4 Intention, Awareness, and Implicit Memory: The Retrieval Intentionality Criterion

Daniel L. Schacter, Jeffrey Bowers, and Jill Booker
University of Arizona

ABSTRACT

The recent surge of interest in implicit memory has spawned an impressive variety of new empirical discoveries concerning the nature of normal and abnormal memory processes (Richardson-Klavehn & Bjork, 1988; Schacter, 1987). Yet as the editors of this volume rightly point out, somewhat less attention has been paid to conceptual and theoretical issues associated with the phenomena of interest. In this chapter, we address a number of conceptual problems concerning implicit memory that we believe need to be, but have not yet been, confronted and discussed directly.

This chapter focuses on the nature of and relations between two critical aspects of implicit memory: unintentional vs. intentional retrieval processes, and awareness vs. unawareness of remembering during implicit test performance. We begin by discussing these phenomena with respect to definitions of implicit memory. We then consider them in regard to the related problem of developing suitable criteria for distinguishing implicit from explicit memory processes, and put forward a *retrieval intentionality* criterion for making such a distinction in terms of intentional vs. unintentional retrieval processes. Finally, we consider a series of experiments that explore the issue of awareness vs. unawareness of remembering during test performance.

DEFINING IMPLICIT MEMORY

By the early 1980s, research on both normal memory (e.g., Graf, Mandler, & Haden, 1982; Jacoby & Dallas, 1981; Tulving, Schacter, & Stark, 1982; Winnick

In: S. Lewandowsky, J.C. Dunn, K. Kirsner (Eds.), Implicit memory: Theoretical issues, Hillsdale, N.J.: Erlbaum, in press.

& Daniel, 1970) and organic amnesia (e.g., Cohen & Squire, 1980; Milner, Corkin, & Teuber, 1968; Moscovitch, 1982; Warrington & Weiskrantz, 1974) had made it abundantly clear that when subjects are given such tests as fragment completion, word identification, and lexical decision, a very different picture of memory could be observed than that provided by standard recall and recognition tests. Experimental variables that had large effects on one class of test had little or none on the other, and amnesic patients who performed disastrously on recall and recognition tests showed robust priming effects on fragment completion and other such tasks. However, there was (and still is) a good deal of theoretical controversy about the observed dissociations; some argued that it was necessary to postulate different memory systems whereas others opted for unitary system accounts.

When Graf and Schacter (1985) introduced the concepts of implicit and explicit memory, they sought to provide a *descriptive*, as opposed to a *process* distinction that would facilitate classification and discussion of relevant phenomena, and at the same time steer clear of the multiple vs. single memory system controversy (1985, p. 501). Graf and Schacter stated 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). The main purpose of this definition was to capture a key difference between recall and recognition tasks on the one hand and word completion, lexical decision, and similar tasks on the other: performance on the former class of tasks involves explicit reference to or "conscious recollection" of a specific prior episode, whereas performance on the latter class of tasks does not.

Unfortunately, there is a potentially confusing ambiguity in this definition, centering on the use of the term *conscious recollection*. As discussed by Schacter (1989a) and Richardson-Klavehn and Bjork (1988), this term can be used in two quite different senses. First, conscious recollection can refer to *intentional* retrieval of recently studied information: the subject deliberately "thinks back" to a learning episode and searches for target information. When used in this sense, "conscious recollection" refers to the way in which the retrieval process is initiated, and is synonymous with such terms as *intentional*, *voluntary*, or *deliberate* recollection. Second, conscious recollection can refer to a phenomenological quality associated with the output of the retrieval process: a "recollective experience" (Tulving, 1983) or awareness of remembering that entails a re-experiencing of a recent episode.

When conscious recollection is used in the first of the two foregoing senses, the notion that performance on a task can be facilitated "in the absence of conscious recollection" (Graf & Schacter, 1985) means that test performance can be influenced by recently studied information even though the subject does not intentionally think back to the study episode. When conscious recollection is used in the latter sense, the statement that performance facilitations occur "in the ab-

sence of conscious recollection" means that subjects have no awareness that the responses they have produced were acquired during a recent episode.

We suggest, and will argue in greater detail shortly, that it is preferable to distinguish explicit from implicit memory in terms of intentional vs. unintentional retrieval processes—rather than in terms of the presence or absence of conscious recollective experience—primarily because we can develop rigorous criteria for making the former, but not the latter, distinction. It must be noted, however, that when we speak of intentional and unintentional retrieval processes, we do so only with reference to a specific study episode. For example, when performing an implicit task such as word completion, subjects who complete test stems with study list items are engaging in "unintentional retrieval" only in the specific sense that they are not deliberately trying to remember study list items; in a more general sense, they are engaging in intentional retrieval of appropriate completions from semantic memory. Similarly, when we speak of presence or absence of recollective experience, or awareness vs. unawareness of remembering, we do so only with respect to a specific study episode. Subjects who complete test stems with study list items are always aware of something—the completed item—but may under certain circumstances be unaware that the item was presented during a specific prior episode.

If we tentatively accept a definition of implicit memory as unintentional retrieval of information from a specific prior episode, a problem immediately arises: How do we characterize situations in which a test cue involuntarily triggers a full-blown "recollective re-experiencing" of a recent event? Schacter (1987) argued that such cases can be described as instances of *involuntary explicit memory* that ought to be distinguished from implicit memory; surely, we do not want to use the concept of implicit memory to refer both to the case in which an amnesic patient exhibits priming effects without any awareness of remembering, and the case in which a normal person is involuntarily reminded of a specific episode from his or her past. But if we accept the above suggestion that implicit memory should be defined in terms of unintentional or involuntary retrieval processes then, as pointed out in a cogent discussion by Richardson-Klavehn and Bjork (1988), we in effect definitionally rule out the concept of involuntary explicit memory.

In view of the foregoing considerations, it might appear most advisable to restrict the concept of implicit memory to those cases in which we can demonstrate that test performance is facilitated by information acquired during a study episode without any recollective re-experiencing or awareness of remembering on the part of the subject. It would thus follow that the concept of implicit memory should be invoked only when it can also be demonstrated that explicit memory performance is at or near chance levels, thereby ensuring that any observed facilitations of performance or priming effects do not involve awareness of the study episode.

Although such a solution does have some attractive features, it probably creates more problems than it solves. The main difficulty is that there are many instances in which it is by no means clear exactly how one goes about ascertaining that sub-

jects lack recollective experience or awareness of remembering at the time of test. The problem with requiring that explicit memory performance not exceed chance levels is that this criterion could easily rule out many instances in which subjects do, in fact, express information on an implicit test without any recollective re-experiencing of a prior episode. As Schacter (1987) notes, just because subjects can consciously remember a prior episode when asked to on an explicit test does not imply that they necessarily do so on an implicit test; the fact that certain kinds of information are *potentially* available for explicit remembering does not mean that they are used during performance of an implicit test. Once we acknowledge and accept this possibility, it becomes evident that with the exception of extreme cases (e.g., studies of severely amnesic patients), ascertaining whether subjects do or do not exhibit any awareness of remembering or recollective re-experiencing is not a straightforward matter.

Intentional Retrieval and Awareness of Remembering: Five Hypothetical Scenarios

To bring the foregoing issues into sharper focus, we present five hypothetical examples that illustrate some of the difficulties in attempting to evaluate whether or not subjects are aware of a prior episode during performance of a fragment completion, word identification, or other such priming test. In each example, we will assume that subjects study a list a familiar words, and after a retention interval of several minutes are asked to complete a series of three-letter stems with the first word that comes to mind.

1. The study list is presented under extremely degraded conditions (e.g., 35 *ms* exposure followed by a mask). On the completion test, subjects write down the first word that comes to mind for each stem, as instructed, and produce a larger number of study list completions than would be expected by chance. They do not become aware while performing the completion test that any of the items represent a study list target. When given a recognition test, subjects fail to recollect having studied any of the words that were produced as completions, and are unable to distinguish old from new items.

2. The study list is presented at a 5 *s*/item rate under elaborative study conditions (e.g., rating the pleasantness of each word). As instructed, subjects complete each test stem with the first word that comes to mind, and produce a large number of study list items. They do not spontaneously become aware while performing the completion test that any of the items represent a study list target. But when given a recognition test that requires them to think back to the study episode, subjects perform quite well, and consciously remember having studied almost all of the words that were produced as completions.

3. Subjects encode target items under elaborative study conditions, later complete each stem with the first word that comes to mind, and produce a large number of study list items. Although only the words themselves "pop to mind" during the completion test, subjects become aware after producing two or three items that

they represent study list targets; subjects do not become aware that several other of their completions are from the study list. These subjects continue to write down the first words that come to mind despite their awareness that some stems represent study list items.

4. Subjects encode target items under elaborative study conditions, later complete each stem with the first word that comes to mind, and produce a large number of study list items. For some stems, all that pops to mind during completion performance is the target word itself, but for others subjects are reminded by the stem of something that occurred during the study episode. For example, when a subject sees the stem *for____*, he is reminded that he had rated the target word *forest* as extremely pleasant because he liked the way it sounds. Nevertheless, the subject continues to write down the first word that comes to mind.

5. Identical to case 4, except that once subjects notice that one or two of the stems can be completed with study list items, they surmise that the experimenter is surreptitiously trying to test their memory, and decide that they can improve their performance by thinking back to the study list and trying to complete each stem with a target. They have no problem recollecting most of the words that were presented during the study episode.

Let us now consider these five cases in relation to the definitional issues of interest. The first case represents an unambiguous example of implicit memory: Subjects both engage in unintentional retrieval on the completion test and express no awareness or recollective experience—even when probed with an explicit test—that the produced items had been presented during the study episode. In contrast, cases two and three illustrate some of the ambiguities that can arise with respect to the awareness issue. In case two, subjects do not at any time experience awareness of the prior episode when performing the stem completion test, yet they can recollect the episode when required to do so on an explicit test. If we define implicit memory as facilitated test performance without awareness of the study episode, and further require that lack of awareness or recollective re-experiencing on an implicit test can be inferred only when subjects perform at chance levels on 3] 3 an explicit test, we would fail to accept case two as an instance of implicit memory.

Case three illustrates even more subtle problems. Here, subjects become aware that some, but not all, of the completions they produced represent study list targets. Moreover, this awareness of the prior episode is a "post-retrieval" phenomenon: A word pops to mind, and after having written it down, a subject recollects that it appeared during the study episode. At the moment of retrieval, however, the subject is reminded of a word, not of the episode in which he or she studied that word. If we were to accept the idea that lack of awareness of the study episode is a defining characteristic of implicit memory, this case would appear to qualify in two respects: first, for some items the subject experiences no recollective awareness, and second, the awareness that is experienced for other items is produced by processes that operate after retrieval of the target item is completed.

On the other hand, the subject does become aware of the study episode at various points during the test, and in that sense one might want to argue that this case is best excluded from the domain of implicit memory.

The foregoing considerations illustrate that in an intermediate case, deciding what does or does not constitute "awareness of the study episode" or "recollective experience" during performance of a completion test is not a straightforward matter. Moreover, these conceptual difficulties are compounded by an absence of online methods for measuring awareness in such cases. We will describe later in this chapter several experiments that have attempted to come to grips with this issue; as we shall see, however, they do not enable us to resolve the kinds of problems posed by case three.

Case four represents an example of what Schacter (1987) referred to as *involuntary explicit memory*: The test stem brings to mind an *event* that occurred during the study episode, not just a lexical item. To take a popular example, this represents an instance of a classical Proustian memory: A cue involuntarily triggers a vivid recollection of a past event. Clearly, the concept of implicit memory was not intended to encompass Proustian recollections. The critical problem concerns how one empirically distinguishes between this case, and cases two and three, which can be sensibly included in the implicit memory domain. As far as we know, there is no extant measure that would allow us to do so.

Finally, case five represents a clear example of explicit memory processes intruding into performance of a nominally implicit test: The subject "catches on" to the nature of the test and intentionally recollects the prior episode. This case cannot be characterized in any sensible way as an example of implicit memory: Subjects engage in intentional retrieval, and are also fully aware of the study episode throughout the test. If the implicit vs. explicit distinction is to be useful at all, we must be able to develop criteria that allow us to determine when this phenomenon occurs and to distinguish it from the preceding cases. Otherwise, our nominal characterization of tasks as "implicit memory tests" may be an inaccurate description of how the task is actually performed. We now turn to a discussion of a criterion that can help us solve this problem.

AN EMPIRICAL BASIS FOR MAKING AN IMPLICIT VS. EXPLICIT DISTINCTION: THE RETRIEVAL INTENTIONALITY CRITERION

The concept of implicit memory is predicated on the notion that test performance can be influenced by information acquired during an episode even though the test does not make reference to the episode. As illustrated by the foregoing case five, however, just because a test does not require a subject to think back to the study episode does not prevent the subject from doing so anyway. Once we acknowledge this possibility, the basis for drawing an implicit vs. explicit distinction becomes hazy indeed; we have no way of determining a priori whether we are dealing with an implicit or explicit form of memory on an allegedly "implicit test", unless we

can convincingly distinguish between intentional and unintentional retrieval of information acquired during a study episode.

We propose an empirical means for making this distinction, referred to as the *retrieval intentionality criterion*, that can be applied to experimental situations straightforwardly and has clearly stated, testable consequences. The criterion is comprised of two key components. First, the nominal or external cues provided to subjects on implicit and explicit tests should be the same, and only test instructions varied: Implicit instructions should require subjects to perform a task that does not require thinking back to the study episode, whereas explicit instructions should require the subject to think back to the study episode. Second, an experimental manipulation should be identified that selectively affects performance on one of these tasks and not the other. The logic underlying this retrieval intentionality criterion is straightforward: If the external cues are held constant on two tasks and only the retrieval instructions are varied, then differential effects of an experimental manipulation on performance of the two tasks can be attributed to differences in the intentional vs. unintentional retrieval processes that are used in task performance. According to this formulation, once we have identified an experimental paradigm that satisfies both of these conditions, we can begin to use the data generated by the paradigm to make inferences about the nature of implicit vs. explicit memory.

This criterion enables us to identify instances in which subjects engage in intentional retrieval during performance of a nominally "implicit" test, as described earlier in case five. If subjects engage in intentional retrieval while performing an implicit test, it should not be possible to obtain an experimental dissociation between implicit and explicit memory under conditions in which the external cues are held constant across tests—performance on an implicit test should be affected by an experimental manipulation in the same way as it influences performance on an explicit test consisting of the same external cues. Accordingly, once a dissociation has been established with an experimental paradigm that assesses implicit and explicit memory with identical cues, we can effectively rule out the possibility that subjects use explicit strategies in the paradigm of interest.

One beneficial consequence of adhering to the retrieval intentionality criterion is that it provides a means for non-circular interpretation of parallel effects of an experimental variable on performance of implicit and explicit tasks. Suppose that variable X influences performance on an implicit test Y and explicit test Z similarly, where tests Y and Z are comprised of the same external cues. It is possible that such a result is providing useful information about the similarities between implicit and explicit memory. Alternatively, it is always possible to argue—albeit circularly—that subjects treated the implicit task like an explicit task, hence the parallel results. However, if we have already established that performance on these two tasks can be dissociated by experimental variable Q, then we can argue strongly against the idea that subjects treated the implicit test like an explicit test; if they had, variable Q could not have produced the dissociation that it did.

To illustrate these points more concretely, let us consider several experiments by Graf and Schacter (1987, 1989; Schacter & Graf, 1986a, 1989) concerning the phenomenon of implicit memory for new associations. In these experiments, subjects studied unrelated word pairs (e.g., *ship–castle*), and were later given a stem completion test in which they were required to write down the first word that came to mind. On this test, some target stems were paired with their study list cues (e.g., *ship–cas___*; same context condition) whereas some were paired with other cues from the study list (e.g., *officer–cas___*; different context condition). A separate group of subjects was given a recall test that contained the identical cue-stem pairs, but required subjects to think back to the study episode and remember the target items.

Graf and Schacter (1985; Schacter & Graf, 1986a) found more priming on the completion test in the same- than different-context condition, and argued on the basis of this finding that newly acquired associations between the studied pairs influenced performance on the implicit memory test. However, this phenomenon of implicit memory for new associations occurred only following study tasks that required some elaborative processing, such as reading the word pairs in a meaningful sentence or generating a sentence to link the pair; when subjects engaged in non-elaborative study processing (e.g., counting vowels and consonants), there were equivalent amounts of priming in the same- and different-context conditions (Graf & Schacter, 1985; Schacter & Graf, 1986a). Not surprisingly, explicit memory for new associations, as assessed by the cued recall test, also depended on elaborative study processing.

The foregoing pattern of results raises interpretive problems that can be clarified with reference to our retrieval intentionality criterion. On the one hand, the Graf and Schacter (G&S) data may be telling us about a potentially important similarity between implicit and explicit memory for new associations: both require some elaborative study processing. On the other hand, however, it is possible that the elaboration-dependence observed on the stem completion test simply indicates that subjects were treating this task like a cued recall test; perhaps they caught on to the fact that some study list items were on the completion test and thus engaged in explicit, intentional retrieval in order to provide as many "correct" responses as possible.

Following the logic of the retrieval intentionality criterion, we can reject the latter possibility if we are able to produce experimental dissociations between stem completion and cued recall in the G&S paradigm: Since the external cues are identical on the two tests, dissociations between them would indicate that subjects do not engage in intentional, explicit retrieval on the completion test. In fact, G&S have reported several such dissociations: Manipulations of *degree* and *type* of elaborative processing (Schacter & Graf, 1986a; Graf & Schacter, 1989), as well as proactive and retroactive interference (Graf & Schacter, 1987) affected cued recall but not completion performance, whereas study-test modality shifts affected completion but not cued recall (Schacter & Graf, 1989). Such dissociations simp-

ly could not be produced if subjects treated the completion test like a cued recall test. We can thus interpret the parallel results obtained with this paradigm (i.e., associative effects on both stem completion and cued recall both require some elaborative study processing) as evidence of a similarity between implicit and explicit memory for new associations, a similarity that could have important theoretical consequences (Schacter & Graf, 1986a, 1989).

Another instance in which the retrieval intentionality criterion plays a key role is in the *triangulation method* of Hayman and Tulving (1989a). The triangulation method represents an attempt to come to grips with difficulties in the measurement and interpretation of stochastic independence between implicit and explicit tests. Although it has been established, for example, that priming effects on a fragment completion test are independent of recognition or non-recognition of the target on a preceding recognition test (e.g., Tulving, Schacter, & Stark, 1982), independence may be an artifact of "test priming" effects produced by presentation of targets on the recognition test (Shimamura, 1985). Hayman and Tulving suggested that this problem can be addressed by comparing the relation between recognition and fragment completion performance in two conditions: one in which the recognition test is followed by a fragment completion test given with implicit memory instructions (i.e., "Complete the fragment with the first word that comes to mind"), and a second in which the recognition test is followed by a fragment completion test given with explicit memory instructions (i.e., "Try to remember the study list target"). If stochastic independence is observed in the former but not the latter condition, as Hayman and Tulving find in their experiments, then independence cannot be regarded as an artifact of priming from the recognition test, because equivalent amounts of such priming occur in the two conditions. The critical point for present purposes is that the Hayman and Tulving procedure adheres to the retrieval intentionality criterion: External cues are held constant on the two fragment completion tests, only the implicit vs. explicit nature of test instructions is varied, and an experimental dissociation is produced (i.e., fragment completion with implicit instructions is independent of recognition, whereas fragment completion with explicit instructions is dependent on recognition).

In summary, the criterion we have outlined provides a non-circular, empirically testable way of distinguishing between explicit and implicit tests by providing a basis for assessing whether subjects are engaging in intentional or unintentional retrieval. It does not, however, address the less tractable question of awareness or recollective experience and thus does not enable us to distinguish between involuntary explicit memory and implicit memory. As discussed earlier, one possible criterion for making this distinction is to require that priming or facilitation on an implicit test be accompanied by chance performance on a parallel explicit test. Although this criterion can be useful when chance performance is obtained, the difficulty is that above-chance performance on an explicit test need not imply that facilitation on an implicit test involves awareness of the study episode, and we presently have no acceptable on-line measures for assessing this problem. We

therefore suggest that at the present time, a reasonable approach is to use the retrieval intentionality criterion outlined above for making the implicit vs. explicit distinction, acknowledge that it would further be desirable to distinguish involuntary explicit memory from implicit memory, and pursue research that explores the awareness issue in order to provide an empirical basis for making this distinction. We next discuss some recent experiments in which we have begun to address this problem.

AWARENESS AND IMPLICIT MEMORY: EXPERIMENTAL STUDIES

Awareness and Stem Completion Priming

Let us now turn to a series of studies in which we have begun to investigate experimentally the relation between awareness of a prior study episode and implicit memory. The main purpose of these experiments was to determine whether significant priming effects would be observed in subjects who, during performance of different kinds of word completion tests, remained unaware of the study episode. It was noted earlier that we do not presently have any useful on-line methods for assessing awareness of a prior episode during performance of implicit tests. As an alternative, we attempted to assess awareness by questioning subjects immediately after they finished the critical task. Initial questions were rather open-ended (i.e., "What did you think was the purpose of the stem completion task that you just finished?"; "What was your general strategy in completing the word stems?"), and subsequent ones were more pointed (i.e., "Did you notice any relationship between the words I showed you earlier and the word produced on the stem completion test?"; "While doing the stem completion test, did you notice whether you completed some of the stems with words studied in the earlier list?"). Subjects who either spontaneously mentioned the study episode in response to the first two questions or responded positively to either of the latter two questions were classified as *aware*; those who did not spontaneously mention the study episode and responded negatively to both questions three and four were classified as *unaware*.

Experiment 1 used a standard stem completion procedure in which subjects were first exposed to a list of 24 familiar words, performed a semantic orienting task on half of them (rating the pleasantness of each word), and performed a nonsemantic or structural orienting task on the other half (counting the number of t-junctions in each word; cf., Graf & Mandler, 1984). After a series of filler tasks (generating names of cities, countries, and famous names, respectively, to letter fragment cues), they were then given a sheet containing 75 three-letter stems (12 items represented target or study list items; 63 were new items) and were asked to complete them with the first word that came to mind. Two between-subjects manipulations were included in a fully crossed experimental design. The first was an intentional vs. incidental study manipulation: Half the subjects were told that their memory for the target words would be subsequently tested, and half were

TABLE 4.1
Mean Proportion of Three-Letter Stems Completed With Target Words as a Function of Encoding Task and Test Instructions

	Type of Encoding		
Test Instructions	*Semantic*	*Structural*	*M*
Informed	.27	.28	.28
Uninformed	.38	.25	.31
M	.33	.27	

Note: Baseline completion rate was .12.

told that their responses on the orienting task were needed for normative purposes; no mention of any memory test was made. To increase the plausibility of the cover story for subjects in the incidental condition, the orienting tasks were preceded by presentation of pictures of faces that all subjects were required to rate for pleasantness, and for whether the eye or mouth was the most distinctive feature. The second between-subjects manipulation concerned whether subjects were *test informed* or *test uninformed*. *Test informed* subjects were told that some of the stems on the completion test could be filled in with study-list items, but that they should nevertheless write down the first word that comes to mind. *Test uninformed* subjects were told that the stem completion test, like the city, country, and name completion tests that preceded it, was simply another task for which normative data were required. The foregoing awareness questionnaire was given only to subjects in the test uninformed groups, since test informed subjects were by definition aware that stems could be completed with study list items.

Results indicated that there was no effect of the intentional vs. incidental encoding manipulation on stem completion performance, so for ease of exposition we will collapse the data across these conditions. As suggested by the results displayed in Table 4.1, performance in each experimental condition was significantly ($p. < .05$) higher than the baseline completion rate of .12, thereby indicating that consistent priming occurred. In addition, following structural (shallow) encoding there was a negligible difference between test informed (.28) and test uninformed (.25) subjects, whereas following semantic encoding there was a marginally significant advantage for test uninformed (.38) over test informed subjects (.27).

Consider next the results from the test uninformed group when subjects are divided according to their responses to the post-test awareness questions (Table 4.2). *Test aware* subjects (n=20) indicated some awareness that test stems had been completed with study list items whereas test unaware subjects (n=20) in-

TABLE 4.2
Mean Proportion of Three-Letter Stems Completed With Target Items in Subjects Classified as Test Aware and Unaware as a Function of Encoding Task

		Type of Encoding		
Classification		*Semantic*	*Structural*	*M*
Test Aware	(N=20)	.43	.23	.33
Test Unaware	(N=20)	.33	.28	.31
M		.38	.26	

dicated no such awareness. The most important point to emerge from these data is that test unaware subjects exhibited robust priming following both semantic and structural encoding tasks; collapsed across encoding conditions, test unaware subjects showed about as much priming (.31) as did test aware subjects (.33). However, whereas the performance of test unaware subjects did not differ significantly in semantic (.33) and structural (.28) conditions, test aware subjects showed significantly more priming following semantic (.43) than structural (.23) encoding.

These data show that priming effects on a stem completion task can be observed in subjects who are not aware of the prior study episode during completion performance, at least to the extent that such awareness is adequately captured by the post-test questionnaire. Moreover, equivalent amounts of priming were observed for test unaware subjects in incidental and intentional learning conditions, thereby indicating that subjects who were at no time aware that they were participating in a memory experiment show normal priming effects. However, aware subjects did show more priming than unaware subjects in the semantic (but not structural) encoding condition. One possible reason for this result is that when subjects became aware of the nature of the completion test, they may have felt that they had "seen through" the nature of this elaborately disguised experiment and attempted explicitly to retrieve target items. Such a strategy would have been useful following semantic encoding, which provides a basis for good explicit recall, but not following structural encoding, which typically leads to extremely poor recall performance (e.g., Craik & Tulving, 1975; Graf & Mandler, 1984; Roediger & Blaxton, 1987b). Consistent with this suggestion, performance on a cued recall test given after the completion test (with the same nominal three-letter cues) indicated that performance in the semantic condition (.47) was considerably higher

than on the completion test, whereas performance in the structural condition (.19) was actually slightly lower than on the completion test.

Several points should be considered in light of the data from this experiment. The observation that test aware subjects showed more priming following a semantic than a structural study task contrasts with the demonstration of equivalent priming effects on the stem completion task following semantic and structural study tasks in our own test informed subjects (Table 4.1) and in previous studies (Graf, Mandler, & Haden, 1982; Graf & Mandler, 1984). These observations suggest that elaborate attempts to disguise the nature of an implicit test can backfire if subjects "catch on" to the nature of the experiment and are not prohibited from using explicit memory strategies, as our test uninformed subjects were not. The fact that test unaware and test informed subjects showed similar levels of priming indicates that as long as instructions emphasize writing down the first word that comes to mind, subjects will do so even if they are aware that some completions come from the study list. Moreover, our data, together with reports of intact completion performance in severely amnesic patients (Graf, Squire, & Mandler, 1984; Warrington & Weiskrantz, 1974), indicate that implicit memory effects on the stem completion task can occur normally without any awareness of a prior study episode. Consistent with this observation, we note that even in test informed subjects, as well as test uninformed subjects who were classified as aware, it is possible that a significant proportion of primed completions were produced without awareness of a prior episode. Test aware subjects were classified as "aware" if they noticed at *any* point during the task that a completion came from the study list; it is entirely conceivable that they did not experience awareness for *all* primed completions. Similarly, the fact that test informed subjects were told prior to test performance that some completions might come from the study list need not imply that they experienced awareness of the prior episode when they produced each primed completion. Uncertainty on this point derives from our lack of adequate on-line methods for assessing awareness during completion performance. Despite these interpretive ambiguities concerning the aware subjects, the data from test unaware subjects indicate clearly that awareness of a prior episode is not necessary for stem completion priming to occur. We now examine this issue with respect to a different yet related implicit memory phenomenon.

Awareness and Implicit Memory for New Associations

As discussed earlier, a number of experiments by Graf and Schacter (1985, 1987, 1989; Schacter & Graf, 1986a, 1986b, 1989) have demonstrated that stem completion performance is influenced by newly acquired associations between unrelated words. This priming of new associations differs from priming of individual words insofar as associative priming, unlike word priming, requires some elaborative study processing (Graf & Schacter, 1985; Schacter & Graf, 1986a; see also Schacter & McGlynn, 1989). We sought to determine whether associative prim-

ing, like word priming, could be observed in subjects who are unaware of the prior study episode during the completion test.

The general design of this experiment was similar to that of the foregoing study, except that only the incidental study and test uninformed conditions were used. Twenty four subjects participated in the experiment. They were told that they were taking part in an experiment that involved rating pictures and words. Subjects were shown 18 critical unrelated word pairs that were presented in meaningful sentences (e.g., "The empty *ship* sailed by the *castle*") and rated the degree to which the sentence meaningfully linked the words (see Schacter & Graf, 1986a, for further details on the sentence rating procedure). They were next given a picture rating task that involved rating complex scenes on various dimensions, followed by the city, country, and name generation tasks described earlier. The completion task was then administered. Half of the critical pairs were tested in the same-context condition (*ship–cas____*), and half in the different-context condition (*mother–cas____*); different context cues (e.g., *mother*) had not appeared on the study list. 84 distractor items that had not appeared anywhere on the study list (e.g., *garden–win____*) were also included on the test sheets in order to further disguise the nature of the completion test. Subjects were instructed to write down the first word that came to mind in response to each stem, and were told that the word paired with the stem might help them to think of a completion. They were required to read each context word aloud before completing the paired stem, but it was emphasized that the completion they provided need not be in any way related to the context word. The awareness questionnaire was administered immediately after the completion test followed by a cued recall test that consisted of the same nominal cues presented on the completion test, in conjunction with explicit instructions.

On the basis of the awareness questionnaire, fifteen subjects were classified as test unaware and nine were classified as test aware. Test aware subjects showed a significant context or associative effect similar to that reported in the G&S experiments: probability of completing a stem with a study list target was .26 in the same-context condition and .12 in the different context condition. In contrast, test unaware subjects did not show a context effect: Probability of completing a stem with a study-list target was .13 in both conditions. In fact, performance of test unaware subjects was at or near the baseline completion rate of .10-.12 obtained in previous experiments using these materials (e.g., Schacter & Graf, 1986a), thereby suggesting that no priming whatsoever occurred in these subjects.

In an attempt to assess the reliability of these results, we performed a third experiment with a different set of 36 subjects that was identical to the preceding one except for a few minor changes in procedural detail. Fifteen of these subjects were classified as test aware, and 21 were classified as test unaware. As in Experiment 2, test aware subjects showed significantly more priming in the same (.28) than different (.15) context condition, whereas test unaware subjects showed no evidence of any priming in either the same (.10) or different (.11) context conditions.

One possible interpretation of the failure to find an associative effect in unaware subjects is that the result was produced by a subject selection effect. For example, subjects classified as unaware may not have fully engaged in the elaborative study processing necessary to show implicit memory for new associations (Schacter & Graf, 1986a) and hence produced few target items on the completion test. These subjects would then have had little or no basis for becoming aware of the prior episode during completion performance. Consistent with this suggestion, unaware subjects performed more poorly than did aware subjects on the cued recall test given after the awareness questionnaire in Experiment 2: Same context recall was .20 in unaware subjects and .43 in aware subjects; different context recall was .06 and .12 in unaware and aware subjects, respectively. A virtually identical pattern of results was observed on the cued recall test in Experiment 3. In addition, unaware subjects in Experiment 3 performed more poorly than did aware subjects on a pair recognition test that was administered after the cued recall test.

Although these data suggest some role for subject selection factors in Experiments 2 and 3, the question arises as to why similar selection factors apparently did not influence the outcome of Experiment 1, where unaware subjects showed substantial word priming on a stem completion task. A likely explanation is that word priming effects, in contrast to associative priming effects, do not require any elaborative study processing; mere exposure to a word appears to be sufficient for obtaining priming (e.g., Graf & Mandler, 1984). Thus, we can safely assume that all subjects performed the minimal encoding operations necessary to show priming effects in Experiment 1, so the sort of subject selection effects that appeared to have influenced Experiments 2 and 3 would have played little or no role.

Whatever the role of subject selection, the fact that unaware subjects failed to show any associative priming raises the possibility that associative effects on stem completion are attributable to the use of intentional retrieval strategies by subjects who have "caught on" to the nature of the task—that is, associative effects may be observed only when aware subjects deliberately think back to the study episode. Unaware subjects, who by definition do not catch on to the nature of the task, also presumably do not engage in intentional retrieval. The problem with this view is that we have already considered evidence that associative effects in stem completion can be dissociated from associative effects in cued recall under conditions in which test cues are held constant and only retrieval instructions are varied (Graf & Schacter, 1987, 1988; Schacter & Graf, 1986a, 1989). As discussed earlier, such dissociations could not be produced if subjects engaged in intentional retrieval on the stem completion task. Therefore, the finding that the associative influence on stem completion occurs only in test aware subjects does not mean that this effect is dependent on the use of intentional retrieval strategies during test performance. The evidence from the G&S studies demonstrates quite clearly that associative effects occur under conditions in which subjects do not engage in intentional retrieval of the study episode.

A more defensible interpretation of the failure to observe associative effects in unaware subjects is that the phenomenon referred to as "implicit memory for new associations" might be more properly characterized as unintentional or involuntary explicit memory for new associations—that is, associative effects on stem completion may be observed only when subjects are explicitly (though unintentionally) reminded of the prior occurrence of a target pair on the study list. This characterization could accommodate the various dissociations that have been reported in the G&S studies, and would also be consistent with the finding that most severely amnesic patients do not show normal priming effects in this paradigm (Cermak, Bleich & Blackford, 1988; Schacter & Graf, 1986b; Shimamura & Squire, 1988). Although this idea cannot be rejected unequivocally, there are several problems with it. First, Cermak and his colleagues (Cermak, Blackford, O'Connor, & Bleich, 1988) have recently reported that a severely amnesic encephalitic patient, S. S., does show intact associative effects in the G&S paradigm, thereby suggesting that this phenomenon can occur without explicit memory for a prior episode. A second problem emerges from consideration of results from the different context condition of our Experiments 2 and 3. Unaware subjects showed no evidence of priming in the different context condition. However, we know from previous studies that even those severely amnesic patients who do not show an associative effect in the G&S paradigm show robust priming in the different context condition (Graf & Schacter, 1985; Schacter & Graf, 1986b; Cermak, Bleich, & Blackford, 1988; Shimamura & Squire, 1989). For example, in Schacter and Graf's (1986b) experiment, the severely amnesic patients' completion rate in the different context condition was .29, compared to the .13 and .11 shown by unaware subjects in our experiments. Since different-context priming was observed in even the most profoundly amnesic patients, who lack the ability to become explicitly aware of a study episode at test, we can assume that the phenomenon is not dependent on explicit memory. Why, then, did test unaware subjects fail to show priming in the different context condition of our experiments, when test unaware amnesic patients show large effects in a similar paradigm? More generally, even aware subjects showed little evidence of priming in our different-context condition. This finding contrasts sharply with the results of numerous experiments by G&S in which significant priming in the different-context condition has been consistently observed across a range of experimental conditions. We think that this contrast provides clues concerning interpretation of the experiments presented here.

Although our experiments were similar in many respects to those in the G&S series, there were several possibly important differences. First, all of the G&S experiments on implicit memory for new associations used *intentional* study conditions: before performing a particular study task (e.g., sentence rating or generating), subjects were instructed that their memory for the target pairs would be probed at some later point in the experiment. In contrast, an entirely *incidental* procedure was used in Experiments 2 and 3 above: subjects did not know at the

time of study that their memory for the target pairs would be tested. Second, in the standard G&S procedure, different context test items are typically formed by *re-pairing* study list cues and targets. By contrast, to form different context items in Experiments 2 and 3, we paired target stems with words that had not appeared anywhere on the study list—what we will refer to as off-list cues. Third, in the awareness experiments, there was a delay of 20-30 minutes between study list presentation and completion testing, whereas in most of the G&S studies retention intervals of about 3 minutes were used.

We have several reasons to believe that only the first of these changes from the standard G&S paradigm—incidental vs. intentional encoding—is critical to the results we obtained. Retention interval is not likely to be a significant factor, because Graf and Schacter (1989) recently reported significant priming in the different-context condition one hour after intentional study. Also, in a recent study we systematically examined the roles of incidental vs. intentional study and repaired vs. off-list cueing in different-context priming. When subjects rated sentences at study, as in the awareness experiments, and completion performance was tested after a three-minute delay, significant different-context priming was observed following intentional but not incidental encoding. Within the intentional condition, equivalent amounts of priming were observed in the repaired and off-list cueing conditions, thereby indicating that the use of off-list cues in the awareness experiments was not a significant factor in producing the observed results. A key implication of these findings is that it may be possible to observe associative effects on a completion task in test unaware subjects following intentional encoding; we are currently investigating this possibility experimentally.

In addition to their bearing on the awareness issue, our data have other implications that merit some discussion. Perhaps the most surprising finding is that different-context priming was consistently eliminated when subjects performed the sentence rating task under incidental encoding conditions. Graf and Schacter (1985; Schacter & Graf, 1986a, 1986b) have argued that priming in the different context condition is attributable to automatic activation of the pre-existing representations of target words at the time of study (see also Cermak, Bleich, & Blackford, 1988; Shimamura & Squire, 1989). This argument is consistent with the observation from earlier studies that priming in the different-context condition is generally unaffected or not significantly affected by experimental manipulations that influence priming in the same-context condition (Graf & Schacter, 1985; Schacter & Graf, 1986a, Experiments 3 & 4; Schacter & Graf, 1989, Experiments 1-3) or level of explicit memory performance (Graf & Schacter, 1987; Schacter & Graf, 1986a, Experiments 1 & 2). However, by this hypothesis, both aware and unaware subjects ought to have shown robust different-context priming in our experiments, and intentional vs. incidental encoding should have had no influence on the magnitude of priming: initial encoding of the critical pairs should have automatically activated the pre-existing representations of target words, which in turn should have increased the tendency to complete test stems

with the recently activated targets in the different context condition of the completion test.

These considerations suggest that priming in the different-context condition is not solely based on automatic activation, but may also depend on gaining access to components of the same newly established episodic representation that supports priming in the same-context condition; the test items presented in the different-context condition may simply be poor cues for gaining access to episodic traces of the study pairs. That is, the cue presented in the different context condition has relatively little feature overlap (Tulving, 1983) with the target pair (e.g., *mother–cas___* for *ship–castle*), and is thus unlikely to reinstate the pair frequently. In contrast, the same-context cue (e.g., *ship–cas___* for *ship–castle*) shares more features in common with the encoded target pair and, assuming that associative study elaboration has occurred, is more likely to reinstate appropriate components of the episodic trace at the time of test. Although it would be premature and post-hoc to attempt a more detailed account of the pertinent data, such an interpretation may be more profitably pursued within an episodic rather than an activation framework.

The foregoing discussion has some intriguing implications for the interpretation of priming effects in amnesia. As stated earlier, most severely amnesic patients do not show more priming in the same- than in the different-context condition of the G&S paradigm, but even the most profoundly amnesic patients show entirely normal priming in the different-context condition (Cermak, Bleich, & Blackford, 1988; Cermak, Blackford, O'Connor, & Bleich, 1988; Graf & Schacter, 1985; Schacter & Graf, 1986b; Shimamura & Squire, 1989). The foregoing investigators have attributed intact different-context priming in amnesia to automatic activation of pre-existing representations. However, according to the data presented earlier and our suggestion that priming in the different-context condition reflects access to components of an episodic trace, amnesic patients' normal performance in this condition may reflect more than just automatic activation of pre-existing representations. Of course, the most densely amnesic patients cannot *explicitly* remember a study episode at the time of test, and often will not recollect that any study list was presented. An interesting task for future research will be to delineate more precisely the exact nature of the episodic information that supports amnesic patients' intact different-context priming.

SUMMARY AND CONCLUSIONS

The main purpose of our chapter has been to highlight and discuss issues concerning the two key features that distinguish implicit and explicit memory: intentional vs. unintentional retrieval processes and awareness vs. unawareness of a prior study episode at the time of test. We suggested that adherence to the retrieval intentionality criterion provides an empirically testable means for determining whether subjects are engaging in intentional or unintentional retrieval of a prior

study episode. Applying this criterion to the experimental evidence, we concluded that both word priming effects and associative priming effects do not require intentional retrieval. We also noted that the retrieval intentionality criterion does not allow us to determine whether subjects are aware of the episode during test performance. Experiments designed to investigate the latter issue indicated that word priming effects can be observed in subjects who are unaware of the study episode throughout performance of a completion test, whereas associative priming effects have thus far been observed only in subjects who show some test awareness. This latter finding, considered together with the evidence that associative priming effects do not require intentional retrieval, suggest that awareness of a study episode is mediated by different processes than is intentional retrieval. This idea forms an important basis of, and is elaborated further in, theoretical models recently put forward by Schacter (1989a) and Moscovitch (1989).

The foregoing considerations remind us that the implicit vs. explicit distinction was put forward as a *descriptive* dichotomy to capture some important differences concerning the distinct and dissociable ways in which memory for recent experiences can be expressed. The concept of implicit memory was not intended to implicate the existence of, and should not be thought of as referring to, a discrete underlying memory system or process. Although it is useful to conceptualize some implicit memory phenomena in terms of multiple memory systems (see Schacter, 1989b, for an attempted resolution of the single vs. multiple memory system controversy), the implicit/explicit distinction itself is mute concerning the possible existence of such systems. Rather, implicit memory refers to *properties* of retrieval phenomena that appear to be mediated, at least in part, by different processes than those involved in explicit remembering (c.f. Parkin, this volume). Elucidation of the nature of and relations among the processes underlying implicit and explicit memory represents the principal challenge for empirical and theoretical analyses.