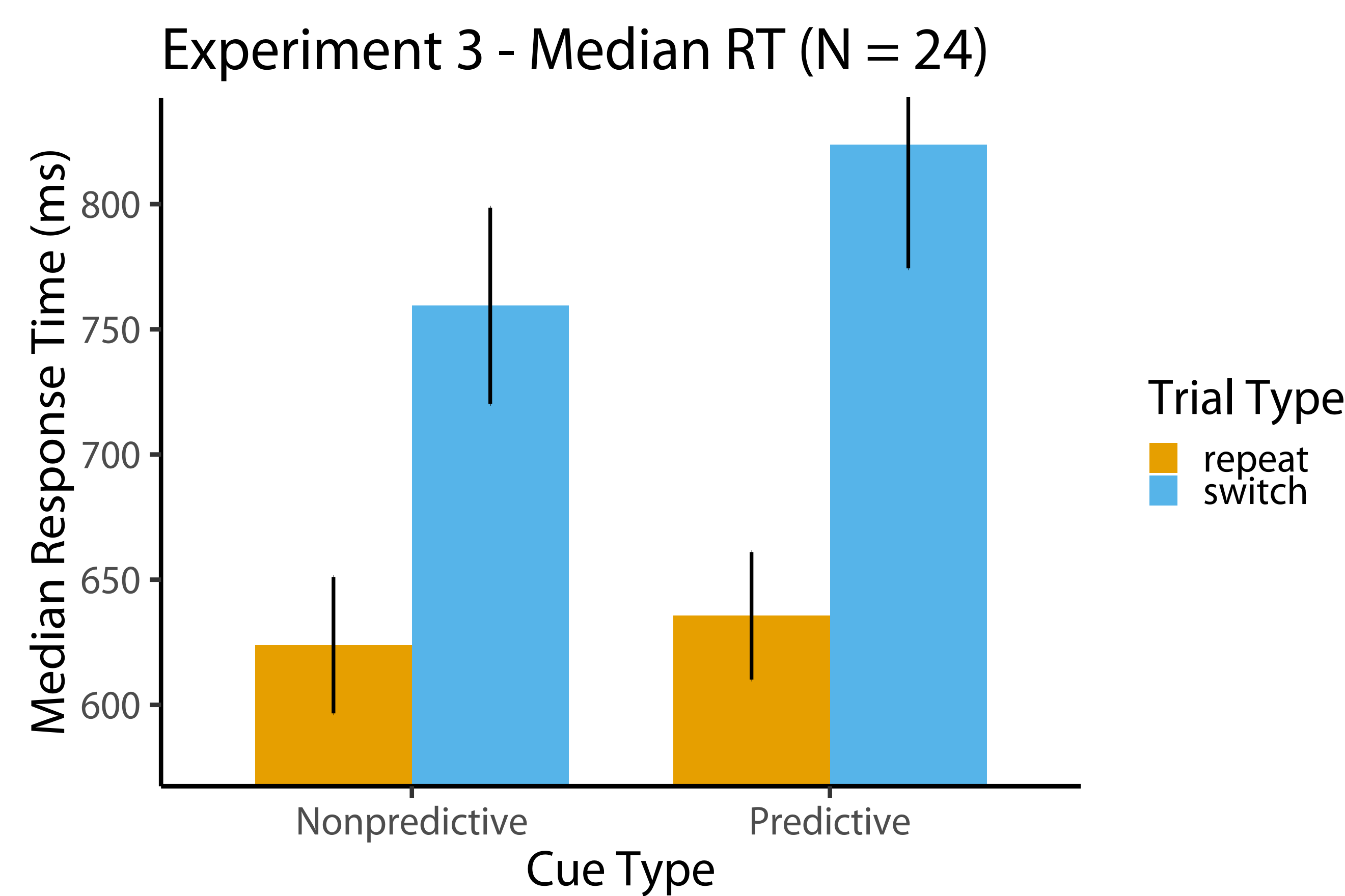
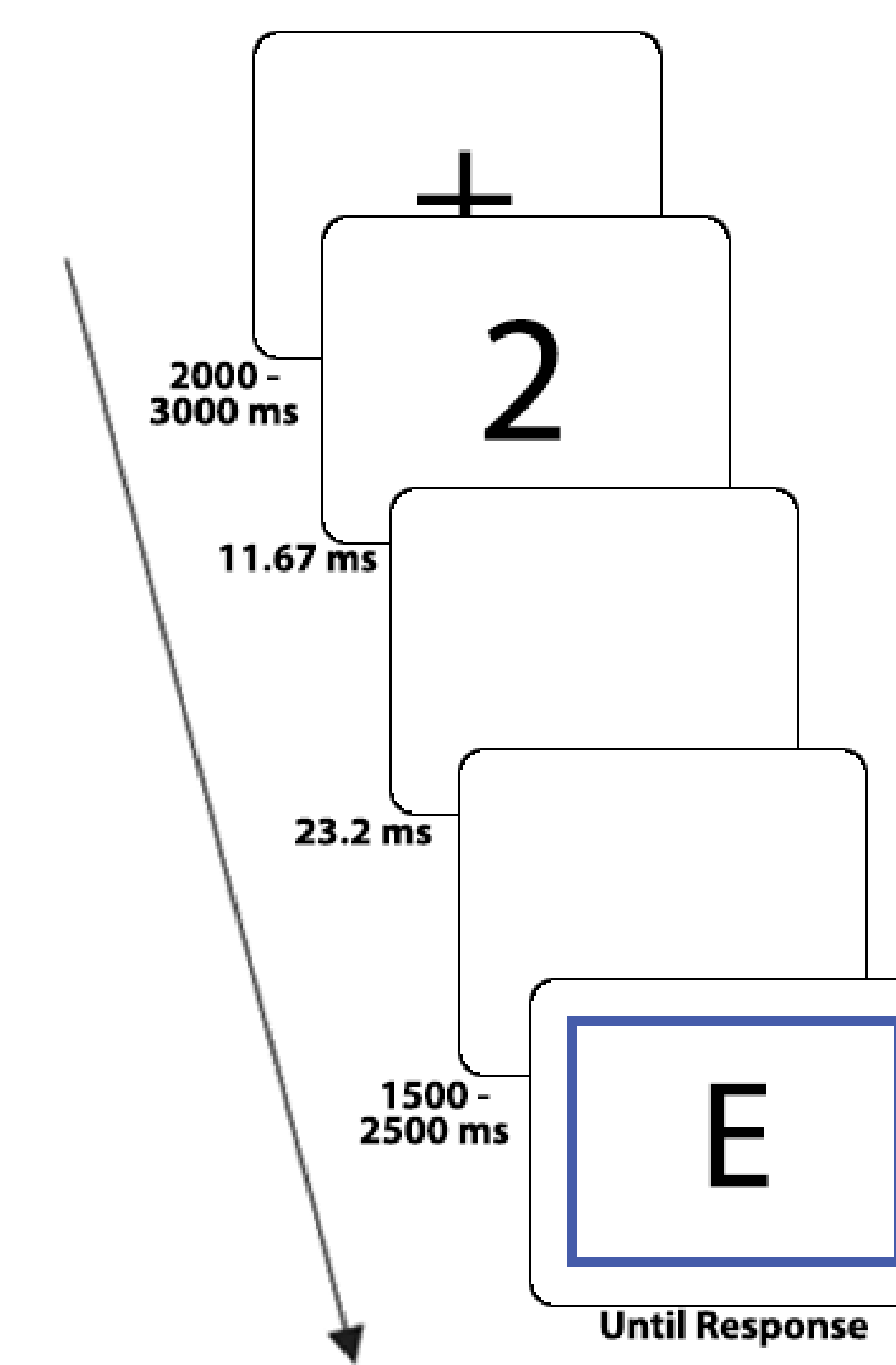
- Average participant identified 3% of individual cues—validating masking



Context x Trial Type: $F(1,26) = 1.724, p = 0.201, \eta_p^2 = 0.062$

Equivalence testing suggests that the index is statistically not different from, and equivalent to, zero ($t(26) = 2.484, p = 0.01$; null: $t(26) = -1.309, p = 0.202$).

E3: Supraliminal, Implicit



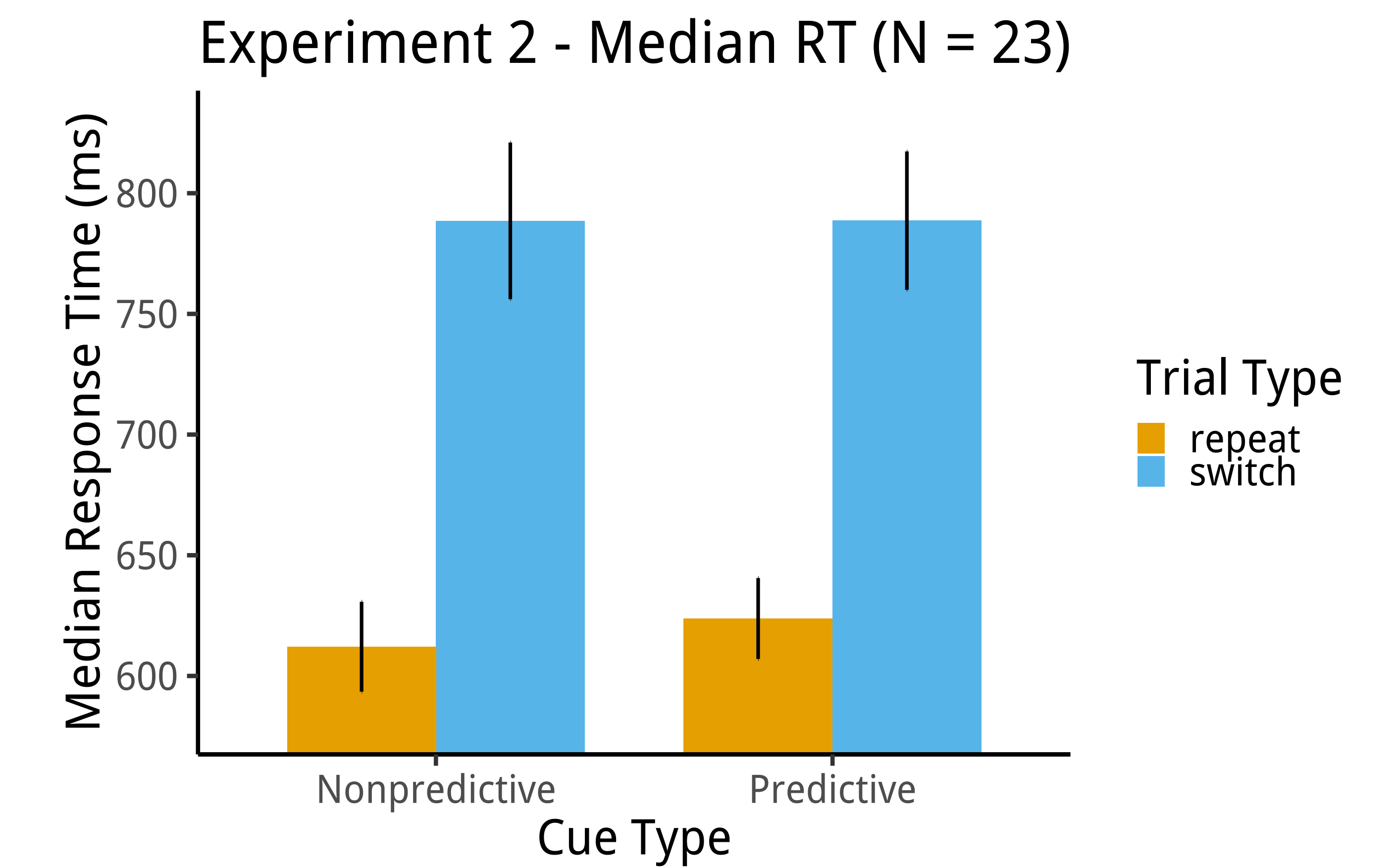
Context x Trial Type: $F(1,23) = 4.005, p = 0.057, \eta_p^2 = 0.148$

Equivalence testing suggests that the index is statistically different from, and not equivalent to, zero ($t(23) = 1.082, p = 0.145$; null: $t(23) = -2.495, p = 0.020$).

Informed of Cues' Meanings

E2: Subliminal, Explicit

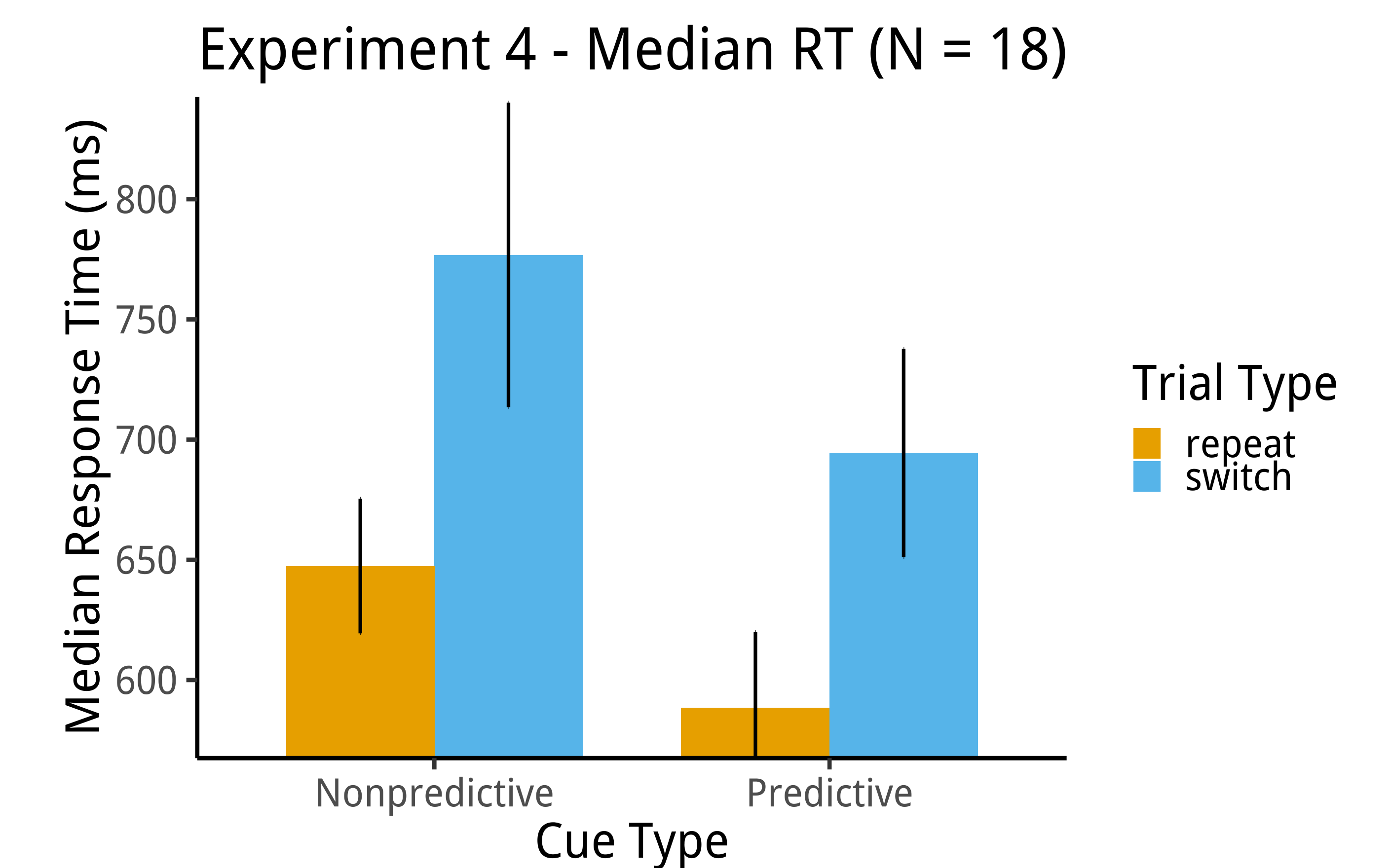
- Average participant identified 16% of individual cues—validating masking



Context x Trial Type: $F(1,22) = 0.191, p = 0.666, \eta_p^2 = 0.013$

Equivalence testing suggests that the index is statistically not different from, and equivalent to, zero ($t(22) = -2.757, p = 0.006$; null: $t(22) = 0.744, p = 0.465$).

E4: Supraliminal, Explicit



Context x Trial Type: $F(1,17) = 1.853, p = 0.191, \eta_p^2 = 0.083$

Equivalence testing suggests that the index is statistically not different from, and equivalent to, zero ($t(17) = -2.332, p = 0.016$; null: $t(17) = 0.766, p = 0.454$).

Conclusions:

- We do not find strong evidence for cue-induced changes in switch costs in any of the conditions.
- Sequential bayes factor analysis suggests that we need to collect more participants for all four experiments.