



# The Role of Item Difficulty in the Testing Effect



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## Introduction

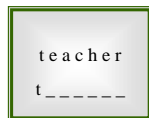
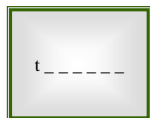
Research on the *testing effect* has explored the potential reasons for why the act of retrieval seems to enhance memory beyond the act of additional encoding. One explanation is based on the more elaborate retrieval processes involved in remembering less accessible information. Specifically, manipulations that render information less accessible at the time of an intervening test often increase retention for that information on a final test. This pattern has been observed in the following situations: (1) Free-recall vs. recognition tests (Bjork & Whitten, 1974), (2) Extended retention intervals (Bjork, 1988; Landauer & Eldridge, 1967), (3) Interfering conditions (Schneider, Healy & Bourne, 2002), and (4) Less effective vs. more effective retrieval cues (Cuddy & Jacoby, 1982). One straightforward interpretation of this pattern is that more difficult retrieval conditions on an intervening test yield better long-term retention on a final test. Note, however, that the findings listed above pertain to manipulations of *task difficulty*. It remains to be seen whether this pattern also applies to *item difficulty*.

The present study directly examines the role of item difficulty in the testing effect using a protocol that produces higher retrieval rates and a wider range of difficulty than is typical of past studies. Participants' memory for word lists was tested using a cued-recall test in which the first letter of each word was followed by blank spaces representing the number of letters in the word. Participants could obtain additional letters if they did not know the correct word, but were instructed to retrieve the word with as few letters as possible. As a result, retrieval success was high on the intervening tests, eliminating the need to conditionalize final test performance on successful prior retrieval. The number of letters required to remember each item was used as an index of item difficulty, and this was determined separately for each participant. If item difficulty affects final retention in a manner comparable to manipulations of task difficulty, then items that required additional letters should be remembered better on a final retention test.

## Method

### Materials and Design:

- 12 eight-item lists were constructed from 96 five to seven-letter nouns.
- Each participant received 6 lists as test trials (left), and 6 lists as study trials (right).



- A final free-recall test over all items was given at the end of the study.

## Results

### Memory for Tested vs. Studied Items

Tested items were retained at significantly higher proportions than studied items ( $t(71) = 10.88, p < .05$ ).

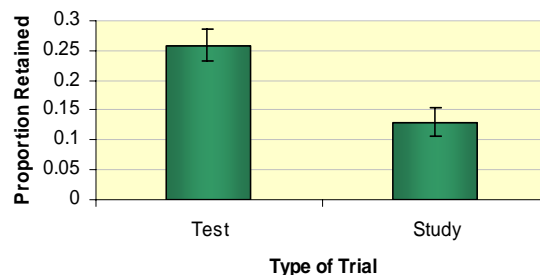


Figure 1. Final retention as a function of test trials vs. study trials. Error bars represent 95% confidence intervals.

### Final Retention as a Function of Difficulty

Number of letters required was inversely related to the proportion of items retained on the final test ( $\beta = -.07, t(305) = -8.61, p < .05$ ).

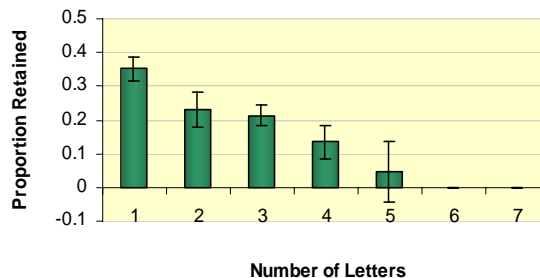


Figure 2. Final retention as a function of number of letters required. Error bars represent 95% confidence intervals.

## Discussion

- A significantly higher proportion of tested items than studied items was recalled on the final test, confirming the advantage of test trials over study trials that has been observed in past research.
- The effects of item difficulty, on the other hand, were contrary to what was expected based on past manipulations of task difficulty. Item difficulty was inversely related to the proportion of items retrieved on the final test.
- This suggests a possible difference between effects of item difficulty versus effects of task difficulty (Schneider et al., 2002). It may be the case that difficult retrieval conditions enhance retention for tested material, whereas difficult item characteristics impair retention for tested material.
- Item characteristics that are known to influence ease of retrieval, such as concreteness and word frequency, can be used in conjunction with task difficulty to more directly examine the differential effects of these two types of difficulty in the testing effect.

## References

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