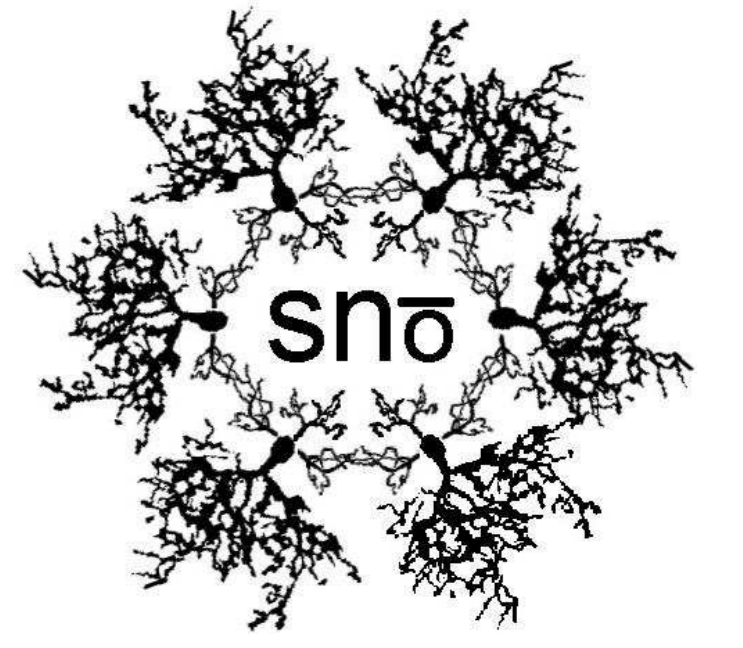




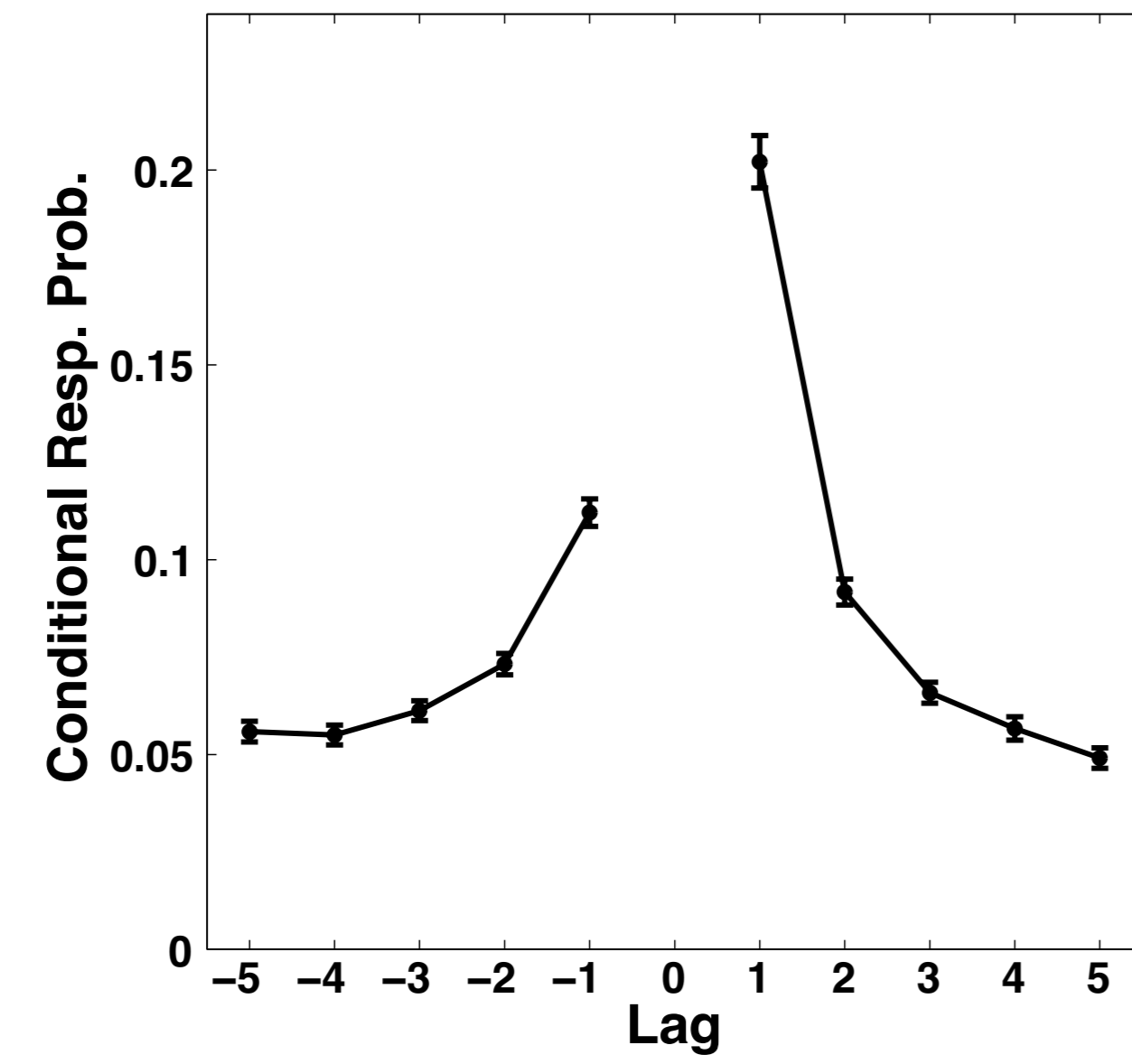
# Associative processes in probabilistic sequence learning

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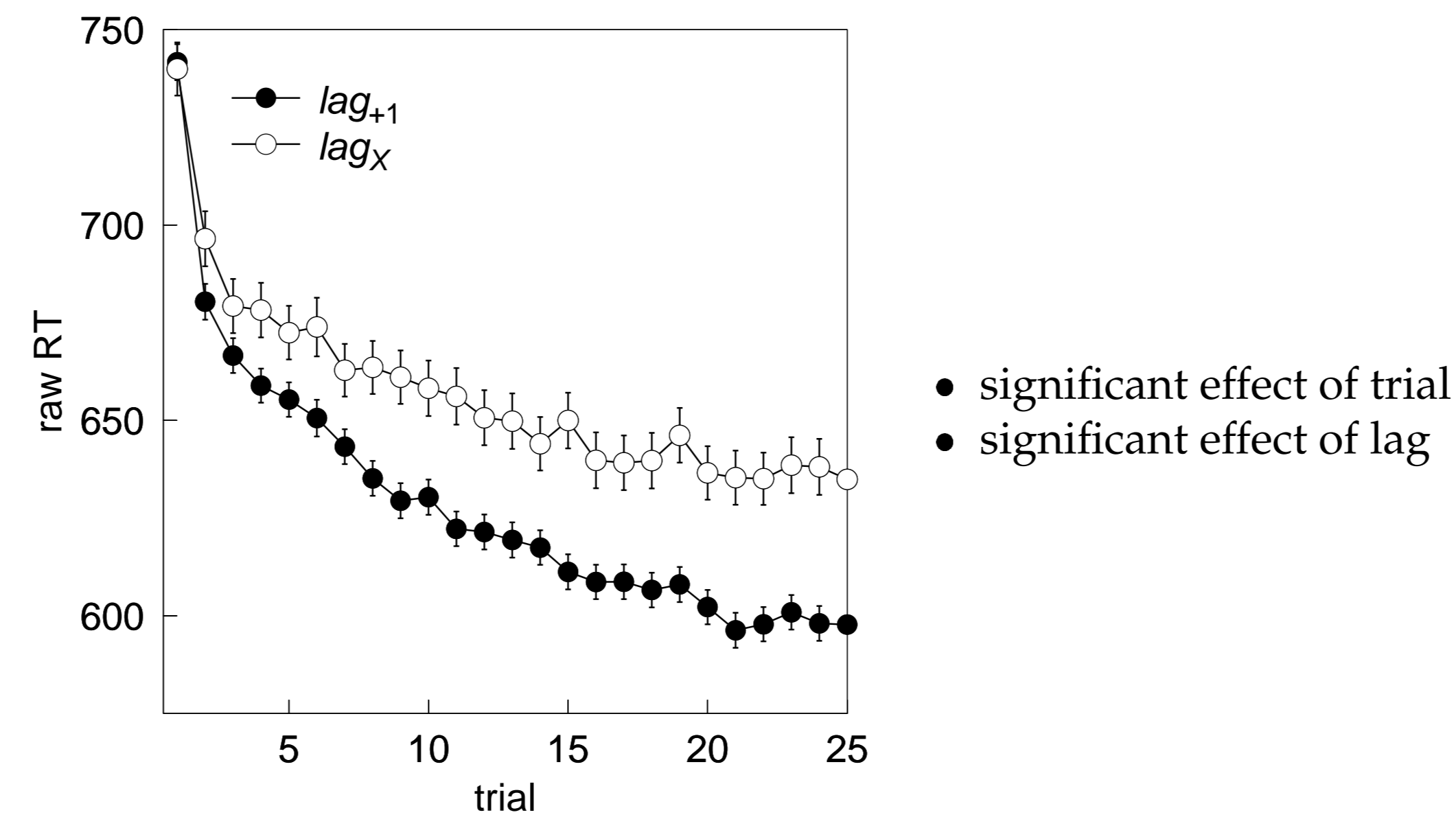


## temporally-defined associations in episodic memory

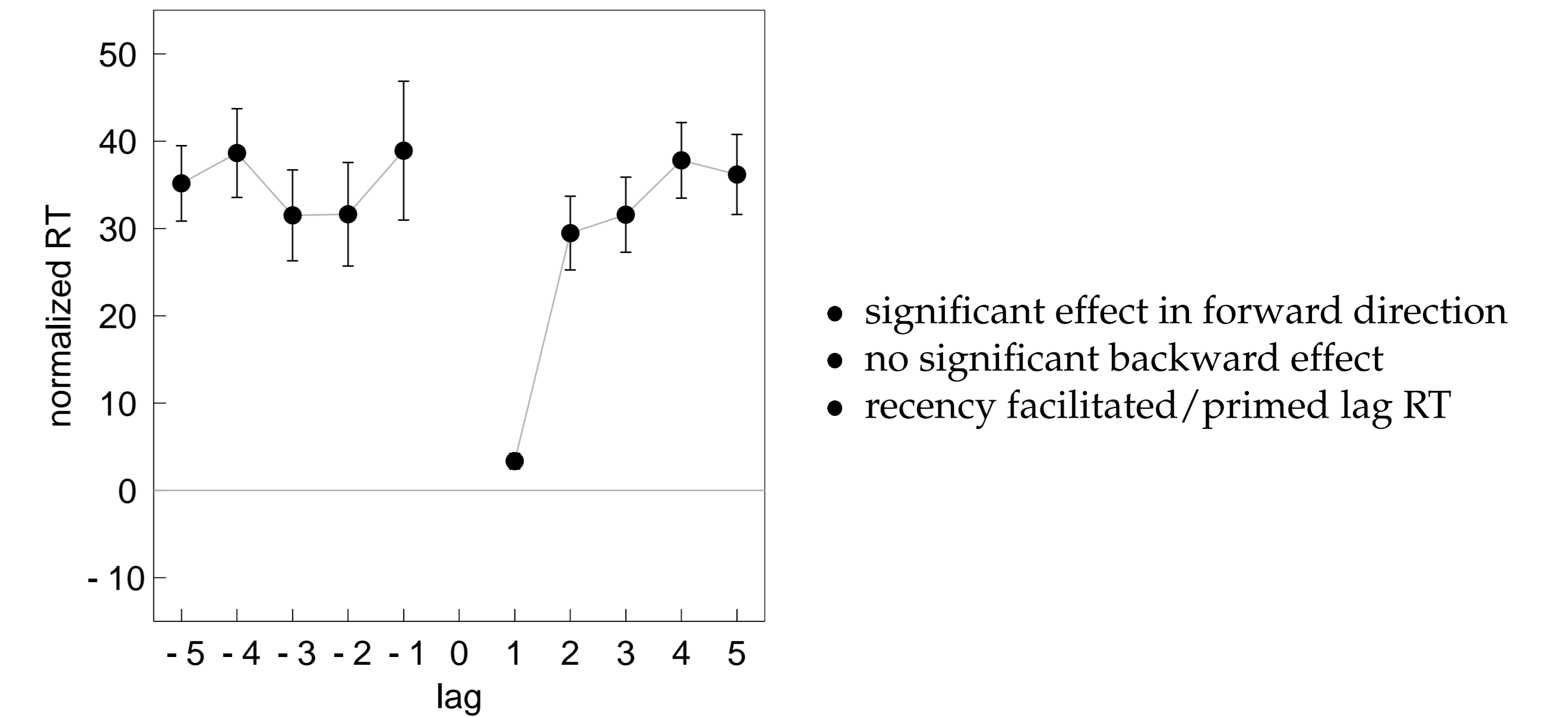
1. serial recall
2. free recall (Howard & Kahana, 1999)
3. cued-recall (Howard, Jing, Rao, Probyn, & Datey, Revised)
4. item recognition (Schwartz, Howard, Jing, & Kahana, 2005)
5. transitive inference (Greene, Spellman, Dusek, Eichenbaum, & Levy, 2001)



## response latency

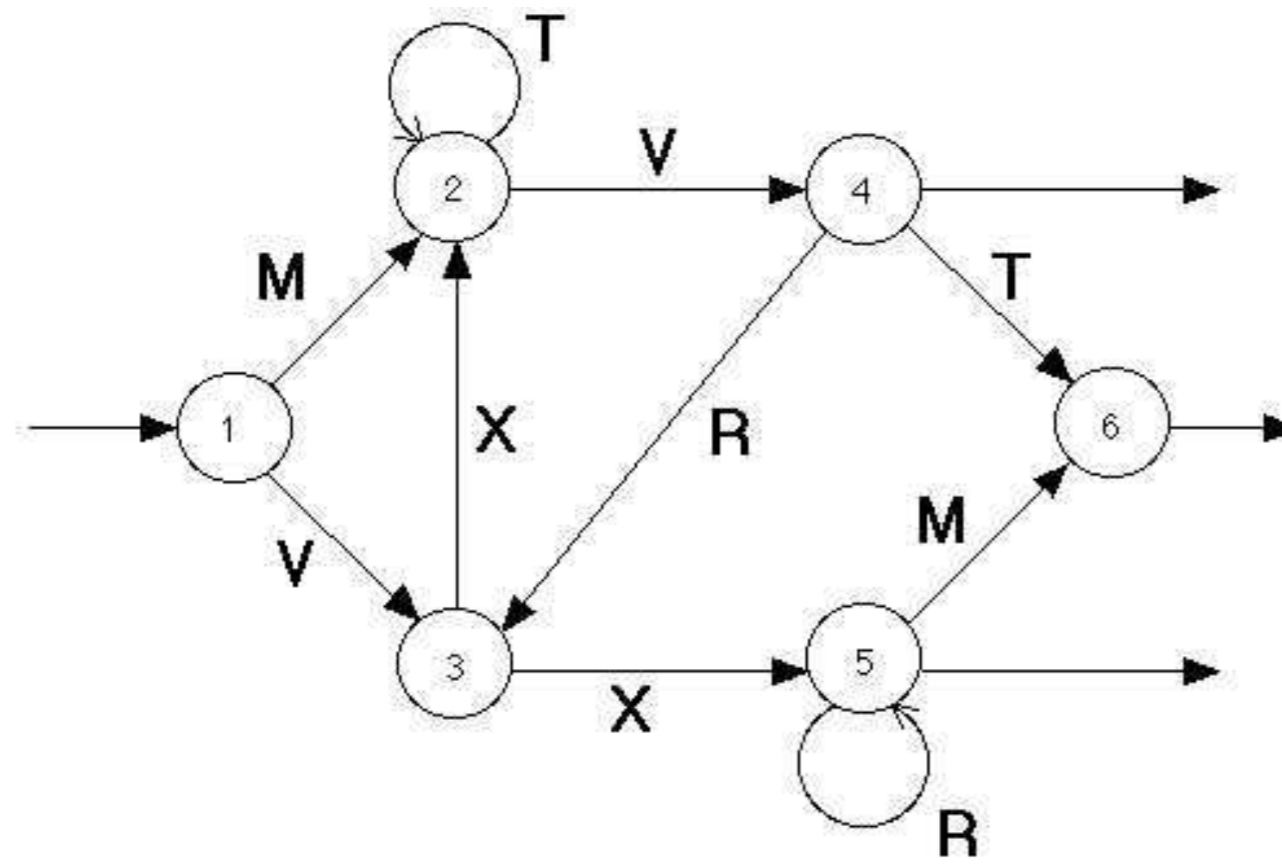


## recency windowed CRL

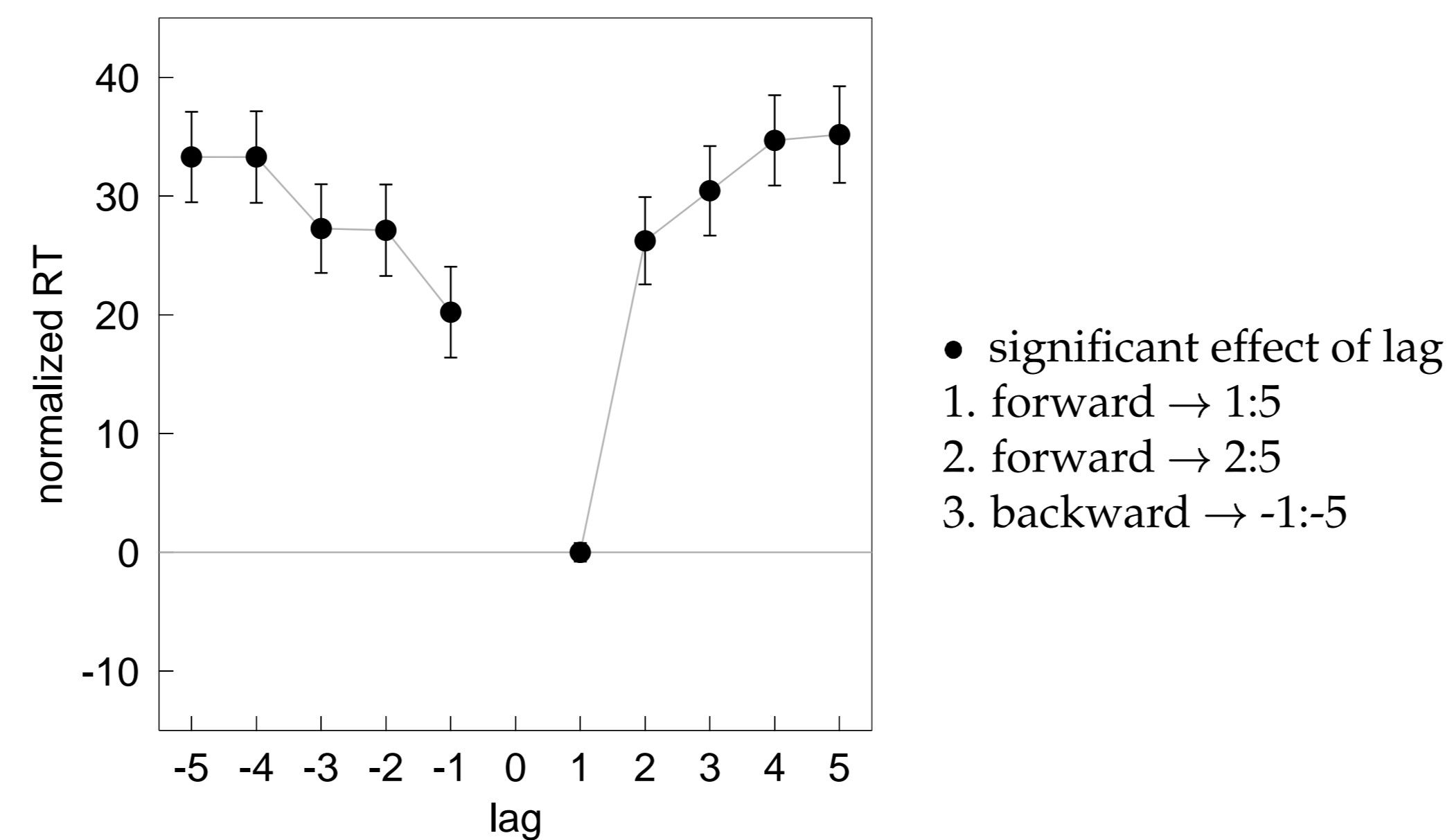


## temporal structure in probabilistic sequence learning

- artificial grammar learning (Elman, 1990; Cleeremans & McClelland, 1991)
- sequence learning (Cleeremans, 1993)
- the role of temporally-defined associations in psl has been hard to assess because the structures are usually complicated

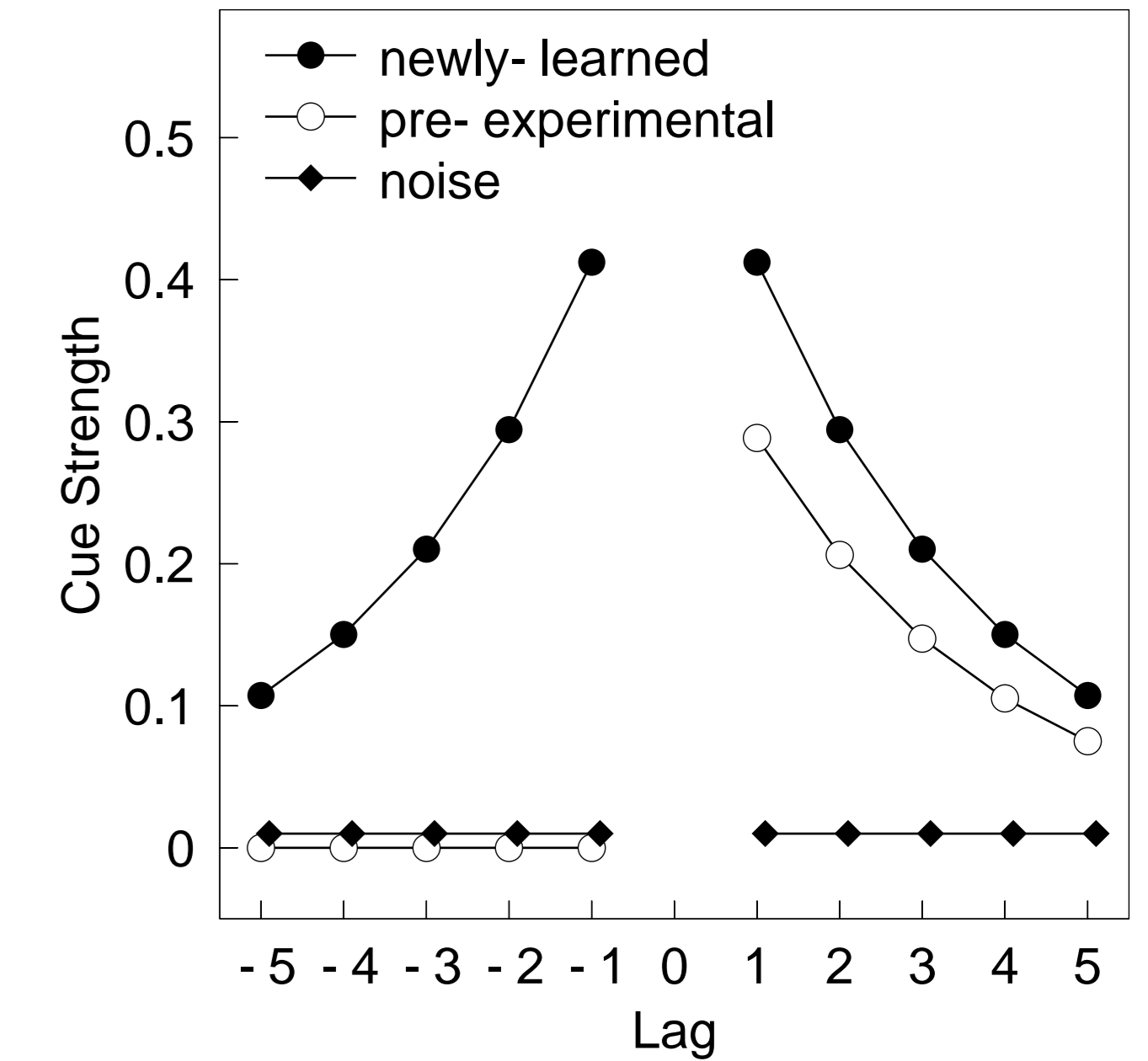


## conditional response latency (CRL)

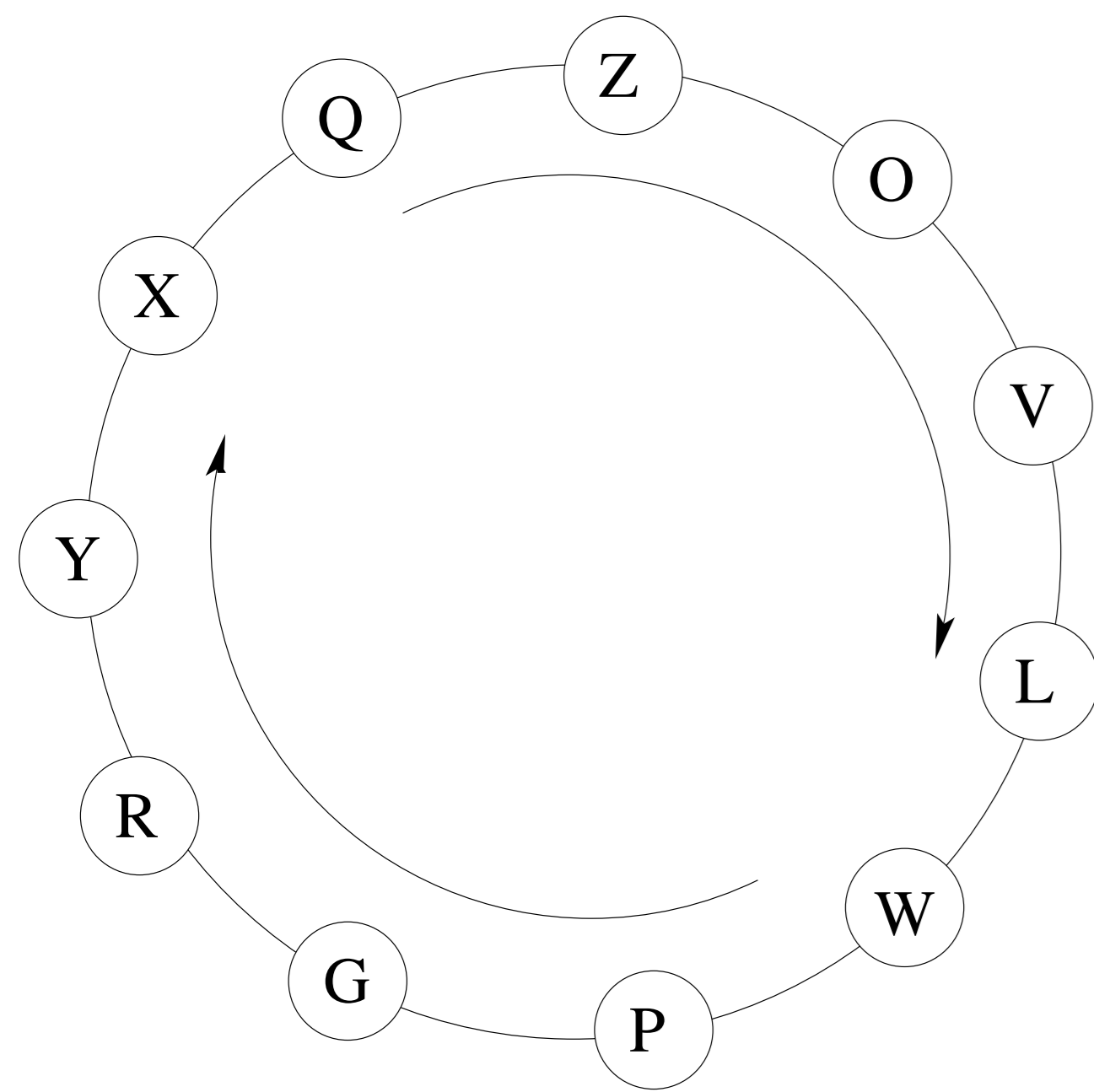


## TCM & forward & backward associations

- retrieved context supports associations
- 2 sources of associations in episodic tasks
  1. one component retrieves contextual states
  2. one component is constant across presentations

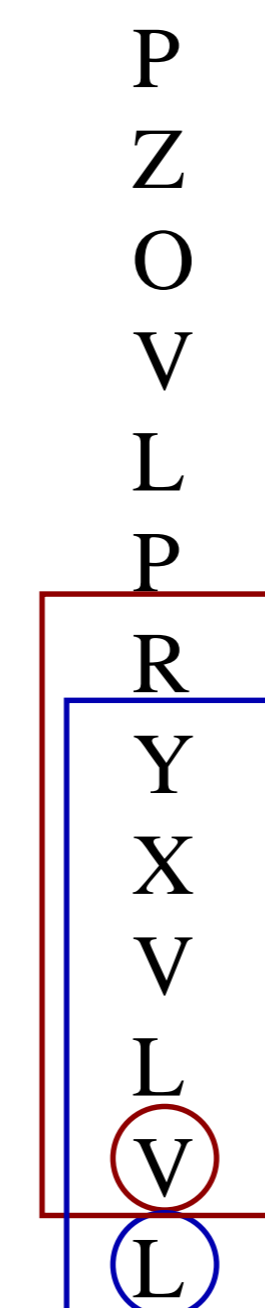
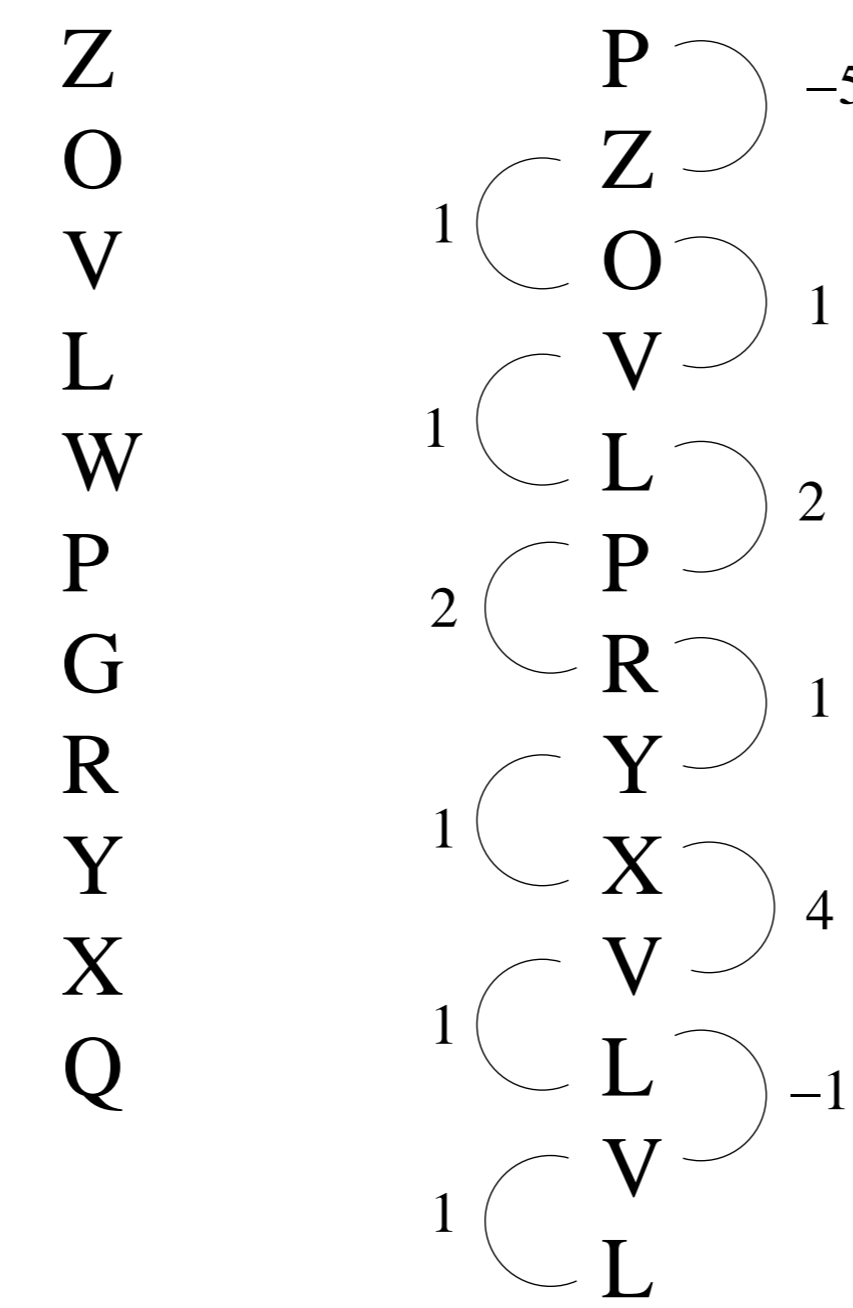


## statistical learning of a one-dimensional structure



	stimulus 2										
	O	V	L	W	P	G	R	Y	X	Q	Z
Z	.7	.03	.03	.03	.03	.03	.03	.03	.03	.03	0
O	0	.7	.03	.03	.03	.03	.03	.03	.03	.03	.03
V	.03	0	.7	.03	.03	.03	.03	.03	.03	.03	.03
L	.03	.03	0	.7	.03	.03	.03	.03	.03	.03	.03
W	.03	.03	.03	0	.7	.03	.03	.03	.03	.03	.03
P	.03	.03	.03	.03	0	.7	.03	.03	.03	.03	.03
G	.03	.03	.03	.03	.03	0	.7	.03	.03	.03	.03
R	.03	.03	.03	.03	.03	.03	0	.7	.03	.03	.03
Y	.03	.03	.03	.03	.03	.03	.03	0	.7	.03	.03
X	.03	.03	.03	.03	.03	.03	.03	.03	0	.7	.03
Q	.03	.03	.03	.03	.03	.03	.03	.03	.03	0	.7

## recency window



## methods

- 11-letter ring
- 60 presentations/trial
- 25 trials
- lag+1 transition probability = .7
- lagx transition probability = .3
- all lagx transitions were sampled equally

## conclusions

- graded contiguity effects in the forward direction
- unlike episodic memory, there was no evidence for a backward association (Jones & Pashler, 2007)

## references

Cleeremans, A. (1993). *Mechanisms of implicit learning: Connectionist models of sequence processing*. Cambridge, MA, USA: The MIT Press.  
 Cleeremans, A., & McClelland, J. L. (1991). Learning the structure of event sequences. *Journal of Experimental Psychology: General*, 120, 235-253.  
 Elman, J. L. (1990). Finding structure in time. *Cognitive Science*, 14, 179-211.  
 Greene, A. J., Spellman, B. A., Dusek, J. A., Eichenbaum, H. B., & Levy, W. B. (2001). Relational learning with and without awareness: transitive inference using nonverbal stimuli in humans. *Memory & Cognition*, 29(6), 893-902.  
 Howard, M. W., Jing, B., Rao, V. A., Probyn, J. P., & Datey, A. V. (Revised). Bridging the gap: Transitive associations are formed from learning items in similar temporal contexts.  
 Howard, M. W., & Kahana, M. J. (1999). Contextual variability and serial position effects in free recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 25, 923-941.  
 Jones, J., & Pashler, H. (2007). Is the mind inherently forward looking? comparing prediction and retrodiction. *Psychonomic Bulletin & Review*, 14(2), 295-300.  
 Schwartz, G., Howard, M. W., Jing, G., & Kahana, M. J. (2005). Shadows of the past: Temporal retrieval effects in recognition memory. *Psychological Science*, 16, 898-904.