

observers seem to enliven the subsequent *schadenfreude*, even producing a sense of poetic justice.

Resentment is often intense and can lead to extreme, sometimes violent actions. Because people feeling resentment believe they have been unjustly treated and wronged, they can correspondingly feel justified in redressing the wrong. However, the possibility of biased, exaggerated, construals of the wrong mean that the redressing actions are themselves wrong. Spiraling retaliatory actions can then ensue. Scholars speculate that many intergroup conflicts mirror this pattern. Clearly, resentment is an important human emotion that deserves careful and sustained study.

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See also Emotion, Cultural Perspectives; Envy; Intergroup Conflict; Jealousy

Further Readings

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RETRIEVAL PRACTICE (TESTING) EFFECT

The *testing effect* is a term used to describe the finding that taking a test on previously studied material leads to better long-term retention relative to restudying the material or not taking a test. Testing is often conceptualized as a neutral event in which the contents of memory are examined but left unchanged. However, the act of retrieving information from memory actually alters the retrieved memory by elaborating on the existing memory trace and/or creating additional retrieval routes. One consequence of these changes is that the probability of successful retrieval in the future is increased, making testing a potent mechanism for enhancing long-term retention. This entry provides a brief history

of testing effect research followed by a discussion of the generalizability of the effect, potential theoretical explanations, and factors that increase its efficacy.

History of Research on the Testing Effect

The idea that retrieving information from memory can increase retention has a long history. Philosophers and other scholars have long recognized the mnemonic benefits of retrieval practice: Aristotle, Francis Galton, and William James, among others, all described how repeatedly recalling information from memory improves its retention. Some early studies in the 1900s confirmed their pronouncements, but only recently have researchers investigated this phenomenon systematically. The early studies were conducted with students in classroom settings and to demonstrate that testing improved retention of course material. In the following decades, research on the testing effect was sporadic. Most studies during this period were part of the verbal learning tradition and investigated the memorial consequences of retrieval in laboratory settings using discrete verbal materials, such as lists of individual words or word pairs. Since the start of the 21st century, a resurgence of interest in the testing effect has arisen, leading to the publication of many studies that explored various theoretical explanations for the phenomenon as well as applications to educational contexts.

Generalizability of the Testing Effect

The testing effect is a robust phenomenon: The basic finding has been replicated over a hundred times and its generalizability is well established. Retrieval practice has been found to promote superior retention of many different types of information, both verbal and nonverbal. These types of information include nonsense syllables, word lists, foreign language vocabulary, general knowledge facts, scientific articles, textbook chapters, pictures, maps, and Chinese characters (among others). In addition, many studies have shown strong, positive effects of testing in a variety of real-world educational contexts, such as after-school programs for elementary school children, middle school classes, college courses, and medical education of residents and nurses. Although for practical reasons, most testing effect studies have used relatively short retention intervals (i.e., a few minutes to a few days), a number of studies have shown that testing produces superior long-term

retention using much longer retention intervals of up to six months. Overall, much evidence exists to support the conclusion that retrieval practice promotes long-term retention of many different types of materials across a variety of different contexts.

Potential Theoretical Explanations

Several theoretical explanations have been proposed to account for the testing effect. One of the first proposed that taking a test after studying resulted in additional exposure to the material (i.e., relative to a control condition in which no test was taken) and this additional exposure produced the superior retention. However, this so-called total time hypothesis (also referred to as the amount-of-processing hypothesis) was disproved by subsequent studies that showed that taking a test led to better retention relative to restudying the material for an equivalent amount of time. Another possible explanation is that the effort involved in retrieval is responsible for the testing effect. One piece of evidence that supports the retrieval effort hypothesis is the finding that production tests (e.g., cued recall, fill-in-the-blank), which require greater retrieval effort, often produce better retention than recognition tests (e.g., multiple-choice, true or false). Yet another idea that helps explain the testing effect is *transfer-appropriate processing*, which holds that memory performance is enhanced to the extent that the processes during encoding match the processes required during retrieval. Thus, retrieving information while taking an initial test may lead to better performance on a subsequent test because the processes engaged on an initial test (i.e., retrieval practice) better match the processes required by the final test (relative to restudying or not taking a test). Finally, the idea of encoding variability provides one more possible explanation. Studying and taking a test represent distinct encoding events, and thus testing after studying may increase encoding variability. Increased encoding variability should result in the elaboration of the existing memory trace and/or the creation of additional retrieval routes to that trace. Although no single theory can explain all the extant findings, the last four theories are not mutually exclusive and can be considered complementary.

Factors That Increase the Efficacy of Retrieval Practice

The critical mechanism in learning from tests is successful retrieval. However, two other factors can increase the efficacy of testing: feedback and repetition. Testing often produces better retention than restudying even when feedback is not provided (provided performance on the initial test is reasonably high). Nevertheless, feedback can enhance learning from tests by enabling test takers to correct errors and maintain low-confidence correct responses, thereby increasing the probability of successful retrieval in the future. Repetition can also enhance learning from tests: A single test confers a substantial mnemonic benefit, but repeated testing leads to even better retention. Repeated testing is particularly effective if it is distributed or spaced out over time rather than massed together. Generally speaking, spaced practice usually leads to superior long-term retention relative to massed practice, a finding that has been termed the spacing effect.

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See also Desirable Difficulties Perspective on Learning; Rehearsal and Memory; Spacing Effect; Spacing Effect, Practical Applications

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