Temporal ambiguity of onsets in a cueing task prevents facilitation but not inhibition of return

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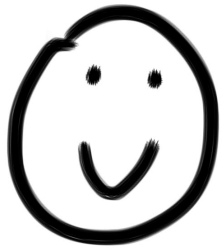
October 20, 2017

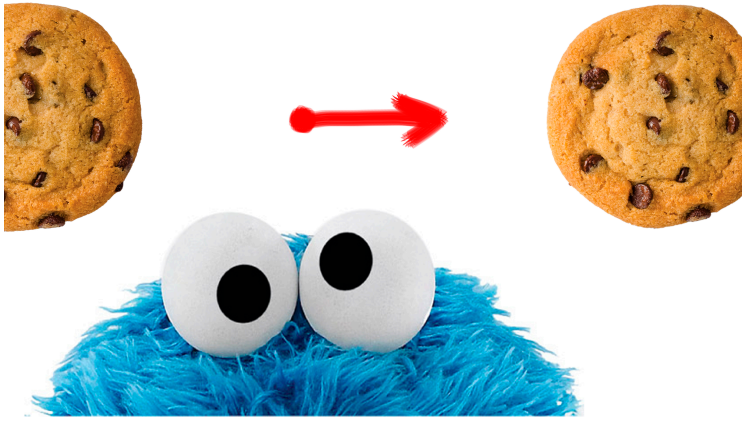
Coming soon…

Malevich, T., Ardasheva, L., Krüger, H.M., & MacInnes, W.J. (in press). Temporal ambiguity of onsets in a cueing task prevents facilitation but not Inhibition of return. *Attention, Perception, & Psychophysics.* doi:10.3758/s13414-017-1435-1

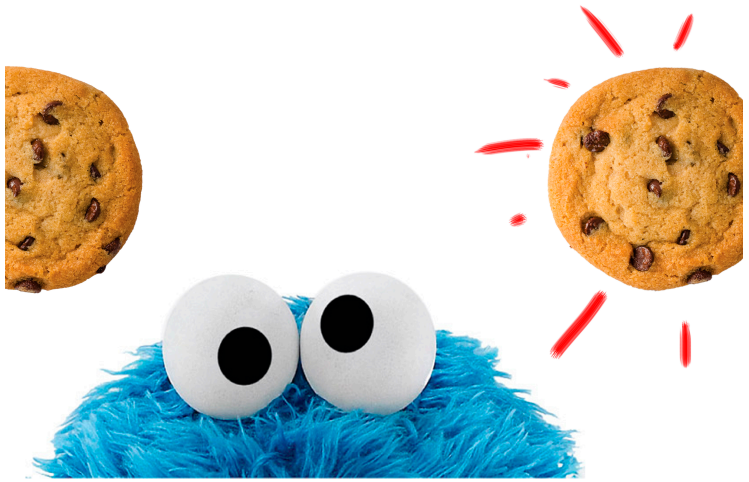


Shifts of attention

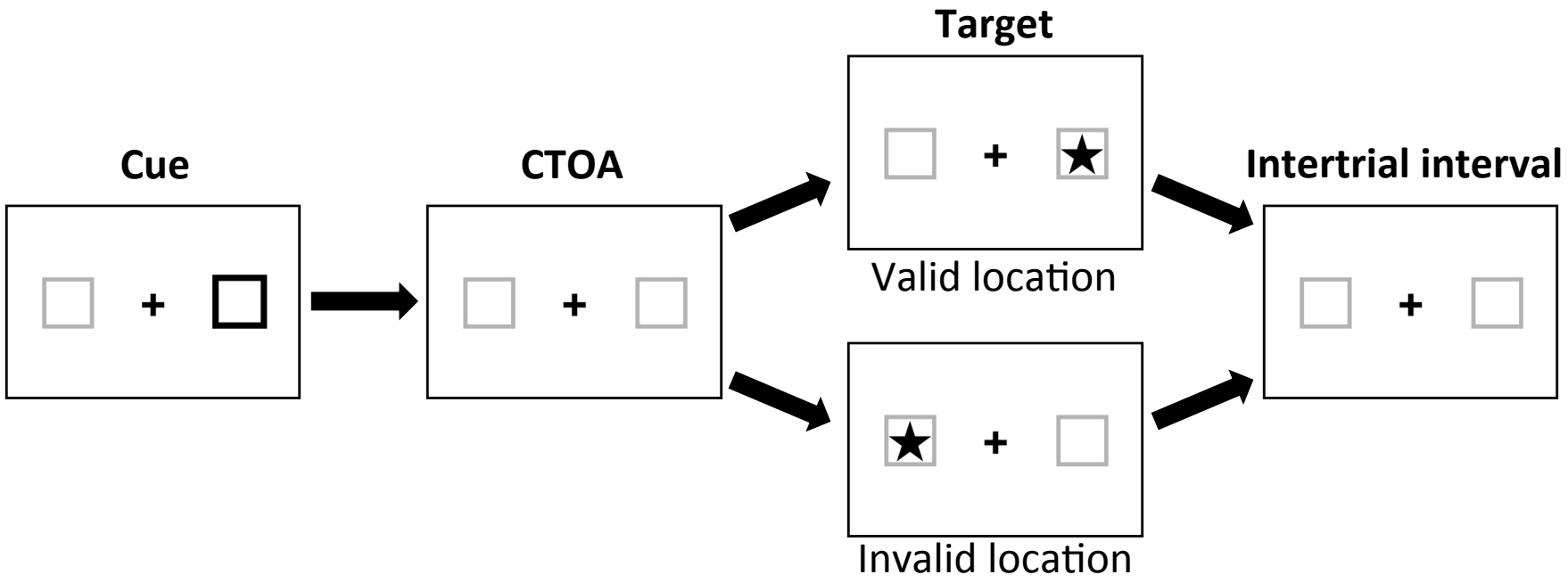
Endogenous



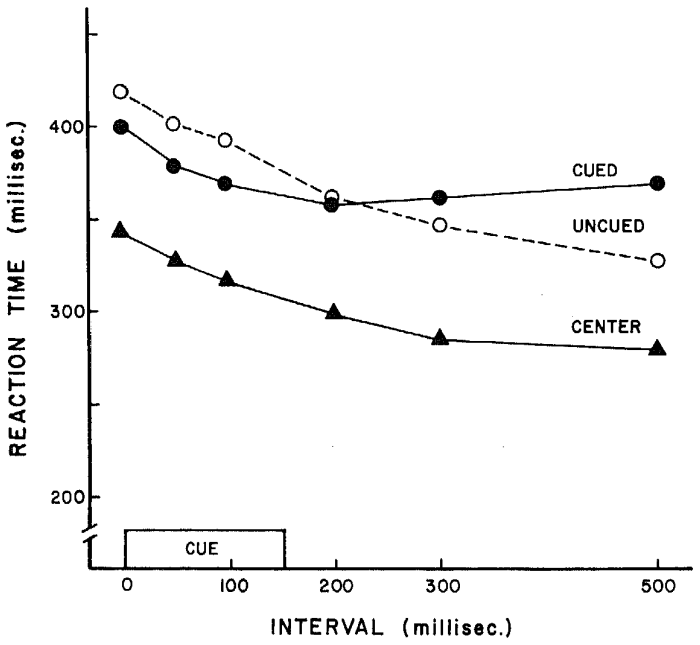
Exogenous



Posner cueing paradigm



Cueing effects



Posner & Cohen (1984)

- **early facilitation of reaction time (RT):**
  faster in case of validly cued locations at short cue-target onset asynchronies (CTOAs)
- **inhibition of return (IOR):**
  longer in case of validly cued locations at long CTOAs

Early facilitation

Traditional attention account

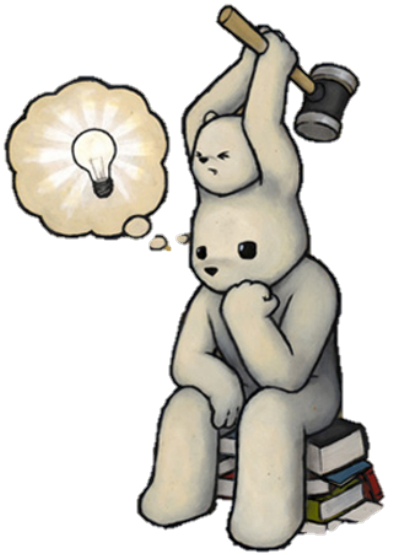
- feedforward information processing + later top-down modulation
- attention speeds the processing of future stimuli at the cued location (Spence & Parise, 2010)

there are some problems

Non-attentional explanations (TBC)

Response inhibition account (Albares et al., 2011)

- a defense mechanism against anticipatory responses to cues in the exogenous paradigm
- cue = a releaser



Non-attentional explanations

Perceptual merging account (Krüger et al., 2014):

1. Feedforward stage: processing of information in striate & extrastriate areas
2. Feedback / reentrant processing stage: noise reduction & confirmation of the perceptual hypothesis

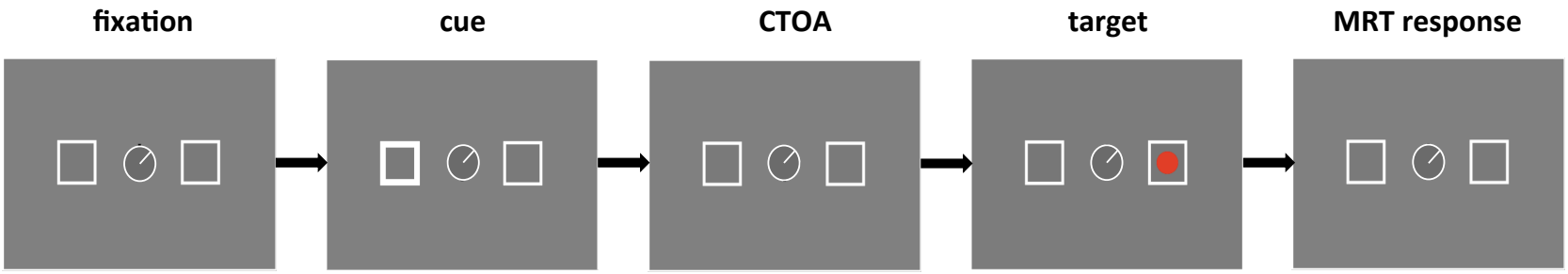
a loop of comparisons

Krüger's experiment

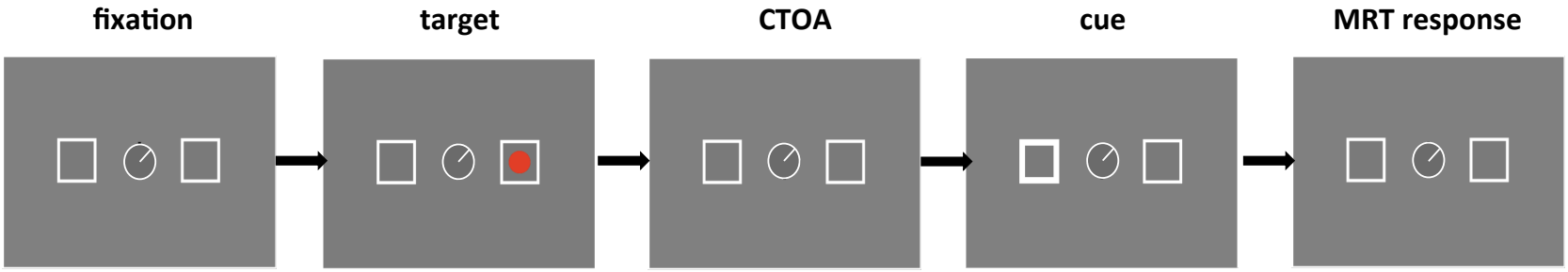
- speeded manual reaction times (MRT) task
- non-speeded perceived onset time (POT) task (Carlson, Hogendoorn, & Verstraten, 2006)
- 2 cue & target locations (valid vs invalid)
- Pre-cue condition: cue prior to target
- Post-cue condition: cue after target
- No-cues & catch included
- Fixed CTOAs (110ms)

Krüger's design

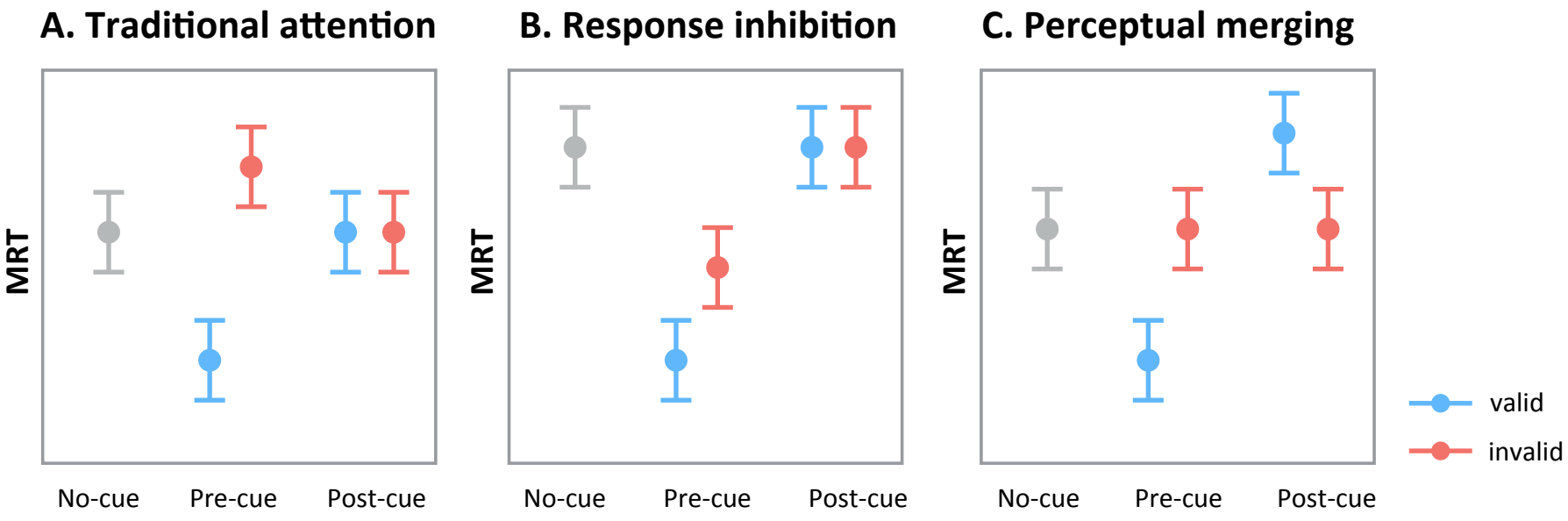
A. Pre-cue condition



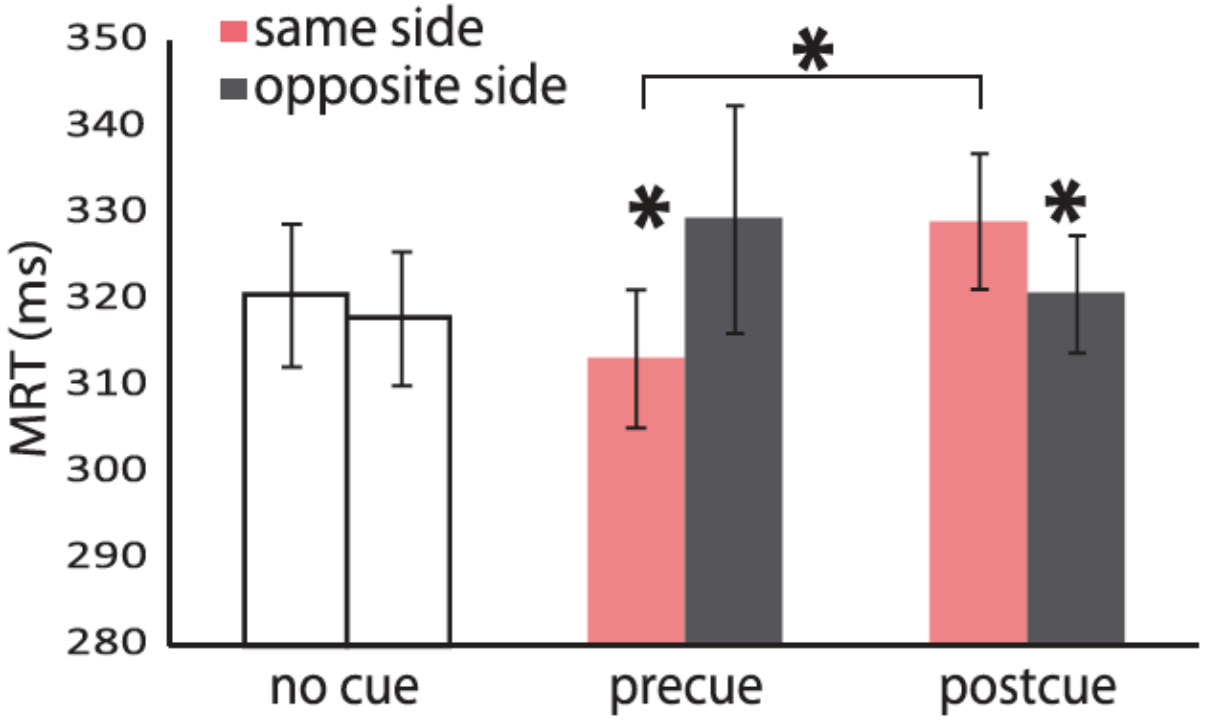
B. Post-cue condition



Krüger's predictions



Krüger's results



perceptual merging rules!

Questions

- a transition between post-cue costs and pre-cue facilitation
- a transition from facilitation to inhibition

continuous design !!!

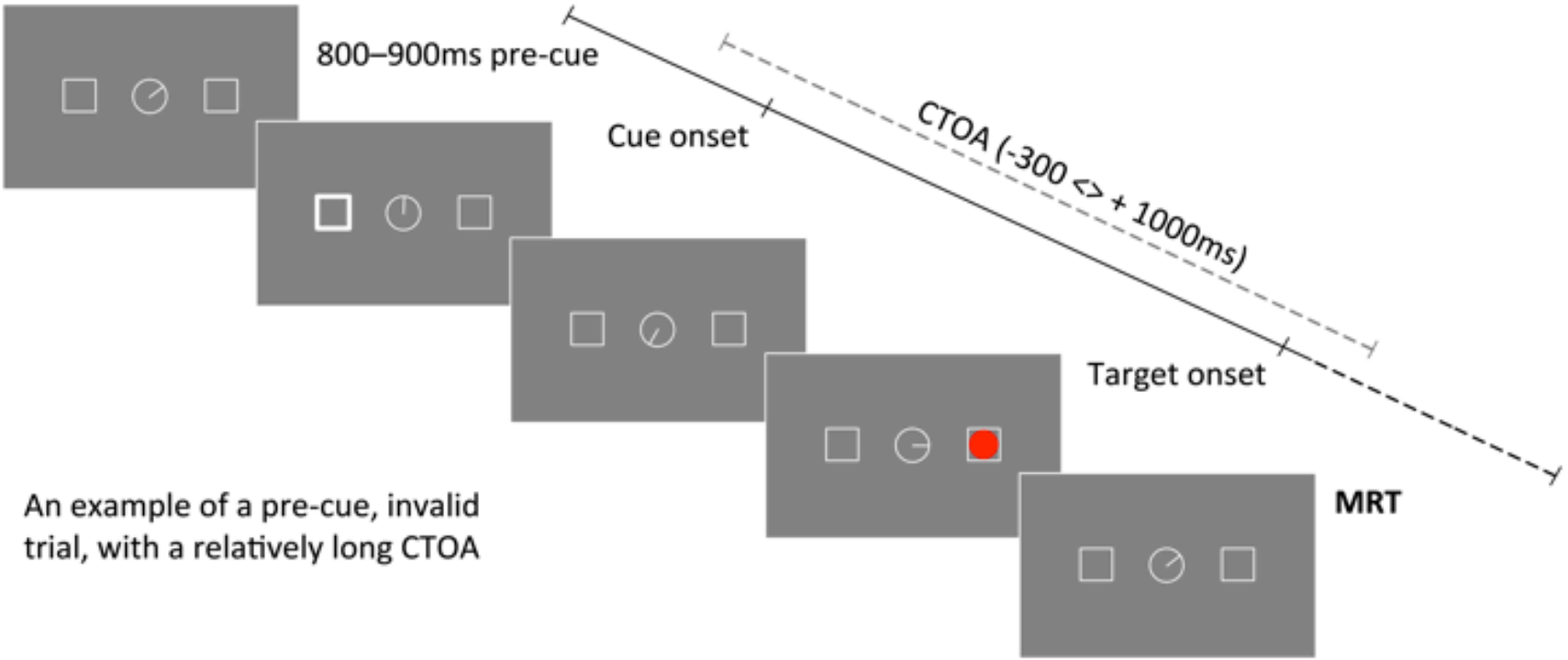
Side note: temporal manipulations

- usually: temporal context / aging manipulations do not affect cueing effects in detection tasks (e.g., Milliken et al., 2003; Gabay & Henik, 2008, 2010)
- a few: elimination / reduction of temporal expectations could affect cueing effects (e.g., Wang et al., 2012; MacInnes, 2017)

Experiment 1

- MRT-task (Krüger et al., 2014)
- exogenous, non-informative cues
- valid vs invalid
- pre- vs post-cue
- catch (10%) included
- random CTOAs: from -300ms to +1000ms
- 176 trials
- N = 21

A trial example



An example of a pre-cue, invalid trial, with a relatively long CTOA

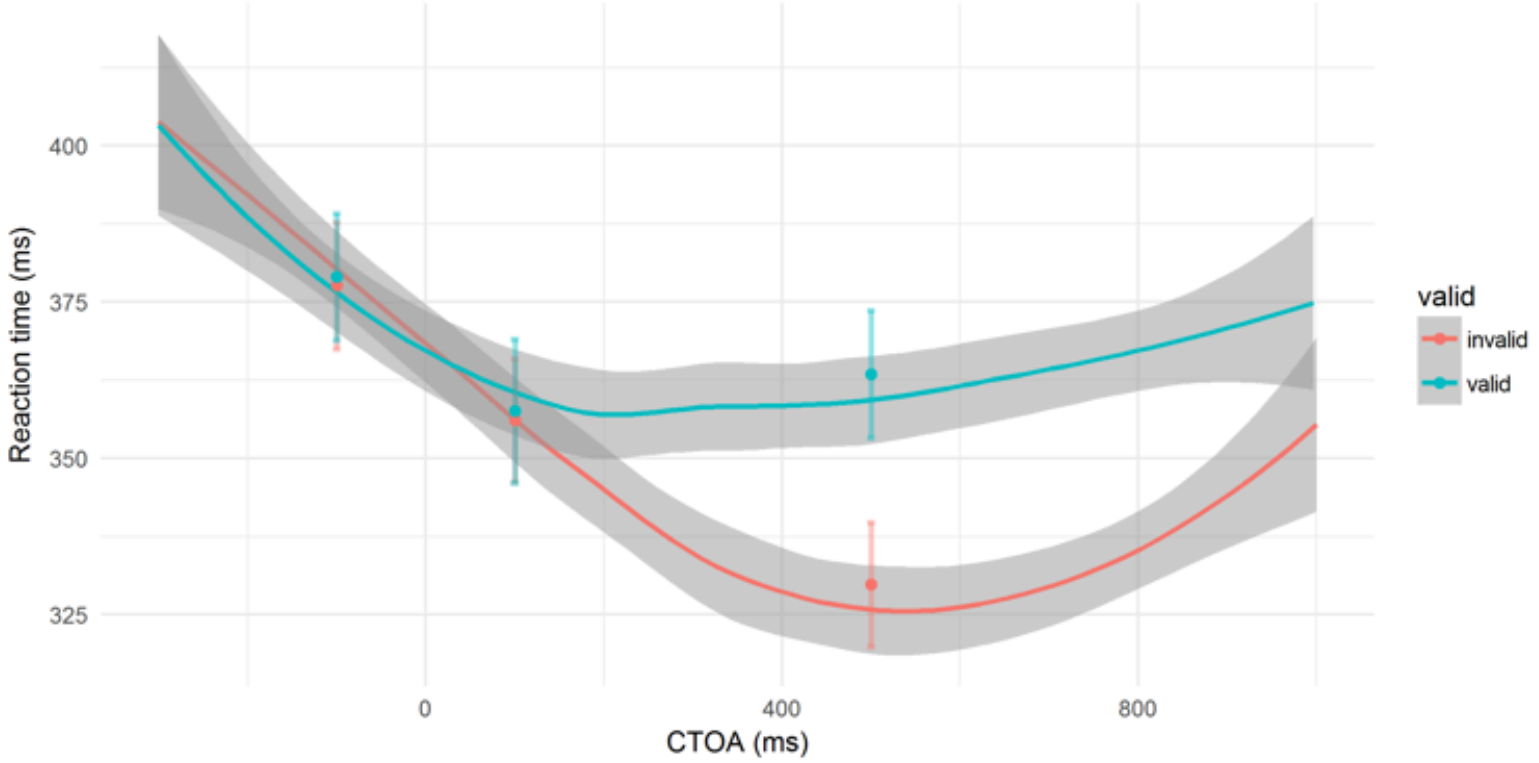
Analysis

- **A linear mixed-effects model:**
  - fixed effects: Validity & CTOA
  - random effect: participant
  - base levels: invalid for Validity & 0ms for CTOA
  - slopes added (don't even ask)
  - a Chi-squared ($\chi 2$) test

Results

Surprise!

Real results



- no facilitation
- no perceptual merging
- robust IOR

Experiments 2-3

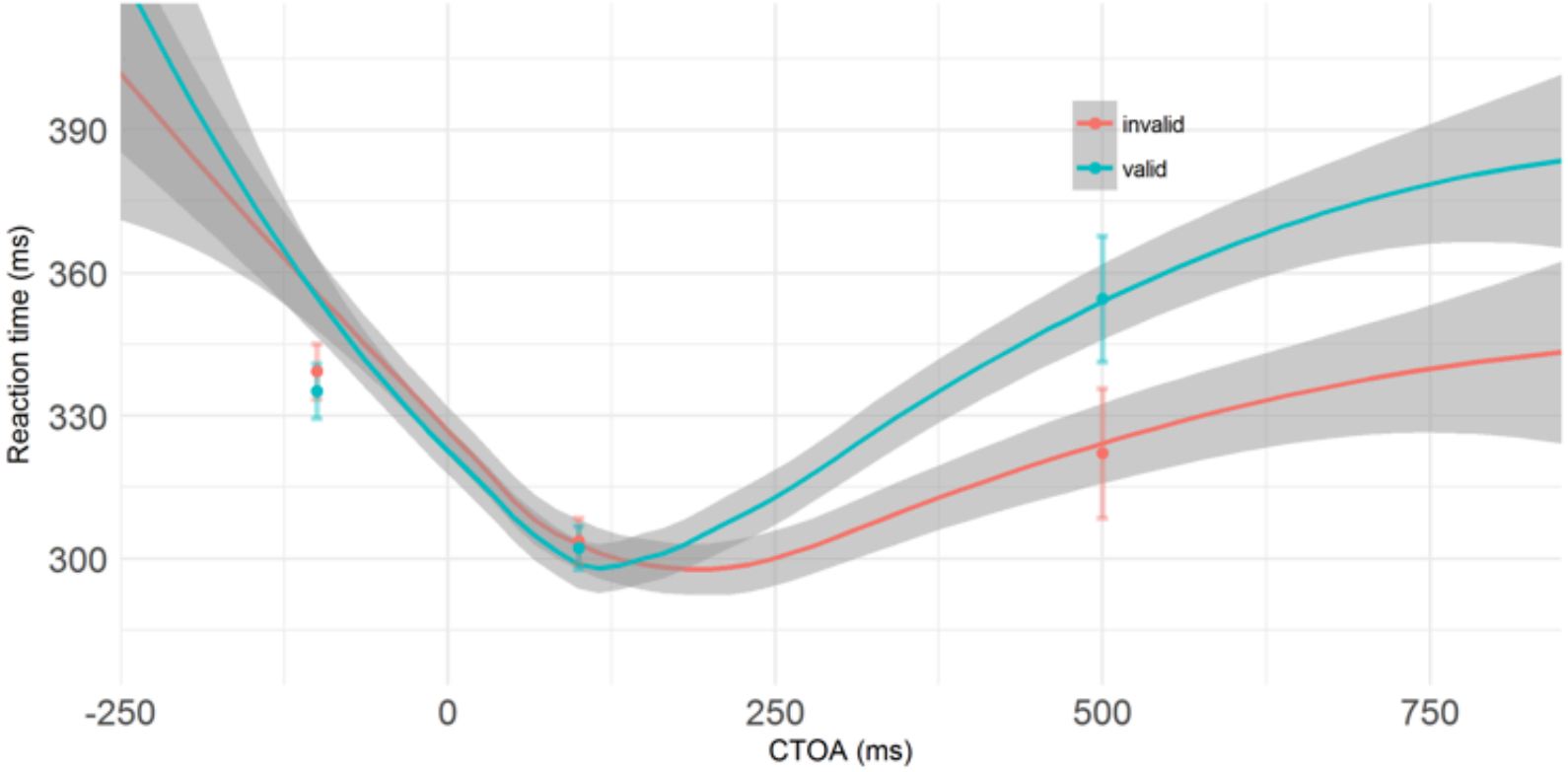
Experiment 2:

- Gamma distribution: 20% post-cues, 50% of trials between 0 and 210ms, & 30% with longer CTOAs
- 176 trials
- N = 21

Experiment 3:

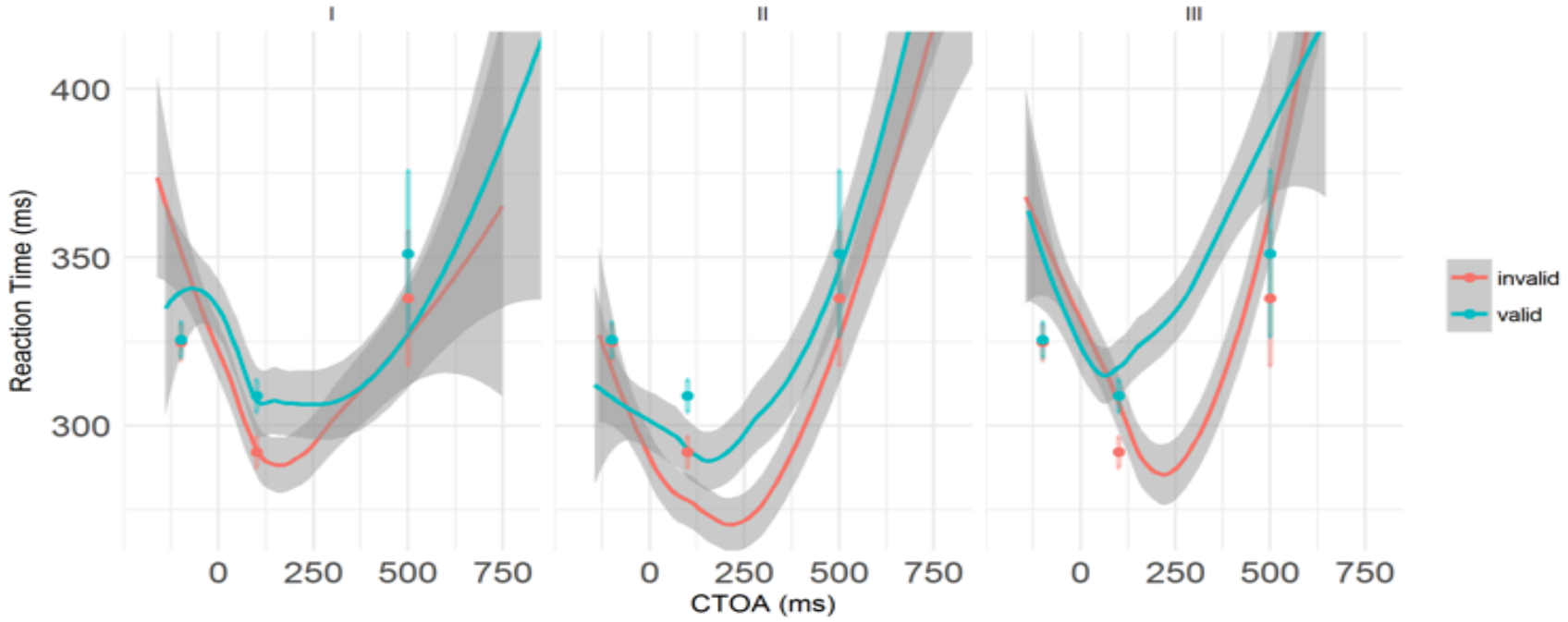
- 5 sessions during 2 days, 880 trials in total
- N = 3

Results: Exp 2



same story

Results: Exp 3



still the same

Meta analysis

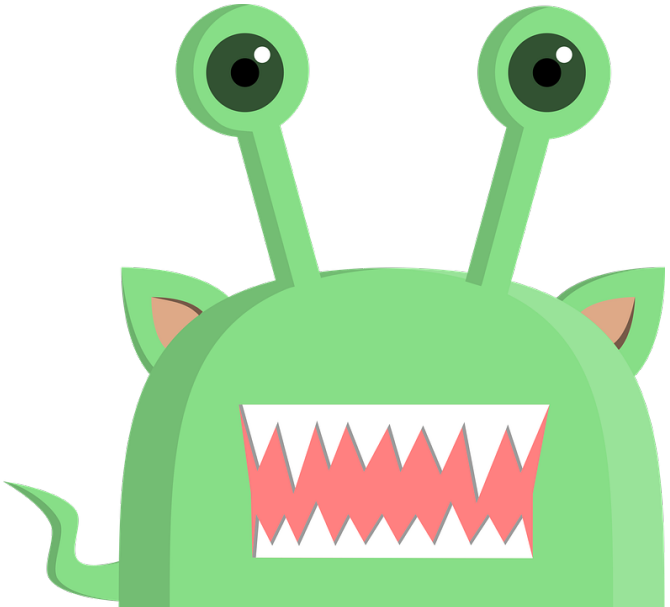
- a significant effect of validity for long CTOAs, $t(44)=8.7$, $p<.001$, $d=.8$, with 32ms of IOR
- no facilitation at short pre-cues, $t<1.0$
- a significant cost (-6.8 ms) of validity in post-cues, $t(44)=2.2$, $p=.025$, $d=.2$

a sort of perceptual merging

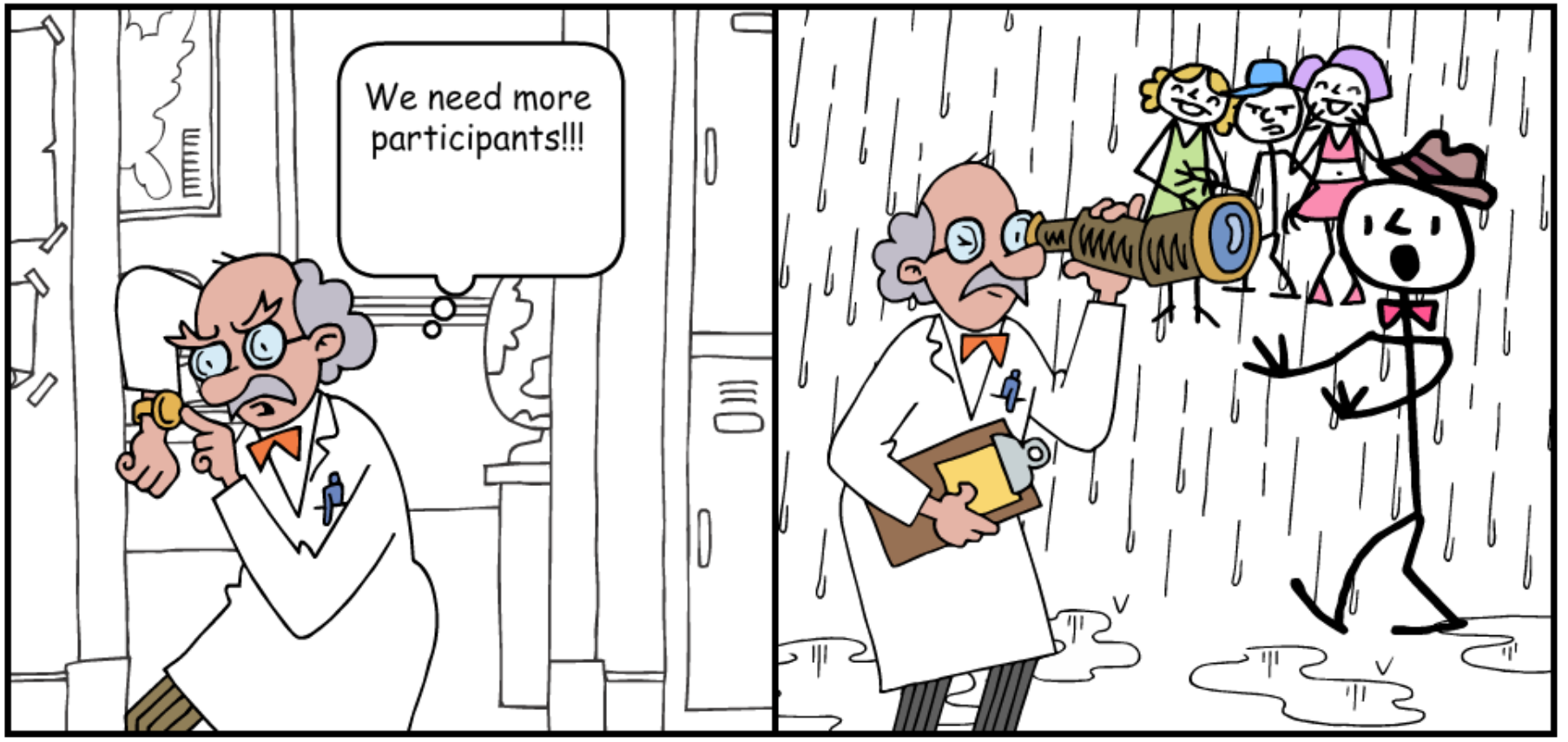
Submit?

- Continuous CTOAs prevent early facilitation but not IOR

Reviewers



Well…



This comic strip was created at MakeBeliefsComix.com. Go there to make one yourself!

Experiments 4 a, b, c

- direct temporal manipulations
- between subject
- only pre-cues (+50ms or greater)
- a simple cross at fixation
- 396 trials in each
- N = 21 for each

Experiments 4 a, b, c

Experiment 4a

- random CTOAs
- CTOAs from 50ms to 900ms
- 3 Gammas (50ms, 400ms and 750ms) for bins

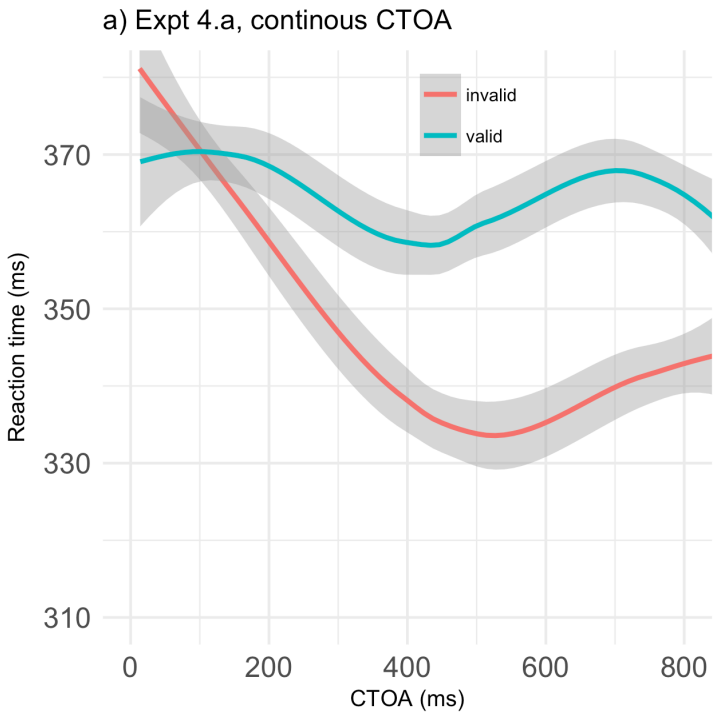
Experiment 4b

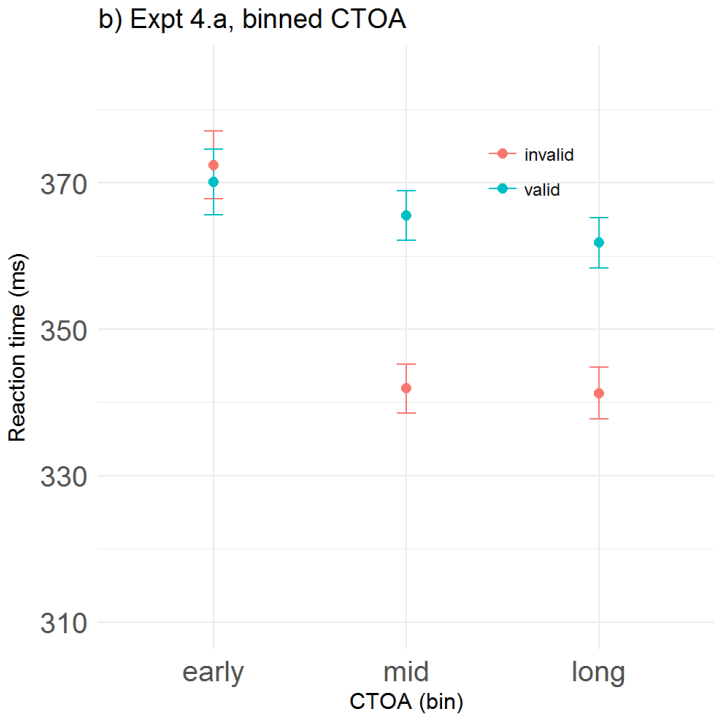
- binned CTOAs (50ms, 400ms and 750ms)
- randomly mixed

Experiment 4c

- discrete CTOAs (50ms, 400ms and 750ms)
- 3 blocks

Results: 4a (continuous)





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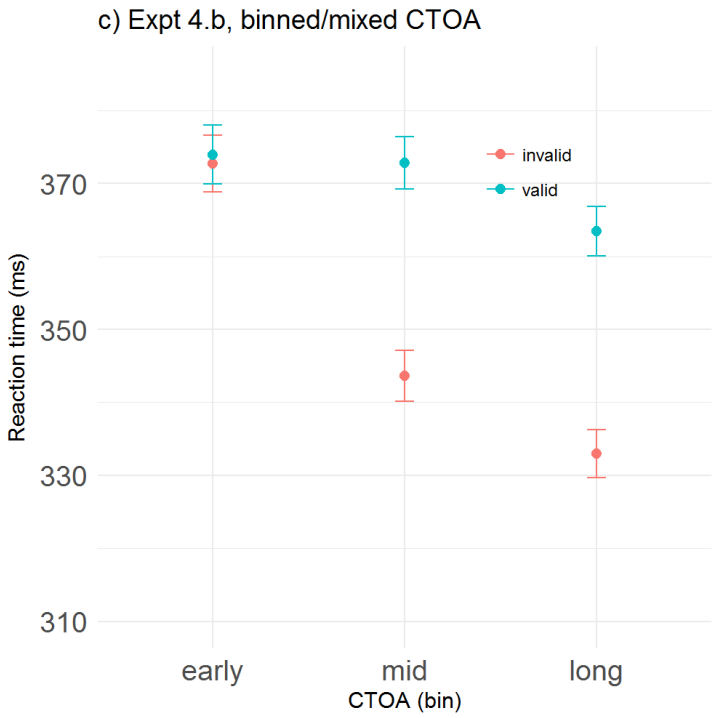
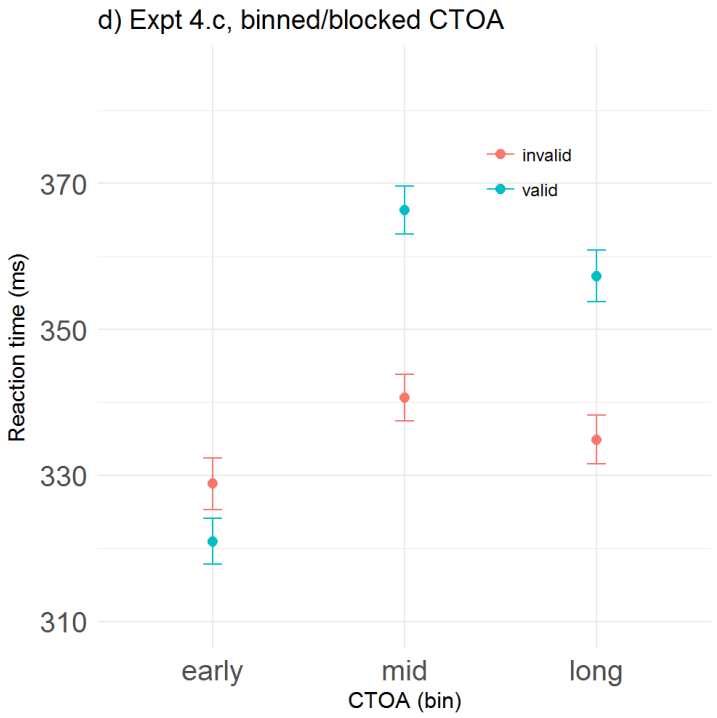
Results: 4b&c (mixed vs blocked)





still the same

facilitation!!!

8.1ms at 50ms CTOA, *t*=-4.09

Summing up

- Random, continuous CTOAs (Exp 1-4a): no facilitations but early onset of IOR
- CTOA probability (Exp 2-3): no effect
- Perceptual merging cost at post-cues: replicated but only in meta analysis (too small effect)
- Mixed CTOAs (Exp 4b): no facilitations but early onset of IOR
- Blocked CTOAs (Exp 4c): the classic biphasic facilitation / inhibition pattern

Discussion (TBC)

- early facilitation could be modulated by temporal expectations (cf. Milliken et al., 2003; Gabay & Henik, 2008, 2010)
- temporal ambiguity eliminates spatial advantages of the valid location at short CTOAs

Discussion (TBC)

- there are other studies that show no facilitation
- conditions differ (Van Der Lubbe et al., 2005; Hayward & Ristic, 2013; Jaffard et al., 2007; Maruff et al., 1999; Taylor et al., 2015; Wang et al., 2012; MacInnes, 2017);
- Van Der Lubbe et al. (2005) & MacInnes (2017): temporal manipulations similar to ours

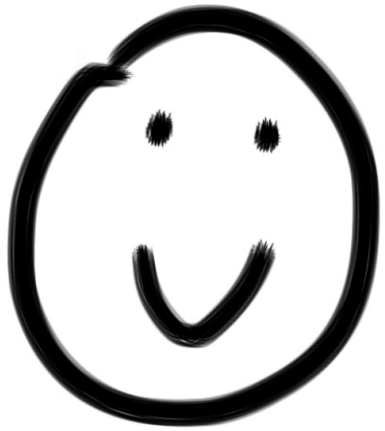
Discussion (TBC)

- the ambiguous temporal nature of random / mixed CTOAs creates an attentional set that causes an early withdraw of attention from the cued location
- fixed CTOAs in traditional cueing studies create an attentional set that encourages increased attention at the cued location
- no attention to the cue, no reentrant processing

Discussion

- IOR and facilitation are separate processes
- early facilitation in exogenous orienting is not necessarily automatic nor reflexive
- exogenous orienting is mediated by attentional control settings

Thank you!



Acknowledgements

The article was prepared within the framework of the Academic Fund Program at the National Research University Higher School of Economics (HSE) in 2016 (grant №27-05-0003) and by the Russian Academic Excellence Project “5-100.”

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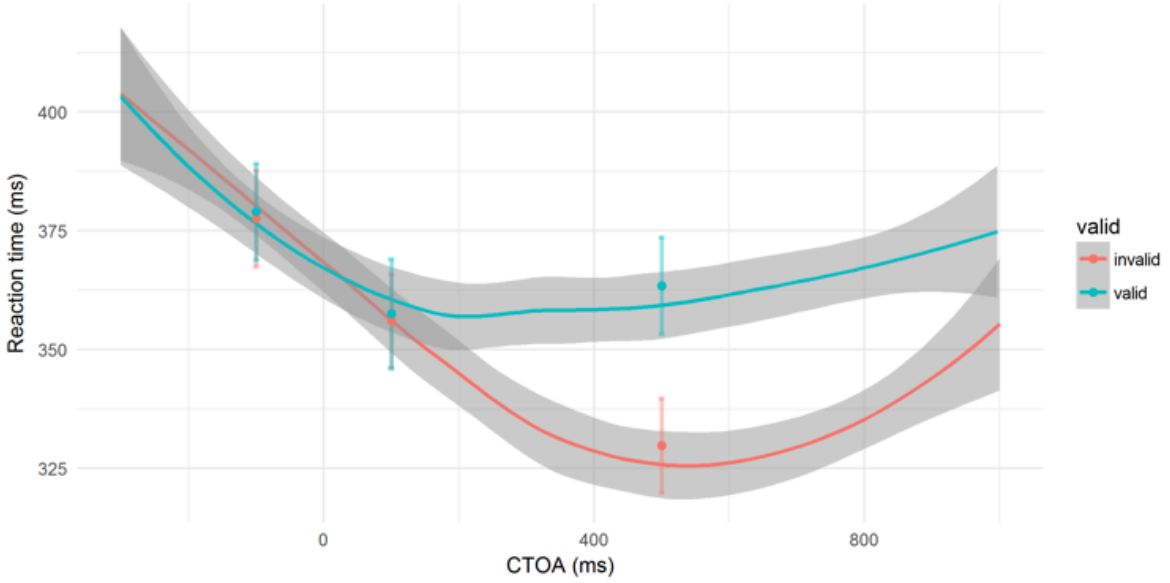
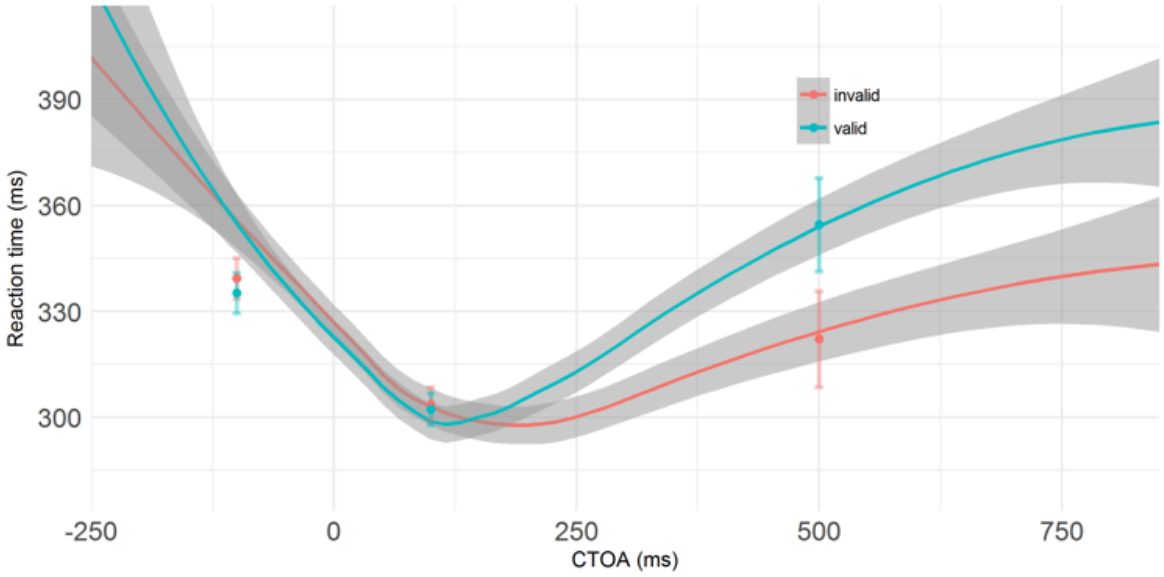
Exp 1



- Main effects of validity ($\chi^2(1) = 51.0$, $p<.001$) and CTOA ($\chi^2(1)=20.6$, $p<.001$)
- Validity by CTOA interaction ($\chi^2(1)=28.0$, $p<.001$): IOR effect (3.2ms/100ms CTOA, *SE* 6.2) for later CTOAs

- ANOVA: post-cue (-300 to 0), short-cue (+1 to 300) & long-cue (>301)
- main effects of validity ($F(1,20)=20.9$; $p<.001$; $\eta^2=.02$) and cue order ($F(2,20)=37.4$; $p< .001$; $\eta^2=.13$)
- the interaction ($F(2,40)=12.7$; $p<.001$; $\eta^2=.03$) showed +33ms of IOR for the long-cue ($t(20)=6.8$; $p<.001$; $d=.8$)

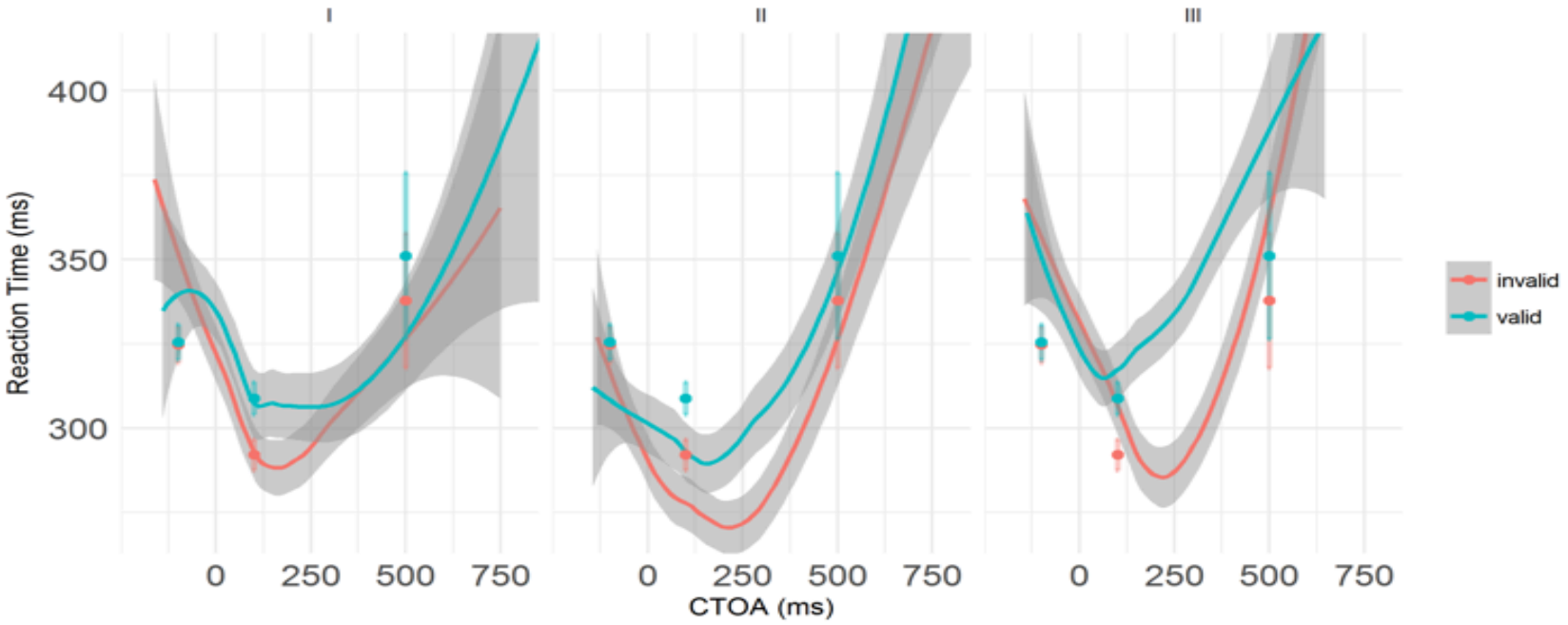
Exp 2



- Main effect of validity ($\chi^2(1) = 5.0$, $p<.001$)
- Validity by CTOA interaction ($\chi^2(1)=34.6$, $p<.001$): larger validity effects at late CTOAs, faster responses at the valid location (-5.1ms/ 100ms CTOA, *SE* 1.6)

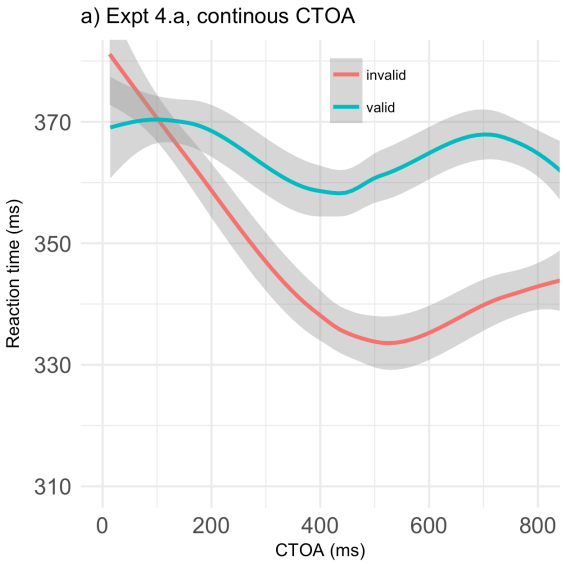
- main effects of validity ($F(1,20)=8.7$; $p=.008$; $\eta^2=.01$) and cue order ($F(2,20)=21.4$; $p<.001$; $\eta^2=.13$)
- the interaction ($F(2,40)=9.7$; $p<.001$; $\eta^2=.02$) showed +34ms of IOR for the long-cue ($t(16)=4.5$; $p<.001$; $d=.9$)

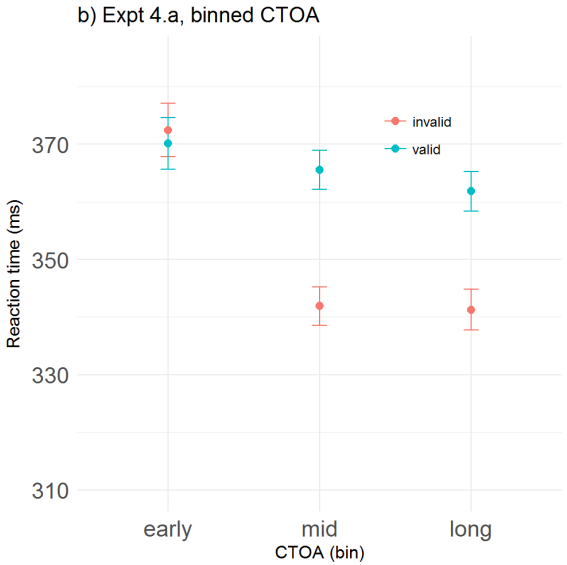
Exp 3



- Main effect of validity ($\chi^2(1)=46.7$, $p<.001$)
- Validity by CTOA interaction ($\chi^2(1)=6.5$, $p=.011$)

Exp 4a

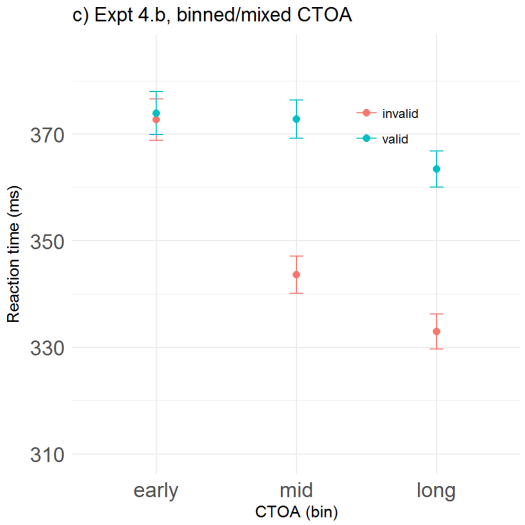


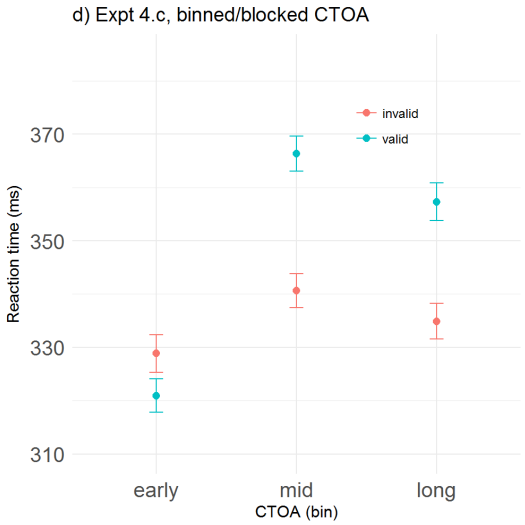


- Continuous:
- Main effects of validity ($\chi^2(1)=136.5$, $p<.001$) and CTOA ($\chi^2(2)=7.0$, $p=.008$)
- Validity by CTOA interaction: IOR effect (3.1ms/100ms CTOA, *SE* .49) for later CTOAs

- Binned (short < 150ms, medium < 500ms, long):
- Main effects of validity ($\chi^2(1)=143$, $p<.001$) and CTOA ($\chi^2(2)=16.5$, $p<.001$)
- Validity by CTOA interaction ($\chi^2(2)=56.8$, $p<.001$)

Exp 4b&c





- 4b (mixed: 50, 400 or 750):
- Main effects of validity ($\chi^2(1)=216$, $p<.001$) and CTOA ($\chi^2(2)=22.5$, $p<.001$)
- Validity by CTOA interaction: IOR at later CTOAs (3.1ms/100ms CTOA, *SE* .49)

- 4c (blocked: 50, 400 or 750):
- Main effects of validity ($\chi^2(1)=129$, $p<.001$) and CTOA ($\chi^2(2)=11.6$, $p=.003$)
- Validity by CTOA interaction: IOR at later CTOAs, 8.1ms of facilitation at 50ms CTOA, $t=-4.09$