Working Memory and Generalization in Predictive Learning

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Background

If consuming icing (**I**) makes Mr.X ill, and consuming jam **(J)** also makes him ill, what will happen if he eats icing and jam **(IJ)?** *Similarity-based* generalization predicts IJ will cause illness. *Rule-based* generalization, however, might note that Mr. X's response to a food combination is always opposite to his reaction to its components (see Table 1). On this basis, IJ predicts no reaction. **Shanks & Darby (1998)** reported that fast learners show rule-based generalization whilst slow learners show similarity-based generalization. Below, we report the effects of concurrent load, and working memory capacity, on the prevalence of rule-based and similarity-based generalization.

Training			Test		
A+	B+	AB-	A?	B?	AB?
C-	D-	CD+	C?	D?	CD?
E+	F+	EF-	E?	F?	EF?
G-	H-	GH+	G?	H?	GH?
I+	**J+**		I?	J?	**IJ?**
		KL-	**K?**	**L?**	KL?
M-	**N-**		M?	N?	**MN?**
		OP+	**O?**	**P?**	OP?

Table 1: A-P are foods eaten by fictitious patient Mr. X, + = allergic reaction; - = no allergic reaction. ? = no feedback given. Test phase follows training phase. Trials in each phase randomly ordered.

1. Working memory capacity

All participants received 8 blocks of training trials. Working memory capacity was measured by OSPAN (Turner & Engle, 1989). High >30, Low <16. High OSPAN show rule-based generalization; low OSPAN show similarity-based generalization (see Figure 1)

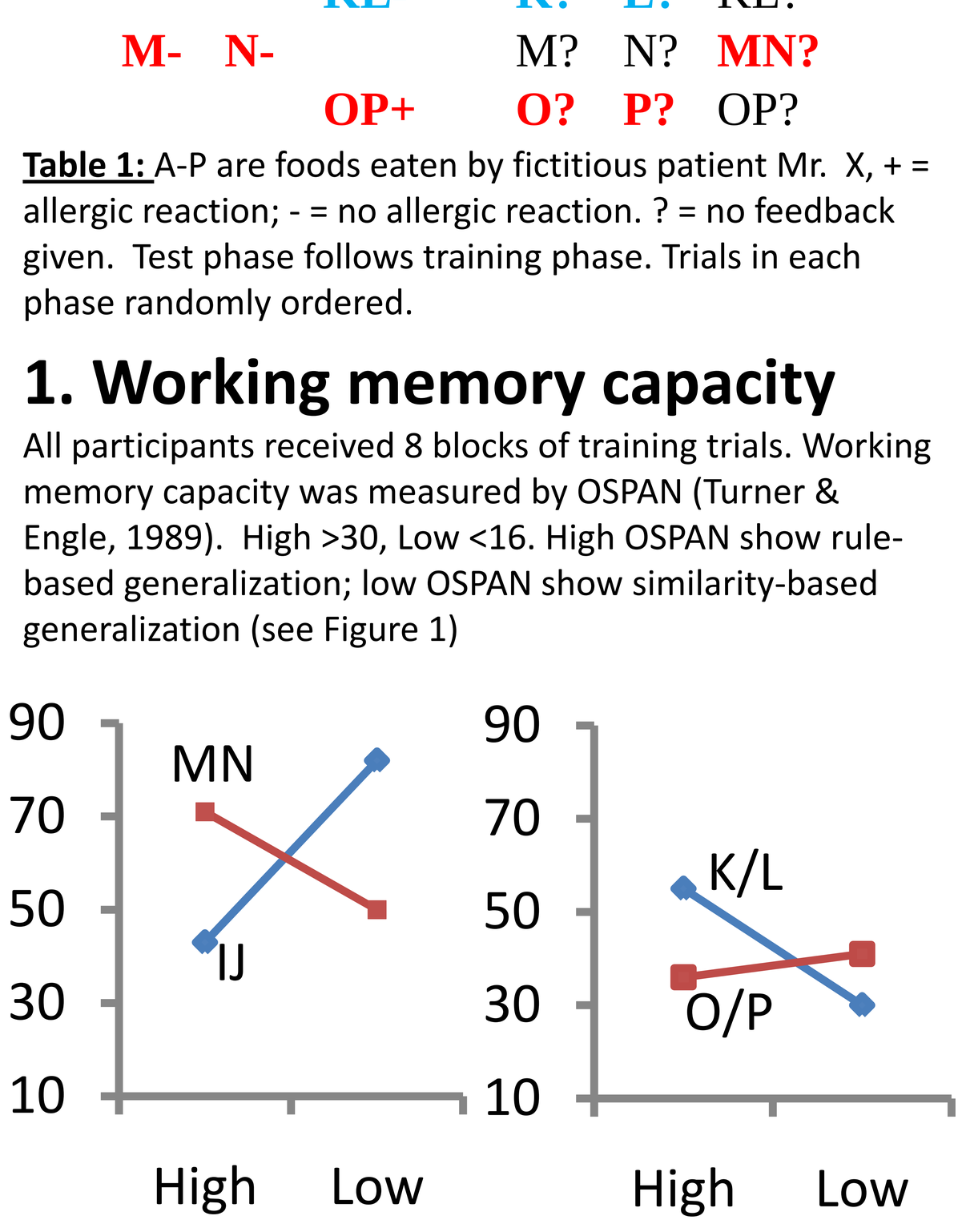

Figure 1: Percentage allergy responses for high and low WM capacity.

2. Concurrent Load

Concurrent load (see Figure 2) was a between-subjects manipulation, and was present throughout training and test. All participants were trained to criterion (86%). Imposition of concurrent load changed responding from rule- to similarity-based (see Figure 3).

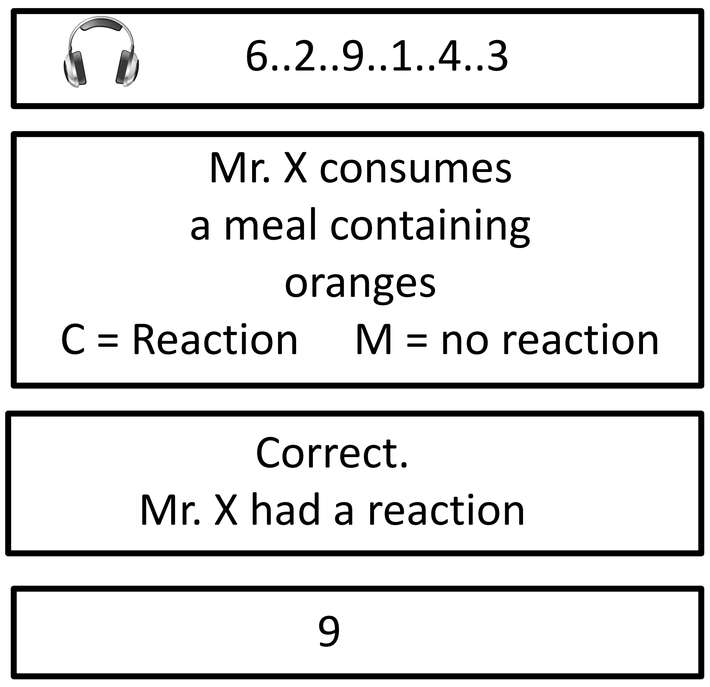

Figure 2: Concurrent load procedure. The correct response to "9" on this trial is "1".

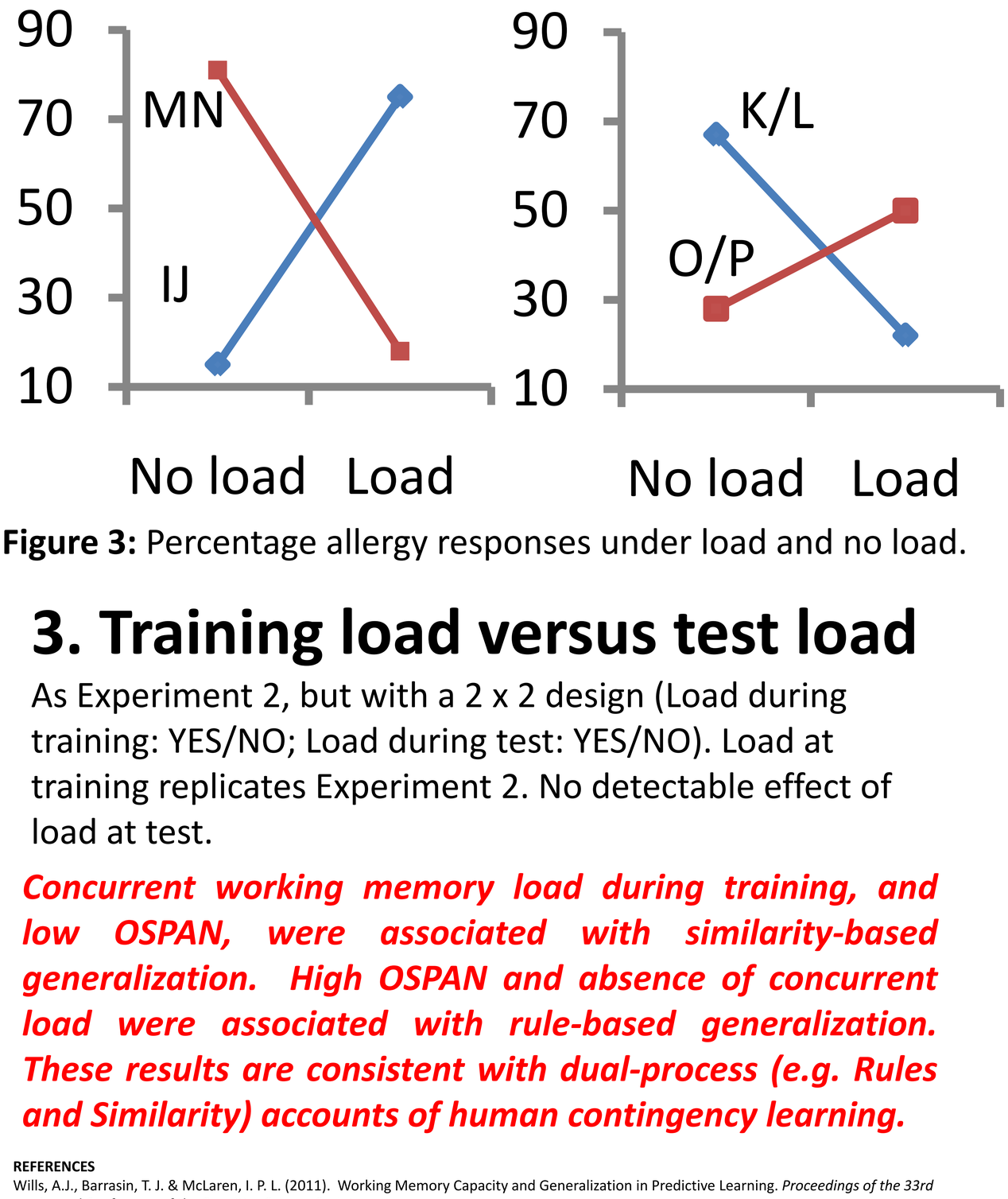

Figure 3: Percentage allergy responses under load and no load.

3. Training load versus test load

As Experiment 2, but with a 2 x 2 design (Load during training: YES/NO; Load during test: YES/NO). Load at training replicates Experiment 2. No detectable effect of load at test.

Concurrent working memory load during training, and low OSPAN, were associated with similarity-based generalization. High OSPAN and absence of concurrent load were associated with rule-based generalization. These results are consistent with dual-process (e.g. Rules and Similarity) accounts of human contingency learning.

REFERENCES

Wills, A.J., Barrasin, T. J. & McLaren, I. P. L. (2011). Working Memory Capacity and Generalization in Predictive Learning. *Proceedings of the 33rd Annual Conference of the Cognitive Science Society*

Wills, A.J., Graham, S., Koh, Z., McLaren, I.P.L. & Rolland, M.D. (2011). Effects of Concurrent Load on Feature- and Rule-based Generalization in Human Contingency Learning. *Journal of Experimental Psychology: Animal Behavior Processes.* Advance online publication. doi: 10.1037/a0023120