Stimulus-driven control in the absence of contingency learning

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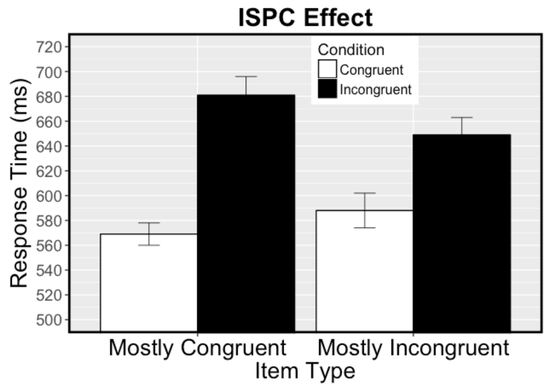
Performance on the Stroop Task Varies as a Function of Experience.

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

Example Stimulus List for an 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%



(Adapted from Jacoby et al., 2003)

According to the **stimulus-driven control** account, the ISPC effect reflects the presence of multiple control settings operating within a single task, updated by stimulus experience, and triggered by the occurrence of a specific word (Bugg & Hutchison, 2013; Bugg, Jacoby, & Toth, 2008).

According to the **contingency learning** account, the ISPC effect reflects an associative learning process where participants use information about the word to predict the likely response (Schmidt, 2013; Schmidt & Besner, 2008).

For Mostly Congruent Items	For Mostly Incongruent Items
Congruent trials P("red"|Red) = 0.75	Congruent trials p("blue"|Blue) = 0.25
Incongruent trials P("green"|Red) = 0.25	Incongruent trials P("yellow"|Blue) = 0.75

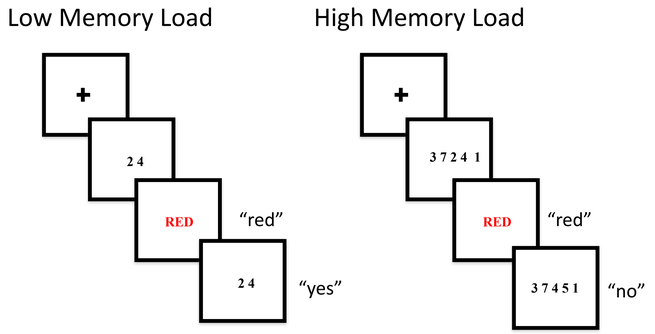
Across several experiments, **stimulus-driven control** and **contingency learning** accounts make similar predictions and have proved difficult to disentangle (Hutcheon & Spieler, 2014; Schmidt, 2013).

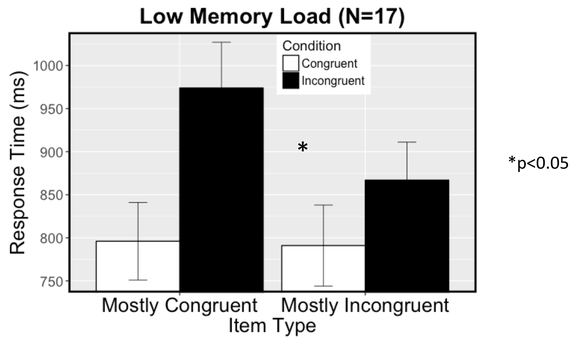
The current experiment tests for the presence of an ISPC effect under conditions where the impact of contingency learning is minimized.

Evidence for Stimulus-Driven Control under a Concurrent Memory Load

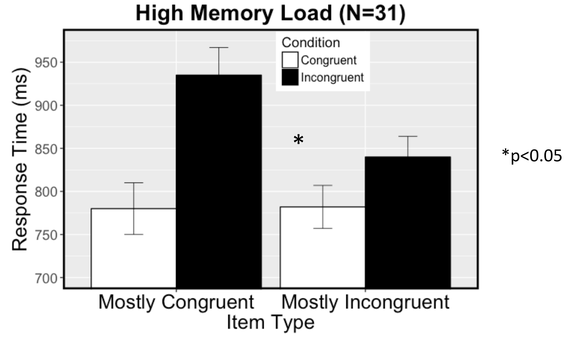
In the current experiment, we implemented an item level manipulation in which participants were also asked to maintain either a high or low memory load.

Maintaining a high memory load has been shown to interfere with contingency learning processes. (Schmidt, De Houwer, & Besner, 2010). Thus, the presence of an ISPC effect under conditions of high and low memory load would suggest the operation of **stimulus-driven control** processes. In contrast, the absence of a ISPC effect in the high memory load condition would imply **contingency learning** is required.





*p<0.05

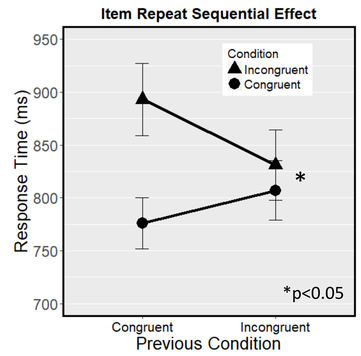


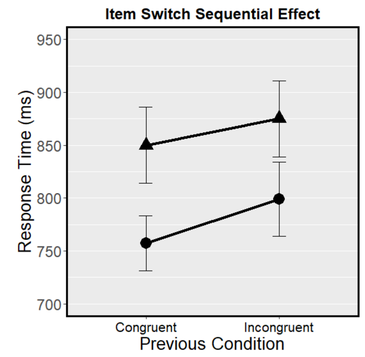
*p<0.05

Consistent with the **stimulus-driven control** account, an ISPC effect was observed under both low and high memory load. When the impact of contingency learning is minimized, the size of the congruency effect is still reduced for mostly incongruent compared to mostly congruent items.

Stimulus-driven Control Operates at a Trial to Trial Level.

Using the high load dataset, we assessed how the occurrence of an incongruent trial on trial N impacts performance on trial N+1 based on whether the item type repeats or switches.





The occurrence of an incongruent trial impacts performance on the next trial when item type repeats but not when item type switches.

This finding is consistent with the presence of multiple control settings in a single experiment (Hutcheon & Spieler, 2014).

Conclusions

In the current experiment, we found evidence for stimulus-driven control under conditions in which the contribution of contingency learning processes were minimized.

These results serve to clarify the control versus contingency debate and suggest that stimulus-driven control processes can operate in context and item level manipulations.

Therefore, these manipulations remain an important tool for studying the organization of cognitive control processes.

References

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For more information about this study, please email Tom Hutcheon (thutcheo@bard.edu).