



# Is the benefit of retrieval practice modulated by motivation?



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## ABSTRACT

Retrieval practice tends to produce better long-term learning than rereading, but laboratory studies have typically used arbitrary material that subjects may not care to learn. The observed advantage of retrieval practice may be exaggerated because low motivation may result in deficient processing during (usually passive) rereading. Thus, when subjects are motivated to learn the material, the type of study strategy (whether retrieval practice or rereading) might be less important. To test this hypothesis, we conducted 3 experiments in which we manipulated the incentives (using monetary bonuses or time savings) for learning Swahili–English word pairs. Items that had undergone retrieval practice were better recalled than reread items on a final test 2 days later, but this effect did not interact with incentive level. These results provide some reassurance that lab findings from the testing effects literature likely generalize to real-world situations in which motivation to learn may be greater.

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## 1. Introduction

Laboratory research on human memory has long shown that a memory test is not a neutral event that merely measures the contents of memory (e.g., Abbott, 1909; Lachman & Laughery, 1968; Tulving, 1967). On the contrary, taking a test typically enhances long-term learning and retention more than rereading of the target information (e.g., Carrier & Pashler, 1992; McDaniel, Wildman, & Anderson, 2012; Rohrer, Taylor, & Sholar, 2010), and processes involved in memory retrieval have been implicated (e.g., Carpenter, 2009; Kang, McDermott, & Roediger, 2007; Karpicke & Zaromb, 2010). This testing effect is often referred to in the research literature as the benefit of *retrieval practice* (for recent reviews, see Carpenter, 2012; Rawson & Dunlosky, 2012). Given that retrieval practice would appear to be a useful instructional tool, in recent years there have been calls for greater application of retrieval practice in the classroom (e.g., Dempster, 1992; Karpicke & Grimaldi, 2012; Roediger, Agarwal, Kang, & Marsh, 2010).

Literally hundreds of experiments have found retrieval practice beneficial for learning—across a wide range of study materials and diverse student populations. It is worth noting, however, that the overwhelming majority of these studies were conducted in the lab,

and one can reasonably wonder whether lab findings will generalize to real-world classrooms (e.g., Efklides, 2012; Lundeberg & Fox, 1991). One difference is that in lab studies, the material is usually arbitrary from the subject's point of view, i.e., it is assigned by the experimenter with little regard for the subject's actual interests or goals (e.g., Swahili foreign vocabulary). By contrast, when students study in real life it is typically in pursuit of some larger goal, perhaps to master some content area that is of interest to the student or to do well on an upcoming exam. Thus, it seems likely that the motivation to learn the material for a typical subject in a lab experiment is substantially lower than for students in most real-world situations.

### 1.1. Motivation and learning

Motivation refers to the condition that initiates and/or maintains a person's goal-directed behavior. It is generally assumed that there are powerful links between motivation, learning, and academic achievement (e.g., Deci, Vallerand, Pelletier, & Ryan, 1991; Dweck, 1986; Lepper, Greene, & Nisbett, 1973). Motivation is generally thought to facilitate learning through several means, such as increasing the attention the individual pays to the materials (as compared to competing stimuli in the environment) and by promoting the adoption of effortful encoding strategies.

How does motivation bear on the enhancement of learning through retrieval practice? It is conceivable that a relatively passive study strategy like rereading (the usual control against which

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retrieval practice is compared) might be particularly vulnerable to lapses in attention (see Szpunar, Khan, & Schacter, 2013). Researchers in the past have raised concerns about reading control conditions being susceptible to subjects' failing to attend to the materials for the entire presentation duration. For instance, Pressley, Symons, McDaniel, Snyder, and Turnure (1988) when assessing the benefits of elaborative interrogation for learning decided to use a more conservative control condition than in past studies: subjects had to read the information (sentences) aloud repeatedly for the entire time that it was presented. They found that the more active reading condition led to better learning compared to the relatively passive reading control used in a previous study (Pressley, McDaniel, Turnure, Wood, & Ahmad, 1987). Other studies have had reading controls that required subjects to copy by hand (i.e., write out) the target information (e.g., deWinstanley & Bjork, 2004), in an effort to ensure that the information would be properly attended to. Moreover, research on learning from prose (via reading) has shown that motivation interacts with text readability: comprehension of hard-to-read texts is generally poorer than easy texts, but this difference is smaller or eliminated in motivated subjects (Fass & Schumacher, 1978; Klare, 1976).

The vast majority of prior studies on retrieval practice have compared retrieval practice against passive rereading, a control condition that might suffer disproportionately when motivation is weak (for the reasons mentioned above). Part of the observed advantage of retrieval practice over rereading in lab studies might therefore be due to the former requiring a higher level of engagement with the material (e.g., the subject is typically asked to make an overt response within a given time limit) than the latter. It is thus plausible that increasing motivation to learn the material would have a greater effect on learning via rereading than via retrieval practice, and in turn reduce the benefit of retrieval practice over rereading.

## 1.2. Present study

We examined whether learner motivation modulates the benefit of retrieval practice. Specifically, we tested the hypothesis that when learner motivation is high, the advantage of retrieval practice over rereading would be attenuated, relative to when learner motivation is low. In the first two experiments learner motivation was manipulated using monetary bonuses; in the third experiment we used time savings (i.e., subjects could leave the experiment early) to motivate learning.

## 2. Experiment 1

### 2.1. Method

#### 2.1.1. Subjects

Thirty-eight undergraduates from the psychology subject pool of a large public university participated for course credit. All subjects were proficient in English and had no prior knowledge of Swahili.

#### 2.1.2. Stimuli

Fifty-six Swahili words paired with their English translations were selected from the Nelson and Dunlosky (1994) norms.<sup>1</sup> The

<sup>1</sup> Some readers might find it ironic that we used Swahili–English word pairs as the study stimuli in the present study, given that we had earlier raised as a potential concern the typical use of arbitrary material in memory experiments (i.e., motivation to learn the material would likely not be high). We decided to use word pairs for two main reasons: (i) a sizeable proportion of previous retrieval practice studies has used word pairs (e.g., Carrier & Pashler, 1992; Karpicke & Roediger, 2008) and we wanted

word pairs were randomly assigned to conditions for each subject, with 7 word pairs assigned to each of 8 conditions (see Section 2.1.3).

#### 2.1.3. Design

Three factors were manipulated within subjects: type of review (retrieval practice vs. reread), amount of review (2 vs. 4 trials), and incentive level (\$0.05 vs. \$0.30 monetary bonus for correct final recall of the item).

#### 2.1.4. Procedure

Subjects were seated at computer terminals and informed that they would study a series of Swahili words paired with their English translations, one pair at a time, and that their aim was to learn the word pairs so as to be able to recall the English equivalent when cued with a Swahili word. All 56 Swahili–English word pairs were first presented once for study, each appearing for 8 s on the computer screen (with a 1-s blank screen between each pair), with the ordering of pairs randomized for each subject.

After subjects had seen all the items once, they were told that additional review would occur in one of the two forms for each item: either re-presentation of the Swahili–English pair for study (reread) or flashcard-style testing with feedback (retrieval practice). Additionally, subjects were informed that each item was associated with a monetary value—either \$0.05 or \$0.30—that they would receive as a bonus if they could correctly recall the English equivalent of the Swahili word on a final test 2 days later, and that the monetary value would be displayed above each item during review. In the reread condition, each trial consisted of a Swahili–English word pair being presented for 8 s followed by a 1-s blank screen (i.e., identical to the initial study presentation). In the retrieval practice condition, each trial began with a Swahili word being presented for 6 s, during which time the subject was instructed to recall and type the English equivalent if they could, followed by 2 s of the intact Swahili–English word pair (i.e., corrective feedback), and finally a 1-s blank screen. Type of review was blocked, with the items assigned to the reread condition reviewed first followed by items assigned to the retrieval practice condition, or vice versa (order of type of practice was counterbalanced across subjects). In each block, items assigned to 2 vs. 4 trials of practice and those assigned to low (\$0.05) vs. high (\$0.30) monetary value were all intermixed, and there were 4 consecutive cycles of review, with items assigned to 2 and 4 trials of review appearing in the first 2 cycles and only items assigned to 4 trials of review appearing in the last 2 cycles. The order of presentation in each cycle was randomized for each subject, with the constraint that the final 2 items in one cycle would not be the first 2 items in the next cycle. After completing their review of the items, subjects were dismissed.

Subjects returned 48 h after the start of the first session for a final test on all the items. The Swahili words appeared on the screen one at a time (in a random order for each subject) and the subject tried to recall and type the English equivalents (the monetary value associated with each item was not displayed). The final test was self-paced and no feedback was provided. After completing the test, subjects were thanked, debriefed, and awarded the appropriate monetary bonus based on their performance on the final test.

our results to be relatable to prior findings, and also (ii) manipulating the type of study material to increase motivation (e.g., having less vs. more interesting texts) would introduce item differences as a potential confound. Our strategy therefore was to use arbitrary study material (in continuity with the bulk of past studies) coupled with incentives to increase learner motivation.

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