Semantic Similarity Does Not Enhance Visual Working Memory Capacity

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Background

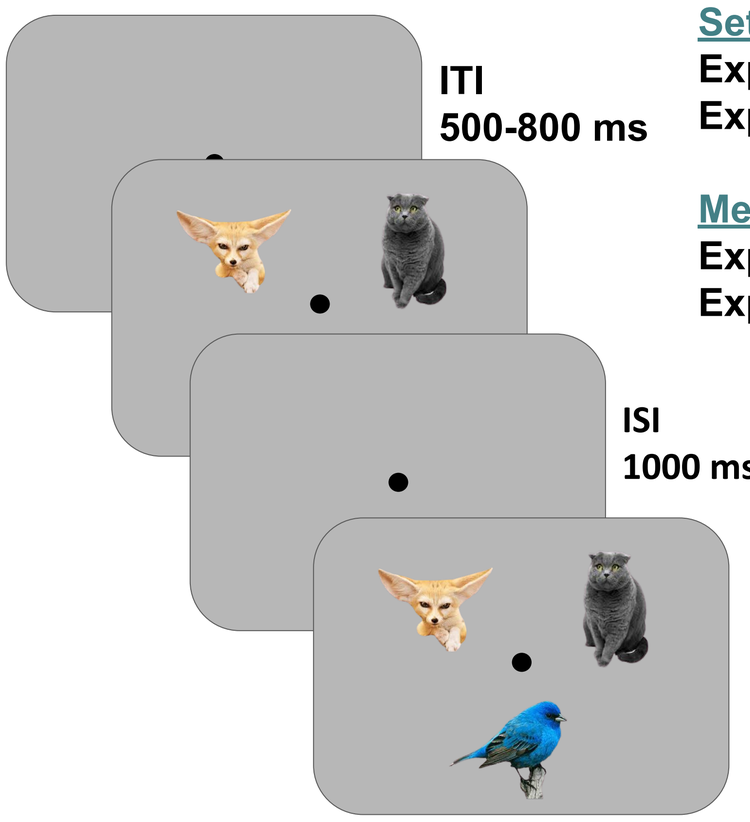
Semantic knowledge enhances VWM capacity(~2-4), yet whether shared semantics across objects provides additional benefits remains controversial.
Some studies report a same-category advantage, consistent with compression hypothesis, while others find no effect of semantic congruency on VWM storage.

We systematically test methodological factors that may explain these discrepancies: memory load, probe type, level of categorical similarity, and encoding duration.

Experimental procedure

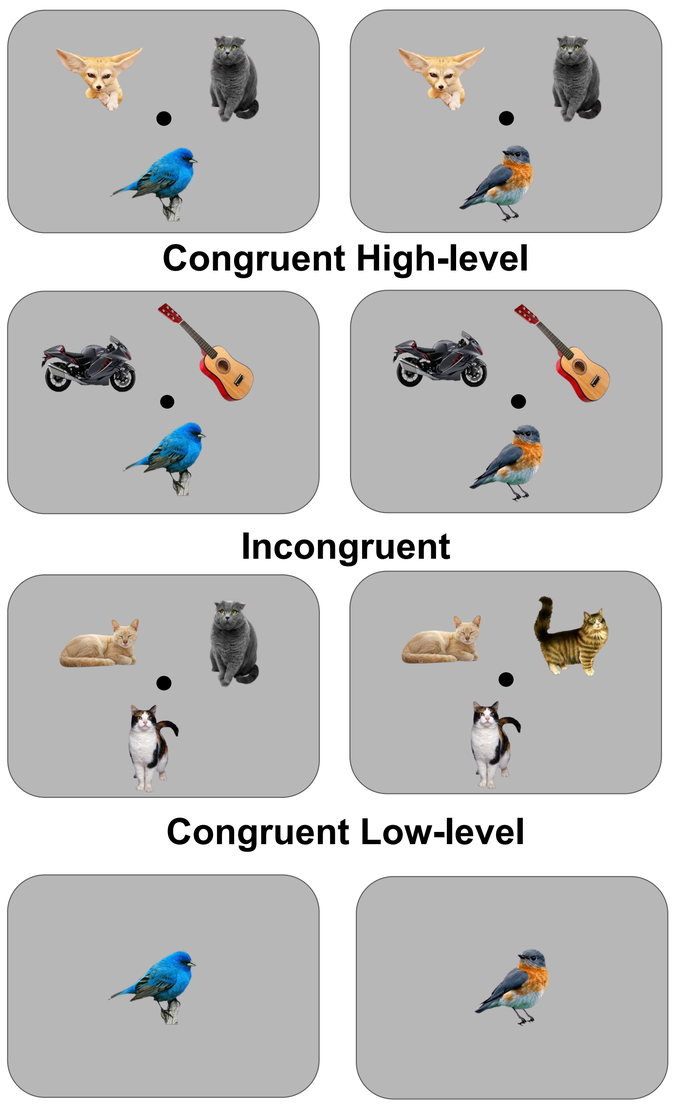
4 Change Detection Experiments

$$d' = z(Hit) - z(FalseAlarm)$$
$$Congruency\ Effect\ (CE) = d'_{Congruent} - d'_{Incongruent}$$



Set sizes:
Exp 1: 2, 3, 6
Exp 2-4: 3, 6

Memory durations:
Exp 1-3: 2500 ms
Exp 4: 125 or 750 ms/item

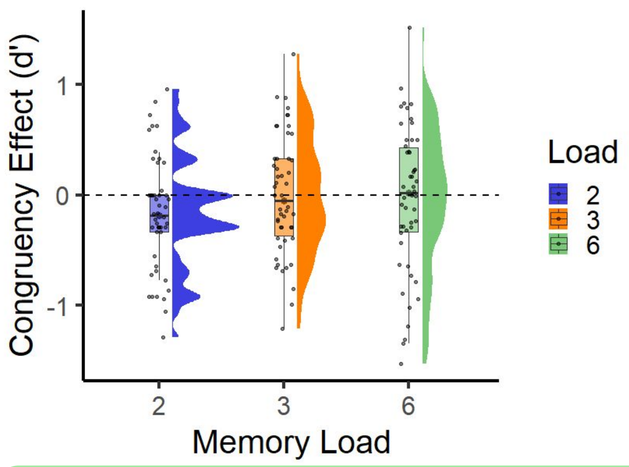


Stimuli Congruency:
Exp 1, 2 & 4: High-level
Exp 3: High vs Low-level

Probe Conditions:
Exp 1,3 & 4: Whole
Exp 2: Single vs Whole

Results

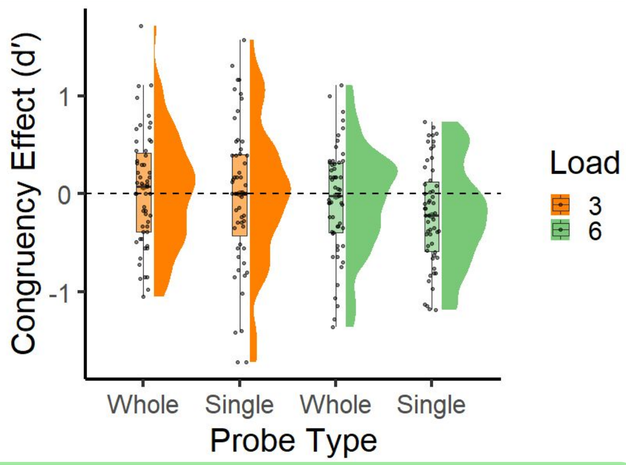
Exp 1. Load: 2, 3 & 6 Items | Whole Probe Report



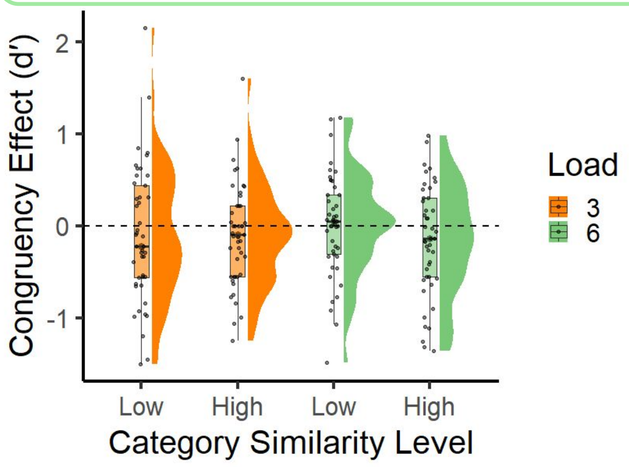
CE did not changed from load 2 to 3 and load 3 to 6

Exp 2. Probe Type: Whole vs Single Probe | 3 & 6 Items

CE did not differ across Single vs Whole Probe for any load



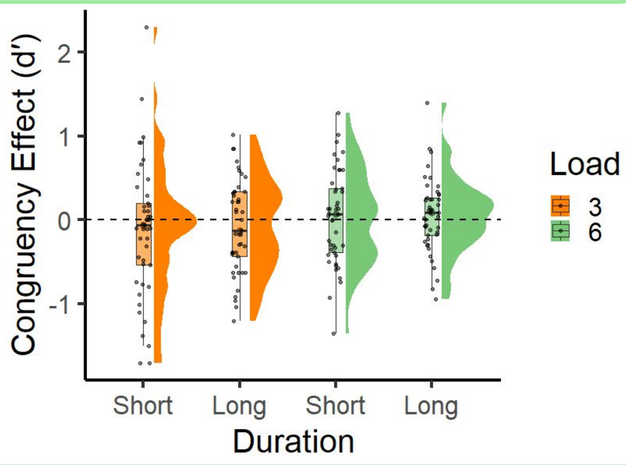
Exp 3. Congruency level: High vs Low-level | 3 & 6 Items



CE was unaffected by the level of categorical similarities for any load.

Exp 4. Encoding Duration: Short vs Long | 3 & 6 Items

CE did not differ across short vs long encoding durations for any load



Conclusion

Semantic compression was not modulated by memory load, probe type, similarity level, or encoding duration.

In contrast, we observed a negative congruency effect at load 2 and in single-probe load 6 trials, where same-category items impaired VWM performance.

These findings challenge the compression account and suggest that shared semantics across objects largely has no role in VWM capacity limits and may even introduce competition, especially when object-level distinctiveness is reduced.