

The Effect of Retrieval Practice on Retention and Comprehension of Expository Text

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Abstract. Practicing retrieval during learning has a profound effect on long-term retention compared to restudying target information. In the proposed study we will investigate the effect of retrieval practice on long-term retention and comprehension of complex text materials. Presented here are the materials created for the experiment (a text about black holes, a cued recall test and a transfer test). Also we present the research design for the proposed experiment and data from a pilot study we conducted to test the materials. The results from the pilot study showed that participants had little foreknowledge about the phenomenon of black holes and we showed that studying the text for 30 minutes significantly improved performance on a subsequent test. Data collection for the proposed experiment is ongoing.

Keywords: Retrieval practice; the testing effect; long-term retention; text comprehension; transfer.

It is a well-established phenomenon that intervening tests enhance long-term retention as opposed to restudying target materials. This so-called *testing effect* has been found using different types of materials, different types of tests and using a variety of retention interval conditions (Roediger & Karpicke, 2006b). Claims have been made that the testing effect is of critical importance for education and some studies have even replicated the general findings in actual classroom settings (McDaniel, Roediger, & McDermott, 2007).

In a study by Roediger and Karpicke (2006a) participants studied short expository texts about general scientific topics under three different learning conditions. In one condition participants repeatedly studied the text materials, in a second condition they studied the text materials three times followed by a free recall test, and in the third condition they studied once followed by three subsequent tests. Although an immediate test seemed to benefit from repeatedly studying the expository text, the results were reversed on a free recall test one week later. On the one week free recall test there was a clear advantage of prior testing on recall of the text materials. Although the implications for educational purposes seem obvious, it is yet to be determined how these findings relate to actual learning from texts. On the one hand, it seems reasonable to argue that one needs to retrieve relevant verbatim information before one can answer complex comprehension questions. On the other hand, it has been argued that remembering a text explicitly and actually learning from a text are two different things altogether (Kintsch, 1994). Learning from a text requires elaborative processing like making inferences, while remembering a text simply means that one is able to verbally reproduce a studied text. Indeed, literature on text comprehension suggests that comprehension is largely dependent on a more abstract representation of a text called a

situation model (van Dijk & Kintsch, 1983). If the effect of retrieval practice on long-term retention is limited to literal reproduction of materials, then the benefits for educational purposes are also limited. In the proposed experiment we aim to establish whether or not the effect of retrieval practice on long-term retention also applies to more provocative question formats that require comprehension.

Method

Participants

Eighty students from the Erasmus University Rotterdam will participate in partial fulfillment of a psychology course.

Materials

A Dutch text about black holes was created for the proposed experiment. The text is 1070 words in length and consists of 60 sentences. The topic of the text (black holes) was chosen, because we expected that participants (psychology students) would have very little foreknowledge about this particular topic. To obtain a rough estimate of readability for the black hole text, we used the sentence-to-sentence comparison feature on the Latent Semantic Analysis website (<http://lsa.colorado.edu/>). The average sentence-to-sentence cosine was .39 indicating that the text was fairly coherent (Foltz, Kintsch, & Landauer, 1998).

A pilot study was conducted to test the materials created for the experiment. Participants were given a dichotomous fill-in-the-blank test to assess foreknowledge about the subject matter. Subsequently they studied the black hole text for 30 minutes and were then given another dichotomous fill-in-the-blank test to assess learning. On the posttest participants scored higher (92%) compared to the pretest (57%), indicating that learning took place, $F(1, 7) = 292.81, p < .001$. Also the pretest score of 57% suggests that the participants did not have a lot of foreknowledge about the subject matter, given that their performance was not that much above chance level.

Besides the text and the fill-in-the-blank test, we also created 10 transfer questions to assess comprehension. Answering these questions correctly requires a deeper understanding of the text materials. Participants had to make predictions about novel situations that were not discussed in the original text. Table 1 shows a translated excerpt from the black hole text with corresponding fill-in-the-blank questions and an example transfer question.

Table 1: Excerpt from the Black Hole Text with corresponding Fill-in-the-blank Questions and an Example Transfer Question.

Excerpt from the Text	Most black holes rotate, because the stars from which they are formed also rotate. Space outside a rotating black hole is dragged along with the black hole. The result is a sort of cosmic whirlpool where it is impossible for objects to remain stationary. This area, where everything is forced to move with the black hole, is called the ergosphere.
Fill-in-the-blank Questions	Most black holes rotate, because the from which they are formed also rotate. Space outside a rotating black hole is with the black hole. The result is a sort of cosmic whirlpool where it is impossible for objects to This area, where everything is forced to move with the black hole, is called the
<i>Example Transfer Question</i>	Besides rotating black holes there also are black holes that do not rotate (static black holes). Do you think these static black holes will have an ergosphere? Motivate your answer.

Research design

A 2 x 2 between-subjects design with learning condition and retention interval as independent variables and test score as dependent variable.

Procedure

The proposed experiment consists of two sessions separated by a one week interval. During the first session participants study the black hole text during a 15 minute initial learning phase. We used sentence by sentence presentation of the text materials, because this is a method that has been used in both research on the testing effect as well as in research on text comprehension (e.g. Chan, 2009; McNamara, & Kintsch, 1996). The text is presented on a computer screen one sentence at a time and participants can progress by pressing the ENTER-key. Because study is self paced it will be possible to read the text more than once. Participants are told in advance that they can study the text for a number of times and that they are actually required to do so until time expires. Also they are told to keep track of time and to try and read the entire text at least once during the fifteen minute period. During study participants receive onscreen information about their progress and the time that is left to study the text. Upon completion of the 15 minute initial learning phase instructions will diverge. One group of participants will continue to study the text materials during a subsequent 15 minute restudy phase. The other group of participants will receive a 15 minute fill-in-the-blank test. Upon completion of the second phase half of the participants receive a final fill-in-the-blank test followed by a comprehension test. The other half of participants will return for testing one week later.

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