Evidence for stimulus-driven control under concurrent memory load

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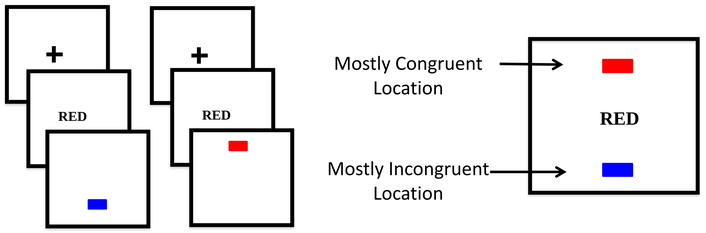
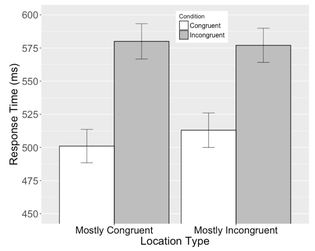
The Context Specific Proportion Congruent Effect

The context specific proportion congruent (CSPC) effect refers to the reduction in the size of the congruency effect at a location with a high proportion of incongruent trials compared to a location with a high proportion of congruent trials (Crump, Gong, & Milliken, 2006).





(Adapted from Crump et al., 2006)

According to **stimulus-driven control** accounts, the CSPC 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 location (Bugg & Crump, 2012; Verguts & Notebaert, 2008).

According to the **contingency** account, the CSPC effect reflects a simple associative learning process where participants use information about the word and location to predict the likely response (Schmidt, 2013; Schmidt & Lemercier, 2018).

		Color			
Location Type	Word	blue	green	red	yellow
Mostly Congruent (Top)	BLUE	36	4	4	4
	GREEN	4	36	4	4
	RED	4	4	36	4
	YELLOW	4	4	4	36
Mostly Incongruent (Bottom)	BLUE	12	12	12	12
	GREEN	12	12	12	12
	RED	12	12	12	12
	YELLOW	12	12	12	12

At the mostly congruent location, word + location is predictive of response:

P("blue"|BLUE + Top) = 0.75

At the mostly incongruent location, word + location is not predictive of response:

P("blue"|BLUE + Top) = 0.25

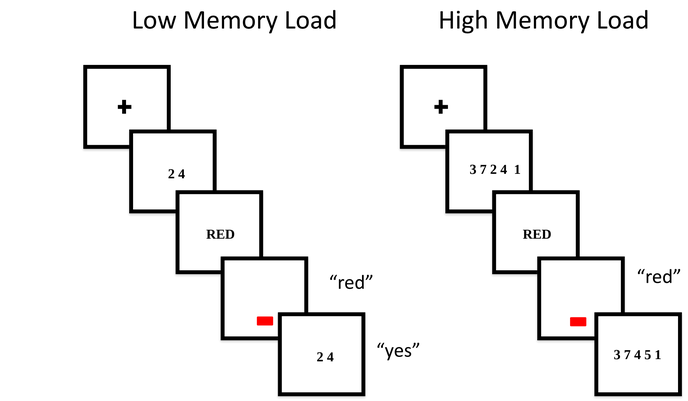
Across several manipulations, stimulus-driven control and contingency learning accounts make similar predictions and have proved difficult to disentangle (Crump, Gong, & Milliken, 2009; Hutcheon & Spieler, 2017; Schmidt & Lemercier, 2018).

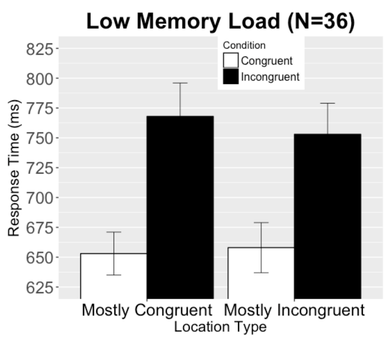
The current set of experiments looks for evidence of stimulus-driven control under conditions where the impact of contingency learning should be minimized.

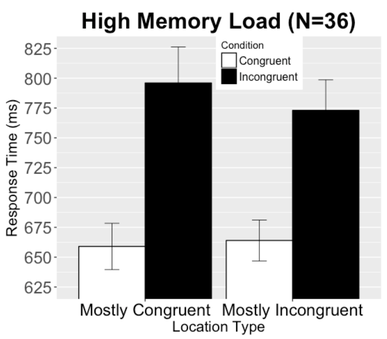
Experiment 1: CSPC Manipulation Under Concurrent Memory Load

In Experiment 1, we implemented a CSPC manipulation in which participants were asked to maintain either a high or low memory load. Elsewhere, contingency learning has been shown to be greatly reduced under high memory load compared to low memory load conditions (Schmidt, De Houwer, & Besner, 2010).

In the current experiment, the presence of a CSPC effect under conditions of both high and low memory load would suggest the operation of stimulus-driven control processes. In contrast, the absence of a CSPC effect in the high memory load condition would imply contingency learning is the primary mechanism accounting for the CSPC effect previously observed in the literature.







Low Load

	Condition			
Location	Congruent (C)	Incongruent (I)	I - C	CSPC Effect
Mostly Congruent	653	768	115	20*
Mostly Incongruent	658	753	95	

*p < 0.5

High Load

	Condition			
Location	Congruent	Incongruen	I - C	CSPC Effect
Mostly Congruent	659	796	137	28*
Mostly Incongruent	664	773	109	

*p < 0.5

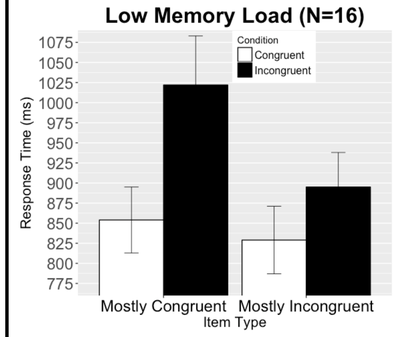
Consistent with stimulus-driven control accounts, a CSPC effect was observed under both low and high memory load conditions. That is, when the impact of contingency learning is minimized, the size of the congruency effect is still reduced at mostly incongruent compared to mostly congruent locations.

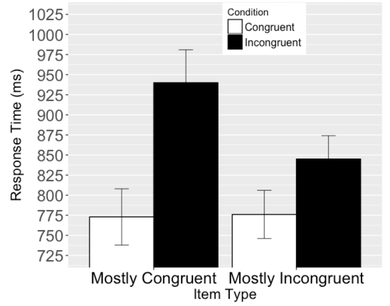
To see if these results generalize to other manipulations, we applied the same approach to the item specific proportion congruent (ISPC) manipulation (Jacoby, Lindsay, & Hessels, 2003).

Experiment 2: ISPC Manipulation Under Concurrent Memory Load

Example Item Level Manipulation

Mostly Congruent (MC) Items		Mostly Incongruent (MI) Items	
RED – 75%	GREEN – 75%	BLUE – 25%	YELLOW – 25%
RED – 25%	GREEN – 25%	BLUE – 75%	YELLOW – 75%





Low Load

	Condition			
Item Type	Congruent (C)	Incongruent (I)	I - C	ISPC Effect
Mostly Congruent	854	1022	168	102*
Mostly Incongruent	829	895	66	

*p < 0.5

High Load

	Condition			
Item Type	Congruent	Incongruen	I - C	ISPC Effect
Mostly Congruent	773	940	167	98*
Mostly Incongruent	776	845	69	

*p < 0.5

Similar to the results of Experiment 1, the size of the congruency effect was reduced for mostly incongruent compared to mostly congruent items under both high and low memory load conditions.

Conclusions

Across two experiments, 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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