HANDBOOK OF IMPLICIT LEARNING

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SAGE Publications
International Educational and Professional Publisher
Thousand Oaks  London  New Delhi
The Question of Awareness in Research on Implicit Learning

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Memory is not to be identified with the act of remembering, or with conscious awareness that one is remembering something from the past, although it includes this. Any measure of change in behavior that reflects the effect of prior experience is a valid index of a memory or a memory trace or an engram. We tend to emphasize too much the use of recall or recognition, which is a highly personal kind of thing, as measures of learning and memory. It seems to me that a measure of change in performance such as is involved in the “relearning” method, where progressive changes in performance occur as a result of experience in the situation but where the subject need not be aware of the use of prior experience, is also acceptable as an index of the presence of a memory trace.

Arthur Melton made this statement as part of his opening remarks at the Second International Interdisciplinary Conference on Learning, Remembering and Forgetting, which was held in 1964 (Kimble, 1967, p. 25). To illustrate his point that measures of change in performance would be good measures of memory, Melton presented experiments patterned on the Hebb (1961) repetition effect, in which subjects’ memory of a list of digits that is repeated intermittently among nonrepeated
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lists improves relative to that of the nonrepeated lists. After presenting his results, Melton heard a now familiar question. Another participant at the conference, Donald Broadbent (who was later to become one of the early leaders in the field of implicit learning; see, e.g., Berry & Broadbent, 1988; Broadbent, Fitzgerald, & Broadbent, 1986; Hayes & Broadbent, 1988) raised the issue of awareness: "I have heard it asserted by people who have repeated this experiment, that in their experience, the only people who showed the Hebb effects were the ones who caught onto what was happening" (Kimble, 1967, p. 41). Melton’s response to the awareness question (also on p. 41) was that

the subject in an experiment of this sort is reacting to each stimulus as though all he has to do is to remember it long enough to write it down. We are in the midst of some further studies of this kind, and, in one study, we have waited until the eighth eight-consonant stimulus before introducing for the very first time, the one that is going to be repeated. When this eighth stimulus is repeated, it occurs again after five intervening eight-consonant units. By the time the subject sees the stimulus a second time, he has had thirteen of these strings of eight consonants, all from the same limited set of nine consonants, and ought to be thoroughly confused. Nevertheless, the second trial on that repeated eight-consonant stimulus shows an improved recall, as compared with the first trial or a control.

Melton’s response was based on the plausible argument that the structure of the task made it unlikely that subjects were deliberately using memory for the first presentation of the repeated list in their attempts to remember it the second time. Of course, it is one thing to assume subjects are not doing this, another to prove it to the avowed skeptic. The awareness question, that is, the question of how to rule out the possibility that conscious processing contaminates what is presumed to be nonconscious processing, is a serious issue confronting researchers interested in implicit learning. It has been suggested that concerns about awareness in tests of implicit memory may have reached levels greater than is warranted (see Roediger & McDermott, 1993), but given that there have been several well-known and well-cited criticisms of how research on implicit learning has addressed the awareness question (Dulany, Carlson, & Dewey, 1984; Perruchet & Amorim, 1992; Perruchet, Gallego, & Savy, 1990; Perruchet & Pacteau, 1990; Shanks & St. John, 1994), it is an issue that must be dealt with carefully and convincingly. The difficulties Melton had concerning

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the issue of awareness are difficulties the field still grapples with (e.g., Dienes & Berry, 1997; Neal & Hesketh, 1997; Shanks & St. John, 1994; Stadler, 1997).

Melton was arguably presenting evidence for implicit learning (in her 1994 review, Seger included as an example of implicit learning the Hebb task that Melton used), although the term would not be introduced until a few years later (Reber, 1967). At the time, however, the paradigm Hebb used would more likely have been described as one involving *incidental learning* (in contrast to *intentional learning*). Interestingly, issues similar to those being considered here were also important in that literature. In a review, Postman (1964) wrote that “a basic obstacle to the definition of the term ‘incidental’ has been that its connotations are negative, i.e., it refers to the *absence* of a set or intent to learn” (p. 185) and that “in then assuming that learning under these conditions occurs without any intent to learn, one is essentially in the position of accepting the null hypothesis” (p. 185). He concluded by noting that “it is hazardous ever to assert that learning is incidental in an absolute sense. We can accept this point without abandoning a substantive problem which is implied in the distinction between intentional and incidental learning” (p. 185). Our view is that researchers interested in implicit learning should similarly focus on the differential effects of implicit and explicit orientations on learning, rather than on attempts to demonstrate that learning is implicit in some absolute sense.

To date, inquiries into subliminal perception and implicit memory have perhaps dealt more effectively with the question of awareness than those into implicit learning (see Reingold & Merkle, 1988, and Roediger & McDermott, 1993, for examination of this issue in the subliminal perception and implicit memory literatures, respectively). Researchers in these areas have used approaches seldom used in studies of implicit learning, so these related literatures may offer some lessons for future research on implicit learning. The reasons for the different levels of progress on this question are not clear. They may owe to the different interests of researchers in the various areas. Or they may simply owe to a difference in levels of activity in the areas. In the 10 years after Graf and Schacter (1985) coined the term implicit memory, the terms *implicit learning* and *implicit memory* have been used in the titles or abstracts of 443 papers indexed in PsycINFO. The overwhelming majority of those publications were concerned with implicit memory (362, or 82% of the 443). In any case, it is worth considering what these other literatures have to offer as help in answering the awareness question.
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DEFINITIONS AND ASSUMPTIONS

The first definitions of the terms implicit learning and implicit memory seem quite similar to Melton’s idea that memory is not confined to “the act of remembering.” Reber (1967) wrote that implicit learning is a process in which “information is abstracted out of the environment . . . without recourse to explicit strategies for responding or systems for recoding the stimuli” (p. 863). Thus, encoding occurs without the subject’s intention to learn, and learning is measured by the influence of that knowledge on another task.

Graf and Schacter (1985) wrote that “implicit memory is revealed when performance on a task is facilitated in the absence of conscious recollection; explicit memory is revealed when performance on a task requires conscious recollection of previous experiences” (p. 501). Here, retrieval, rather than encoding, occurs without the subject’s intention and, as in implicit learning, memory is inferred from a change in performance on a transfer task rather than being tested with recall or recognition.

Some differences do exist from one author to the next in the precise use of the term implicit. It has been used with reference to task instructions, so that implicit learning would refer to essentially the same thing as incidental learning (see Postman, 1964), or with reference to mental processes, to indicate a characteristic of those processes or a form of learning (see Frensch, Chapter 2, this volume, for a detailed discussion of this issue). This state of affairs could, of course, lead to some confusion. Richardson-Klavehn and Bjork (1988) outlined several potential difficulties that similar confusion over the term implicit memory might cause and so recommended the use of the term indirect to refer to the task distinction and the term implicit to refer to the form of learning distinction. Those objections could apply just as readily to the term implicit learning. However, such problems are not new and may not be that problematic. Roediger and McDermott (1993) pointed out that the term episodic memory, for example, is used to describe both a hypothetical memory system and a class of memory tasks without much confusion. The manner in which the term implicit is used is usually clear from the context.

Without putting too much emphasis on purely definitional concerns, it is worth distinguishing implicit learning from implicit memory (see also Buchner & Wippich, Chapter 1, this volume). Despite the apparent similarity in the terms, implicit learning and implicit memory were defined at
different times by different people for different purposes. The implicit learning literature has traditionally focused on learning of relatively complex novel information over many (even thousands) experimental trials. To the extent that it has been compared to explicit learning (see below), it has focused on encoding processes, following Reber's idea that implicit encoding occurs without the use of conscious strategies. The implicit memory literature, in contrast, has focused largely on effects of single presentations of already familiar stimuli (e.g., words) and has emphasized the nature of retrieval. Encoding of material often occurs under intentional learning conditions, although the intentional or incidental nature of encoding often does not affect performance (measured by priming) on implicit memory tests (e.g., Roediger, Weldon, Stadler, & Riegler, 1992).

The distinction between encoding and retrieval is especially important in distinguishing implicit learning and implicit memory. For example, the typical test of learning in the artificial grammar-learning situation used by Reber (see Reber, 1989, for a review) was one in which subjects were informed that the stimuli they had seen in the first part of the experiment were composed according to complex rules and that they should then attempt to classify new stimuli according to whether they followed those rules or not. In the 1967 study, each subject "was instructed to make his decisions on the basis of what he had learned about the grammar from the 20 sentences he had previously memorized" (p. 860). This test meets Graf and Schacter's (1985) definition of an explicit, not implicit, retrieval test. At least as originally defined, subjects might or might not be aware of implicitly acquired knowledge; Reber only said that the information could be applied on a transfer test, not necessarily that it could be applied without awareness. (In other parts of that article, however, Reber did also make the claim that subjects were not aware of and could not verbalize what they had learned.)

The operational definitions of implicit learning and implicit memory cited above may be combined in various ways (implicit encoding with implicit retrieval; implicit encoding with explicit retrieval; explicit encoding with implicit retrieval; explicit encoding with explicit retrieval; see Stadler & Frens, 1994). Thus, implicit learning as studied in the standard artificial grammar-learning paradigm is a case of implicit encoding and explicit (intentional) retrieval, although Reber (e.g., Reber, Allen, & Regan, 1985) has typically argued that even with instructions for explicit retrieval, subjects are unable to do this, so their judgments are influenced by non-conscious knowledge. In other procedures, such as implicit sequence learn-
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ing in reaction time (RT) tasks (e.g., Nissen & Bullemer, 1987; Stadler, 1995), both encoding and retrieval occur under implicit instructions. Most recently, Shanks and St. John’s (1994) definition of implicit learning focused on conditions at test; they held that implicit learning occurred when, at the time of the test, subjects were unaware of both the to-be-learned information and the episode in which it was learned. Their definition was mute on the nature of encoding, so it could presumably be either implicit or explicit. Thus, we have covered with these various definitions of implicit learning three of the four cells in the matrix: implicit encoding with explicit retrieval (in the typical artificial grammar-learning experiment), implicit encoding with implicit retrieval (in the usual serial reaction time [SRT] experiment), and explicit encoding with implicit retrieval (a possibility allowed for in Shanks & St. John’s definition but not yet realized in the implicit learning literature). There is agreement, at least, that explicit encoding with explicit retrieval does not qualify as a case of implicit learning.

Part of the confusion here may stem from the different purposes for which claims concerning awareness have been used. Recall Postman’s (1964) definition of incidental learning. One reason to measure subjects’ awareness is to be able to make strong claims about learning without awareness, defining implicit learning in the absolute sense that Postman cautioned against. Another, we believe better, reason for making such a claim is to allow for the investigation of unintentional learning, in the sense of investigating the functional differences between deliberate, strategy-driven encoding and incidental, automatic (i.e., obligatory) encoding. In the latter case, claims about awareness are made as assurance that encoding was unintentional; subjects cannot intentionally encode something of which they are not aware. Thus, the interest is not in learning without awareness per se, just in being as sure as possible that subjects did not use intentional learning strategies.

LEARNING WITHOUT AWARENESS

To make claims about learning without awareness, researchers obviously need adequate measures of awareness (which, because they require intentional processing, are explicit measures). Reingold and Merikle (1988) examined two important assumptions that can be made about explicit measures. One is the exhaustiveness assumption, which is that the explicit measure completely measures subjects’ conscious knowledge. This has been
important in the implicit learning literature, because without some demonstration that subjects have no explicit knowledge, critics will be able to claim that what is said to be implicit learning is actually explicit learning that went undetected by the researcher. And of course, many criticisms of claims for nonconscious processing are based on a claim that this assumption has not been met (e.g., Holender, 1986; Shanks & St. John, 1994). Unfortunately, it is probably impossible to guarantee that this assumption is met by any particular measure.

The other assumption is the exclusiveness assumption, which is that the explicit measure only measures explicit knowledge and is not influenced by implicit knowledge. Proponents of nonconscious processing in implicit learning tend to focus more on this assumption. The problem with some explicit measures, particularly recognition and other forced-choice discriminations, is that they may not be process-pure (Jacoby, 1991). That is, they may also be influenced by nonconscious processing. For example, recognition judgments might be influenced by a nonconscious fluency of processing, thus contaminating a purportedly explicit measure with implicit processing.

There are several good reasons to be concerned about the exclusiveness assumption. Fluency at least potentially influences recognition judgments (Fendrich, Healy, & Bourne, 1991; Johnston, Dark, & Jacoby, 1985; Johnston, Hawley, & Elliott, 1991). Also, there are nonconscious influences on performance that cannot be controlled by explicit instruction (e.g., Jacoby, 1991; Jacoby, Woloshyn, & Kelly, 1989). Finally, subjects are reliably able to distinguish recognition judgments based on “remembering” of an item from those based only on “knowing” that an item was previously presented (Gardiner, 1988; Gardiner & Java, 1993; Tulving, 1985). These two classes of responses have been systematically dissociated from one another in ways that suggest that remember responses reflect explicit processing, whereas know responses depend on implicit processing (Rajaram, 1993). All of these factors show that it would be treacherous indeed to assume that the exclusiveness assumption is met by a given explicit test.

Fortunately, Reingold and Merikle (1988) also offered a solution to these problems, one that would be based on a much simpler and more reasonable assumption. Their logic requires first that the implicit and explicit measures be comparable, differing only in that subjects are instructed to rely on conscious knowledge for the explicit measure but not the implicit measure. Comparability means that subjects must receive the same stimuli under the same conditions, that the tests must be the same except for the
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presence or absence of the instruction to use conscious recollection, that
the tests must use the same number of alternatives and the same scale of
measurement, and so on. Such comparability may be difficult to achieve in
some cases, but the ability to do without the exclusiveness and exhaustive-
ess assumptions makes this approach worth pursuing. Using this logic,
one need only assume that the explicit measure is at least as sensitive to
conscious knowledge as the implicit measure. If so, then any result in which
the implicit measure is more sensitive to knowledge than the explicit mea-
sure implies the existence of nonconscious processing.

Merkle and Reingold (1991, Experiment 2) reported an implicit mem-
ory study in which, after studying a list of words, subjects were tested on
words displayed against a background mask of varying contrast. Subjects
in the explicit test group were instructed to indicate whether each word
was old or new. Subjects in the implicit test group were instructed to indicate
whether each word had high or low contrast. Following Jacoby, Allan,
Collins, and Larwill (1988), the expectation was that words seen previously
in the experiment would tend to be judged as having high contrast, words
not seen as having low contrast. Both groups of subjects were tested over
three blocks of trials. As shown in Figure 3.1, for the first two blocks, the
implicit test was more sensitive to prior presentation than the recognition
test; this pattern reversed in the third block. Given that the testing condi-
tions were identical except for instructions, and given the very reasonable
assumption that the recognition test was at least as sensitive to conscious
memory as the contrast test, this study clearly demonstrates a case of
nonconscious memory.

As a further illustration of this approach, consider a study by Mandler,
It also meets the conditions set forth by Reingold and Merkle (1988). In
the first phase of this experiment, subjects were presented with five 1 ms
exposures to each of 10 irregular octagons. In the second phase, four groups
of subjects were shown pairs of these shapes, one of which was presented
during the first phase of the experiment, one of which was not. One group
was asked to make a recognition judgment, indicating which of the shapes
had been presented during the first phase of the experiment. Another group
was asked to indicate which of the two figures they liked the best. A third
group was instructed to indicate which figure appeared to be brighter, and
a fourth to indicate which appeared to be darker. The performance of
subjects in the recognition condition was not different from chance, whereas
subjects in the other groups reliably selected the shape that had been
Figure 3.1. Mean sensitivity ($A'$) of the recognition and contrast tasks at each trial block in Experiment 2A and Experiment 2B. (Bars indicate standard errors.)

previously presented. Here again, an implicit measure was more sensitive than an explicit measure taken under comparable conditions, thus demonstrating nonconscious memory.

There are not, to our knowledge, many published studies of implicit learning that meet all of Reingold and Merikle’s (1988) criteria. One that meets many of them is an experiment by Stadler (1989), which was the only study that Shanks and St. John (1994) acknowledged to have demonstrated implicit learning with procedures not open to one or another of their methodological criticisms. That study used a prediction measure to test explicit learning in an SRT task modeled after Lewicki, Czyzewska, and Hoffman’s (1987) study. In that task, subjects looked for a target presented in one of four locations and pressed a key that corresponded to the location in which the target appeared. Subjects were trained on 24 different seven-trial repeating sequences over several days. An implicit measure showed that subjects learned the patterns; when the patterns were changed, RT increased dramatically. In a final phase of the experiment, however, subjects responded to the first six trials of each sequence exactly as they had in training, but on the seventh trial were shown a blank display and asked to indicate where the target would have appeared. Although the implicit (RT) measure indicated that subjects had learned these repeating sequences, they performed at chance on this prediction task. Thus, the implicit measure appears to have been more sensitive than the explicit measure. The one way in which this study does not meet Reingold and Merikle’s criteria is the difference in response metrics between the implicit (RT) and explicit (four-alternative forced-choice recognition) measures.

Jiménez, Méndez, and Cleeremans (1996) recently reported a study based specifically on Reingold and Merikle’s (1988) logic. In a six-choice RT task in which the sequence of stimuli was determined by complex probabilistic rules, they found that although there was a positive correlation between comparable implicit and explicit measures of knowledge of sequential structure, when the explicit scores were partialed out, there was still a significant relation between the implicit scores and the to-be-learned sequential structure. They concluded that the knowledge reflected in that partial correlation was nonconscious. Thus, although this approach has not been used extensively in the study of implicit learning, it appears to hold promise that can only be realized with additional research.

Reber’s (1976) study of artificial grammar learning used similar but not identical logic. Two groups of subjects were tested under identical conditions, one given implicit (incidental) study instructions during the
study phase of an artificial grammar-learning experiment, the other given explicit (intentional) study instructions. In the test phase, both groups of subjects were shown new grammatical and nongrammatical items and asked to indicate whether each item was grammatical or nongrammatical. The implicit study group was accurate on about 77% of the items, the explicit group on only about 65% of them. Part of a later study (Reber, Kassin, Lewis, & Cantor, 1980) that replicated the conditions of Reber’s (1976) study produced the same pattern of results, although not at a statistically significant level. It is tempting, given Reingold and Merkle’s (1988) reasoning, to conclude that because the implicit study condition produced better performance on the test, subjects in that condition learned more. Note, however, as Reber (1976) did, that subjects in the explicit study condition may have formed incorrect hypotheses about the structure of the stimuli, attempted to use those hypotheses at the time of test, and thus performed more poorly. A critic might argue that both the implicit and the explicit study groups have conscious knowledge about, say, individual items (e.g., Brooks, 1978) or parts of grammatical items (e.g., Perruchet & Pacteau, 1990), but that knowledge is not expressed in the explicit condition because subjects choose to base their judgments on whatever hypotheses they developed in the study phase.

Definitions of Awareness

As we have noted, there have been few attempts to use Reingold and Merkle’s (1988) logic to demonstrate implicit learning. More studies have attempted to apply Cheesman and Merkle’s (1984) distinction between the subjective and objective thresholds of awareness. Often, positive demonstrations of subliminal perception could be criticized on the grounds that measures of subjects’ awareness of the subliminal stimuli were not reliable or sensitive enough. Cheesman and Merkle conducted an experiment with more stringent threshold-setting measures and demonstrated that with those measures, no evidence for subliminal perception was obtained. Then, to account for differences between their negative finding and previous positive findings, they distinguished between an objective definition of awareness, at which subjects’ performance on a forced-choice discriminative test is at chance, and a subjective definition, at which subjects’ belief is that their performance on the forced-choice discrimination is at chance. They suggested that previous studies reporting positive evidence for subliminal perception had employed equivalents of subjective definitions of
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awareness. They then performed a second experiment that revealed no evidence of subliminal perception with an objective definition, but positive evidence with a subjective definition. Merikle and Cheesman (1986) subsequently argued that the subjective criterion might be preferable because it most closely reflects subjects' phenomenological experiences.

Several studies have adopted this approach to investigate implicit learning. The study by Stadler (1989) included a subjective measure. Based on Cheesman and Merikle's (1984) findings, the expectation was that subjects might be judged unaware by the subjective measure but aware by the objective measure. Instead, subjects appeared to be unaware of the repeating patterns by either measure. More recently, several studies that used subjective measures of awareness have been done on artificial grammar learning. After reviewing this evidence, and some suggestive evidence from other tasks used to study implicit learning, Dienes and Berry (1997) tentatively concluded, in line with Cheesman and Merikle (1984), that whereas subjects would often be judged aware by an objective definition of awareness, they would not be by a subjective definition. This pattern of results, aware by an objective measure but not by a subjective measure, reinforces concerns about the exclusiveness assumption. Subjects appear to have little or no metaknowledge about what has been learned in an implicit learning task, yet by the objective tests, they might be judged aware. This suggests again that implicit knowledge is contaminating performance on the objective tests, in violation of the exclusiveness assumption discussed above. Although critics of the notion of implicit learning are concerned that implicit measures are contaminated by explicit knowledge, the evidence would seem to suggest that the opposite is at least as much of a problem. Roediger and McDermott (1993) have made this same argument in implicit memory research.

Which is the best criterion, subjective or objective? Stadler (1997) argued that although the subjective definition may have more face validity (this will always be open to debate, of course), use of the objective definition of awareness is most likely to convince the skeptics, simply because it is more conservative. Recall, too, that even if the objective test is somewhat contaminated by implicit knowledge, implicit learning can still be demonstrated if a comparable implicit measure is more sensitive to learning than the explicit measure (Reingold & Merikle, 1988).

The real difficulty here may be that in this debate, implicit learning is defined in terms of awareness (i.e., it occurs when subjects are not aware that knowledge has been encoded and retrieved) instead of in terms of intention (i.e., knowledge was acquired unintentionally, as an automatic
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consequence of performing some task; see Reber’s [1967] definition). The most effective answer to the awareness question may actually sidestep it and deal instead with the more empirically tractable question of intention, which we consider next (see also Frensch, Chapter 2, this volume; Stadler & Frensch, 1994).

UNINTENTIONAL LEARNING

To this point, we have reviewed ways of defining implicit learning and assumptions that may be used to construct measures of implicit learning and checks on explicit learning. One reason for doing this, recall, is to provide assurance that conditions presumed to involve unintentional encoding of information do not actually involve intentional encoding. However, definitions and assumptions such as those reviewed so far may seem reasonable to some but unreasonable to others and so must be put to empirical test for validation. Ultimately, we need a series of converging operations to support a theoretical construct (when Garner, Hake, and Eriksen introduced the idea of converging operations in 1956, they used subliminal perception and issues related to those being reviewed in this chapter to illustrate some of their points). Converging operations can be provided by dissociating the construct of interest (implicit learning) from related or competing ideas (explicit learning). Such converging operations provide support for the assumptions and definitions but at the same time provide valuable information about the nature of the processes being studied and how they are similar to and different from other processes.

Cheesman and Merikle (1986) noted that their distinction between the objective and subjective thresholds, which were identifiably and reliably different (Cheesman & Merikle, 1984), still raised the question of whether those definitions of awareness meaningfully distinguished between different perceptual states, conscious and nonconscious. That is, was perception under conditions when subjects were not aware by a subjective definition meaningfully different from conditions when they were aware? If this question is answered affirmatively, then we have converging operations for the distinction, and we have learned something about the theoretical constructs in question.

For example, Cheesman and Merikle (1986), building on their earlier experiments (Cheesman & Merikle, 1984), measured subjects’ latency to name the color of color patches in a Stroop (1935) experiment. In one
condition, masked color-word primes were presented briefly, at the subjective threshold, right before presentation of the color patch; in another, the primes were presented supraliminarily before the color patch. As shown in Figure 3.2, Stroop interference was found in both conditions; naming latencies were longer when the prime was incongruent with the color patch (the prime green before a blue patch) than when the prime was congruent with the patch (the prime green before a green patch).

Cheesman and Merkle's (1986) main finding, however, was that the size of the Stroop effect could be manipulated by manipulating the proportion of trials when the prime was congruent with the patch, but only in the supraliminal conditions. Under conditions where subjects are aware of the stimuli, they might be expected to use various strategies, to form expectations or hypotheses, or to make inferences and judgments that subjects would not make if they did not believe they were perceiving any stimuli in the first place. Consistent with this, in the supraliminal condition, the difference between the naming latencies on congruent and incongruent trials was smaller when incongruent trials were frequent, larger when they were infrequent. This suggests that subjects' expectancies influenced their strategies in performing the task, but only when the prime was presented supraliminarily. Presumably, subjects do not adopt such strategies when they think there was no prime stimulus. Thus, subjects' behavior is quite different in the subliminal and supraliminal conditions. If no such differences could be found, then there would be little reason to be interested in a distinction between subliminal and supraliminal perception. But because these two forms of perception are in fact different, the distinction has been one of great interest (e.g., Greenwald, 1992; Kihlstrom, 1987).

Jacoby and Whitehouse (1989, Experiment 2) provided another interesting and convincing example of qualitative differences between conscious and nonconscious information processing. In the first phase of the experiment, subjects read a list of words. In the second phase, subjects made recognition judgments about test words. In an unaware condition, test trials were arranged so that test words were preceded by context items that were masked so that subjects could (presumably) not consciously read them. In an aware condition, the context items were presented for longer durations, and subjects were instructed to try to remember them for a later test. The context items could match the test word, be another nonmatching word, or, as a control, consist of the letter string xoxoxoxox. As shown in Table 3.1, the context items influenced subjects' performance, particularly on new test words (words not presented in Phase 1) and did so differentially

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![Graph showing mean naming latencies for congruent and incongruent trials as a function of congruent-trial probability under subjective and suprathreshold conditions.]

**Figure 3.2.** Mean naming latencies for congruent and incongruent trials as a function of congruent-trial probability under subjective and suprathreshold conditions.


depending on whether subjects were aware of them. In the unaware condition, presentation of a matching context item increased the probability that subjects would call a new test word “old” (i.e., that they would make a false alarm) whereas in the aware condition, presentation of a matching context item decreased the probability of a false alarm. This pattern of findings strongly suggests that subjects in the unaware condition were actually not aware of the context items. Had they been, their performance presumably would have been more comparable to that of the aware condition. Again, qualitative differences such as these are important because they demonstrate that it is theoretically meaningful to distinguish conscious and nonconscious perception. The ways in which various factors influence subjects’ behavior change depending on whether subjects are aware of the stimuli or not.

The implicit memory literature has thrived on the discovery of such dissociations between implicit and explicit tests (for reviews, see Richardson-Klavehn & Bjork, 1988; Roediger & McDermott, 1993; Schacter, 1987).
TABLE 3.1 Probability of Calling a New Test Word “Old”

<table>
<thead>
<tr>
<th>Condition</th>
<th>Match</th>
<th>Nonmatch</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aware</td>
<td>.21</td>
<td>.36</td>
<td>.33</td>
</tr>
<tr>
<td>Unaware</td>
<td>.26</td>
<td>.17</td>
<td>.17</td>
</tr>
</tbody>
</table>


For example, performance on perceptual implicit memory tests tends to be influenced by manipulations of surface structure and modality, whereas performance on explicit memory tests tends not to be; performance on implicit memory tests tends not to be influenced by manipulations of elaborative processing during study, whereas performance on explicit memory tests does tend to be influenced by such manipulations (Schacter, 1987). These and many other dissociations provide convincing converging evidence for the distinction between implicit and explicit memory and have been influential in the vigorous debate about competing theories.

In contrast, there has been very little work in the implicit learning literature directly contrasting implicit and explicit learning.¹ Thus, we know relatively little about what kinds of dissociations might exist between them and what kinds of differences in processing those dissociations might imply. This may also account for why the field is caught up in a debate over whether implicit learning exists in the first place (see Shanks & St. John, 1994, and the subsequent commentary); compared to work on implicit memory, there have been relatively few converging operations, specifically studies of qualitative differences, to support the distinction.

One difficulty with the dissociation approach in implicit memory research has been that implicit and explicit testing conditions have often differed in more ways than the nature of the retrieval conditions (Neely, 1989). Consider a typical experiment in which two groups of subjects study a list of words and are then given a test, either a free-recall test of explicit memory or a word-fragment completion test of implicit memory (e.g., Roediger & Blaxton, 1987). The retrieval instructions differ, as implied by Graf and Schacter’s (1985) definition of implicit memory, but so do many other things: the types of cues present on the test (or the lack thereof), the order and pace of subjects’ responses, and so on. Thus, such studies suffer
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from the same problem as any experiment with a confound: There are potential alternative explanations for any observed differences between implicit and explicit memory. As when using Reingold and Merikle’s (1988) approach, the logic of dissociation works best when the only difference between conditions is, in implicit memory, the retrieval instructions. In studies of implicit learning, of course, the difference would be in the encoding instructions. Many studies comparing explicit and implicit memory tests have overcome this difficulty (e.g., Roediger et al., 1992). Unfortunately, there are relatively few such studies in the implicit learning literature.

Another difficulty has sometimes been the relative lack of control of possible contamination by intentional retrieval strategies (Schacter, Bowers, & Booker, 1989). Schacter and his colleagues delineated several scenarios that could occur during implicit testing, should conscious knowledge of the relation between study and test occur and depending on whether and how the subject acted on that knowledge. These ranged from cases in which awareness was essentially epiphenomenal, such that the subjects notice that they have studied some of the items before but do not act on that fact, to cases in which such conscious knowledge poses serious problems because subjects act on their awareness by deliberately attempting to use memory for the study episode in performing the implicit task. To circumvent this problem, Schacter et al., like Reingold and Merikle (1988) and Neely (1989), advised that implicit and explicit test conditions should differ only in the instructions given to subjects; everything else should be comparable across conditions. Then, a variable must be found that dissociates performance on the two tests. For example, if variable X influences the explicit test but not the implicit, or if it has a different effect on the implicit test, then it can be inferred that subjects did not use intentional retrieval in the implicit condition. If they had, their performance would have been influenced by variable X in the same way as that of the subjects in the explicit test condition. Further investigations can then use such a finding as a benchmark to guard against possible contamination of the implicit measure by explicit retrieval strategies.

Roediger et al. (1992, Experiment 1) applied this logic in studies comparing the word-fragment and word-stem completion tasks. For both the implicit and explicit tests, subjects were tested under identical conditions. Everything, including the cues given at test, was the same except for the instructions. Subjects in the implicit testing conditions were instructed to complete the word fragments or word stems with the first item that came to mind, whereas subjects in the explicit testing conditions were instructed
to use the fragments or stems as cues to help them remember the study items. The key finding for present purposes was that for both tests, when the study stimuli were printed words, a level of processing manipulation had a strong effect on the explicit test, but no effect on the implicit test (even with \( n = 60 \) in each condition). If subjects engaged in intentional retrieval of study items, they should have shown the same levels of processing effect found in the explicit test condition.

Similarly, Java (1994, Experiment 2) manipulated study conditions by having subjects read words or generate them from cues and then tested both groups with word-stem cues, giving one group implicit retrieval instructions and another explicit retrieval instructions. For the implicit test, reading the word produced better performance than generating, but for the explicit test, generating produced better performance than reading (see Table 3.2). This is a key result because the study manipulation produced opposite effects on the implicit and explicit tests. It would thus be difficult to argue that subjects in the implicit test condition were using explicit retrieval strategies; if that were so, their performance should have been similarly affected by the study manipulation. These results also provide important converging evidence for the distinction between retrieval modes. Following Cheesman and Merkle’s (1986) argument, there would be little reason for interest in the distinction between implicit and explicit retrieval if they differ only in whether or not subjects are aware of the prior study episode. There is much more reason for making the distinction if, as in Java’s study, the two modes of retrieval produce qualitatively different patterns of results.

Studies of implicit learning have generally not compared implicit learning to explicit learning (for some exceptions see Curran & Keele, 1993; Freensch & Miner, 1994; Jiménez et al., 1996; Reber, 1976; Reber et al., 1980), so Stadler (1997) suggested the adoption of an \textit{encoding intentionality criterion} to complement Schacter et al.’s (1989) retrieval intentionality criterion. The logic would be to test two groups, manipulating encoding instructions while holding everything else constant. One group would be instructed to intentionally encode the to-be-learned material; the other would simply be instructed in how to do the task and thus exposed to the to-be-learned material incidentally. If, under these conditions, a variable were found to influence the intentional encoding condition differently than the incidental encoding condition, then the argument could be made that processing in the incidental condition was implicit; if subjects in that condition had intentionally learned the material, then results in that condition

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TABLE 3.2 Proportion Correct on Explicit and Implicit Tests  
(Implicit Scores Are Priming Scores)

<table>
<thead>
<tr>
<th>Test</th>
<th>Nonstudied</th>
<th>Read</th>
<th>Generate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit</td>
<td>0.04</td>
<td>0.22</td>
<td>0.41</td>
</tr>
<tr>
<td>Implicit</td>
<td>0.14/0.15</td>
<td>0.33</td>
<td>0.19</td>
</tr>
</tbody>
</table>


would be expected to parallel those in the intentional learning condition. Note the shift in emphasis from awareness to intention. Awareness is something that must be measured, but for which no widely agreed upon measure has been found, as discussed above. Intention is something that can be manipulated with instructions and should not invite the kind of debate that surrounds measures of awareness.

Reber et al.’s (1980) study essentially took this approach. This study replicated the manipulation of study intentionality used in Reber’s (1976) experiment but also manipulated the format in which items were presented, so that for some subjects, presentation order was random, but for others, presentation order systematically reflected the structure of the grammar. Reber et al. found that structured presentation produced much better performance than random presentation for the explicitly instructed subjects but that there was no difference between these conditions for implicitly instructed subjects. This suggests that the implicitly instructed subjects did not engage in any intentional learning strategies. Unfortunately, Dulany et al. (1984) failed to replicate this result, and, to our knowledge, this manipulation has not been tested again. Similarly, a study by Hayes and Broadbent (1988), which also satisfied the logic of the encoding intentionality criterion, could not subsequently be replicated (Green & Shanks, 1993). Other recent studies (e.g., Curran & Keele, 1993; Frensch & Miner, 1994; Jiménez et al., 1996) have manipulated intention and found some differences between implicit and explicit learning orientations, although not qualitative differences. Still, given the positive results from the use of the retrieval intentionality criterion in the implicit memory arena, the encoding intentionality criterion holds promise, but it is at present unrealized.

The dissociation logic can be extended even further. Jacoby has employed what he calls the method of opposition (e.g., Jacoby, 1991; Jacoby
et al., 1989). The idea is to give subjects instructions that oppose or discourage the use of the implicit knowledge. Jacoby et al.'s (1989) experiments involved two phases, a study phase in which subjects read aloud a list of nonfamous names, and test phase in which they decided whether each name in another list was famous or nonfamous. The test list included some old nonfamous names that had been presented in the study phase, and some new nonfamous names that had not been. Subjects knew that if an item was in the study list, it is nonfamous, so they could use their memory of study list items to help make the fame judgments. In Experiment 2, the study phase was conducted in conjunction with a secondary task for half the subjects; the other half of the subjects did the study task alone. As shown in Table 3.3, subjects in the secondary task condition incorrectly called more old nonfamous names “famous” than did subjects in the single-task condition. Because subjects knew that any name they recognized from the first phase of the experiment was nonfamous, this greater propensity to call an old nonfamous name famous indicates an influence of prior experience that could not be consciously controlled and was thus automatic or nonconscious. This study also compares implicit and explicit memory directly, but by manipulating subjects’ ability to rely on explicit memory with the presence or absence of a secondary task requirement. The key feature of this study and the others reviewed in this section is the direct comparison of implicit and explicit retrieval modes.

In another extension of this logic, Jacoby (1991) examined how conscious and nonconscious processes might contribute to performance under two specific conditions. Consider an experiment with two phases, a study phase during which subjects are exposed somehow to a set of items and a test phase during which subjects are asked to respond to some kind of cue or test item. The dependent variable is the probability that subjects will respond to the test item with a previously studied item. In one condition, which Jacoby termed inclusion, subjects are instructed to respond to the test items with the first thing that comes to mind, including items they may have encountered during the study phase of the experiment. In the second condition, termed exclusion, subjects are instructed to respond to the test items with the first thing that comes to mind that was not encountered during the study phase. Thus, any response in the exclusion condition that consists of an item from the study phase is assumed to be due to nonconscious processing. Furthermore, assuming that the conscious and nonconscious processes are independent, it is possible to estimate the contributions of each of these to performance. Performance in the inclusion condition,
I, may depend on both conscious (C) and nonconscious (N) influences of the study item, so that I = C + N – NC. In the exclusion condition (E), in contrast, the study item will only be produced if it influenced the nonconscious process and not the conscious process, so that E = N (1 – C), or E = N – NC. The parameter C can then be estimated by I – E; an estimate of N can then be calculated using simple algebra.

Jacoby and his colleagues have done numerous studies exploring various possible uses of the process dissociation procedure (e.g., Debner & Jacoby, 1994; Jacoby, Toth, & Yonelinas, 1993; Toth, Reingold, & Jacoby, 1994; Yonelinas & Jacoby, 1995; Yonelinas, Regehr, & Jacoby, 1995). However, the status of the procedure is somewhat uncertain at present. There have been several critiques and extensions of it (e.g., Buchner, Erdfelder, & Vaterrodt-Plünnecke, 1995; Cowan & Stadler, 1996; Dodson & Johnson, 1996; Ratcliff, Van Zandt, & McKoon, 1995). Further research will be required to tell whether this and related procedures will help distinguish conscious and nonconscious processing. One step in this direction has been taken by Buchner, Steffens, Erdfelder, and Rothkegel (1996), who recently extended Jacoby’s (1991) approach by developing a multinominal model of implicit learning in the SRT task.

**CONCLUSIONS**

How then should we answer the awareness question? Generally, a promising strategy will be to follow the lead of researchers interested in implicit memory and subliminal perception, who have to date dealt with this ques-
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tion quite effectively. More specifically, we see two possible approaches
worth pursuing. One is to try to answer the awareness question directly,
using the logic outlined by Reingold and Merkle (1988). If an implicit
measure is more sensitive to learning than a comparable explicit measure,
and we assume that the explicit measure is at least as sensitive to conscious
knowledge as the implicit measure, then we have demonstrated implicit
learning. This approach does not say that a particular explicit measure or
particular type of explicit measure is absolutely correct; indeed, this ap-
proach allows for the possibility that the explicit measure is contaminated
by implicit knowledge. It also has the important advantage that it meets
the demands of critics, at least some of whom have acknowledged that
Reingold and Merkle's logic is convincing (e.g., Shanks & St. John, 1994).
This approach alone, however, still leaves unanswered the question of
whether there are any functional differences between these two modes of
learning.

The other approach to answering the awareness question is to shift the
focus from awareness to intention. An important element of this approach
is the direct comparison of implicit and explicit learning orientations
through the use of the encoding intentionality criterion (Stadler, 1997).
Indeed, Reber (1967) originally defined implicit learning in terms of in-
tention, some of his later investigations focused on this variable (Reber, 1976;
Reber et al., 1980), and the manipulation of subjects' intentions is consistent
with and complements current approaches to studying implicit memory.
What we do not yet know is precisely whether and how implicit and explicit
learning are different, although several chapters in this book begin to offer
some answers. As Stadler (1997) argued, this requires two things, an ex-
perimental methodology for finding out the differences and development
of theories that account for processing under the different learning orienta-
tions. The encoding intentionality criterion may help on the methodology
side. On the theoretical side, there are several information-processing mod-
els of implicit learning (e.g., Cleeremans, 1993; Cleeremans & Jiménez,
Chapter 10, this volume; Keele & Jennings, 1992; Servan-Schreiber &
Anderson, 1990). These models do not account for explicit learning or the
differences between it and implicit learning but could perhaps be expanded
to do so.

The approach we recommend for studying implicit learning is essen-
tially the same as the one used by Melton, although it has been greatly refined
since then. What we must do is establish conditions that make unlikely, and
even rule out, the possibility that subjects use intentional learning strategies so that we can see how implicit learning is different from explicit learning.

NOTE

1. In his 1964 review of research on incidental and intentional learning, Postman concluded that any differences between the two were differences of degree, not differences in kind. However, the prominent theoretical questions and experimental paradigms of that time may not have lent themselves to the discovery of such differences in kind. Given the differences researchers have observed between incidental and intentional retrieval reviewed in this chapter, it seems likely that similar kinds of differences may be found for incidental and intentional encoding.

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