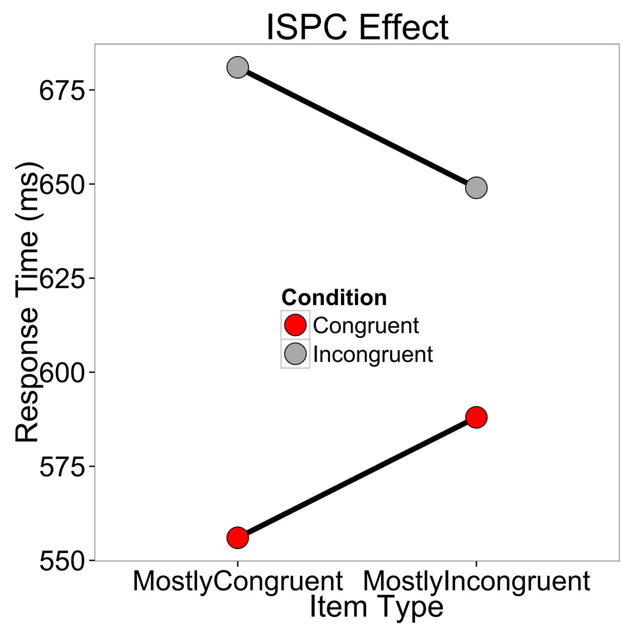
Applying Response Time Distribution Analysis to Item-Level Manipulations: Evidence for Stimulus-driven Control

Thomas G. Hutcheon, Aileen Lian, & Anna Richard
Bard College, Psychology Program, Annandale-On-Hudson, New York

Competing Accounts for the ISPC Effect

The item specific proportion congruency (ISPC) effect refers to the reduction in the size of the congruency effect for words frequently presented as incongruent trials compared to words frequently presented as congruent trials (Jacoby, Lindsay, & Hessels, 2003).

Example Item Level Manipulation	
Mostly Congruent (MC)	Mostly Incongruent (MI)
RED – 75% GREEN – 75%	BLUE – 25% YELLOW – 25%
RED – 25% GREEN – 25%	BLUE – 75% YELLOW – 75%

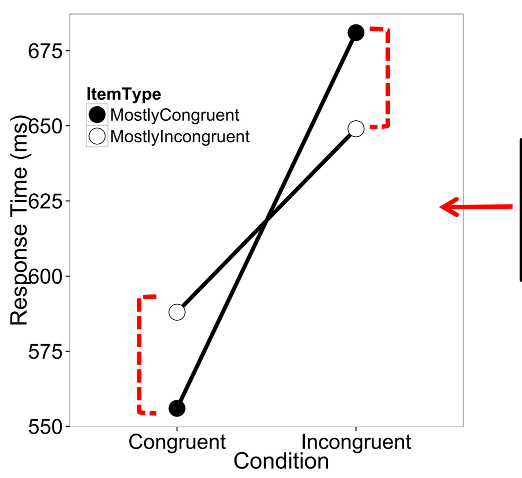


From a **stimulus-driven control** perspective, the ISPC effect reflects the presence of multiple control settings operating within a single task, triggered by the occurrence of a specific word (Bugg & Hutchison, 2013; Bugg, 2015).

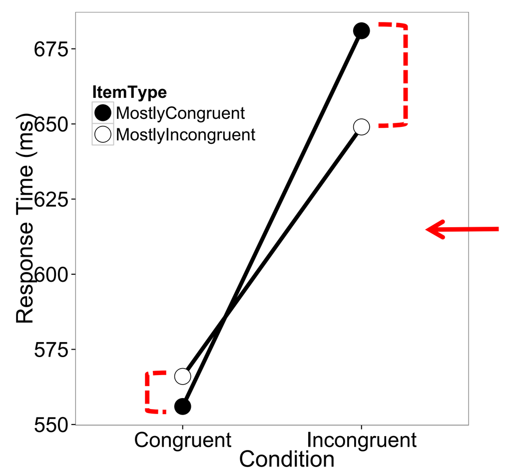
From a **contingency** perspective, the ISPC effect reflects a simple associative learning process where participants use word information to predict the likely response (Schmidt, 2013; Schmidt & Besner, 2008).

One method for disentangling these two perspectives is comparing the influence of proportion congruency on congruent and incongruent trials (Schmidt & Besner, 2008; Bugg & Hutchison, 2013).

Hypothetical Re-analysis



Symmetrical influence can be attributed to contingency learning.



Asymmetrical influence can be attributed to stimulus-driven control.

Contingency Account for Asymmetry

Although studies have demonstrated the asymmetrical influence of incongruent trials in ISPC effects (Bugg & Hutchison, 2013; Bugg, Jacoby, & Chanani, 2011), it has recently been argued that these finding can be attributed to contingency learning.

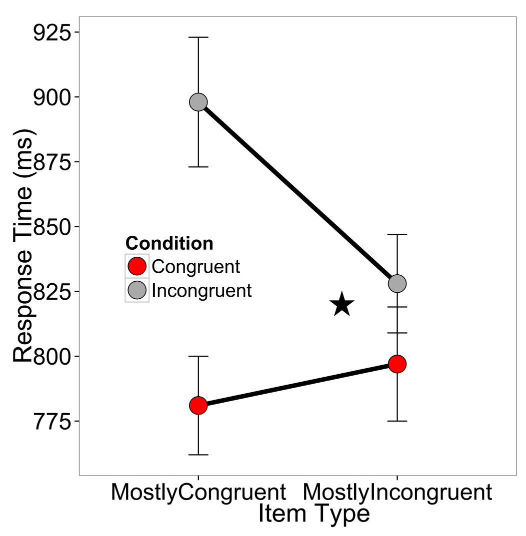
Specifically, since incongruent trials are responded to more slowly than congruent trials, this allows more time for contingencies to bias responding (Schmidt, 2013).

To test whether the asymmetry observed on incongruent trials emerges as response time increases, we applied a quintile analysis in which individual's RTs are rank ordered from slowest to fastest and placed into each bin. Bins are then averaged across participants to assess the impact of conditions at different points of the response time distribution.

Experiment 1: Item-level manipulation with 50 msec RSI

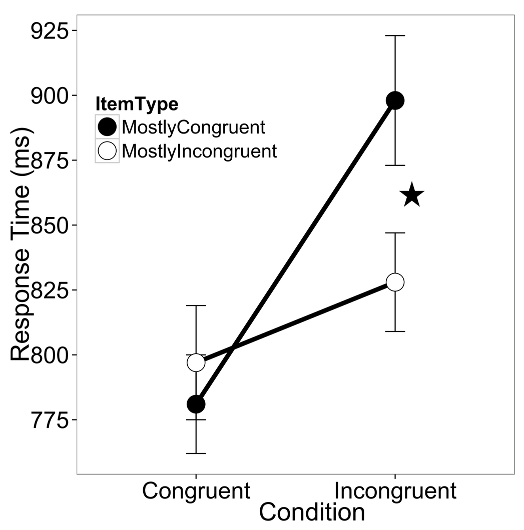
16 participants (Mean Age = 18.75) completed a manual item-level manipulation with two-item response sets.

Standard Analysis



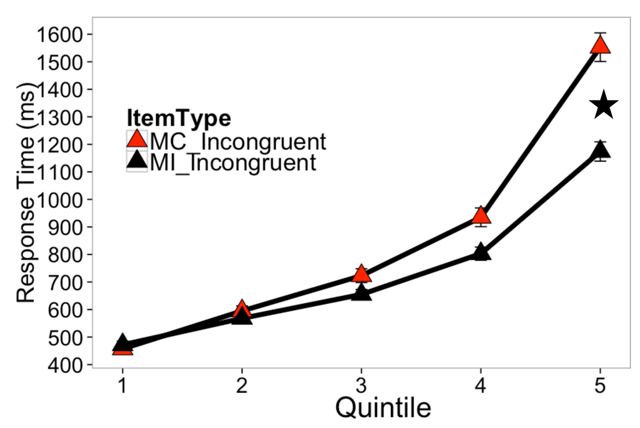
★Significant Item Type X Condition interaction.

Assessing Asymmetry



★ Significant difference between incongruent trials.

Quintile Analysis



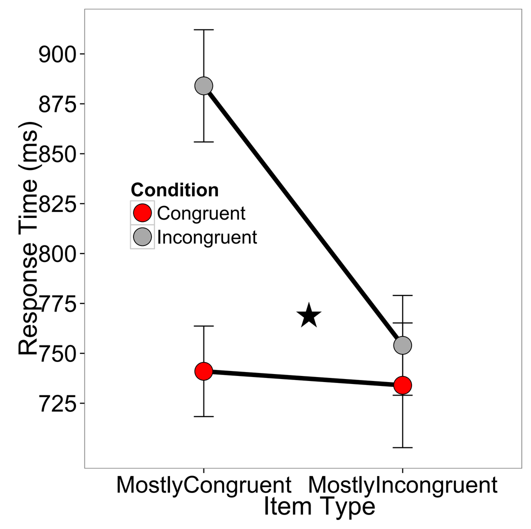
Significant Condition X Quintile interaction.

Consistent with the contingency account, asymmetry emerges as length of trial increases.

Experiment 2: Item-level manipulation with 2000 msec RSI

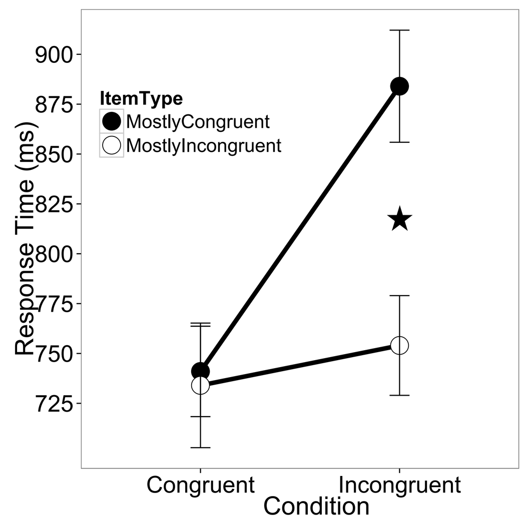
21 participants (Mean Age = 19.15) completed a manual item-level manipulation with two-item response sets.

Standard Analysis



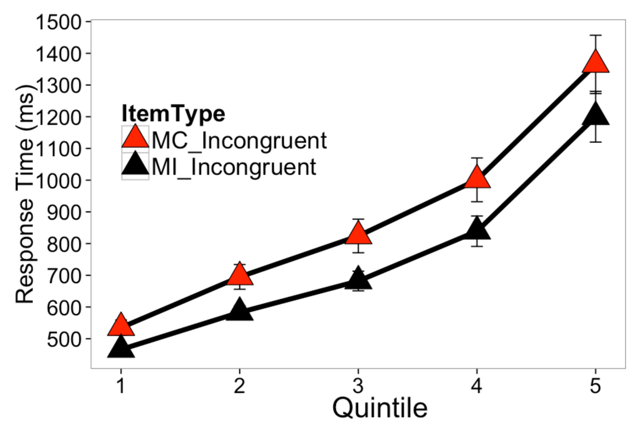
★Significant Item Type X Condition interaction.

Assessing Asymmetry



★ Significant difference between incongruent trials.

Quintile Analysis



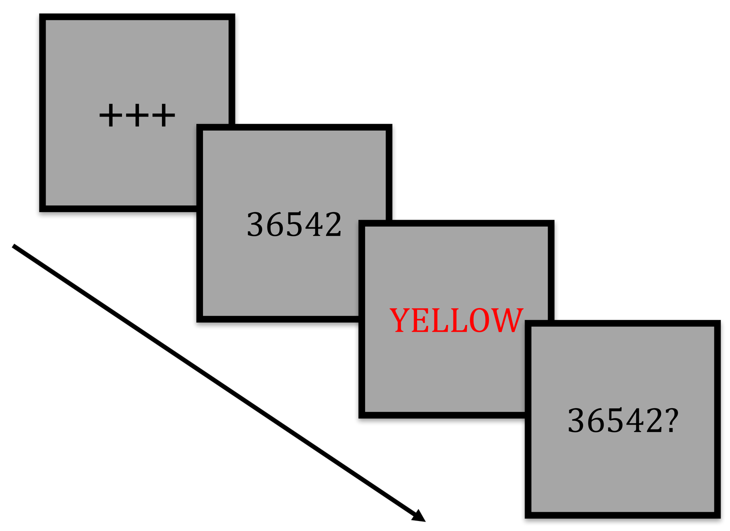
Significant Main Effect of Item Type

In contrast with the results of Experiment 1, here we find no evidence for the emergence of asymmetry as the the length of trial increases. This finding is consistent with the operation of stimulus-driven control.

Memory Load Attenuates Contingency Learning

Contingency learning in Stroop-like paradigms is reduced under memory load (Schmidt, De Houwer, & Besner, 2010).

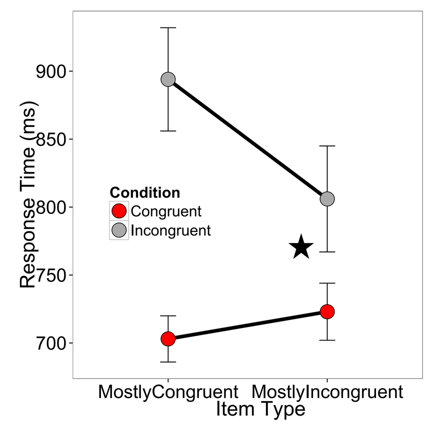
In the current experiment, we implement a memory load within the context of an item-level manipulation.



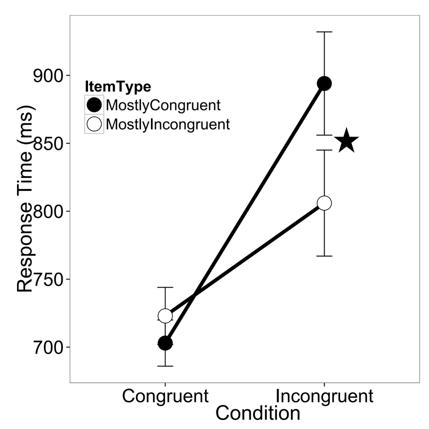
Experiment 3: Item-level manipulation under high memory load

12 participants (Mean Age = 18.36) completed a vocal item-level manipulation with three-item response sets.

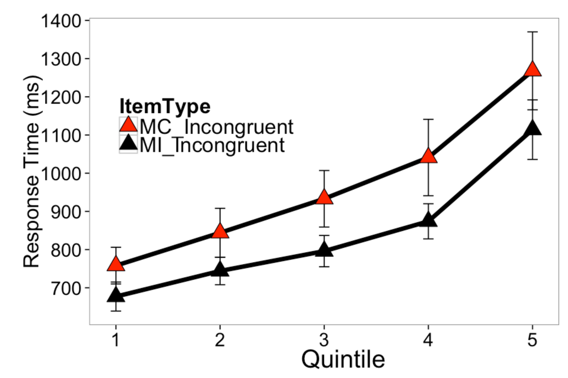
Standard Analysis



Assessing Asymmetry



Quintile Analysis



Consistent with the results of Experiment 2, in an experiment designed to reduce the impact of contingency learning, we find no evidence for the emergence of asymmetry in incongruent trials as the length of the trial increases.

Conclusions

We propose a new method for differentiating control and contingency accounts for the ISPC effect.

Applying this quintile analysis to three datasets, we find evidence for both contingency learning and stimulus-driven control. We find that stimulus-driven control operates under memory load and at long but not short RSIs.

This analysis can be applied to existing datasets and should allow for a clearer picture of the factors that impact participants reliance on contingency learning and stimulus-driven control (Bugg, 2015; Hutcheon & Spieler, in press).

Together, the results point to a flexible cognitive control system that is sensitive to stimulus experience.

References

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Thanks to Elizabeth Fitzgerald and Sigrun Nielsen for help with data collection.
For more information, please contact Tom Hutcheon (thutcheo@bard.edu).