Semantic influences on episodic memory distortions

CENTER FOR COGNITIVE NEUROSCIENCE

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Introduction

Consolidation not only stabilizes and stores new memories, but may also transform episodic information into semantic knowledge. This transformation is thought to arise from the loss of unique details of related events and the extraction of their commonalities[1-2].

However, this account neglects the fact that new memories are often recombinations of people, places, and objects for which we already have rich semantic knowledge.

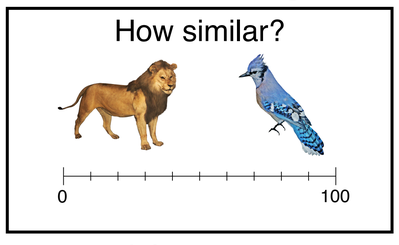
Existing semantic knowledge changes how we learn new events by facilitating encoding of related items[3-5] and accelerating their cortical representation[6].

How does existing semantic knowledge influence or bias new encoding over the course of consolidation? How does this bias interact with forgetting?

Goal: Develop a behavioral task that disengangles biases driven by semantic knowledge from errors due to forgetting for **individual** episodic memories.

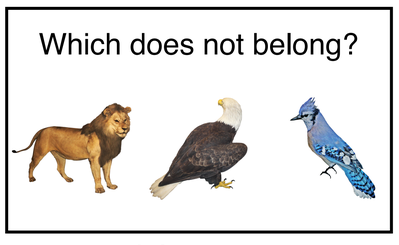
Similarity judgments

Pair-wise ratings



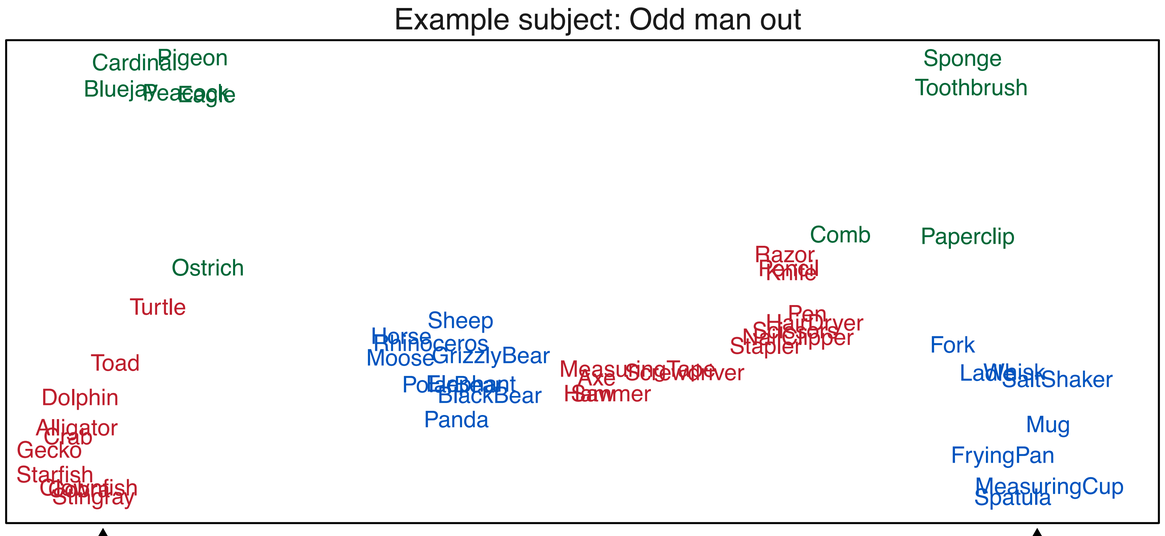
300 trials per category
35 - 45 minutes, one session
N = 40

Odd man out

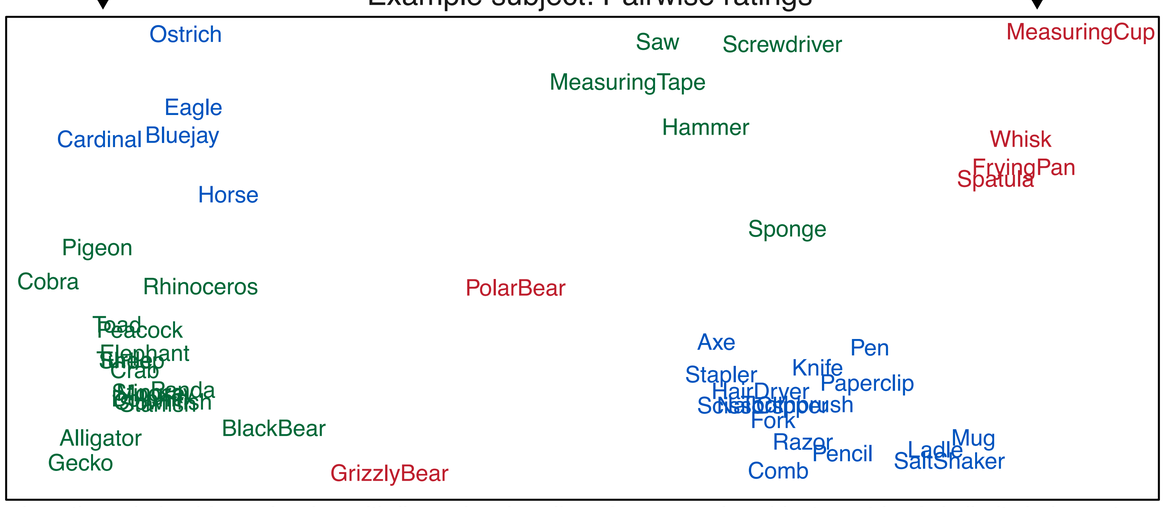


2300 trials per category
3 - 4 hours, across 20 sessions
N = 6 (also completed pair-wise ratings)

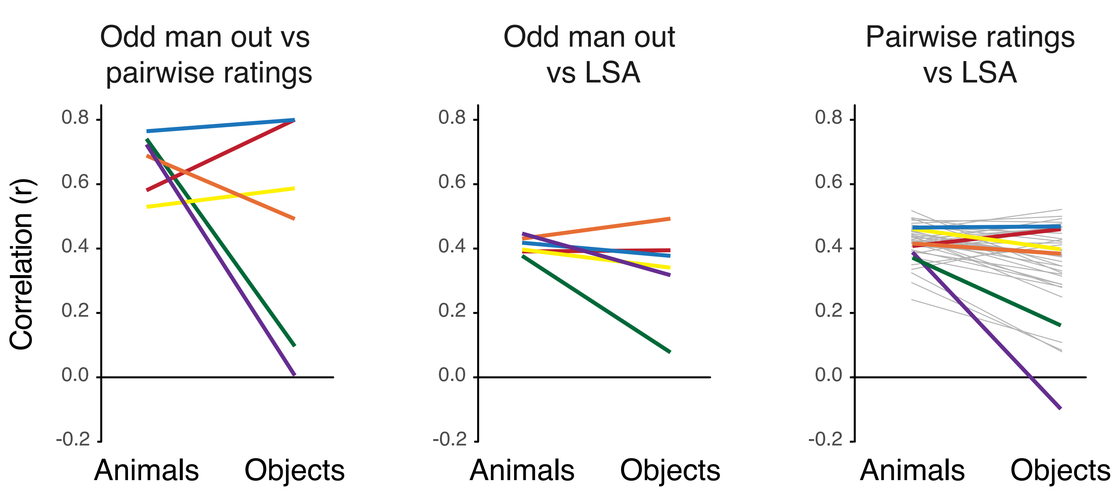
Example subject: Odd man out



Example subject: Pairwise ratings

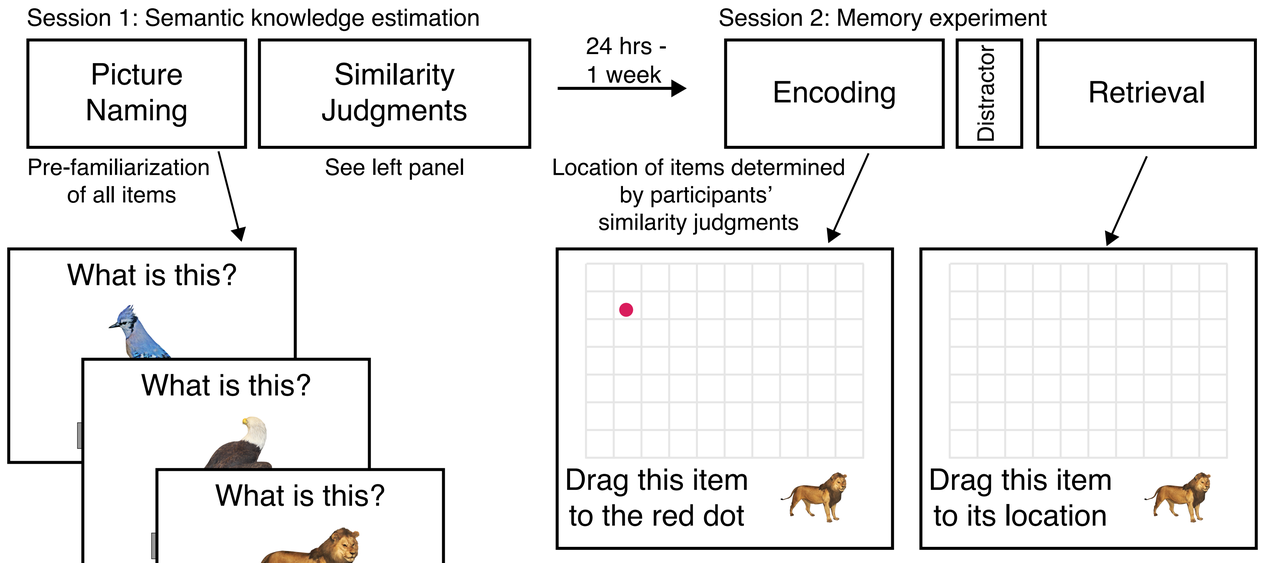


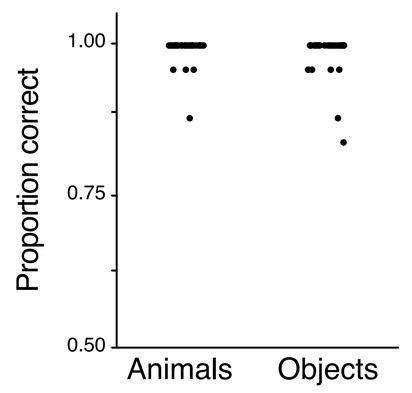
Locations derived from classic multi-dimensional scaling of an example subjects matrix of similarity judgments. Colors reflect K-means clustering (3 clusters per category).



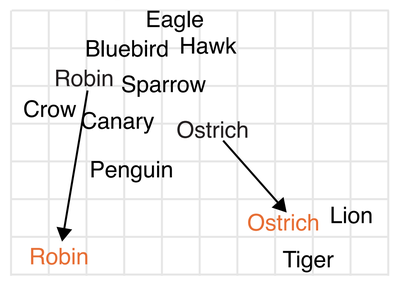
The correlation between similarity generated by pair-wise and by odd man out judgments varied across the six participants. Both moderately correlate with group norms (LSA).

Design



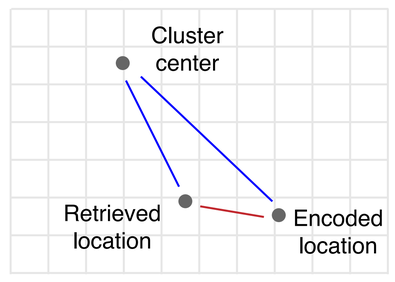


Example item locations



Consistent with judgments
Inconsistent with judgments

Example retrieval trial



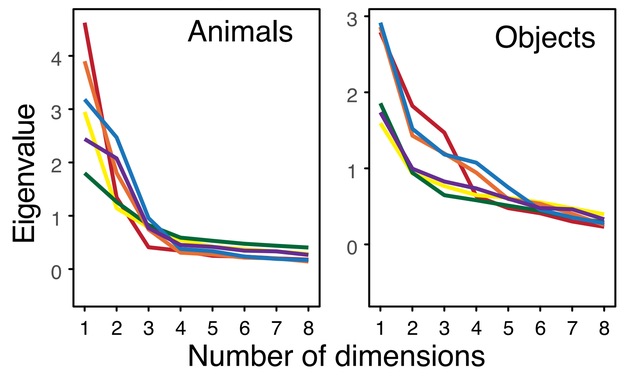
Forgetting:
Retrieved - Encoded

Semantic bias:
(Retrieved - Cluster center)
(Encoded - Cluster center)

Odd man out characteristics

Question: How well are particiapants' judgments characterized by a two-dimensional display?

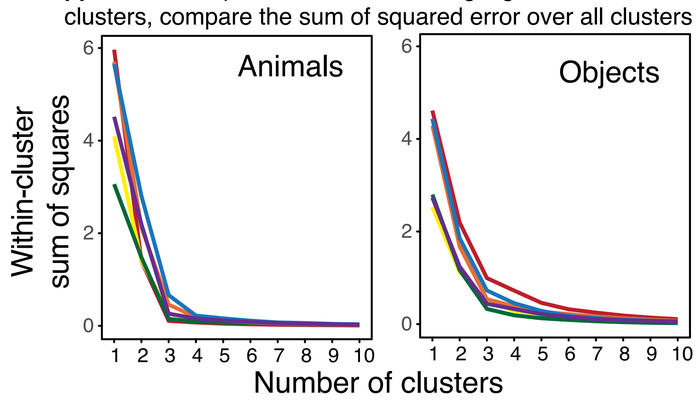
Approach: Plot eigenvalues from multi-dimensional scaling



Participants' judgments of animals and objects are best characterized in 2 - 3 dimensions.

Question: Do participants' judgments cluster differently?

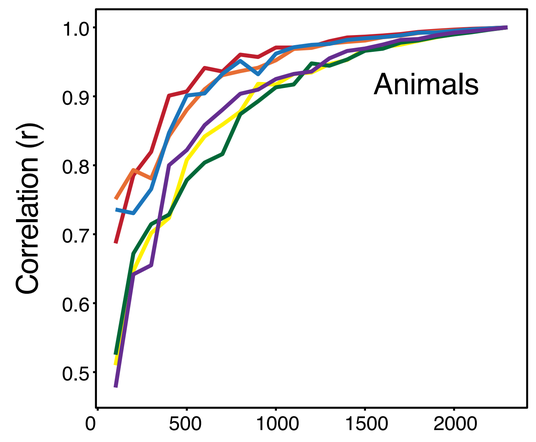
Approach: Compute k-means clustering algorithm with 1 to 10 clusters, compare the sum of squared error over all clusters



Participants' judgments of animals and objects are best characterized with three clusters.

Question: A complete odd man out task requires 2300 unique trials for 25 items. How robust are similarity judgments with fewer trials?

Approach: Randomly select X trials, generate matrix with subset and compare with full matrix



0.8 correlation and above with 1000 trials

Planned Analyses

Leverage the hierarchical structure of semantic knowlege to understand how it biases the content of new episodic memories
- Typicality: change location of typical and atypical items
- Levels of abstraction: move items across and within categories

Manipulate interval between encoding and retrieval to measure changes in the relative use of episodic and semantic information during retrieval as memories become consolidated.

QR code here

References

1. McClelland, J. L., McNaughton, B. L. & O'Reilly, R. C. 1995 Psychol. Rev. 2. Winocur, G., Moscovitch, M. & Bontempi, B. 2010 Neuropsychologia 3. van Kesteren, M. T. R. van, Rijpkema, M., Ruiter, D. J. & Fernández, G. 2010 J. Neurosci. 4. Bein, O., Reggev, N. & Maril, A. 2014 Neuropsychologia. 5. Coutanche, M. N. & Thompson-Schill, S. L. 2010 J. Exp. Psychol. Gen. 6. van Kesteren, M. T. R. van, Fernández, G., Norris, D. G. & Hermans, E. J. 2010 PNAS

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