COGNITIVE METHODS

and Their Application to Clinical Research

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IMPLICIT MEMORY TASKS: RETENTION WITHOUT CONSCIOUS RECOLLECTION

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Implicit memory refers to the influence of past events in current behavior when people are not trying to retrieve the past events and when they are usually not even aware of the events' influence. The contrast is with explicit memory, which refers to conscious attempts to retrieve memories of past events. On implicit memory tests there is no conscious effort to retrieve studied material, whereas on explicit memory tests instructions refer to a specific encoding event. Graf and Schacter (1985) first proposed the distinction between explicit and implicit memory, although the history of the idea of conscious and unconscious forms of memory is much older (see Schacter, 1987, for a historical review). Others have used the terms *direct memory tests* and *indirect memory tests* to refer to the same contrasts as between explicit and implicit memory (Richardson-Klavehn & Bjork, 1988; Segal, 1966).

The customary use of the terms *memory* or *remembering* refers to explicit, conscious recollection during which people attempt to travel back in time mentally to relive or reexperience past events. However, many behaviors people perform reflect past learning even when no conscious attempts at retrieval occur; therefore, these behaviors reflect the manifestation of im-

plicit memory. Some of these behaviors involve motor skills. When you tie your shoes or ride a bicycle or walk, you need not consciously retrieve your first attempts to learn these skills. The same is true of other types of learning. You may have noticed that it is much easier to read a passage of text if you have read it before, even if you are not consciously trying to remember the original time you read the passage (Kolers, 1976). Therefore, repetition of procedures is important in expression of both mental and physical skills. Similar phenomena occur in various clinical states. For example, individuals with clinical depression often report that negative thoughts about past failures come to them without them wanting to have the thought. In anxiety disorders, previous experiences with threat-relevant situations may lead to more salient threat cues for the afflicted individual.

As these examples indicate, implicit expressions of knowledge are sometimes referred to as occurring rather automatically, or at least as having an automatic component (Jacoby & Dallas, 1981). Explicit recollection is often proposed to be primarily consciously controlled, whereas implicit retention is more automatic; however, without special precautions and procedures, it is difficult to provide tests that reflect pure manifestations of explicit or implicit processes (Jacoby, 1991). Although the term *automatic* is often used in the clinical literature (e.g., negative automatic thoughts), few researchers have specifically examined the contribution of automatic processes to implicit memory (see Kazes et al., 1999, for an example of this approach).

Explicit and implicit memory tests can often be relatively similar in laboratory situations. For example, after study of a target word such as *elephant* in a long list, participants may be given a cue such as ele-; on an explicit test they would be asked to recall a word from the list that began with these letters, whereas on an implicit memory test they would be told to respond with the first word that comes to mind and they could say *element*, *elegant*, *electricity*, and so on, in addition to *elephant*. Any of these words is correct on the implicit test from the participant's viewpoint. On the explicit test, the measure of interest is probability of recall of the target word, and usually the guessing rate (that is, the probability of producing *elephant* to the cue if the word *elephant* had not been in the list) is quite low. On the implicit test, in which the participant is told to produce the first word to come to mind, the baseline probability of producing *elephant* when the word had not been presented in the prior list may be higher because it is an acceptable response. The measure of interest in implicit memory tests is the difference between the probability of producing the response when the target item had been presented in the list relative to the case when it had not been presented; this measure is referred to as priming, because the presentation of the word in the list usually primes its production on the later test (relative to the baseline condition).

The tests described above are called word stem completion (the implicit form of the test) and word stem cued recall (the explicit form). In

many research projects, investigators compare performance on an implicit and an explicit test, as these tests are affected by either subject variables (different types of people) or independent variables (those under the experimenter's control). Word stem completion and word stem cued recall are often compared because they differ only in the instructions participants are given just before the test (Schacter, Bowers, & Booker, 1989). Everything else (materials, encoding instructions, test cues, etc.) is held constant. However, many other explicit and implicit memory tests are widely used. The most popular explicit memory tests are free recall (recalling a list in any order), recognition memory (either a forced or multiple choice test, or free choice or yes/no test), and cued recall with various types of cues besides word stems (e.g., *tusk* might be used as a cue for *elephant*). In all these cases, participants are instructed to try to recall or recognize recently studied material.

Likewise, many implicit memory tests have been developed. In practically all cases of implicit tests, the comparison of interest is between a nonprimed condition and a primed condition, with some cue serving as a prompt to produce a response. Participants are instructed to say the first item or items that come to mind. The cues can be word stems (ele-), word fragments (try to fill in letters to make e_e_h_n_ a word), or brief flashes of words in which participants try to guess their identities (a test called perceptual or word identification). Verbal materials are not always used, as people can study pictures and then be tested with a fragmented form of the picture or be given a brief flash of a picture and be asked to guess what it is. These tests are but a few examples of the many varieties of implicit memory measures that have been developed by cognitive psychologists. Clinical investigators have modified these tests to suit the clinical needs of studying specific populations or because of the theoretical viewpoint being investigated. For example, when studying social anxiety, researchers have presented their participants with simulated social interaction videos. Implicit memory is revealed if previously seen videos are rated as clearer than are novel videos.

The forms of implicit test described above are called perceptual (or data-driven) implicit memory tests (Blaxton, 1989; Roediger & Blaxton 1987). The participant's task in these tests is always to guess the identity of an object from an impoverished perceptual clue. Manipulation of perceptual factors during study (such as presenting words visually or auditorily) greatly affects performance on perceptual implicit tests. Another primary class of implicit memory tests is conceptual tests. For example, after studying *elephant*, participants might be asked to generate the names of all the animals that they could think of in 30 seconds (a category association test); or they might be asked to generate associations to the word *tusk* (a free association test); or they might be asked to answer the question "What animal aided Hannibal on his attack on Rome?" In each case the measure of interest is again priming: the difference between producing *elephant* if the item had been recently presented and producing *elephant* if the word had not been recently presented.

These tasks are called conceptual or meaning-based tests, because the cue for producing the answer is related to the target on the basis of meaning rather than perceptual resemblance. More important, the variables that affect these conceptual implicit memory tasks are quite different from the ones that affect perceptual tasks. For example, modality of presentation has no effect on the amount of priming, but manipulations of meaning have a great effect (e.g., Blaxton, 1989; Srinivas & Roediger, 1990). Conceptual implicit memory tests are of particular relevance to clinical conditions where psychopathologists have postulated the role of implicit memory for material relevant to the clinical conditions (e.g., depression; Watkins, 2002). Perceptual implicit memory tests are more relevant to clinical conditions that involve a pervasive deterioration of memory functioning in explicit memory tests but spared functioning in implicit memory tests, although both perceptual and conceptual tests can be used in these cases.

The study of implicit memory tests grew out of clinical situations, in particular those involving neuropsychologists studying the abilities of memory-impaired (amnesic) patients. In the late 1960s, Warrington and Weiskrantz (1968, 1970) reported the first research that used what are today called implicit memory paradigms. One of their studies can serve as a good starting point (1970, Experiment 2). They presented four amnesic patients (three with Korsakoff's syndrome and one with a temporal lobectomy) with words to remember and then assessed their retention on four different tests (for different lists of words). A total of 16 patients without brain damage were similarly tested. Two of the four tests would today be classified as involving explicit memory (free recall and recognition) and the other two as assessing implicit retention (naming of fragmented words in which each letter was degraded and word stem completion, described above, of three-letter cues such as ele-). In free recall, people recalled words in any order on a blank sheet of paper. In recognition, the studied words were intermixed with new words and people had to judge which ones had been previously studied. The other two tasks—word fragment and word-stem completion—seem to have been presented to the participants as word guessing games (although the instructions given were not provided in the original report of the experiment). The measure of performance was priming or completion of the fragment or stem above the baseline.

Warrington and Weiskrantz's (1970) results are presented in Figure 7.1, with explicit test performance at the top and priming on the implicit tests at the bottom. In the top two panels, it is apparent that amnesic patients performed much worse in both free recall and recognition than did control patients. This is, in some sense, not surprising. After all, the way one becomes classified as a memory-impaired or amnesic patient is by performing poorly on memory tests (as well as not being able to remember normally in situations outside the lab).

The remarkable results reported by Warrington and Weiskrantz (1970) are shown in the bottom two panels. Priming on the implicit memory tests

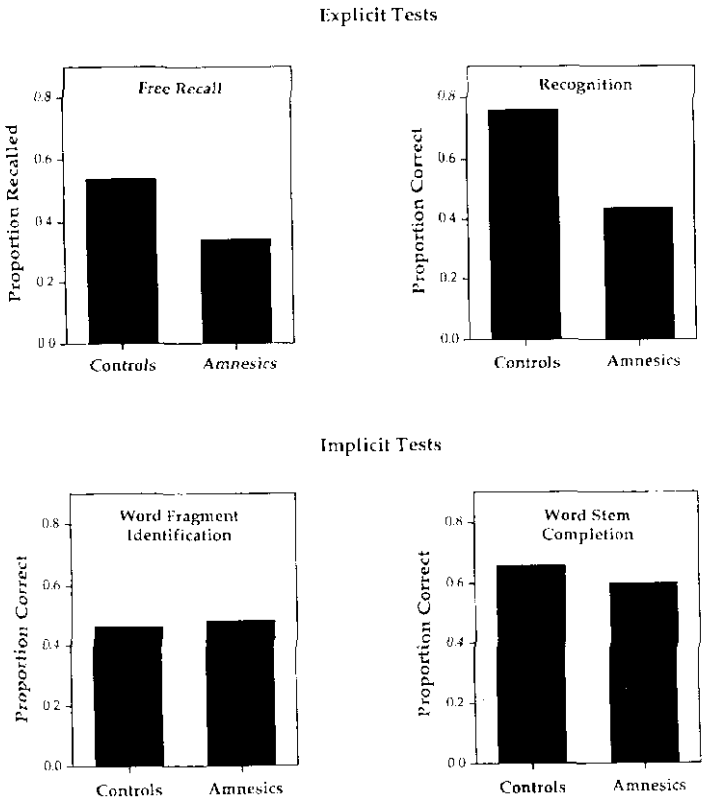

Figure 7.1. Performance of amnesic and control patients on four memory tasks: two explicit (free recall and recognition) and two implicit (word fragment and word stem completion). Amnesic patients showed much worse performance than did controls on the two explicit memory tests, but showed equal priming on the two implicit memory tests. Data from "Amnesic Syndrome: Consolidation or Retrieval?" by E. K. Warrington and L. Weiskrantz, 1970, *Nature,* p. 630.

was of equal magnitude for both groups. Because the items used had been normed to have a very low completion rate if the words had not been studied, these priming effects definitely reflect a form of memory. However, the form seems quite different from that measured on standard, explicit memory tests. The fact that the patients show normal priming indicates that experiences of these patients are somehow being encoded and retained; the difficulty seems to be in expressing retention on tests that require effortful, deliberate, conscious recollection. On implicit tests, which seem more automatic in nature and on which people do not deliberately try to remember the past, the patients and the controls show equal priming. These striking dissociations between memory-impaired and control patients on implicit memory tests were replicated by other groups (e.g., Graf, Squire, & Mandler, 1984).

Many other types of patients have been studied and compared using explicit and implicit memory tests, as we explore in chapters 8 and 9

Experimental psychologists took up these implicit or indirect tests of memory and were quick to show dissociations similar to those found with patient groups by the manipulation of independent variables. Overall, the data show a strong dissociation between explicit and implicit tests of memory. Just as memory-impaired patients display large deficits on explicit tests relative to control participants, experimental conditions (e.g., questions about physical appearance of words) that lead to large deficits on explicit tests (Craik & Tulving, 1975) can produce normal levels of priming (Jacoby & Dallas, 1981). These strong dissociations both in patient populations and with variables under experimental control are why so many researchers have investigated implicit memory tests and their comparison with explicit tests. Attempting to understand what these differences reveal about human memory and its vicissitudes has been in the forefront of psychology for the past 20 years or more.

Clinical psychologists have attempted to use the methods developed by cognitive psychologists to elucidate the nature of various clinical conditions. Although this research must be informed by the findings from cognitive psychology, a number of unique challenges and unique rewards are evident in studies of implicit memory in clinical populations. For example, the materials used for tests of implicit memory in clinical populations need to be relevant to the clinical condition. This requirement, however, provides a considerable challenge to clinical scientists who also need to consider basic cognitive issues (e.g., the need to match materials on lexical features such as word frequency). These challenges are well worth the effort, because implicit tests offer the possibility of unique insights into the nature of different clinical conditions. These insights include a better description of the clinical phenomenon and prediction of future symptoms, as well as the possibility of developing better treatments for clinical populations.

Chapters 8 and 9 discuss the conduct of research with implicit memory tests. Roediger and Geraci (see chap. 8, this volume) discuss research on healthy adult populations and address, among other topics, the rather tricky issue of ensuring that implicit memory tests are really measuring memory indirectly and that participants are not aiding performance by attempting to consciously recollect information. Amir and Selvig (see chap. 9, this volume) are concerned with the important issue of adapting implicit memory tests to ask interesting questions of various clinical populations.

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