Differential Patterns of Dynamic Cognitive Control
Revealed by Matching Stroop and Flanker Interference Tasks

Mark E. Faust[1], Kristi S. Multhaup[2], Kathleen M. Greenfield[2], & Fadel Zeidan[1]

University of North Carolina at Charlotte[1] & Davidson College[2]

INTRODUCTION

- Cognitive control over the processing of task-irrelevant information plays an important role in cognition (Faust & Balota, 2007; Hasher, Zacks, & May, 1999). Conflict monitoring theory, (Botvinick, et al., 2001) predicts that detection of conflicting task-irrelevant information leads to dynamic cognitive control to adapt for future conflict (***Conflict Adaptation***).
- Congruency effects (i.e., less efficient responding in the presence of task-irrelevant information that is incongruent with the task-relevant information than responding to congruent displays), have been found to be smaller following an incongruent trial than a congruent trial (Notebaert et al., 2006). Such sequential modulation of congruency effects is consistent with conflict adaptation due to dynamic changes in cognitive control (Botvinick et al., 2001), but has also been proposed to be due to priming effects across sequential trials (e.g., Mayr, Awh, & Laurey, 2003).
- Notebaert et al. (2006) compared trial sequences with (***Repetitions***) and without repetition (***Alternations***) of task-relevant and task-irrelevant stimulus dimensions and found evidence for (a) conflict adaptation effects for alternations and (b) priming effects for repetitions. Conflict adaptation effects were found for the longer (200 ms) but not for the shorter (50 ms) RSI, suggesting that observed modulations were attributable to dynamic cognitive control (***Top-Down Pattern***).
- Fernandez-Duque and Knight (2008) found evidence for a sustained cognitive control that produced task-specific conflict adaptation, but they used a task-switching methodology which may have influenced the results.
- The present study further examines conflict adaptation using two congruency tasks that are blocked to avoid issues of task switching. We also varied the delay between trials to better dissociate conflict adaptation and priming modulation of congruency effects.

Tasks

- A manual Stroop task (Notebaert et al., 2006) and a matching Eriksen flanker task (Eriksen & Eriksen, 1974) were used.
- 3 colors and names (Red, Green, Blue), RSI between subjects.
- **Trial Sequence Types:** **Alternation sequences** (no repetition of target or distractor item/dimension) & **Repetition sequences** (target and/or distractor item/dimension repeated)
- **Percent Incongruent Trials**: 67%, 33%
  - —Stroop stimuli: Incongruent= **GREEN**, Congruent= **GREEN**
  - —Flanker stimuli: Incongruent= **BLUE** **GREEN** **BLUE**, Congruent= **GREEN** **GREEN** **GREEN**
  - —***Congruency Effect*** = Incongruent RT – Congruent RT.

Questions

- How widely will the Notebaert et al. (2006) top-down pattern of conflict adaptation effects (alternation sequences) replicate in both tasks?
- Will the percent of incongruent trials modulate overall congruency effects similarly in both tasks?

Acknowledgments

Portions of this data were presented at the 49th annual meeting of the Psychonomic Society in Psychology (Faust, Multhaup, Greenfield, & Maury, 2008). We would like to thank **Erica Bleicher, Joshua Ebner, Brian Hartman, Blaire Weidler,** and **Isaiah Wright** for their help with data collection.

RESULTS

Dynamic Trial-by-Trial Effects

Alternations: Task x Incongruency Percent x RSI x Prior Trial Congruency interaction (p = .044), indicating that Conflict Adaptation was reduced in the Stroop task with a reduction in the percent of Incongruent trials, but the opposite was true for the Flanker task.

Repetitions: Task x RSI x Prior Trial Congruency interaction (p = .025), indicating that Priming Modulation effects decreased for increasing RSIs for the flanker task, but the opposite was true for the Stroop task. Incongruency Percent did not interact with Priming Modulation effects.

Experiment-level Modulation Effects

Overall Congruency Effects (traditional rather than trial x trial measures)**:** Task x Incongruency Percent interaction (p < .001) indicating that the Congruency effect was larger in the 67% Incongruent than the 33% Incongruent conditions for both tasks, and that this difference was larger for the Stroop task.

DISCUSSION

1. The present results support the existence of both conflict adaptation & priming modulation of congruency effects in both tasks.
2. The Notebaert et al. (2006) finding of a top-down control pattern for conflict adaptation effects (alternations) in a high proportion incongruent version of the Stroop task was replicated, supporting **dynamic cognitive control** (sub-second timescale).
3. The pattern of conflict adaptation differed for the flanker task, and was not as robust (cf. Bugg, 2008), supporting task-specific **dynamic cognitive control**.
4. There was also task-specific conflict adaptation of the overall congruency effect (i.e., collapsing across sequential variables), consistent with **sustained cognitive control** (longer timescale).
5. The present results suggest **interaction of sustained and dynamic cognitive control**, supporting the idea of a hierarchical system of cognitive control.

References

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Figure 1: Stroop (67% Incongruent)

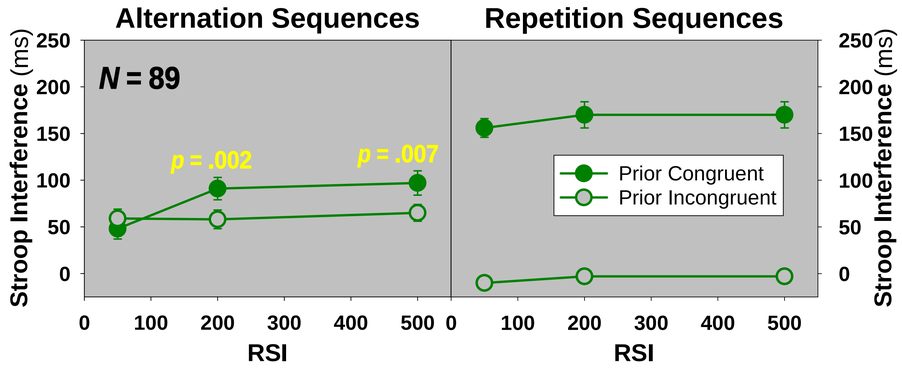


Figure 2: Stroop (33% Incongruent)

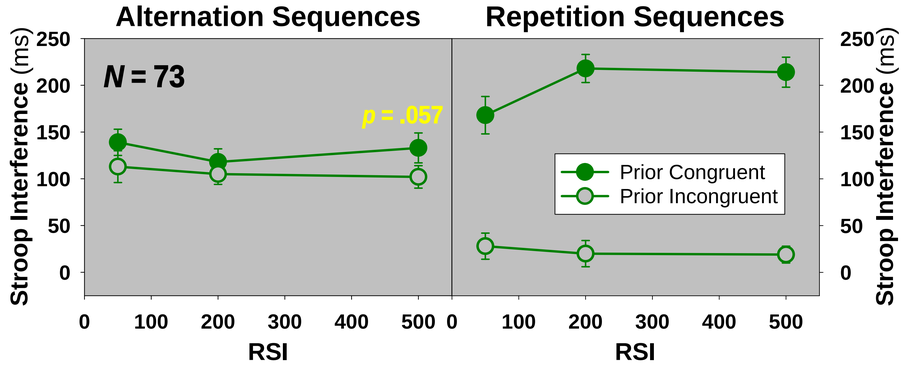


Figure 3: Flanker (67% Incongruent)

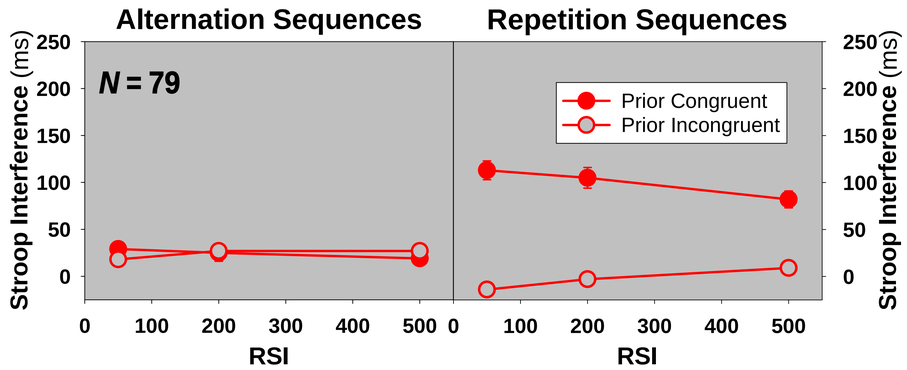
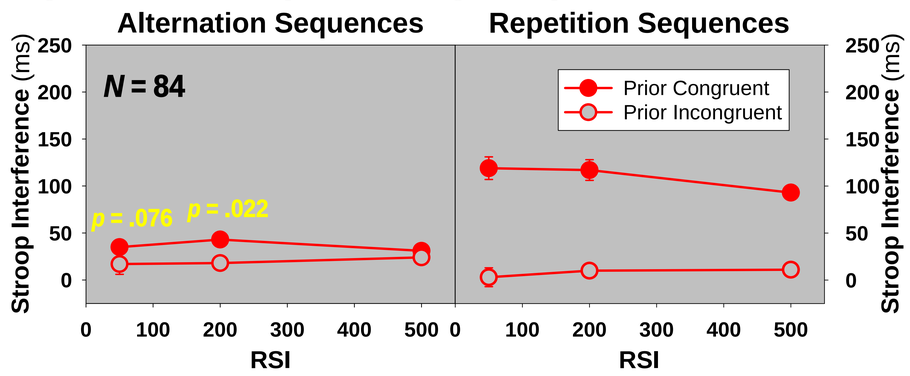


Figure 4: Flanker (33% Incongruent)



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