A Recovery Learning Account of the Testing Effect

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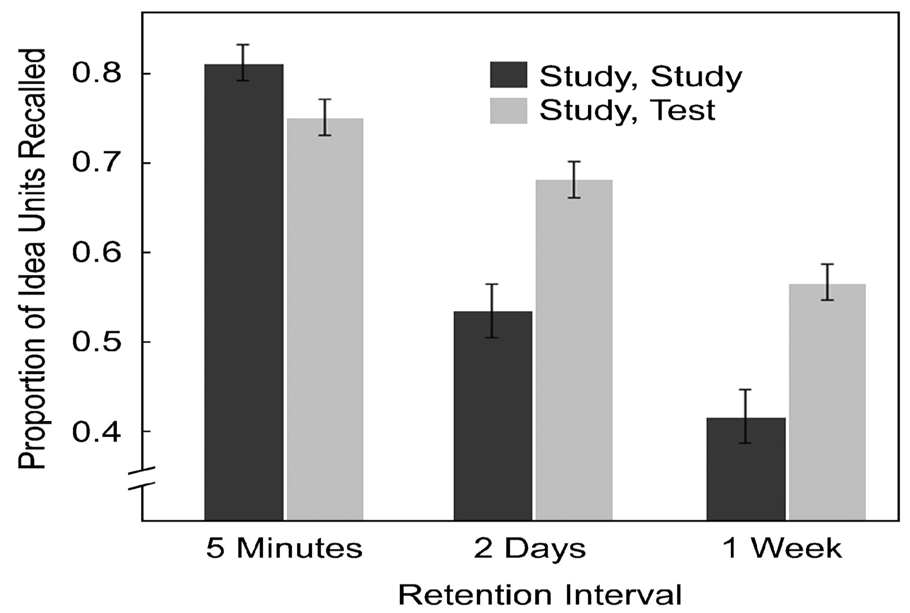
The Testing Effect

- Testing yourself can be more beneficial than restudying (E.g. Flash Cards > Re-reading)
- This advantage is not immediate, but appears as the retention interval between study and test grows (Roediger & Karpicke, 2006b).

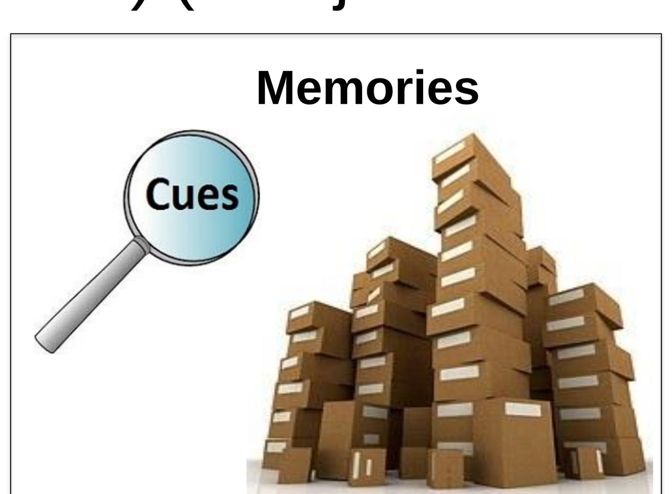


- Test practice involving recall produces the most robust difference in forgetting rates (Dempster, 1996; Carpenter & DeLosh, 2006).

SAM, A Global Matching Model of Memory

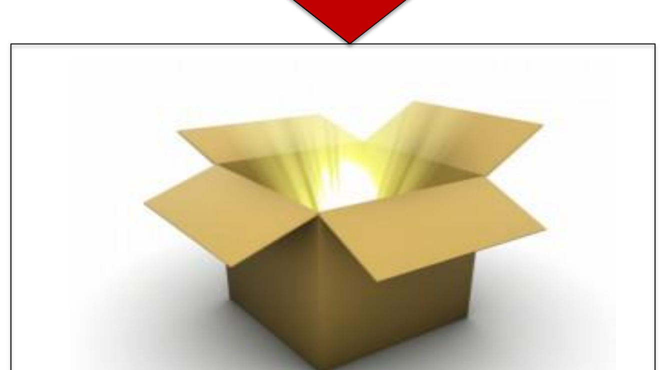
- We sought to model this effect using a modified version of the Search of Associative Memory Model (a.k.a. SAM) (Raaijmakers & Shiffrin, 1981).

1. Stage 1 – **Sampling**
   Entire contents of memory is searched using retrieval cues



2. Stage 2 – **Recovery**
   After a single memory image is selected, attempt to recover item-specific details

3. If both sampling and recovery are successful, you are able to recall



SAM-Recovery Learning

- We believed that the testing effect might stem from an increase in the ability to recover item specific information, due to recall practice
- In the original SAM model, the same parameters that determined the probability of sampling a memory, *p(S)*, also determined the probability of recovering, the details of that item, *p(R)*.
- We have removed this assumption, and allow for separate learning in sampling and recovery, depending on the type of intervening practice

$$p(S) = \frac{\boldsymbol{S1}}{\sum_1^n \boldsymbol{S1}_i + \boldsymbol{O}} \qquad p(R) = \frac{\boldsymbol{R1}}{\boldsymbol{R1} + \boldsymbol{O}}$$

- Additional studying allows for increases in the probability of sampling, but not recovery

$$p(S) = \frac{\boldsymbol{S2}}{\sum_1^n \boldsymbol{S2}_i + \boldsymbol{O}} \qquad p(R) = \frac{\boldsymbol{R1}}{\sum_1^n \boldsymbol{R1}_i + \boldsymbol{O}}$$

- Correct recall on a practice test allows for increases in both sampling and recovery probabilities

$$p(S) = \frac{\boldsymbol{S2}}{\sum_1^n \boldsymbol{S2}_i + \boldsymbol{O}} \qquad p(R) = \frac{\boldsymbol{R2}}{\sum_1^n \boldsymbol{R2}_i + \boldsymbol{O}}$$

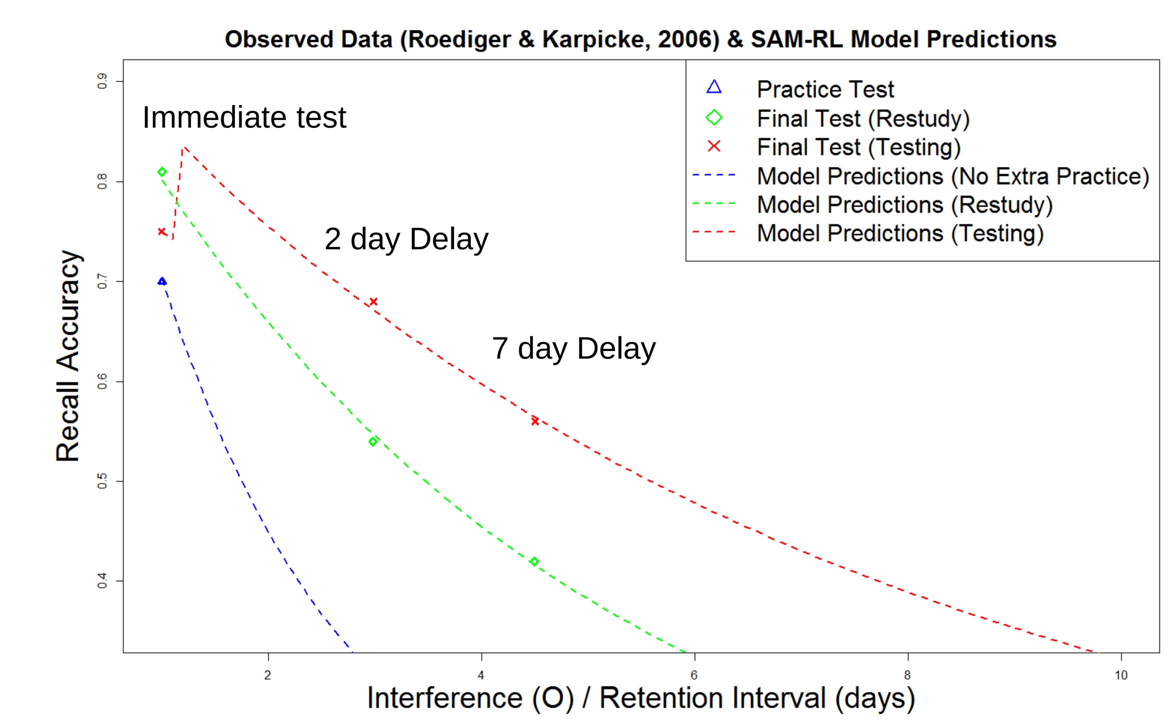
- Incorrect recall on a practice test does not allow for any increases in either sampling or recovery probabilities
- *O* represent interference from competing memories and recoveries. It is a scaling parameter fixed at 1 for the initial study/test, and increases with the retention interval.
- Recall accuracy is calculated by allowing *k* independent sampling attempts for each item, but recovery attempts are not independent

$$p(Recall) = 1 - \left(1 - P(S)\right)^k \times p(R)$$

Modeling Results

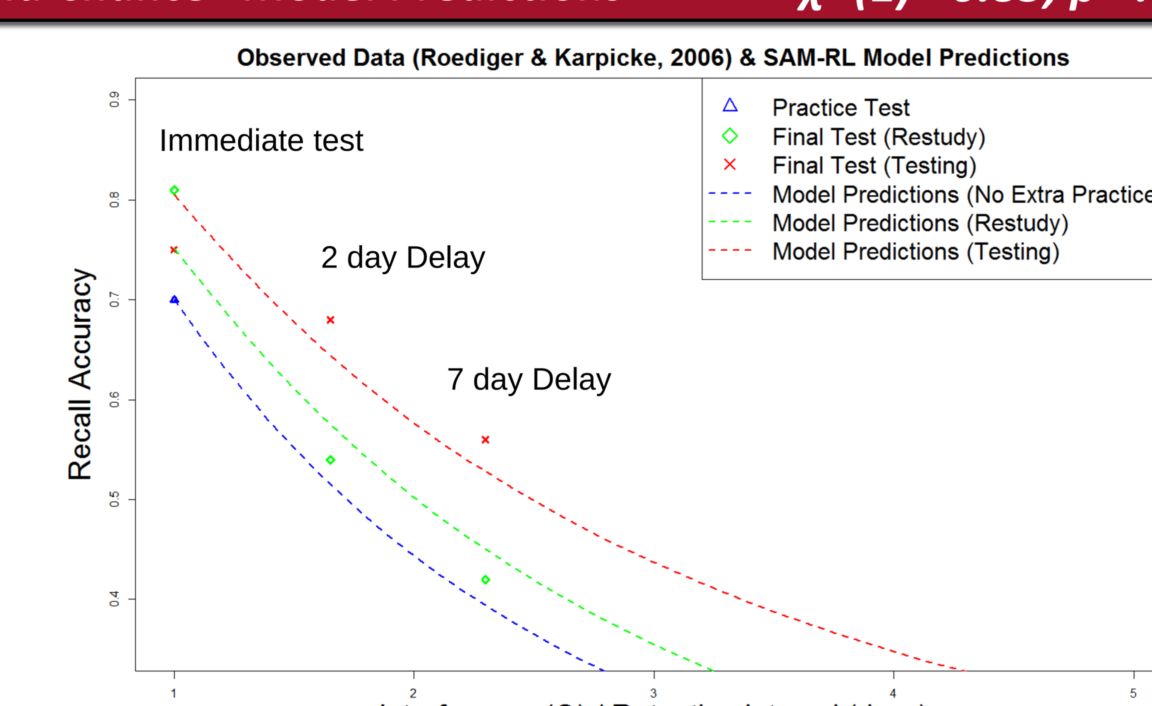
- If an item is sampled but not recovered during test practice, that item cannot be recovered during the immediate final test
- The 'loss' of these items persists until a new set of search cues is utilized
- The only items missed on the practice test that can be recalled at a final test immediately after are those that were never sampled
- Under this assumption, SAM-RL produces the an immediate advantage for restudying, and a delayed advantage for testing.

"One Shot" Model Predictions χ^2 (1)= .17, p =.68



- If unrecovered items are allowed a 'second chance' on all tests, SAM-RL predicts an advantage for test at all time points, and equal forgetting rates for study and test practice.

"Second Chance" Model Predictions χ^2 (1)= 6.85, p =.01



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