Context-specific proportion congruent effect for frequency unbiased items: Novel extensions and analyses of reproducibility

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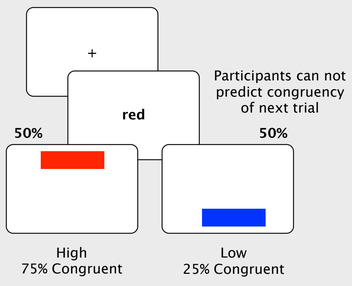
Contextual cues associated with high vs. low proportion congruent can modulate interference effects in selective attention tasks

Crump & Milliken (2009) tested whether context-specific proportion congruent effects (CSPC effects) were entirely driven by a learning process sensitive to event frequency

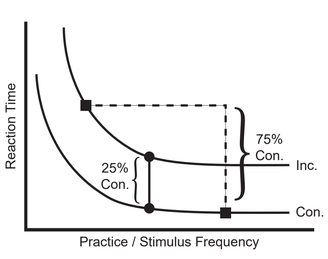


75% Congruent

Word \ Color	R	G	B	Y
R	9	1	1	1
G	1	9	1	1
B	1	1	9	1
Y	1	1	1	9

25% Congruent

Word \ Color	R	G	B	Y
R	3	3	3	3
G	3	3	3	3
B	3	3	3	3
Y	3	3	3	3



They found that CSPC effects (larger Stroop effects in the high than low proportion congruent contexts could be obtained for a set of frequency-unbiased items

Context 1 75% Congruent

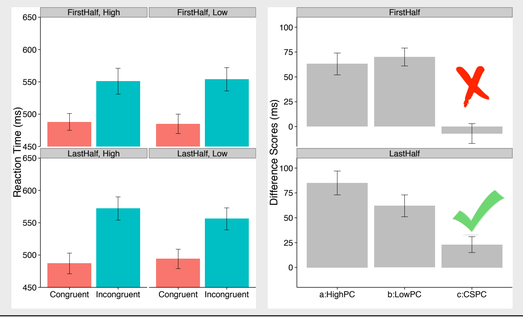
red	12			
green		12		
blue			6	6
yellow			6	6

} Frequency unbiased items

Context 2 25% Congruent

red		12		
green	12			
blue			6	6
yellow			6	6

} Frequency unbiased items



A recent independent replication attempt failed to reproduce the CSPC effect for frequency unbiased items from Crump & Milliken's (2009) experiment 2.

Present Aims

1. **To assess the reproducibility of the CSPC effect for frequency unbiased items using Amazon's Mechanical Turk**
2. **To determine whether the CSPC effect for frequency unbiased items can be found in a Flanker task, where similar CSPC effects have been demonstrated for frequency-biased items.**

Flanker Extensions

Crump & Milliken (2009) E1: Frequency biased items 100%

N= 146 (Amazon Mechanical Turk)

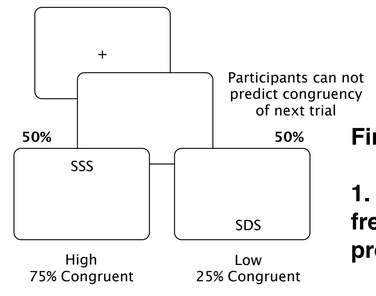
4 blocks of 96 trials

75% Con

	S	D	J	K
S	12			
D		12		
J			6	6
K			6	6

25% Con

	S	D	J	K
S		12		
D	12			
J			6	6
K			6	6



Findings

1. We replicated the CSPC effect for frequency unbiased items in a flanker procedure

		RT		SE		ER		Flanker		CSPC	
Half	PC	Con	Inc	Con	Inc	Con	Inc	(I-C)	SE	H-L	SE
First	High	783	885	12	12	0.03	0.04	102	6		
	Low	787	879	12	11	0.03	0.05	92	6	10	8
Last	High	742	841	10	11	0.02	0.03	99	5		
	Low	749	837	11	11	0.02	0.03	88	5	11	5

Crump & Milliken (2009) E2: Frequency biased items 92%

N= 49 (Amazon Mechanical Turk)

4 blocks of 96 trials

71% Con

	S	D	J	K
S	11	1		
D	1	11		
J			6	6
K			6	6

	S	D	J	K
S	1	11		
D	11	1		
J			6	6
K			6	6

Same general Flanker procedure as above

Findings

1. **No evidence of CSPC effects for frequency biased (B) items**
2. **Marginal evidence of CSPC for frequency unbiased (U) items**

			RT		SE		ER		Flanker		CSPC	
IT	Half	PC	Con	Inc	Con	Inc	Con	Inc	(I-C)	SE	H-L	SE
B	First	High	827	931	25	28	0.03	0.08	104	18		
		Low	847	949	27	28	0.04	0.03	102	18	2	26
	Last	High	786	873	26	26	0.02	0.03	87	17		
		Low	815	889	27	24	0.01	0.03	74	13	13	20
U	First	High	830	942	26	27	0.03	0.04	112	11		
		Low	845	932	25	26	0.03	0.03	87	8	25	10
	Last	High	771	880	22	24	0.02	0.03	109	8		
		Low	789	880	23	23	0.02	0.03	91	8	18	10

Stroop Replications: Typing Response vs. Keypress

Crump & Milliken (2009) E1: Frequency biased items 100%

N= 49 button response, 45 typing response (Amazon Mechanical Turk)

4 blocks of 96 trials

75% Con

red	12			
green		12		
blue			6	6
yellow			6	6

25% Con

red		12		
green	12			
blue			6	6
yellow			6	6

Findings

1. We replicated the CSPC effect for frequency unbiased items for both button and typing responses

			RT		SE		ER		Stroop		CSPC	
Resp.	Half	PC	Con	Inc	Con	Inc	Con	Inc	(I-C)	SE	(H-L)	SE
Button	First	High	796	862	21	22	0.03	0.04	66	12		
		Low	806	857	23	24	0.02	0.03	51	11	15	11
	Last	High	768	837	31	34	0.02	0.03	69	11		
		Low	773	818	27	24	0.02	0.03	45	7	24	11
Typing	First	High	731	859	16	17	0.01	0.03	128	10		
		Low	740	859	17	21	0.01	0.02	119	16	9	16
	Last	High	716	823	19	17	0.00	0.02	107	10		
		Low	732	807	20	15	0.02	0.01	75	10	32	9

Note: RT = Reaction Time; SE = Standard Error; ER = Error Rate; PC = Proportion Congruent; Con = Congruent; Inc = Incongruent; (I-C)= Incongruent-Congruent; CSPC = Context-specific proportion congruent.

Crump & Milliken (2009) E2: Frequency biased items 92%

N= 24 button response, 25 typing response (Amazon Mechanical Turk)

4 blocks of 96 trials

71% Con

red	11	1		
green	1	11		
blue			6	6
yellow			6	6

29% Con

red	1	11		
green	11	1		
blue			6	6
yellow			6	6

Findings

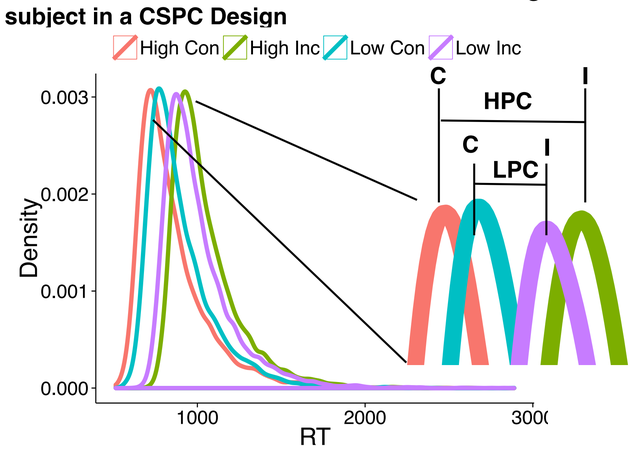
1. CSPC effects for frequency biased (B) and unbiased (U) were not significant

				RT		SE		ER		Stroop		CSPC	
Resp.	IT	Half	PC	Con	Inc	Con	Inc	Con	Inc	(I-C)	SE	H-L	SE
Button	B	First	High	749	802	25	33	0.03	0.05	53	25		
			Low	741	814	21	24	0.08	0.03	73	21	-20	35
		Last	High	708	804	28	30	0.02	0.02	96	23		
			Low	679	780	24	28	0.02	0.03	101	15	-5	30
	U	First	High	751	822	27	25	0.03	0.05	71	12		
			Low	747	826	27	27	0.02	0.06	79	13	-8	11
		Last	High	739	798	33	26	0.03	0.03	59	15		
			Low	722	789	30	31	0.03	0.04	67	11	-8	17
Typing	B	First	High	725	855	23	31	0.00	0.03	130	26		
			Low	708	850	25	21	0.01	0.02	142	13	-12	26
		Last	High	718	799	24	21	0.01	0.03	81	18		
			Low	698	821	27	24	0.03	0.02	123	21	-42	19
	U	First	High	723	846	28	24	0.02	0.02	123	11		
			Low	732	859	26	27	0.01	0.02	127	9	-4	15
		Last	High	710	824	26	25	0.01	0.01	114	13		
			Low	731	824	31	26	0.02	0.01	93	16	21	14

Reproducibility Analysis

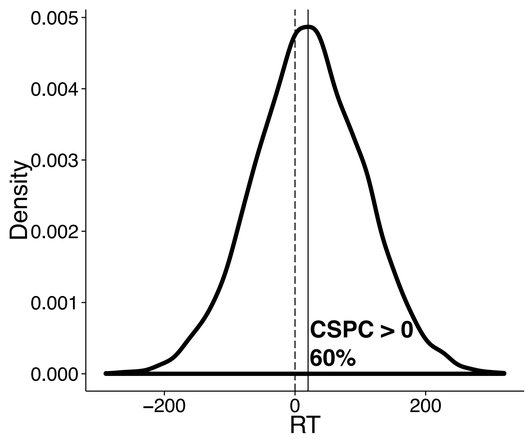
Monte-Carlo Simulations of CSPC effects

Simulated Reaction Time Distributions for a single subject in a CSPC Design

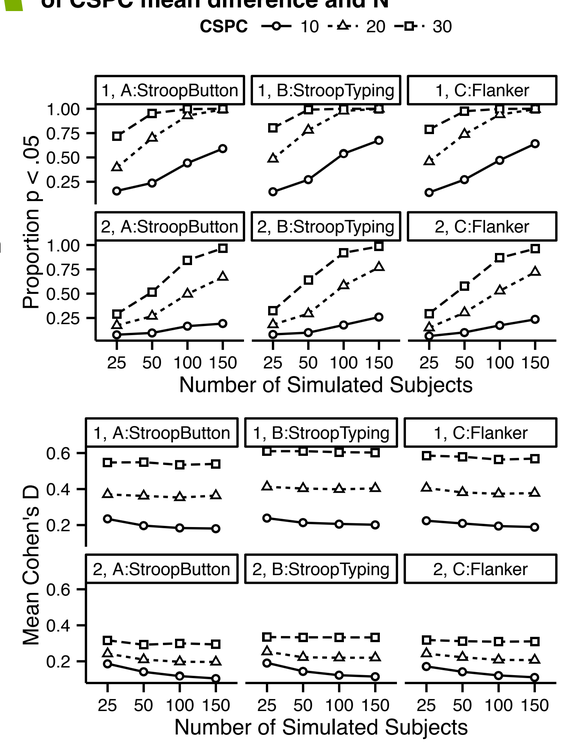


1. The CSPC effect is a difference between two difference scores computed from base RT distributions. CSPC= HPC[I-C]-LPC[I-C]
2. We estimated the variability of the CSPC effect by simulating trial-level data from RT distributions that were representative of our subjects

Example simulated distribution of individual subject CSPC effects given the cell-size from Crump & Milliken (2009) (n=10,000, programmed CSPC effect = 20ms)



Reproducibility Analysis showing proportion of significant simulated experiments as a function of CSPC mean difference and N



Conclusions

1. **We found CSPC effects for frequency unbiased items using the E1 (Context 100% predictive for frequency biased items), but not using the E2 design (Context 92% predictive for frequency biased items) from Crump & Milliken (2009)**
2. **CSPC effects for frequency unbiased items were found in both new versions of the Stroop task and the Flanker task using the online worker population from Amazon's Mechanical Turk**
3. **The reproducibility analysis showed that prior work likely overestimated power, and that N of 100-150 is needed to achieve power ~ 1.**
4. **Crump & Milliken (2009) designs are suitable for measuring group-level effects with large n, but would not be suitable as a potential measure of individual differences in contextual control modulations of attention**