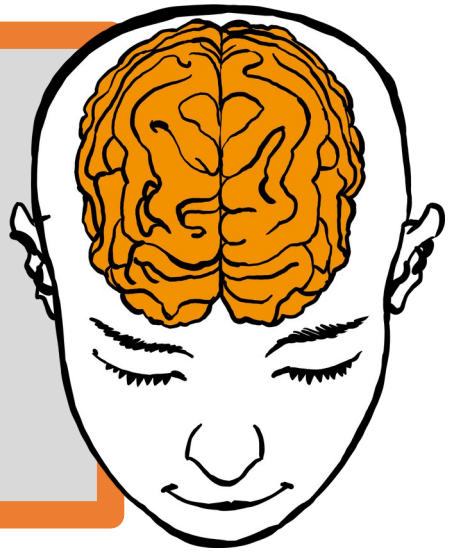
MemLear:
Prediction, Memory, and Learning



November, 1, 2021

Lifespan Cognitive and Brain Development (LISCO) Lab
Goethe University Frankfurt

Francesco Pupillo

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

LISCO

THEORETICAL BACKGROUND

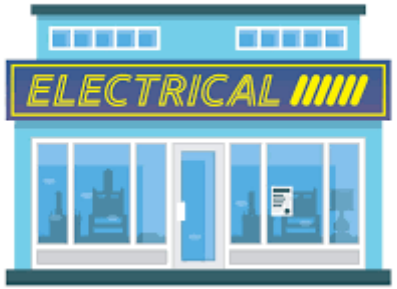
The human mind constantly tries to form expectations about regularities in the environment, a process called statistical learning (Sherman, Graves, & Turk-Browne, 2020).

THEORETICAL BACKGROUND

These regularities can organized in schemas: general knowledge that provides expectations about current events based on prior experience (Sakamoto & Love, 2004).

THEORETICAL BACKGROUND

What happens when new information, congruent or incongruent with a previous schema, is introduced?



THEORETICAL BACKGROUND

What happens when new information, congruent or incongruent with a previous schema, is introduced?

Schema aids encoding for schema-congruent information (Bartlett, 1932; van Kesteren et al., 2010; Tse et al, 2007).

Integration-elaboration hypothesis: target item is assumed to integrate more easily with a congruent context (Depth of processing effect, Craik & Tulving, 1975).

Mismatched expectation could also lead to enhanced episodic encoding, and thus better memory for events that are not fully predicted (Henson & Gagnepain, 2010). Events that violate expectations might be represented more distinctively.

THEORETICAL BACKGROUND

Congruent Incongruent



.90

.10

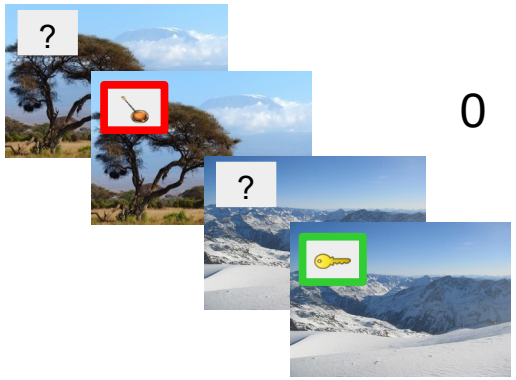

.50

.50

Strong Priors

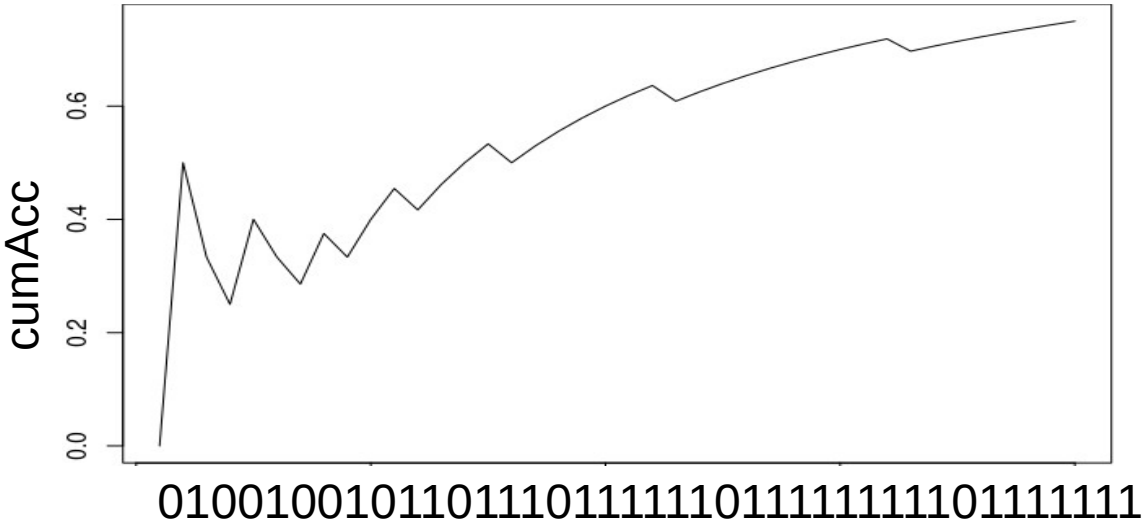
Flat priors

Phase1. Contingency learning



0

1



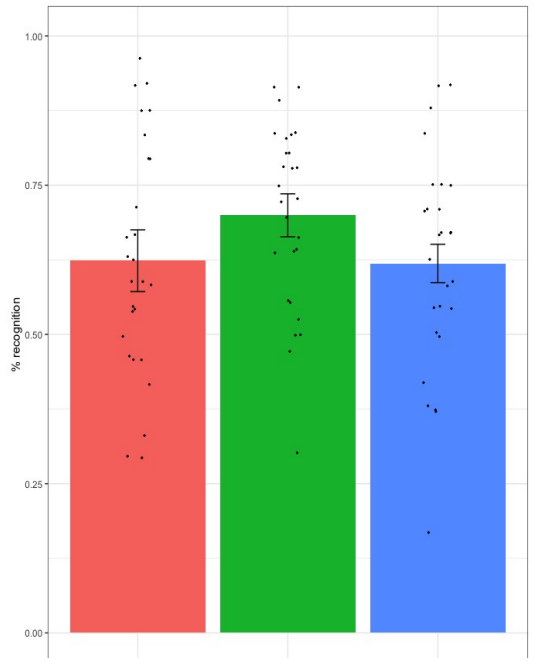
THEORETICAL BACKGROUND

Phase1. Contingency learning

Phase2. Encoding

Phase3. Memory test

THEORETICAL BACKGROUND



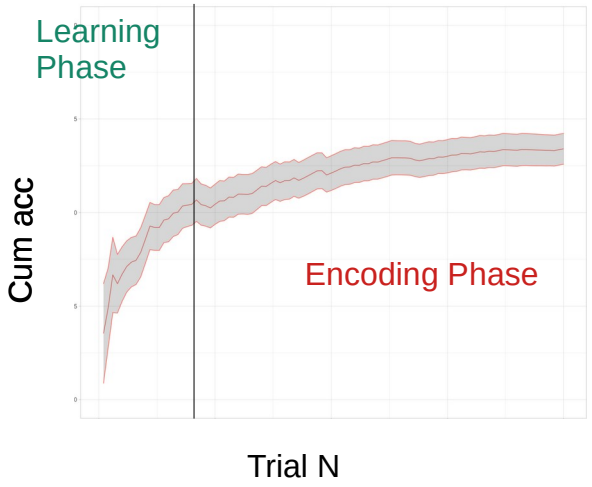
Congruent Flat Incongruent

Proposed explanations:

- SL-EM trade-off: in flat conditions, attention is driven away from the SL task (predictive mode) and directed towards the object when there is nothing to learn.
- Increased uncertainty: increased attention and information seeking in more uncertain context.

THEORETICAL BACKGROUND

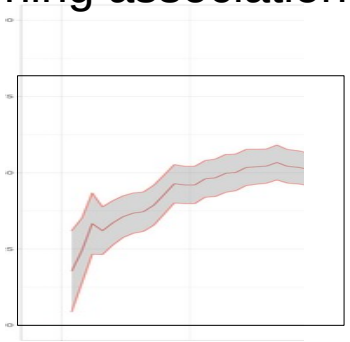
In this previous study, the associations have been already learned prior to the encoding task.

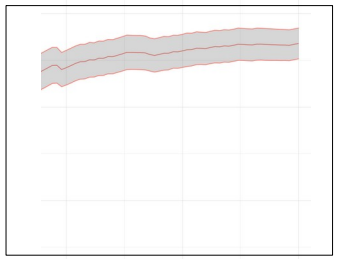


What it is not clear is what are the consequences of learning new associations – having no priors.

Strong	.90, .10	
Flat	.50	.50
None	-	-

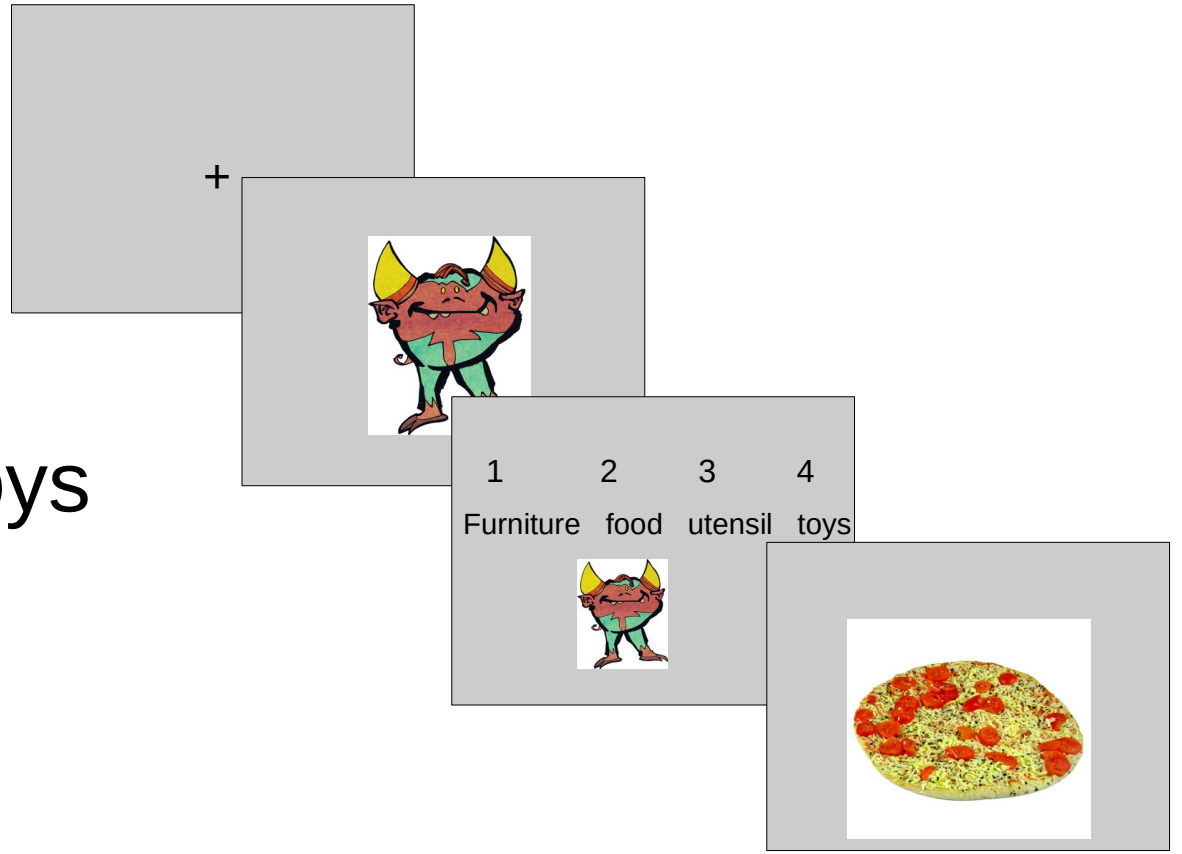
Learning associations vs Known associations





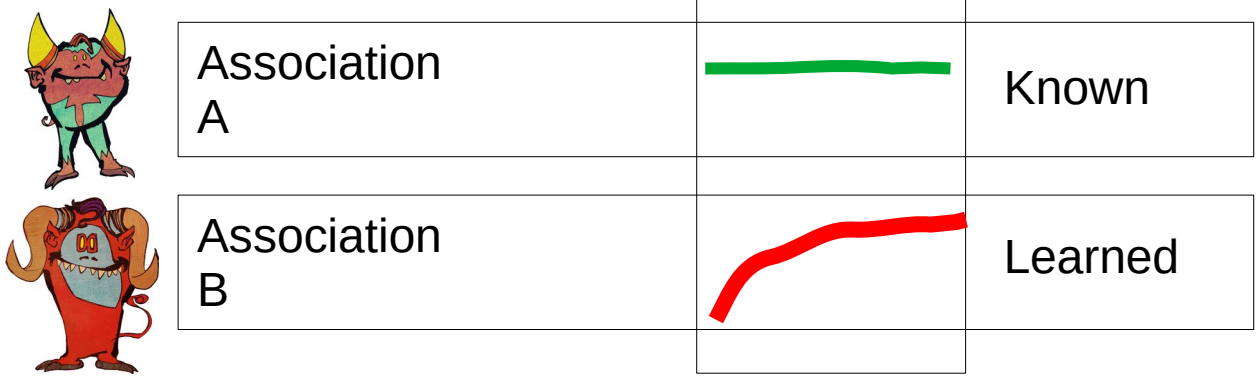
METHODS

furniture food utensil toys

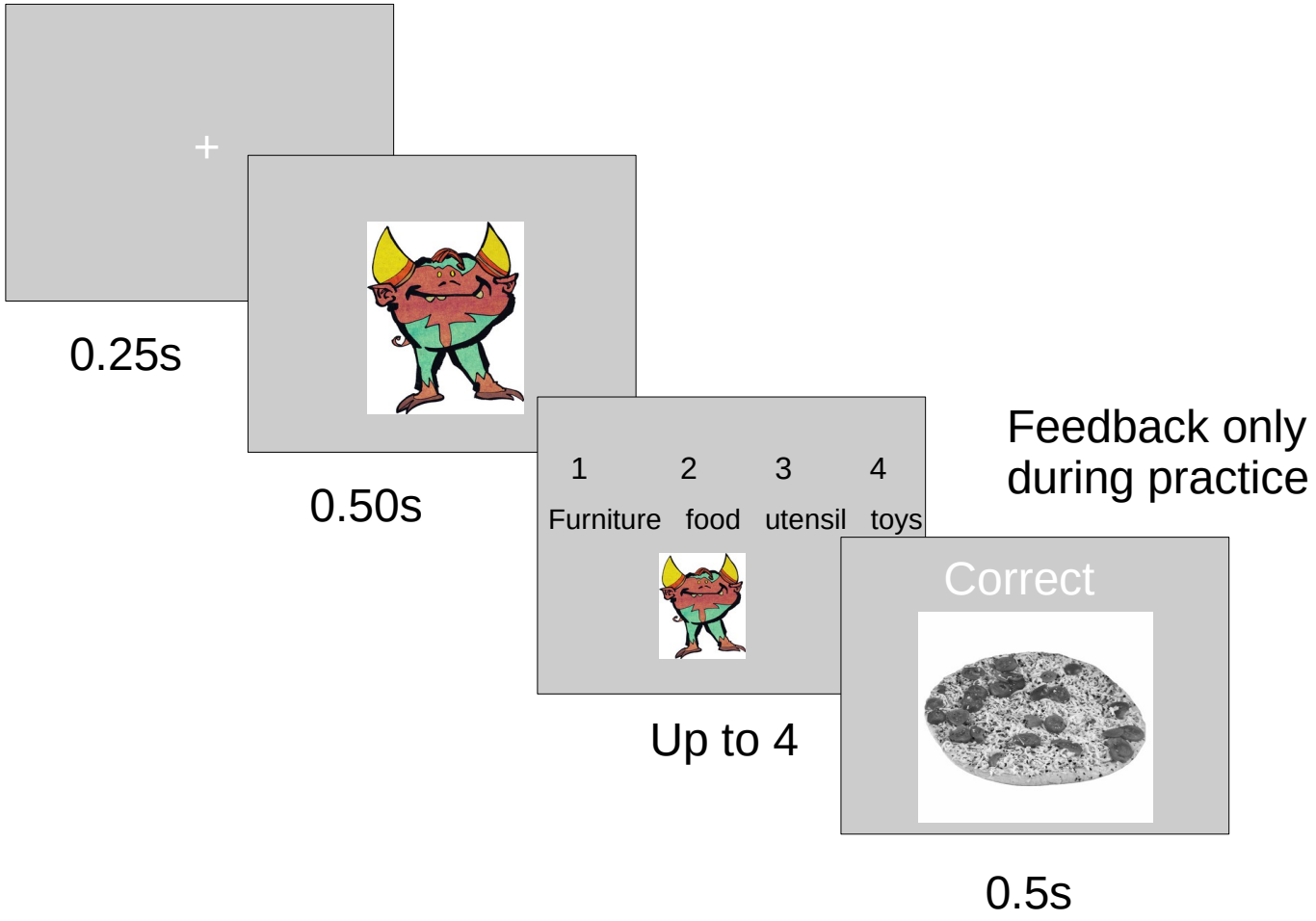


METHODS

Time confound: learning occurs always at the beginning of a session



METHODS



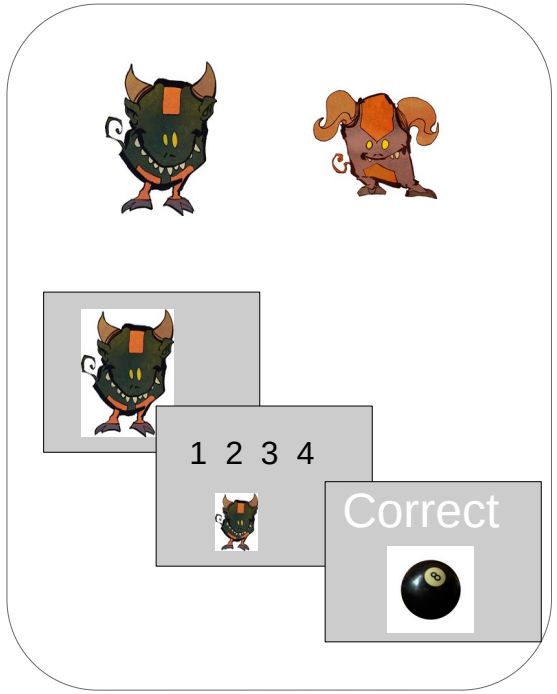
Bank of Standardized Stimuli (BOSS)

Brodeur, Guerard, Bouras, M. (2014)

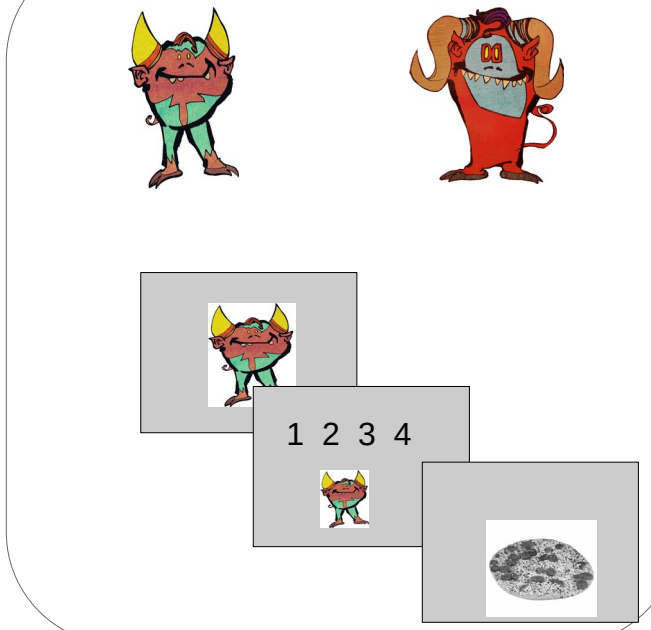
METHODS

Task structure and instructions.

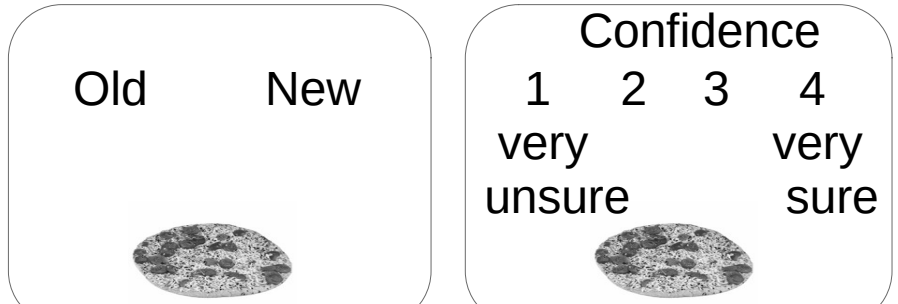
Practice task



Encoding block



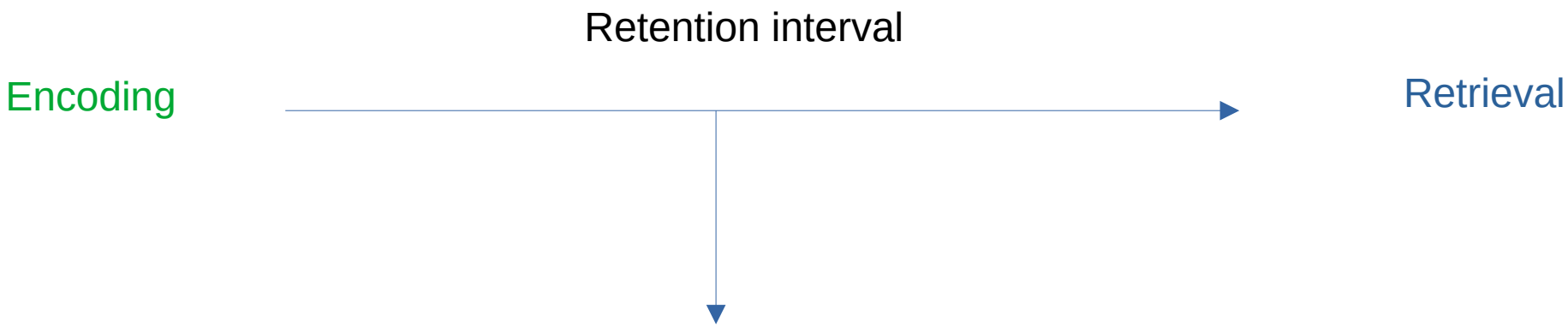
Recognition



"Every monster has a preference for one particular object category. Try to predict what a monster 'will buy' every time". Practice stops after 90% optimal choice in the last 10 trials.

"Just continue what you have been doing so far. There will be new monsters and categories now. For one of the new monsters, the preferred category is x. For the other one, you will have to learn.

Number of trials



Distractor task:
Working memory 2-back task or?

Including it as a covariate in analysis

Number of trials - counterbalancing

Contingencies: 70 10 10 10

	furniture	food	utensil	toys	
List 1	42	6	6	6	Known
	6	6	6	42	Learned
List 2	6	6	6	42	Known
	42	6	6	6	Learned
List 3	6	42	6	6	Known
	6	6	42	6	Learned
List 4	6	6	42	6	Known
	6	42	6	6	Learned

METHODS

Number of trials

Contingencies: 70 10 10 10

Encoding

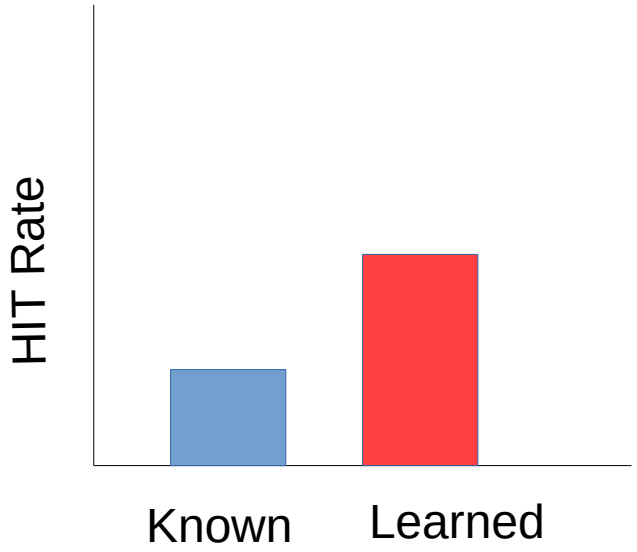
furniture	food	utensil	toys
42	6	6	6
6	6	6	42

Retrieval

	furniture	food	utensil	toys	tot
Old	48	12	12	48	120
New	24	6	6	24	60

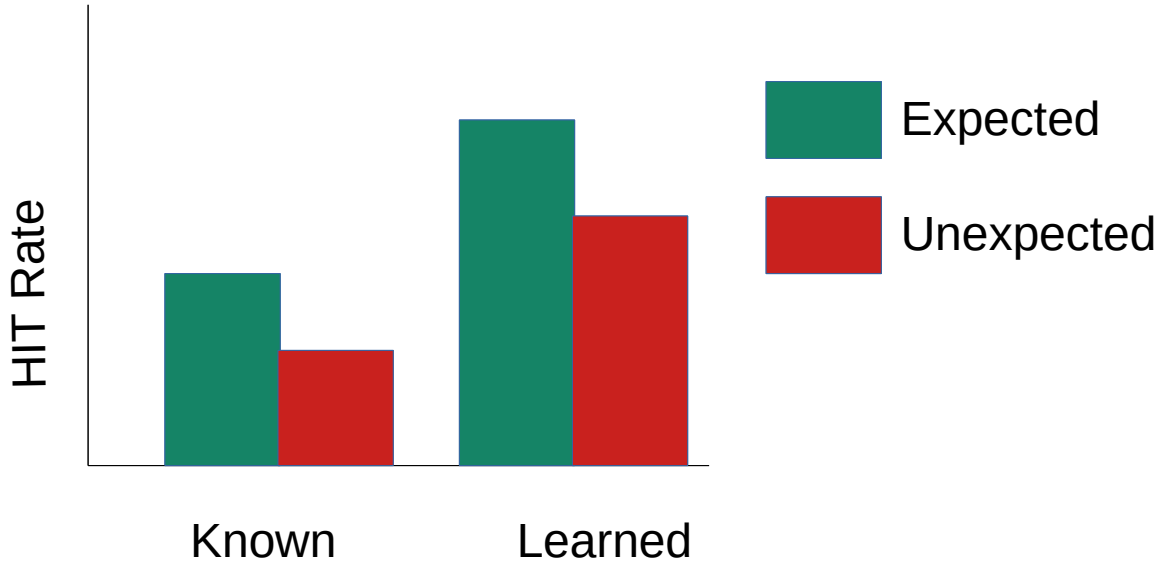
RESULTS: Hypotheses

Increased uncertainty, heightened attention, predictive value

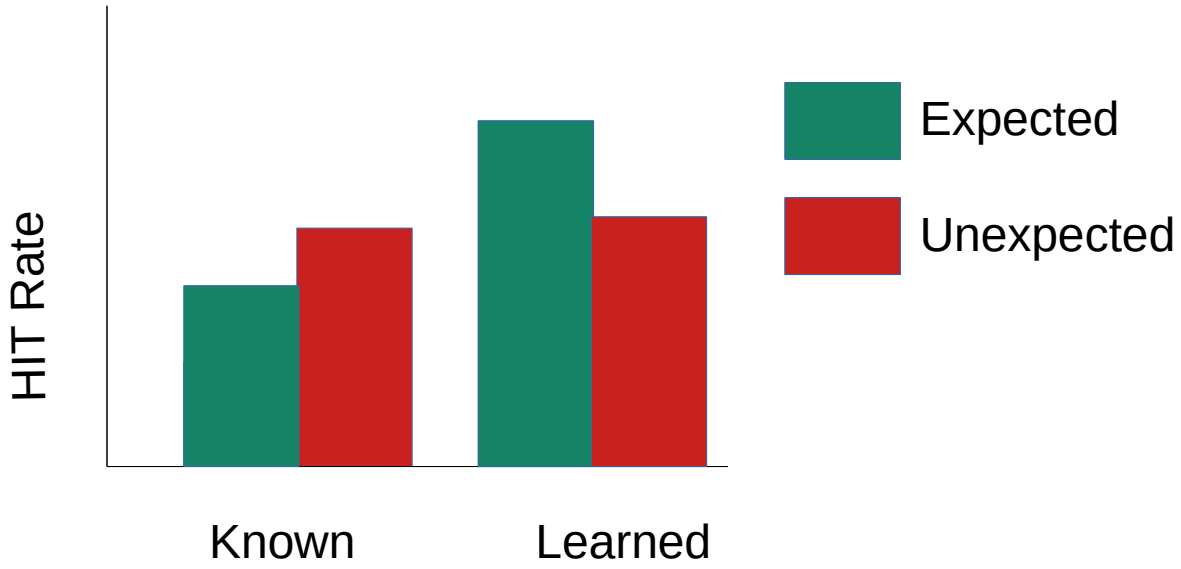


RESULTS: Hypotheses

Effect of condition and expectancy



Condition by expectancy interaction



Softwares used:

- Stimuli presentation and response recording: Psychopy

- Online testing platform: Pavlovia

- Recruiting platform: SONA System

- Data analysis software: R

Thank you!

Questions?

References

- Bartlett, F.C. (1932) Remembering: A Study in Experimental and Social Psychology, Cambridge University Press.
- Craik F., Tulving E. (1975) Depth of processing and retention of words in episodic memory. Journal of Experimental Psychology-General 104: 268–294.
- Henson, R. N., & Gagnepain, P. (2010). Predictive, interactive multiple memory systems. Hippocampus, 20(11), 1315-1326.
- Rouhani, N., Norman, K. A., & Niv, Y. (2018). Dissociable effects of surprising rewards on learning and memory. Journal of Experimental Psychology: Learning, Memory, and Cognition, 44(9), 1430.
- Sakamoto, Y., & Love, B. C. (2004). Schematic influences on category learning and recognition memory. Journal of Experimental Psychology: General, 133(4), 534.
- Sherman, B. E., Graves, K. N., & Turk-Browne, N. B. (2020). The prevalence and importance of statistical learning in human cognition and behavior. Current opinion in behavioral sciences, 32, 15-20.
- Tse, D. et al. (2007). Schemas and memory consolidation. Science 316, 76–82
- van Kesteren, M.T. et al. (2010). Retrieval of associative information congruent with prior knowledge is related to increased medial prefrontal activity and connectivity. J. Neurosci. 30, 15888–15894