Does Relative Speed Drive the Concealed Knowledge Test?

Chris Baker

Travis Seymour

University of California, Santa Cruz

Abstract

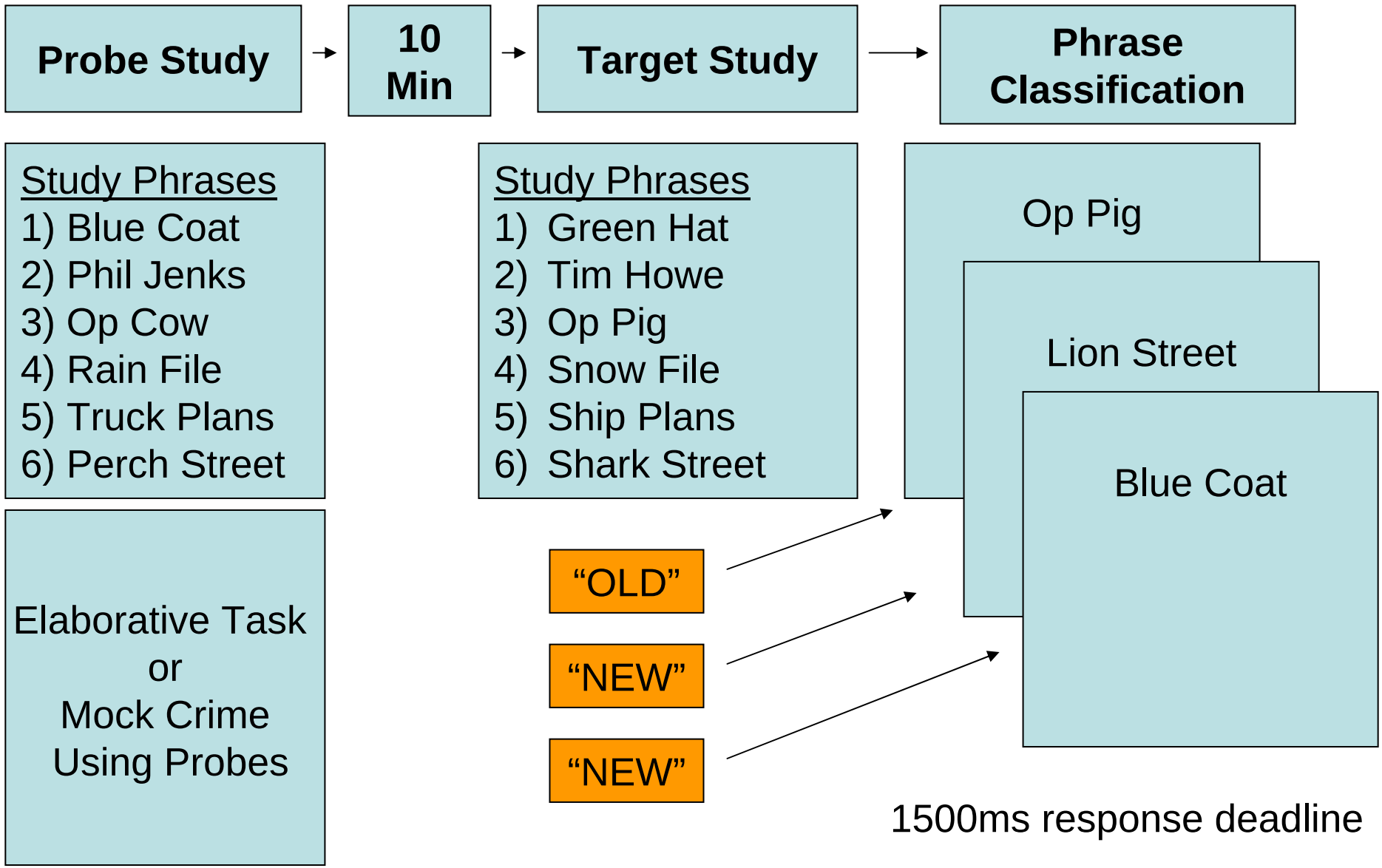
The Concealed Knowledge Test is an alternative to the traditional “lie detector” that measures prior exposure to crime-related stimuli instead of lying. Responses to familiar Probes in this test are slower and less accurate than to unfamiliar items. The Parallel Task-Set model suggests that two parallel task-sets prepare competing responses to familiar Probes only. We show support for this model’s relative speed assumptions, despite previous suggestions that relative speed does not drive response competition tasks.

The Concealed Knowledge Test

The Concealed Knowledge Test (CKT; Lykken, 1959) detects one's familiarity with privileged information despite intentions to conceal this knowledge. In an exclude-recognition paradigm, participants are shown recently learned items (Targets) to which they respond "Old", and new items (Fillers) to which they respond "New". Critical items (e.g., crime details) are also presented and are to be rejected ("New"). For the innocent or unaware, Probes and Fillers can be rejected quickly and accurately. However, those familiar with Probes are slower and less accurate when rejecting these items, but not Fillers (e.g., Seymour et al., 2000). Slide 4 shows a typical CKT paradigm, while slide 7 ("observed") shows the concealed knowledge effect on RT & accuracy.

Concealed Knowledge Task

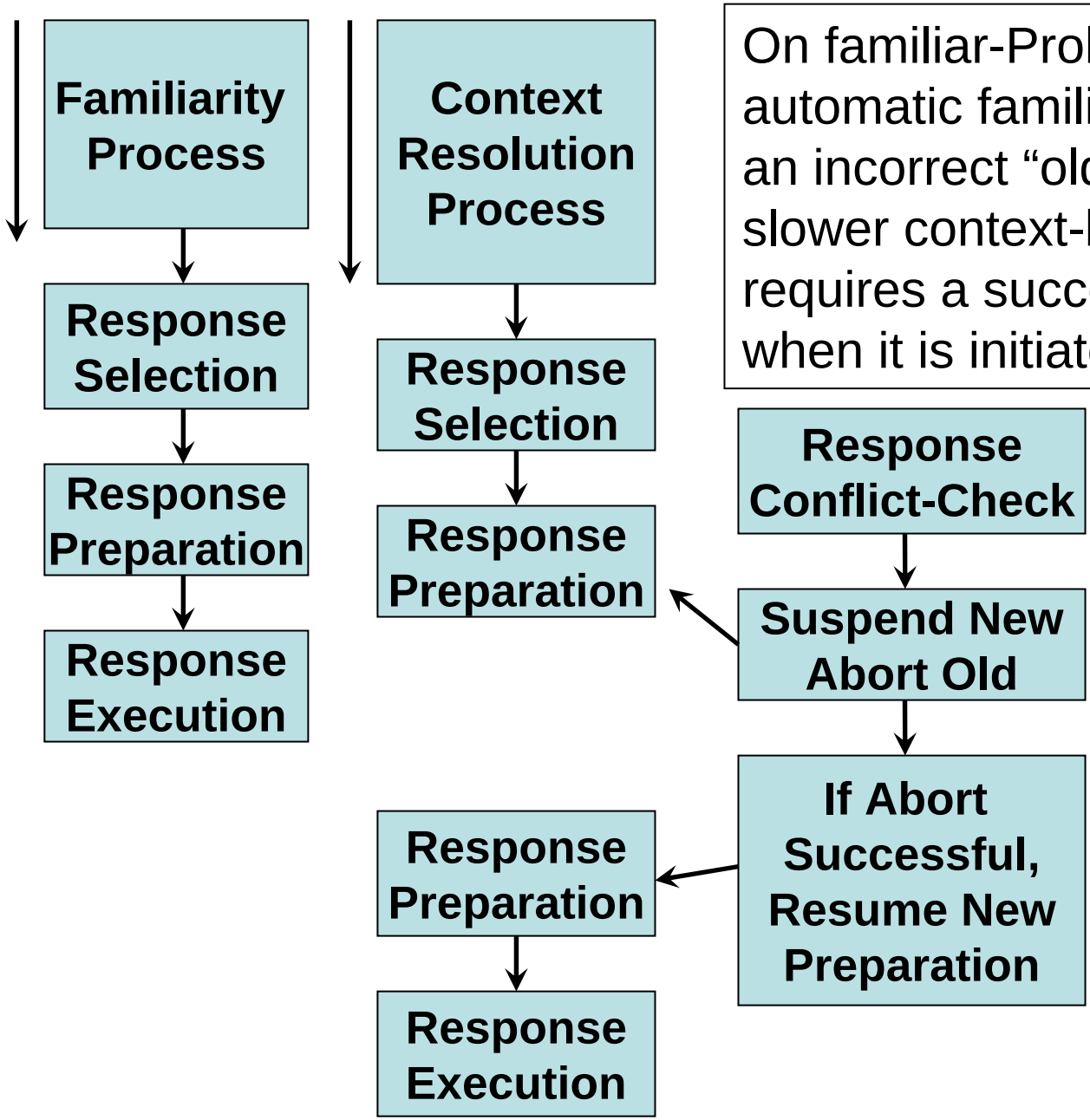
(e.g., Seymour et al., 2000)



The Parallel Task-Set Model

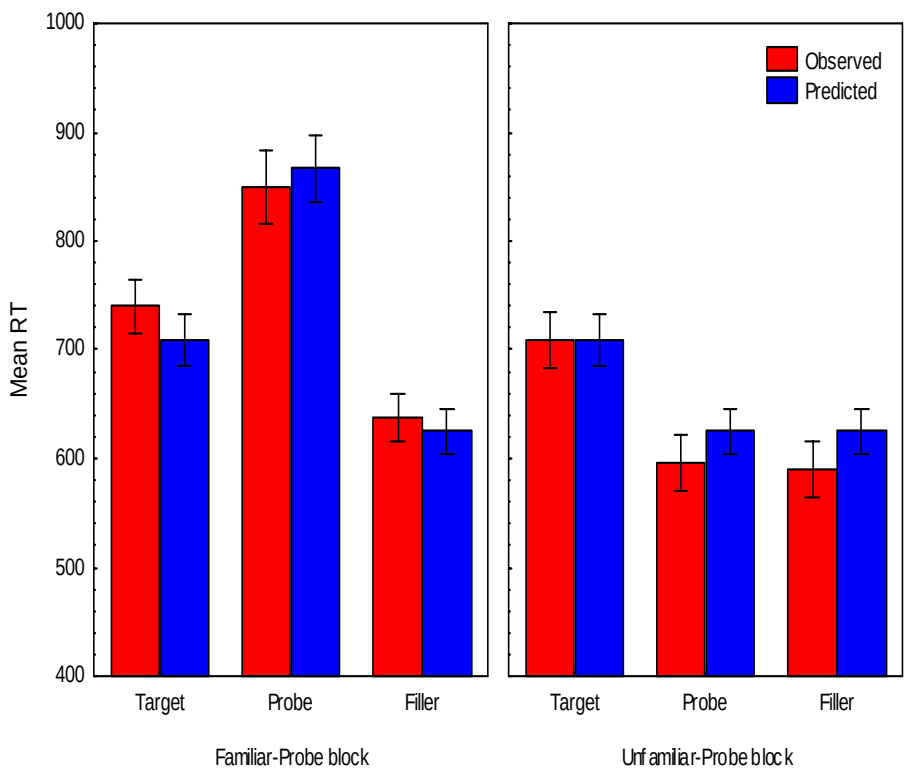
The concealed knowledge effect is robust even when participants are motivated to "beat the test" (Seymour et al., 2000). To understand this effect, Seymour (2000) proposed the Parallel Task-Set Model (PTS; see slide 6). Two independent, and parallel task-sets are triggered by the stimulus. One initiates a fast familiarity-based response, the other a slower source-based response. On Target and Filler trials, the initiated responses are identical. However on familiar-Probe trials, the responses conflict. To avoid this, conflict management processes attempt to abort fast and incorrect "yes" responses in favor of slower but correct "no" responses. The PTS model suggests that determining an item's familiarity is faster than determining it's study context. Slide 7 ("predicted") shows the fit of the PTS model to data from the CKT.

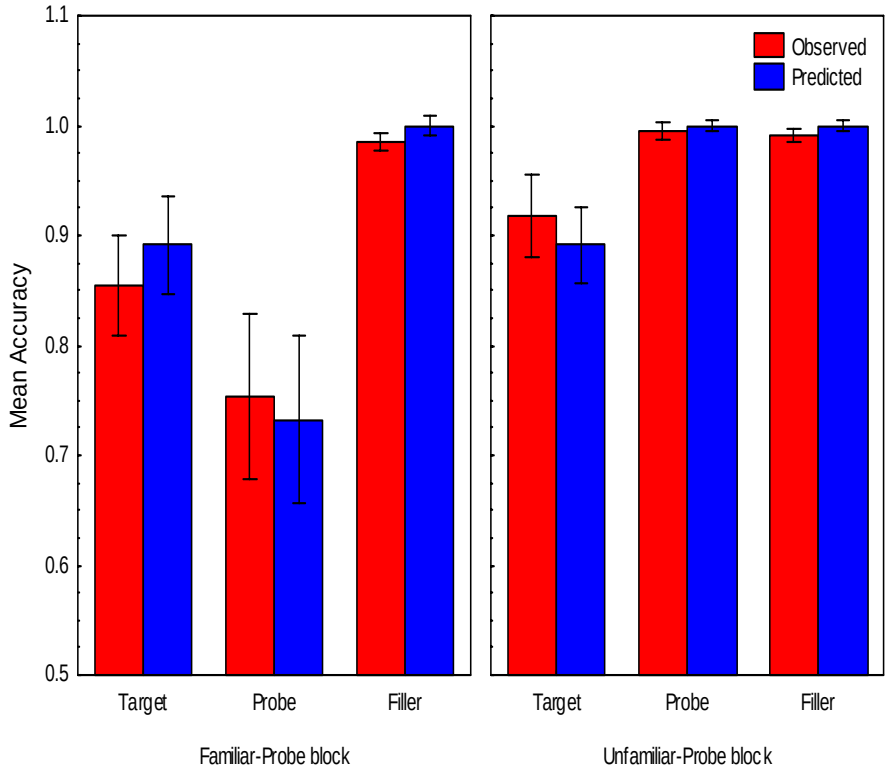
Parallel Task-Set Model (Seymour, 2000)



On familiar-Probe trials ("new"), the automatic familiarity task-set initiates an incorrect "old" response. The slower context-based "new" response requires a successful abort, but fails when it is initiated too late.

PTS Model Fit of CKT data





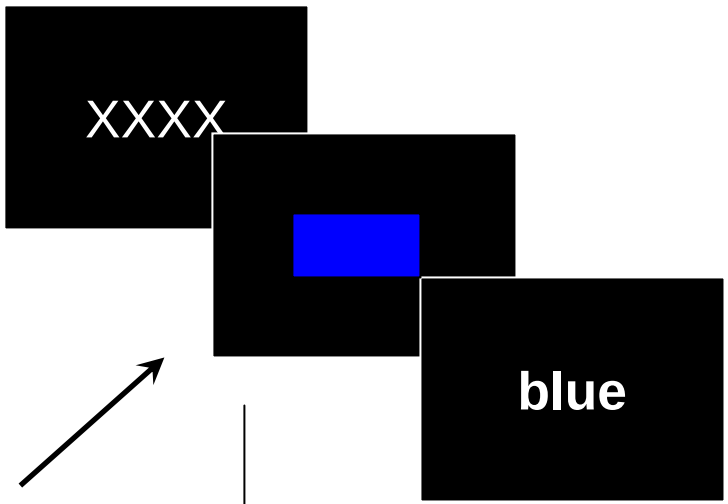
The EPIC Computational Architecture (Meyer & Kieras, 1997a) was used to simulate the CKE based on the Parallel Task-Set Model. The left graph shows the model fit of the typical RT data. The right graph shows the model fit of the typical accuracy data. The PTS model leads to a close fit of both the RT and accuracy data for this task (Seymour, 2000).

The Case Against Relative Speed

The PTS model casts the CKT as a response conflict task where relative speed of competing processes is critical. However, in the Stroop task (another competition task), relative speed has been dismissed because paradigms using a color pre-cue have little impact on word-reading (e.g., Glaser & Glaser, 1982). Work by Meyer and Kieras (1997a) suggests that there should be a pre-cue effect, not because the color-naming process is being sped up, but because at short SOA's the pre-cue causes a response preparation bottleneck, and at long SOA's the cue is irrelevant (opposite the previously predicted direction). Previous efforts failed to show an effect because participants were not required to process the pre-cue on all trials. Experiment 1 uses a revised pre-cue paradigm.

Experiment 1: Stroop Pre-Cue Paradigm

Read Word Trial (50%)

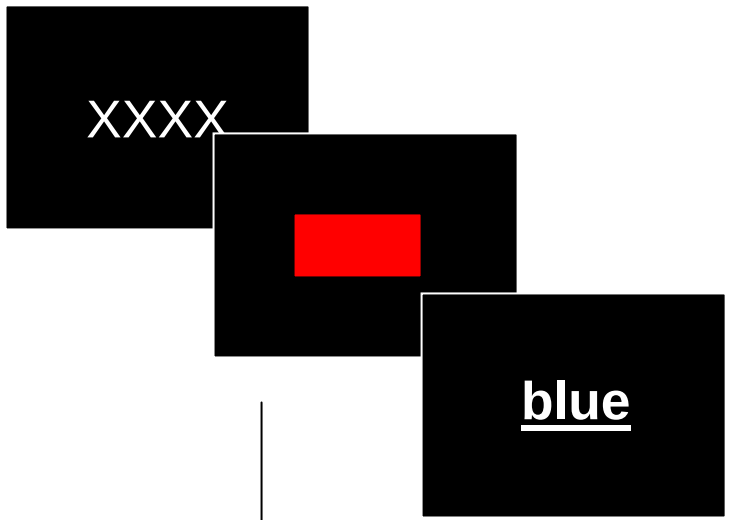


“BLUE”

SOA

Participant must remember pre-cue in case word is underlined!

Name Ink Color Trial (50%)



“RED”

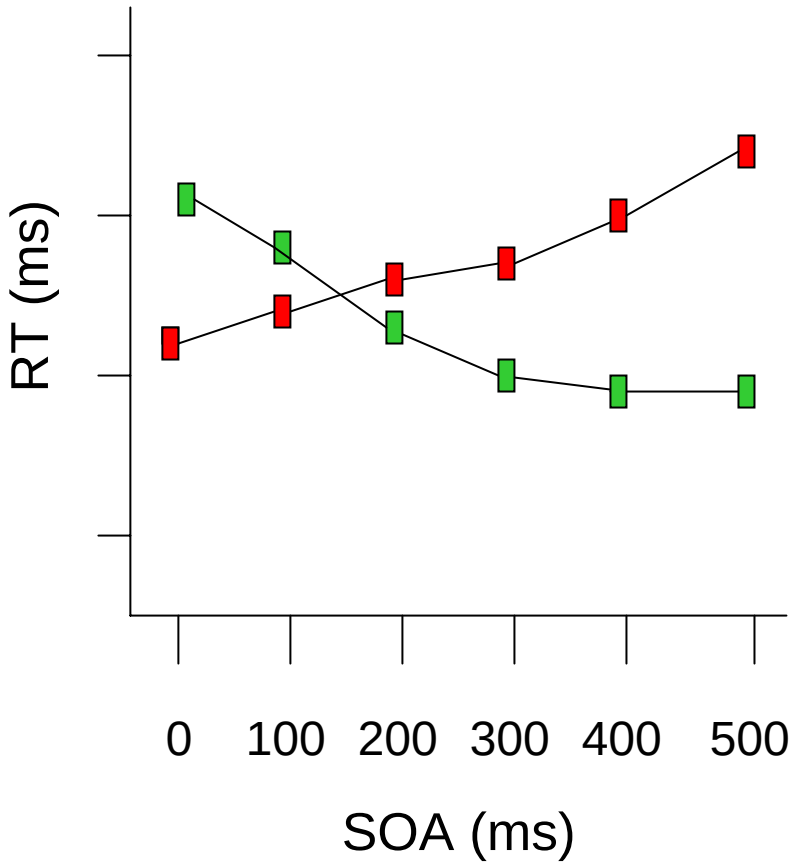
SOA

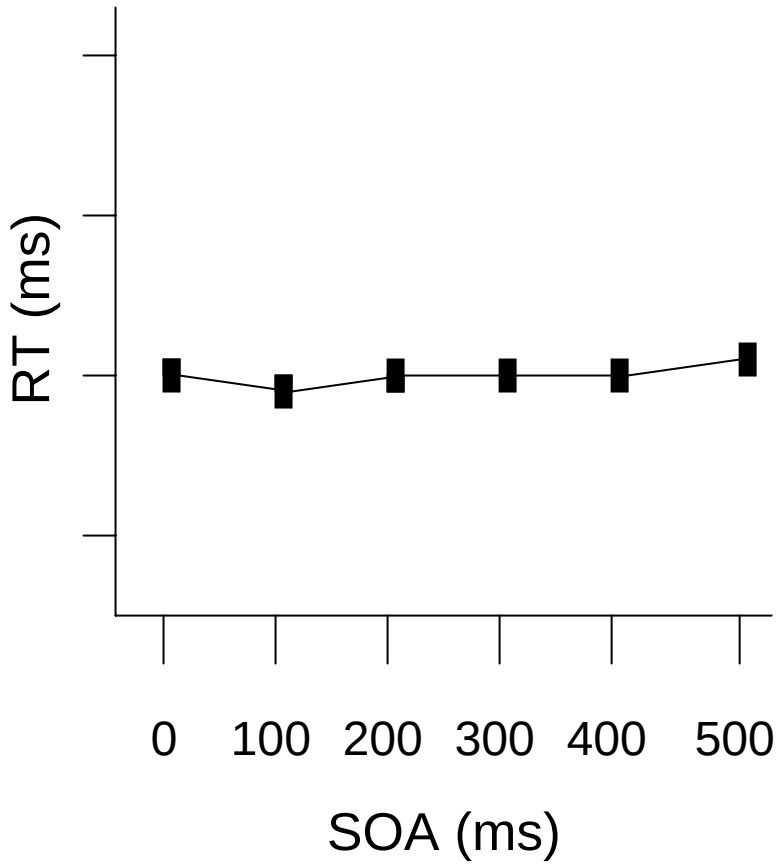
SOAs used 200ms, 400ms, 600ms, 1500ms

If NOT UNDERLINED – **Read Word** If UNDERLINED – **Name Color**

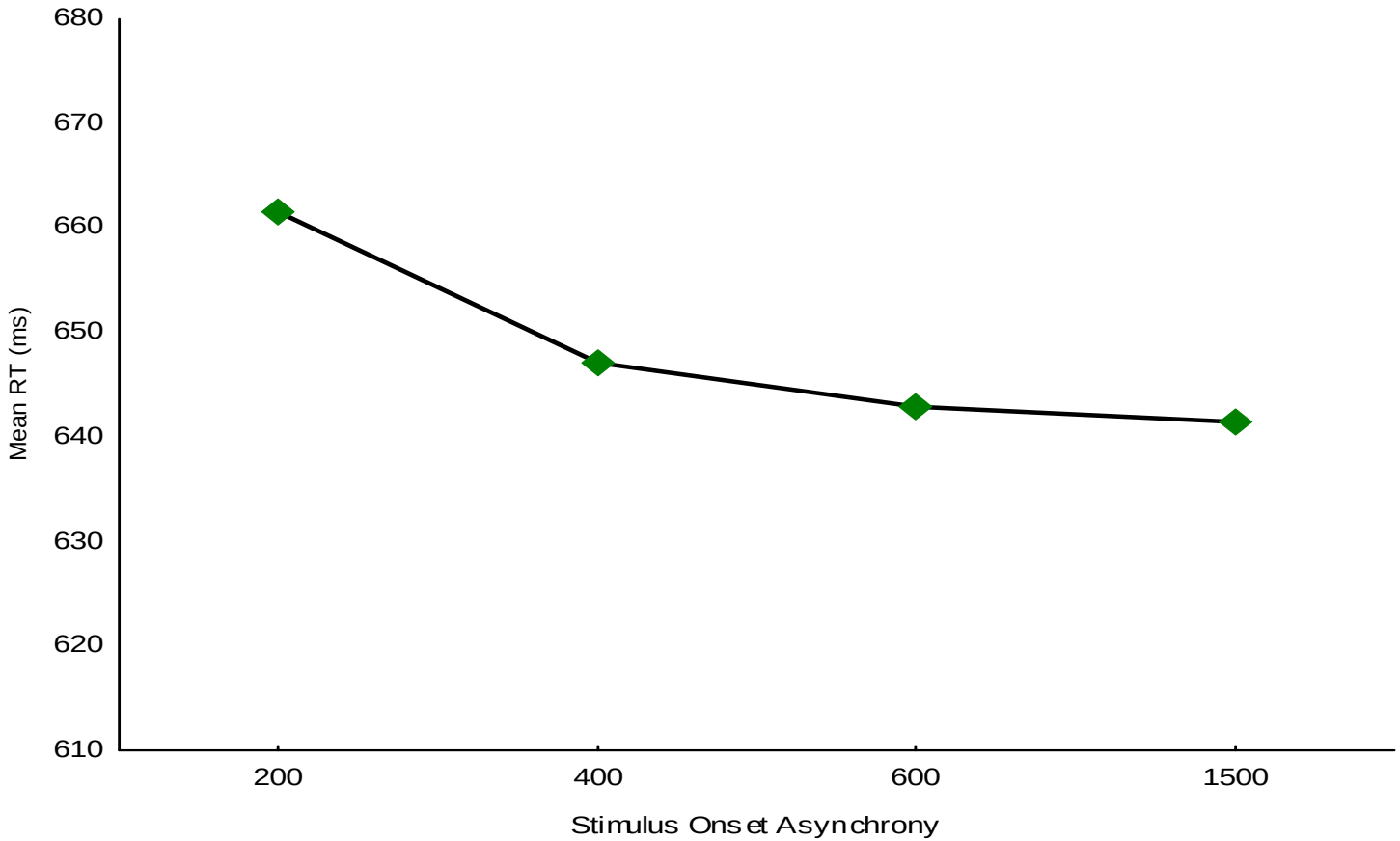
Competing Predictions

- Glaser & Glaser 1982 prediction
- Glaser & Glaser 1982 results
- Meyer & Kieras 1997 based prediction





Experiment 1 Results



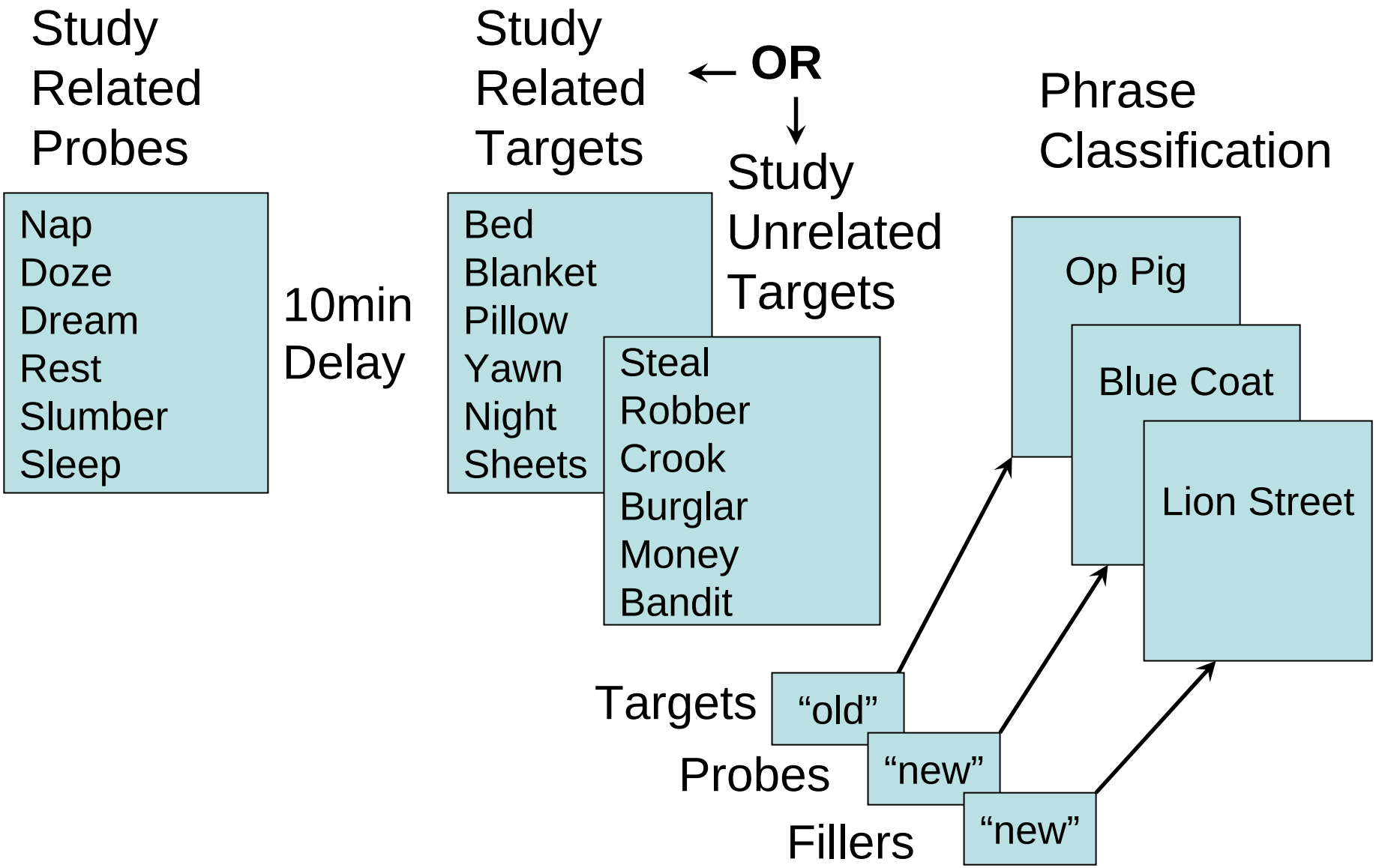
Predicted by a response preparation bottleneck (Meyer & Kieras 1997), shorter pre-cues cause RT slowing whereas longer pre-cues do not, $F(3,75) = 5.170$, $p < .01$. Glaser and Glaser (1982) predicted the opposite pattern, and found no effect of SOA.

A Better Test of Relative Speed

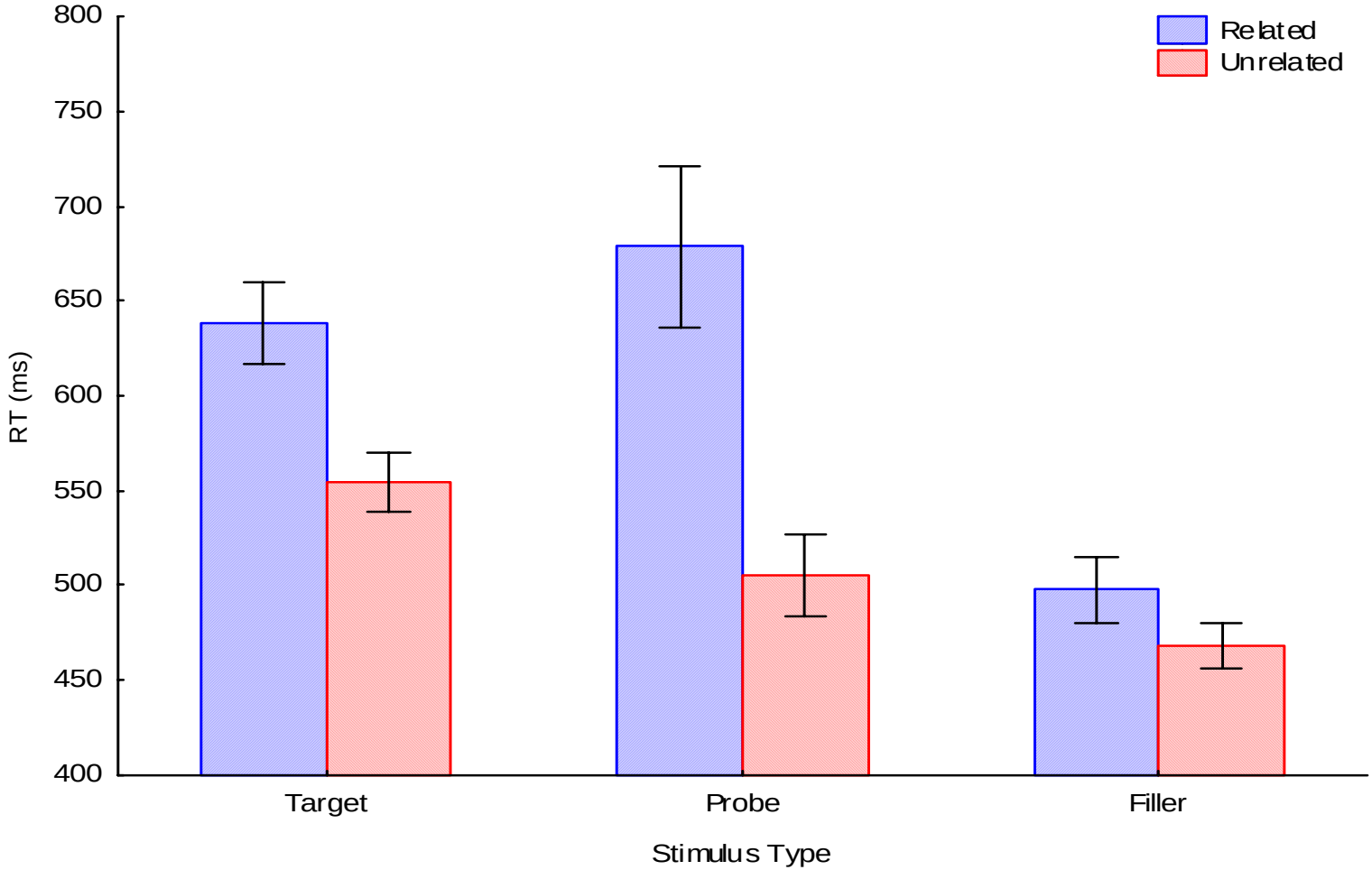
Apparently, even a strong pre-cue Stroop paradigm shows only that short pre-cues lead to overlapping response preparation (Meyer & Kieras, 1997a). This manipulation does not influence the relative processing speed of color naming and word reading processes. The task should ideally be altered to influence the completion duration of one process and not the other. This is difficult in Stroop, but not in the CKT. According to Ratcliff (1978), the difficulty and duration of context resolution increases with the relatedness of the items in the test list. Presumably familiarity remains unaffected. In Experiment 2, we used the CKT paradigm but manipulated whether Target items were semantically related to Probes. The PTS model predicts that decreasing relatedness will shorten context resolution, increase abort likelihood, and attenuate the concealed knowledge effect.

Experiment 2

CKT with Semantic Relatedness Manipulation

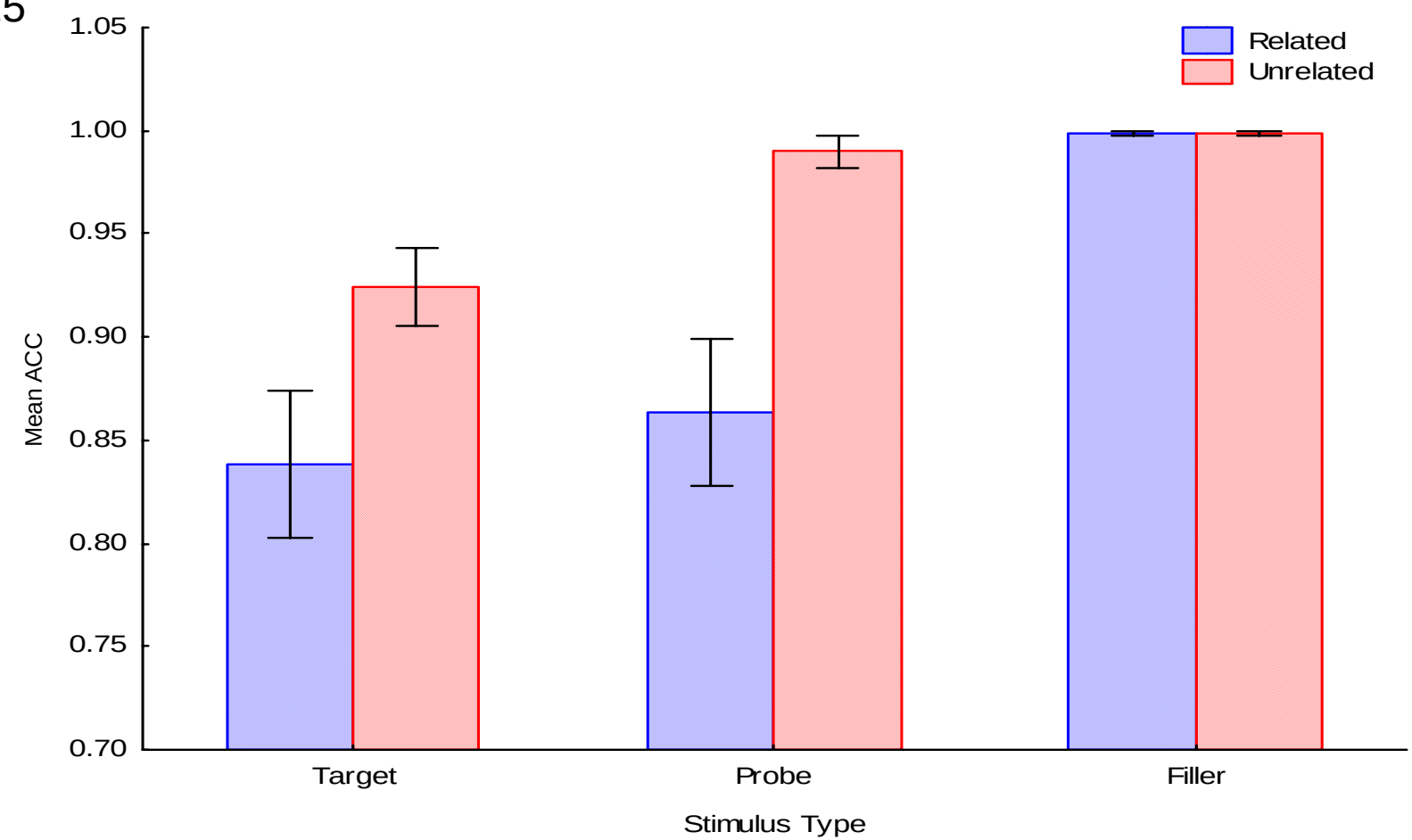


Experiment 2 RT Results:



The effect of relatedness on RT is as predicted by the PTS model. When Targets and Probes are related, the typical Probe-Filler difference emerges, $F(1,17) = 88.421, p < .001$, but in the unrelated condition, this difference is attenuated, $F(1,17)=14.73, p < .001$.

Experiment 2 Accuracy Results:



Also as predicted, related Targets and Probes lead to a Probe-Filler accuracy difference, $F(1,17) = 23.51, p = .00015$. In the unrelated condition, this effect is attenuated, $F(1,17) = 1.445, p > .05$.

Conclusions

- Previous evidence against relative speed in conflict tasks may not constitute an ideal test. When processing of color pre-cue is required, results suggest a response preparation bottleneck rather than a color-naming head-start.

- Using the Concealed Knowledge Test we were able to influence context-resolution, but leave familiarity in tact. This pattern is predicted by the PTS model (Seymour 2000) and the related work by Ratcliff (1978) and Meyer and Kieras (1997).

- Results support PTS model's relative speed assumption, and suggest that relative speed may be a viable mechanism in other response competition models.

- Results also caution applied use of the CKT: Using unrelated Targets and Probes may compromise test.

References

- Glaser, M. O. & Glaser, W. R. (1982). Time Course Analysis of the Stroop Phenomenon. *Journal of Experimental Psychology: Human Perception and Performance, 6, 875-894.*
- Glaser, W. R. & Glaser, M. O. (1989). Context Effects in Stroop-Like Word and Picture Processing. *Journal of Experimental Psychology: General, 118,* 13-42.
- Kieras, D. E., & Meyer, D. E. (1998). The Epic Architecture: Principles of Operation.
- Klein, G. S., (1964). Semantic power measured through the interference of words with color-naming. *American Journal of Psychology, 77:4*.
- Lykken, D. T. (1959). The GSR in the detection of guilt. *Journal of Applied Psychology,*
- *Dec*, 385-388.
- MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin, 109,* 163-203.
- Meyer, D. E., & Kieras, D. E. (1997a). A computational theory of executive cognitive processes and multiple-task performance: Part 1. Basic mechanisms. *Psychological Review, 104*(1), 3-65.
- Monsell, S. (1996). Control of mental processes. In V. Bruce (Ed.), *Unsolved mysteries of the mind: Tutorial essays in cognition* (pp. 93-148). Hove, England: Erlbaum, Taylor & Francis.
- Ratcliff, R. (1978). A theory of memory retrieval. *Psychological Review, 85*, 59-108.
- Seymour, T. L., Seifert, C. M., Mosmann, A. M., & Shafto, M. G. (2000). Using Response Time Measures to Asses “Guilty Knowledge.” *Journal of Applied Psychology, (85)*1.
- Seymour, T.L. (2000). An EPIC Model of the ‘Guilty Knowledge Effect’: Strategic and Automatic Processes in Recognition*. Dissertation Abstracts International: Section B: The Sciences & Engineering*, 61 (10-B), US: Univ Microfilms International; 2001, 5591.
- Stroop, J. R. (1935b). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*, 643-662.