

The Critical Importance of Retrieval— and Spacing—for Learning

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Abstract

We examined the impact of repeated testing and repeated studying on long-term learning. In Experiment 1, we replicated Karpicke and Roediger's (2008) influential results showing that once information can be recalled, repeated testing on that information enhances learning, whereas restudying that information does not. We then examined whether the apparent ineffectiveness of restudying might be attributable to the spacing differences between items that were inherent in the between-subjects design employed by Karpicke and Roediger. When we controlled for these spacing differences by manipulating the various learning conditions within subjects in Experiment 2, we found that both repeated testing and restudying improved learning, and that learners' awareness of the relative mnemonic benefits of these strategies was enhanced. These findings contribute to understanding how two important factors in learning—test-induced retrieval processes and spacing—can interact, and they illustrate that such interactions can play out differently in between-subjects and within-subjects experimental designs.

Keywords

learning, memory, testing, retrieval practice, spacing

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Memory tests do not merely assess memory. The retrieval practice promoted by testing acts as a "memory modifier" (Bjork, 1975) by rendering successfully retrieved information more recallable in the future than if that same information had not been tested or had been merely restudied (i.e., *the testing effect*). Testing can also potentiate, or enhance, the effectiveness of subsequent study sessions (for a review of the direct and indirect benefits of testing, see Roediger, Putnam, & Smith, 2011).

In a highly cited article, Karpicke and Roediger (2008) reported a particularly dramatic demonstration of the benefits of retrieval practice. In their experiment, subjects studied Swahili-English vocabulary pairs (e.g., *afrika-science*) according to several different learning schedules that varied in the amount of repeated studying and repeated testing during the acquisition phase. They used four between-subjects conditions, each with four study (S)–test (T) cycles: ST, in which all pairs were studied and then tested in each cycle; $S_N T$, in which pairs recalled on a test were dropped from subsequent study periods but retained in subsequent test periods; C^N refers to "nonrecalled" items, and thus S_N

indicates that only nonrecalled items were restudied); ST_N , in which pairs recalled on a test were dropped from subsequent test periods but retained in subsequent study periods; and $S_N T_N$, in which pairs recalled on a test were dropped from both subsequent study and subsequent test periods. At the end of the acquisition phase, subjects were asked to predict how many pairs they would remember on a test in 1 week. They then returned after 1 week for a final retention test that included all of the pairs.

The results of Karpicke and Roediger's (2008) experiment were clear and striking. Although cumulative learning at the end of the acquisition phase was virtually identical across the four conditions—in the sense that each subject, regardless of condition, had recalled almost every pair at least once successfully—and although subjects in the four

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The Critical Importance Of Retrieval For Learning

John Michels (Journalist)



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The Learning Skills Cycle William R. Klemm, 2017-03-01 This book's ideas demonstrate how students are not adequately taught the learning skills necessary for superior academic achievement. The major reason schools are failing is that there is less emphasis on teaching students how to learn; the focus is on what to learn instead. This book provides teachers and parents with many concepts and tactics that they can use to teach children how to learn more efficiently and effectively. This book identifies and explains those skills and frames them as interacting in a mutually interacting and reinforcing cycle that I call the Learning Skills Cycle. Supporting Children and Young People with Test Anxiety in School Helen Barsham, 2025-11-28 This accessible and informative book provides educators with a unique approach to supporting children and young people with test anxiety, combining key research and practical guidance to improve wellbeing and test outcomes. The book focuses on three core areas for promoting wellbeing: test anxiety theory, desirable difficulties, and self-efficacy theory. Underpinning research is presented in an accessible format, and each topic is explored in depth with case studies and reflection points to deepen understanding and bring theory to life. Chapters go on to introduce an innovative, easy-to-implement intervention. The intervention focuses on increasing children's metacognition of their own learning, from how memory works to knowing how to revise, lowering anxiety around high-stakes exams, and boosting overall wellbeing and ultimately academic success. Including a wealth of examples and tips for tangibly supporting children and young people's learning outcomes, this book is a crucial read for Special Educational Needs Coordinators (SENCOs), teachers, and anyone with responsibility for the pastoral care and wellbeing of young people. Research Methods Pedagogy: Engaging Psychology Students in Research Methods and Statistics Lynne Roberts, 2016-11-09 Research methods and statistics are central to the development of professional competence and evidence-based psychological practice. Noun masculine research on the development of psychological literacy. Despite this, many psychology students express little interest in, and in some cases of active dislike of, learning research methods and statistics. This ebook brings together current research, innovative evidence-based practice, and critical discourse. International Perspectives in Online Instruction Jaimie Hoffman, Patrick Blessinger, 2021-11-04 Focusing on effective practices in online teaching, this volume of *Innovations in Higher Education Teaching and Learning* begins with discussing the use of videos in online teaching and then pivots to consider methods for supporting and managing faculty who teach online. Computer Supported Education H. Chad Lane, Susan Zvacek, James Uhomoibhi, 2020-11-09 This book constitutes the thoroughly refereed proceedings of the 11th International Conference on Computer Supported Education (CSEDU 2019) held in Heraklion, Crete, Greece, in May 2019. The 30 revised full papers were carefully reviewed and selected from 202 submissions. The papers cover wide research fields, including authoring tools and content development, AV communication and multimedia, classroom management, e-Learning hardware and software, blended learning, critical success factors in distance learning. *Psychology* Daniel L. Schacter, Daniel T. Gilbert, Daniel M.

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metal hydroxides such as sodium hydroxide or

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web an i acid bpse neutralization reaction is 2 a n is a substance that conductp electricity 3 the chloride ion cl is the l base of hydrochloric acid hcl 4 the formula hro