The Unequal Variance Signal-Detection Theory of Recognition Memory: Tests of the Encoding Variability Hypothesis

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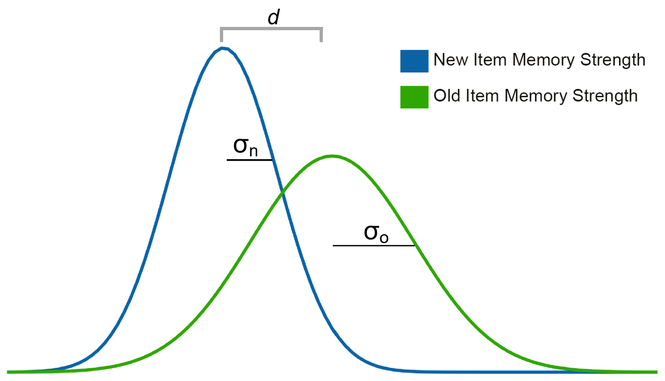
Introduction



The **unequal variance signal-detection (UVSD)** model of recognition memory is well established, though the psychological explanation for unequal variances ($\sigma_o > \sigma_n$) is unclear.

The **encoding variability hypothesis** explains this as:

$$O = B + Y$$

Where *B* and *Y* are Gaussian variables, representing baseline memory strength, and added strength as a result of factors at encoding, respectively. *O* is the resulting old item strength distribution.

No previous research has found evidence for the encoding variability hypothesis.

Are estimates of σ_o greater under high vs. low encoding variance conditions?

Experiment 1 Method

A Given Study Phase Trial:

Stimulus (word)	Inter-Trial-Interval (ITI)	Fixation ("+")
	1000 ms	500 ms

Fixed condition: 3000 ms

Variable condition: duration sampled from a normal distribution with constraints (*M* = 3000 ms, *SD* = 1100 ms)

Test Phase:

130 old + 130 new items presented: participants make recognition memory ratings (1 = sure new…6 = sure old)

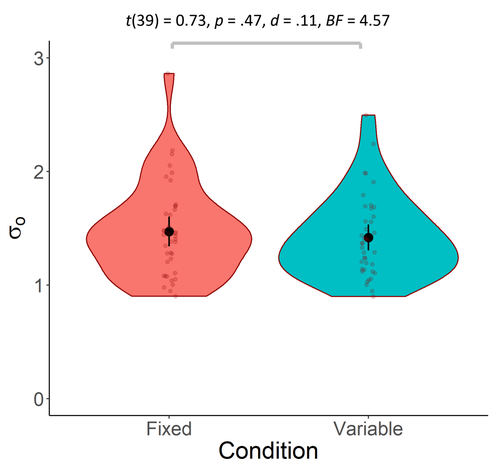
Note: *N* = 40 (also in Experiment 2)

Prediction:

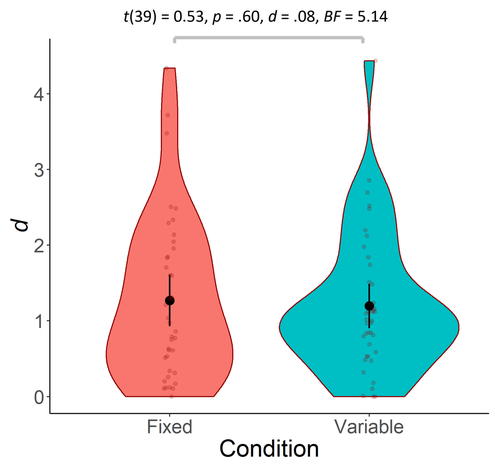
Old item strength variance (σ_o) will be greater in Variable Condition, due to variation in exposure duration

Experiment 1 Results

Q: Is old item strength variance greater because of added encoding variability?



No difference in UVSD estimates of σ_o (old item variance) between conditions



No difference in UVSD estimates of *d* (memory strength) between conditions

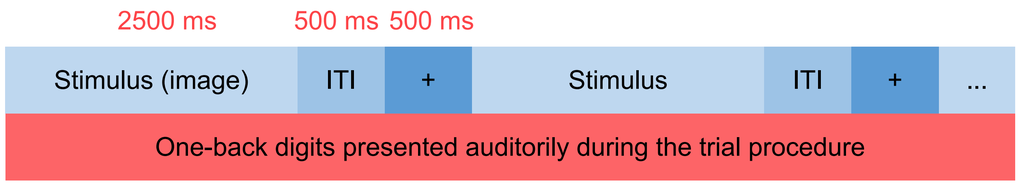
- Dual process (DPSD) and mixture signal-detection (MSD) model fits also showed no differences in old item variance or strength.
- Study duration very weakly (but significantly) correlated with recognition ratings.

A: No evidence for encoding variability through a study duration manipulation.

Can a different manipulation (trial-to-trial level of attention) demonstrate an effect predicted by the encoding variability hypothesis?

Experiment 2 Method

Study Phase: Participants viewed images and completed a simultaneous one-back task.



Fixed Condition: inter-digit interval is 3500 ms (synchronised with image presentation)

Variable Condition: inter-digit intervals are sampled from a normal distribution with constraints (*M* = 3500 ms, *SD* = 1100 ms) (digits are asynchronous with image presentation)

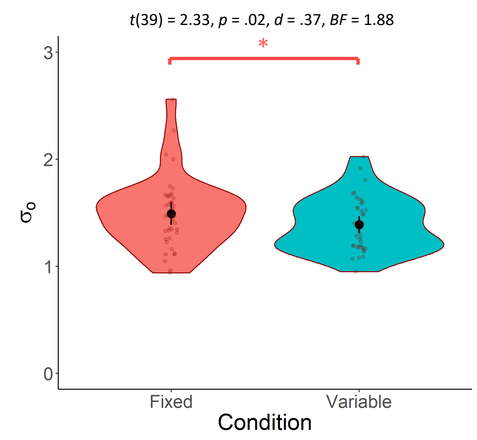
Test Phase: The same as in Experiment 1.

Prediction:

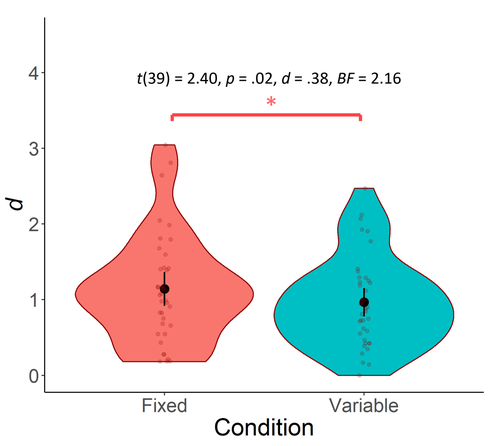
Old item strength variance (σ_o) will be greater in the Variable Condition, due to greater fluctuations in attention to visual stimuli caused by variation in one-back task digit intervals.

Experiment 2 Results

Q: Is old item strength variance greater because of added encoding variability?



σ_o was greater in the **fixed** condition



d was greater in the **fixed** condition

*$p < .05$ **$p < .01$

- There was a strong association between estimates of strength (*d*) and old item variance (σ_o) in the UVSD model.
- This trend was present in DPSD and MSD inter-parameter correlations (*R* vs *d'*, and d_A vs λ).
- DPSD and MSD models also predicted greater strength (*d'*, d_A) and old item variance (from *R* and λ) in the fixed condition.

A: Old item variance (σ_o) was linked to memory strength, not encoding variability

Conclusions

No evidence was found for the encoding variability hypothesis.

- Contrary to predictions, greater variance in study duration and trial-to-trial level of attention at encoding did not produce greater estimates of σ_o.
- Instead, estimates of σ_o were linked to estimates of *d* (across conditions and participants).
- A further experiment will manipulate encoding variability using word frequency.
- The findings have no bearing on the validity of the UVSD model, but do question the encoding variability hypothesis, evidence for which is still lacking.

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