3

Emotion and Implicit Memory

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A topic of major theoretical interest within cognitive psychology pertains to the bidirectional relations among cognitive and emotional processes. In this literature, most attention has been focused on memory phenomena of various kinds (Blaney, 1986; Bower, 1981; Ellis & Ashbrook, 1987, 1988; Johnson & Magaro, 1987). And almost without exception, this research has focused on "conscious" or explicit memory: the person's conscious, intentional recollection of some previous episode, most commonly reflected in standard tests of recall and recognition. So, for example, congruence between the the individual's mood states at encoding and retrieval appears to affect the accessibility of memories (Eich & Metcalfe, 1989). Moreover, the retrieval of emotional memories obviously can affect the individual's mood state—although this effect has not received much attention in the experimental literature. However, there is more to memory than what the individual can bring to awareness in an act of conscious, intentional, recall or recognition. The purpose of this chapter is to review findings that can be conceptualized as involving what has variously been referred to as unconscious memory (e.g., Breuer & Freud, 1893/1955; Prince, 1914), memory without awareness (e.g., Eich, 1984; Eriksen, 1960; Jacoby & Witherspoon, 1982), or implicit memory (Graf & Schacter, 1985; Schacter, 1987, 1989, in press).

DISSOCIATIONS BETWEEN IMPLICIT AND EXPLICIT MEMORY

Defined most broadly, implicit memory is demonstrated by a change in behavior that is attributable to some prior episode of experience, but that cannot be accounted for by explicit memory for that event. Typically, implicit memory is revealed by tasks that do not require conscious or intentional recollection of those experiences (Schacter, 1987, p. 501). For example, in an experiment by Kihlstrom (1980), hypnotized subjects memorized a list of words, followed by suggestions of posthypnotic amnesia for the learning experience. As expected, these subjects showed a dense amnesia for the wordlist, as measured by free recall. Nevertheless, they were more likely to produce list items as responses on a word-association task. Similar results were obtained in a second experiment involving category instance generation. In an experiment by Graf and Schacter (1985), amnesic patients and normal controls studied a list of paired associates. Later, they were presented with the first word of the pair. For some test items, the subjects were asked to recall the associated word from the previously studied list; not surprisingly, the amnesic patients performed quite poorly. For other items, the subjects were provided with the first three letters of the second item and gave the first word that came to mind: On this task, amnesics and controls were equally likely to give an item from the previous list.

In both experiments, subjects showed a facilitation in task performance that was attributable to a prior experience. Nevertheless, these same subjects were unable to remember the experiences themselves. Thus, these experiments illustrate the dissociation between explicit and implicit memory (for more complete reviews, see Richardson-Klavehn & Bjork, 1988; Schacter, 1987, 1989, in press). This dissociation is manifested in one of two ways. First, explicit memory is impaired whereas implicit memory is (at least relatively) spared. This situation is illustrated in the specimen experiments described before, as well as in aging (Schacter, Kaszniak, & Kihlstrom, in press) and surgical anesthesia (Kihlstrom & Schacter, 1990a). Second, different variables affect performance on explicit and implicit memory tasks. For example, some experiments find that level of processing affects explicit but not implicit memory (Graf & Mandler, 1984), whereas others find that modality shifts between study and test affect implicit but not explicit memory (Schacter & Graf, 1989).

It is possible that explicit and implicit memory effects reflect the operations of several different memory systems in the brain concerned with the perceptual representation of experience, procedural

memory for skill knowledge, semantic memory for conceptual relations, and episodic memory for experiences (Tulving & Schacter, 1990). Although theoretical interpretation of relevant phenomena remains somewhat controversial, what is clear is that explicit and implicit memory are two different modes by which memory for some prior event can be expressed. In this chapter, we focus on implicit expressions of memory, in order to address two fundamental questions derived from the bidirectional relations between memory and emotion: "Does implicit memory affect emotional experience?"; and "Does emotional experience affect implicit memory?"

EMOTION AS IMPLICIT MEMORY

Although studies of implicit memory have most commonly employed verbal tasks such as stem and fragment completion, lexical decision, or free association, in principle a great variety of tasks can reveal the impact of a previous event on experience, thought, and action. For example, Schacter, Cooper, and Delaney (1990) showed that implicit memory facilitated subjects' decisions about whether line drawings represented possible or impossible objects—a perceptual task far removed from conventional memory paradigms. Implicit memory has also been revealed on tasks involving eyelid conditioning (e.g., Weiskrantz & Warrington, 1979), identification of dot patterns (Musen & Triesman, 1990), and judgments of auditory noise (Jacoby, Allan, Collins, & Larwill, 1988). Accordingly, it seems possible that implicit memory may also be expressed through emotional responses; that is, emotional responses, as well as performance on perceptual and semantic memory tasks, may reflect implicit memory for some prior experience.

Consider the following illustrations of the type of phenomenon we have in mind:

> In a classic demonstration of organic amnesia, Claparede (1911/1951) pricked an unsuspecting Korsakoff's syndrome patient with a pin hidden in his hand. Subsequently the patient refused to shake his hand, despite the fact that she had no explicit memory for the prior incident.
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> Madame D, a case reported by Janet (1893, 1904), acquired hysterical somnambulism with amnesia after some men jokingly deposited her drunken husband on her doorstep and announced that he was dead. She had no conscious recollection of the event but "froze with terror" every time she passed that door.
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> Bagby (1928) reported on a woman with a phobia for running water. She had no memory of the circumstances under which this reaction had been

acquired until adulthood when she was visited by an aunt who triggered memory for a childhood incident where she had strayed away from a picnic and became trapped under a waterfall.

Levinson (1967) reported on a woman who came out of surgery inexplicably weepy, depressed, and disconsolate. To his surprise the woman blurted out while under hypnosis, "the surgeon says it might be malignant"! Further investigation revealed that the doctors had discovered a possible malignancy during the surgery and had discussed it while she was anesthetized.

In each of these cases, the person shows a change in emotional response—refusing to shake hands, freezing at a doorway, fearing running water, or feeling depressed—that is directly attributable to some previous experience; yet in each case, the experience itself is not remembered. In principle, this dissociation between the person's emotional response and his or her conscious recollection is analogous to the dissociation between implicit and explicit memory observed in the laboratory. In the following pages, we expand this anecdotal evidence, reviewing four areas of research that seem to reveal experience-based changes in evaluative judgment, affective response, or emotional state that occur in the absence of explicit memory for the experiences themselves: emotional behavior in brain-damaged patients, functional amnesias observed in the dissociative disorders, hypnotic alterations in emotional state, and "mere exposure" effects in implicit perception.

Neurological Patients

Some of the most dramatic dissociations between explicit and implicit memory have been observed in patients with organic brain syndrome. For example, bilateral lesions in the medial portions of the temporal lobe (including the hippocampus) and diencephalon (including the mammillary bodies) results in a gross anterograde amnesia, such that the patients cannot remember events that occurred since the damage occurred. For example, when asked to study a list of familiar words and then recall the items, they show gross impairments of memory. However, when asked to complete a stem or fragment with a meaningful word, they show much the same priming effects as intact subjects, demonstrating intact implicit memory (e.g., Graf, Squire, & Mandler, 1984; Moscovitch, 1982; Schacter, 1985; Warrington & Weiskrantz, 1974).

Both anecdotal evidence and formal experiments indicate that emotional responses can be preserved as implicit memories in

amnesic patients, in the absence of explicit memory for the experiences on which these responses are based. The observation by Claparede (1911/1951), already noted, could be construed in this manner. Even earlier, Korsakoff (1889)—who first identified the amnesic syndrome—observed that a patient who had received an electrical shock, but had no explicit memory for the experience, responded to the case that contained the shock apparatus by stating that the doctor had probably come to electrify him, again suggesting a link between emotional response and implicit memory.

Two studies by Johnson, Kim, and Risse (1985) turned these kinds of anecdotal observations into formal experiments. Their first study was based on the "mere exposure" effect documented by Zajonc (1968), who showed that repeated exposure to an object tends to increase judgments of likability, even if there is no substantive information presented that would support such attitudinal change.[1] In the experiment, Korsakoff patients and controls were presented with unfamiliar Korean melodies. As expected from the mere exposure effect, both Korsakoff patients and controls preferred old melodies over new melodies. However, the patients showed greatly impaired levels of recognition. A second study provided subjects with more substantive contact with the stimulus materials. Amnesics and controls were presented with pictures of two faces, accompanied by fictional biographical information, that depicted one individual positively and the other negatively. When asked whom they preferred, control subjects always chose the face that had been paired with the positive information; and they were always able to state that their judgment was made on the basis of the accompanying descriptive information. The patients also showed a strong preference for the "good guy"; however, they could give only vague reasons, usually the person's physical appearance, for their judgment. This preference was maintained at 1-year follow-up.

A similar experiment was performed by Damasio, Tranel, and Damasio (1985) using patient Boswell, a man who was rendered densely amnesic following a case of herpes encephalitis. Despite a profound inability to recognize people, it had been noted that Boswell would go to a particularly generous staff member if he

[1]Whether these kinds of preference judgments represent truly affective responses is open to debate. Preferences may be based on emotional considerations, as when one falls in love; but they may also reflect purely intellectual judgments, as when one admires a musical composition by Elliot Carter for the way the notes are strung together; in some cases, they may merely stem from a social requirement to make a choice, despite the lack of any motivation or basis for doing so. Whatever their source, it is clear that expressed preferences may have emotional consequences.

wanted something. In the experiment, Boswell had an extended series of positive, negative, and neutral encounters, respectively, with three different confederates. Upon subsequent questioning, Boswell was unable to recall anything about any of the people and never indicated that they were familiar in any way. Nonetheless, when asked on a forced-choice test whom he liked best, and would approach for rewards and favors, he strongly preferred the "good" confederate over the "bad" one, with the neutral confederate falling inbetween. These preferences were also maintained at a 4-year follow-up.

The Damasio et al. (1989) experiment is somewhat more difficult to interpret than the one by Johnson et al. (1985), because the pairing of faces and affective valence was not counterbalanced, no information regarding checks on pre-experimental preferences was given, and exposure time was confounded with valence. Nevertheless, pending confirmation with tighter controls, the study suggests that emotional responses involving relatively complex behavioral interactions can reflect implicit memory in amnesic patients. It also offers a new type of implicit measure, a social judgment (who the patient would they go to for treats), and thus broadens the areas of emotional behavior that can be said to be affected by implicit memory.

Somewhat similar findings have been observed in prosopagnosic patients who suffer a deficit in facial recognition following bilateral lesions in the mesial portions of the occipital and temporal cortex. These patients are unable to recognize previously encountered faces as familiar, but they do show differential autonomic responses to old and new faces, as measured by skin conductance or resistance (Bauer, 1984; deHaan, Young, & Newcombe, 1987; Tranel & Damasio, 1985). Of course, such responses are not necessarily emotional in nature. Nevertheless, most theorists agree that emotion is accompanied by physiological arousal. Thus, these studies raise the possibility that at least the beginnings of an emotional response to a face may be preserved, even in the absence of conscious memory for the prior experience(s) on which that response is based.

Functional Amnesia

In addition to the disorders of memory produced by lesions to specific brain structures, there are also functional amnesias—memory losses attributable to events or processes that do not result in damage or injury to the brain but that produce more forgetting than would normally occur (for reviews, see Hilgard, 1977; Kihlstrom & Schacter, in press; Kihlstrom, Tataryn, & Hoyt, 1990; Schacter & Kihlstrom,

1989). Chief among these are the dissociative syndromes of psychogenic amnesia (also known as limited amnesia), psychogenic fugue (also known as functional retrograde amnesia), and multiple personality disorder. In each case, the patient experiences a loss of autobiographical memory, often accompanied by a loss or change in personal identity as well. In most instances, the memory loss is instigated by some traumatic event, which is itself covered by the amnesia. One of the interesting features of the functional amnesias is that patients often display implicit memory for events lost to conscious recollection: Sometimes this implicit memory takes the form of an emotional response. Janet's (1893, 1904) case of Madame D., cited earlier, illustrates this point. Another case involved a woman who had no conscious recollection of the events surrounding the death of her mother but had recurring "hallucinations" regarding those events that contained specific emotionally laden memories from the days immediately preceding and following the death.

More recent case studies show the same kinds of effects. For example, Gudjonsson and Haward (1982) found that a fugue patient who had been suicidal prior to the onset of her amnesia responded to Rorschach inkblots predominantly with death-related images, even though she had no explicit memory for her suicide threats or the circumstances surrounding it. In a case reported by Kaszniak et al. (1988), a victim of attempted homosexual rape was amnesic for the incident but experienced severe distress when shown a TAT card picturing a person attacking another from behind. Similarly, Christianson and Nilsson (1989) observed that a woman who had suffered severe amnesia following assault and rape became extremely upset when taken back to the scene of the assault, even though she had no explicit memory for the event.

Amnesia between personalities has come to be known as one of the most striking features of multiple personality disorder (Schacter & Kihlstrom, 1989) although this phenomenon is unfortunately not well represented in current diagnostic criteria (Kihlstrom et al., 1990). As in other cases of functional amnesia, there is some indication that certain types of implicit memory may transfer across ego states (e.g. Nissen, Ross, Willingham, Mackenzie, & Schacter, 1988), and that implicit memory may take the form of an emotional response. Prince's (1910) Miss Beauchamp is such a case. Personality "B IV," experienced strong emotional reactions to people and places that had emotional meaning to personality "B I" and vice versa. However, neither personality had explicit memory for the emotionally arousing objects of the other, and each would be puzzled by their intense reactions to such stimuli.

An experimental study by Ludwig and his colleagues (Ludwig, Brandsma, Wilbur, Bendfeldt, & Jameson, 1972) examined transfer of acquired information between personalities in the case of patient Jonah, one of whose ego states was densely amnesic for the other three. They found evidence for the transfer of a conditioned fear response to a light or tone (previously paired with shock) and of a GSR response to words that had unique emotional significance for each of the personalities. This study was not formally conceptualized in terms of the explicit–implicit distinction, and the transfer of implicit memory between alter egos was not limited to emotional material. Nevertheless, the results show that dissociated ego states can share emotional responses to events, even if they do not share conscious access to the memories on which these responses are based. Insofar as amnesia is a diagnostic feature of multiple personality (Kihlstrom et al., 1990), further study of emotional learning in multiple personality would seem to be in order.

Amnesia and the Hypnotic Induction of Emotion

Hypnosis is a social interaction in which one person offers suggestions to another person for imaginative experiences involving alterations in perception, memory, thought, and voluntary behavior. Among the most dramatic effects is posthypnotic amnesia, in which subjects are unable to remember the events and experiences that transpired during hypnosis. Nevertheless, as indicated earlier, a wide variety of studies indicates that the effects of posthypnotic amnesia are selective, impairing explicit memory but sparing implicit memory (e.g., Kihlstrom, 1980; for reviews, see Kihlstrom, 1985; Kihlstrom & Hoyt, 1990). Hypnotic suggestions are typically intended to alter some aspect of cognitive functioning, but they can also have emotional and motivational effects; that is, subjects' emotional states can be altered, directly or indirectly, by means of hypnotic suggestion.

In a classic series of studies, Luria (1932) suggested to hypnotized subjects that they had committed a crime that was too terrible to think about; this paramnesia was then followed by a further suggestion for posthypnotic amnesia. Although the subjects did not have any conscious recollection for the paramnesia suggestion and failed to recognize the significance of words drawn from the paramnesia, they tended to respond to stimulus words relating to the paramnesia with irrelevant hand movements (a sign of emotional distress; see Wishner, 1955), despite their failure to recognize the relevance of the

critical words to the suggestion. Luria's observations were essentially confirmed by Huston, Shakow, and Erickson (1934; see also Erickson, 1935, 1944). These and other early findings (for reviews, see Deckert & West, 1963; Reyher, 1962) prompted further research by a number of investigators. For example, Reyher (1967) and his colleagues, working from an avowedly psychoanalytic perspective quite different from that which guided Luria, suggested paramnesias designed to induce sexual or aggressive feelings.

Other researchers have employed alternatives to the paramnesia technique. For example, Blum (1967, 1979) and his colleagues asked hypnotized subjects to relive an actual experience from their own childhood that is of a conflictual, ego-threatening nature. The remembered event itself was then covered by an amnesia suggestion, leaving the subject in a state of free-floating emotional arousal. They have shown that arousal, manipulated in this manner, affects performance on a variety of cognitive and personality tests. Similarly, Bower (1981) devised a hypnotic mood induction technique that involves giving suggestions during hypnosis to visualize and reexperience personal emotionally valent events and experience a certain intensity of affect during this retrieval. A posthypnotic suggestion is then given that they will have no memory for the images that generated the emotions but that they will nevertheless respond to a cue (a colored piece of paper) with a particular emotion.

Levitt and his colleagues (e.g., Levitt & Chapman, 1979; Levitt, Persky, & Brady, 1964), by contrast, administered direct suggestions for anxiety, followed by suggestions for amnesia. In both cases, the subjects showed increased signs of emotional arousal on both standard psychological tests (e.g., responses on the MMPI or projective techniques) and experimental tasks (e.g., psychophysiological indices, Stroop performance), compared to controls. Reyher (1967) and his colleagues have gone even further, by showing that their procedures can produce a variety of somatic symptoms, such as nausea, headaches, and perspiration. However, by virtue of amnesia the subjects in these experiments are unaware of the source of their emotional state.

Except for Bower's (1981) work, these studies were designed and interpreted within an explicitly psychoanalytic framework, in which posthypnotic amnesia was construed as analogous to repression. Thus, the experience of emotion and other signs of conflict, in the context of a failure to consciously remember the source of the emotional state, were considered to be analogous to the "return of the repressed" in classic Freudian theory. However, there is no good evidence that posthypnotic amnesia is analogous to repression

(Kihlstrom & Hoyt, 1990). An alternative interpretation is simply in terms of the dissociation between explicit and implicit memory; that is, the amnesic subjects lack explicit memory for the suggestion (e.g., to relive a particular emotional experience); but the emotional arousal they subsequently experience can be construed as an implicit memory for that event. Thus subjects exhibit implicit memory for the images in their responses to the cue in the absence of any explicit memory for why they are experiencing the emotion.

"Mere Exposure" Effects in Implicit Perception

In the standard implicit memory experiment, subjects are aware of the event at the time it occurs but subsequently fail to consciously recollect that event. However, similar effects can be observed even in the absence of conscious awareness (Kihlstrom, 1987, 1990). For example, Zajonc and his colleagues have obtained mere exposure effects on preference ratings even when subjects are unaware of the exposure trials. Wilson (1979) found that subjects preferred tones that had been presented in the unattended channel during a dichotic listening procedure to tones that had not been previously presented, despite the fact that their recognition of these tones was significantly impaired. Similarly, Kunst-Wilson & Zajonc (1980; Zajonc, 1980) gave subjects brief tachistoscopic presentations of irregular polygons and found that rated preference was affected by prior exposure, even though the stimuli themselves were recognized at chance levels. Their "subliminal" mere exposure effect was replicated and extended by Seamon and his colleagues (Seamon, Brody, & Kauff, 1983a, 1983b; Seamon, Marsh, & Brody, 1984). Mandler, Nakamura, and Van Zandt (1987) also confirmed this finding and extended it to a variety of other, nonemotional, judgments.

Subjects' expressed preferences, reflecting implicit perception and memory, may have implications for subsequent emotional judgments and behavior that would be clearly labelled as "emotional." Bargh and Pietromonaco (1982) found that subjects who had been subliminally exposed to hostile words attributed significantly more negative qualities to a pictured person than subjects who had not received this exposure. Similarly, Bornstein, Leone, and Galley (1987) found that subliminal exposures can affect not only preferences for people's faces but also subsequent interpersonal behavior towards those same people. Finally, Greenwald, Klinger, and Liu (1989) found that evaluative judgments of words were facilitated by the masked presentation of a prime with the same affective valence.

Dissociation and Desynchrony

All four of the areas just reviewed provide some evidence for changes in evaluative judgment, affective response, or emotional state in the absence of explicit memory for the experiences themselves. In some respects, the dissociation observed between emotional responses to an event on the one hand, and explicit memory for the event itself on the other, is reminiscent of the concept of desynchrony among response systems in emotion (Hodgson & Rachman, 1974; Rachman, 1978; Rachman & Hodgson, 1974). In classic research on experimental neurosis in dogs (for a review, see Mineka & Kihlstrom, 1978), Gantt (1953) had observed that separate components of a conditioned response may be acquired and extinguished at different rates and persist for different lengths of time, resulting in a state of "schizokinesis." More recently, Lang (1968, 1971) proposed a multiple-system theory of emotion, in which several components—subjective, behavioral, and physiological—were only imperfectly coupled. When all three systems act together, the person experiences intense emotional arousal. Under conditions of mild arousal, however, they may be partially independent. Later, Rachman (1978; Hodgson & Rachman, 1974; Rachman & Hodgson, 1974) explored the implications of desynchrony among emotional systems for the treatment of anxiety disorders. For example, treatments such as flooding (implosion therapy) will affect the behavioral component of fear before they affect the subjective and physiological components (see also Mineka, 1979, 1985a, 1985b).

Desynchrony is nicely illustrated by research by Miller (Miller & Marlin, 1979; Miller & Springer, 1973) on electro convulsive shock (ECS) induced amnesia in rats. In their experiment, administration of ECS immediately following a standard one-trial, step-down, passive-avoidance conditioning paradigm (rats stepped off a shelf and received footshock) produced the usual retrograde amnesia: The animal no longer made the passive-avoidance response. However, when the rats stepped off the shelf, EKC recordings showed a substantial increase in heart rate. The discrepancy between the behavioral response (passive avoidance) and the physiological response (heart rate acceleration) to a fear stimulus is what is meant by desynchrony. Of course, both responses are indices of memory (for the footshock) as well as fear (of stepping down), and it is worth noting that similar dissociations between verbal behavior and physiological responses have been documented in the studies of amnesic syndrome and hypnotic amnesia described earlier.

Although the analogy between desynchrony and dissociation is tempting, it is not exact. Thus, for example, verbal reports of recall or recognition, usually classified as evidence of explicit memory, presumably reflect the subjective experience of remembering; but they are also items of behavior. Accordingly, it is not easy to identify explicit memory with one component of emotion, and implicit memory with the others. Furthermore, it would seem that the subjective experience of emotion itself has at least three components, reflecting the person's awareness of his or her emotional state, of the eliciting stimulus, and of past emotional encounters with that stimulus. In this way, the dissociation between explicit and implicit memory offers a new perspective on the problem of desynchrony: There may be dissociations *within* emotion components, as well as between them (Hugdahl, 1981).

EMOTIONAL EFFECTS ON IMPLICIT MEMORY

We turn now to a consideration of whether mood or emotional state can affect implicit memory, as expressed on nominally nonemotional tasks. The effects of mood on memory fall into three general categories: (a) mood-dependent memory effects, where retrieval is facilitated by a match between encoding and retrieval mood states; (b) mood-congruent memory effects, where mood at time of encoding or retrieval facilitates retrieval of affectively congruent material; and (c) resource allocation effects, where extreme or negative mood states at encoding or retrieval impair processing. As noted earlier, all these effects have been documented in studies of explicit memory, employing conventional tests of recall or recognition. This raises the question of the effects of emotional state on implicit memory.

Two Hypotheses About Context and Memory

From one point of view, it might be expected that emotional state would have relatively little effect on implicit memory. Consider the phenomenon of mood-dependent retrieval. A shift in mood state between encoding and retrieval can be considered analogous to a change in the subject's internal physiological environment, as in the classic phenomenon of drug-state-dependent memory, or in the external ecology, as in the phenomenon of environment-dependent memory. In all three cases, the shift in context (internal or external, physiological or mental) appears to induce a type of amnesia. In many forms of amnesia, memory loss often is greatest in the explicit

domain, with implicit memory being relatively preserved. From this fact, one might expect that implicit memory would be preserved for material that is rendered inaccessible to explicit memory because of mood shifts. That is to say, implicit memory may transfer over various mood states, even when explicit memory does not.

This hypothesis is supported by further consideration of the functional dissociations observed between explicit and implicit memory. Although explicit memory is affected by a wide variety of encoding factors, the variables that most consistently have been found to affect implicit memory are changes in the surface features of the events (e.g., Roediger & Blaxton, 1987; Roediger, Weldon, & Challis, 1989; Schacter, in press)—at least when the implicit measure is data driven or perceptually based. Because affect changes the connotative meanings of events, but not their perceptual features, mood may constitute another variable that affects explicit but not implicit memory.

On the other hand, there may be reasons to suggest that context effects, including mood effects, will be observed to a *greater* extent in implicit memory than explicit memory. For example, the psychoactive drugs that induce state-dependent memory in humans (e.g., alcohol, marijuana, barbiturates) can alter sensory-perceptual processes. In fact, Graf (1989) suggested that environmental contexts directly alter the processing of perceptual or surface features of events, producing effects analogous to modality shifts. Accordingly, Graf has found that shifts in environmental context affect implicit memory even when they do not affect explicit memory. The same argument could be made for the effects of mood contexts: Perhaps the world does look darker to sad people, and brighter to those who are happy.

Moreover, it is important to recognize that mood is not just a state, like sleep or hypnosis, that alters perception or induces a kind of amnesia. Mood is also a contextual cue, like other cues, that is processed when memories are encoded and guides the course of retrieval. In an effort to understand the apparent unreliability of context-dependent memory, Eich (1980, 1989) has argued that state-dependent memory is a cue-dependent phenomenon that critically depends on the nature of the cues available at retrieval (see also Kihlstrom, 1989; Kihlstrom, Brenneman, Pistole, & Shor, 1985). From his point of view, a primary reason for inconsistency in the results of studies on context-dependent memory findings is the tendency for other, stronger cues to overshadow the usually weak context cue. These potentially stronger cues may include experimenter-presented or subject-generated cues. So, for example, state-dependent effects on memory are greatest under conditions of free

recall, as opposed to cued-recall or recognition tests (Eich, 1980, 1989). And environment-dependent memory effects are abolished when subjects are instructed to *imagine* the environment in which the items had been studied (Smith, Glenberg, & Bjork, 1978).

The foregoing analysis suggests two conditions under which chances of finding mood dependency would be increased: (a) if the link between the subject's mood and the list items is strengthened; and (b) if other potentially superceding cues are eliminated, thereby highlighting the mood cue (a similar argument can be made for context dependency; see Smith, 1987).

With respect to the mood–item link, there is no reason to think that this association is encoded automatically (Kihlstrom, 1989). Rather, it seems likely that the mood–item connection will most likely be made if subjects actively attend to their moods. Of course, one way to insure that subjects will attend to their moods is to make the moods relatively intense—a requirement that may be difficult to meet in the laboratory (Tobias, Buenaver, Hinderliter, & Kihlstrom, 1989). Moreover, Bower and Mayer (1989) have argued that the links between items and mood can be most effectively strengthened if subjects are asked to relate the items they study to the mood they are in. This procedure highlights the relevance of mood to the material and increases the likelihood that mood cues will be encoded with the memory. On the other hand, it increases the risk that mood-dependent memory will be confounded with mood-congruent memory (Teasdale & Fogarty, 1979); that is, if items are explicitly related to mood at the time of encoding, it is no longer clear if these items receive an advantage in recall because of the congruence between encoding and retrieval moods, or because of the congruence between mood and memory.

With respect to the elimination of potentially competing cues, use of free recall-tests, as opposed to cued recall or recognition, effectively reduces the amount of cue information supplied by the experimenter (Tulving, 1974). Moreover, incidental as opposed to intentional learning conditions minimizes the probability that subjects will generate cues at time of encoding that can later be used to aid their own retrieval. Indeed, Ellis (1985, 1990) has found that mood effects are more likely to emerge when encoding is impoverished and incidental. However, whereas incidental learning and free recall would seem to substantially reduce competing cues, they cannot eliminate them completely. Free-recall tests still specify the spatiotemporal context in which learning occurred, and subjects are highly likely to generate cues for themselves over the course of intentional retrieval, even if they did not generate them during incidental encoding.

We propose that use of implicit memory tests can further reduce both experimenter-supplied and subject-generated cues. By definition, implicit memory tasks eliminate all explicit references to any prior learning episode: They do not require retrieval of autobiographical memories. Thus, no cues pertaining to spatiotemporal context are supplied by the experimenter; and subjects have no incentive to deliberately generate episodic cues that might aid their performance. Therefore, the combination of incidental learning and implicit memory will reduce the salience of potentially competing cues and isolate and highlight cues pertaining to mood and other aspects of context.[2]

. . . and Some Experiments

Implicit memory has only recently emerged as a topic for formal research, and so it is perhaps not surprising that few experiments have assessed mood effects (or, indeed, any type of context effect) on implicit memory. Weingartner, Miller, and Murphy (1977) found evidence for state dependency in the generation of word associations: Subjects were more likely to generate the same associates when they were in the same mood as on a previous trial. However, this study was not explicitly designed as a test of implicit memory and did not include a comparable explicit memory task. More recently, Hertel and Hardin (1990) found that implicit memory (homophone spelling) transferred between depressed and neutral moods, whereas recognition did not.

Another recent study, by Mathews, Mogg, May, and Eysenck (1989), examined attentional biases in anxious subjects (mood-congruent encoding) using threat-related words and stem completion. The results indicated a bias in clinically anxious subjects towards retrieving threat-related words in both the implicit and explicit conditions; however, this differential tendency was significant only in the implicit memory condition. Thus, as predicted, the effects of mood were stronger on implicit than on explicit memory. Mathews et al. (1989) suggested that the relation between emotional state and memory for mood-congruent items is not straightforward, but they interpreted their data as demonstrating attentional bias. Unfortunately, the operation of mood effects at encoding or retrieval

[2]It should be noted that this logic applies to mood-congruent effects as well as mood-dependent effects. In studies of mood congruency, the power of mood to cue affectively related material may still be overshadowed by the effects of other experimenter-supplied and subject-generated cues.

and the contribution of explicit effects cannot be ruled out because mood was not manipulated in this experiment; nor was a clear functional dissociation shown between implicit and explicit memory. In fact, findings from our laboratory, discussed later, suggest that mood-congruent retrieval, but not mood-congruent encoding, may be found in implicit memory.

We have recently begun to study the effects of experimentally induced happiness and sadness on both explicit and implicit memory. In our first study (Tobias, Schacter, & Kihlstrom, 1989), we sought evidence of mood-dependent implicit memory using the word-stem completion paradigm. Mood was manipulated at encoding and retrieval by means of a musical mood induction. No evidence of mood dependency was found in either explicit or implicit memory. Nor was mood-congruent retrieval evident in a subsequent study that also used a stem-completion task. However, although stem completion is the paradigm of choice for many studies of implicit memory, it may not be ideal for experiments on mood and other context effects. In the first place, three-letter stems are relatively powerful cues; thus, this experimenter-supplied information may well overshadow mood cues. Another possible difficulty with stem completion is that it is primarily data driven (Roediger & Blaxton, 1987; Roediger et al., 1989): It taps into memory for the perceptual qualities of the list items (e.g., how they appear on the page, or how they sound when spoken). Although it may be argued, following Graf, that mood "colors" our perception of events, it is also clear that mood changes how they are interpreted. If emotional effects are primarily conceptual in nature, considerations of transfer-appropriate processing (Roediger et al. 1989) lead us to expect that mood would have no effect on a data-driven task such as stem completion.

Accordingly, we set out to develop a set of novel implicit memory tasks that both minimized experimenter-supplied nominal cues and were classifiable as conceptually driven, in the hope that they would prove more sensitive to context cues (Tobias, Wunderlich, & Kihlstrom, 1990). The subjects first studied a list of positive, negative, and neutral words, about which they made either structural or semantic judgments. Following this encoding activity, they listened to 15 minutes of tape-recorded mood music. Subjects in the implicit memory condition were then falsely informed that the tape was of the "subliminal perception" variety, in which a list of words had been masked by the music. In order to determine whether the words had been subliminally perceived, they were asked to perform one of four tasks:

1. One group was given a sheet with blank spaces on it, setting up the conditions for a free-recall test.
2. A second group was provided with the first letters of target words, thus creating a cued-recall test with minimal cues.
3. A third group was provided with cues representing broad conceptual categories, in the form of phrase completions: "The person felt ____ " or "The person bought the ____ "
4. A fourth group was prompted with standard three-letter stems. In all conditions, subjects were asked simply to list the first words that came to mind. A comparable set of cued recall memory tasks was also administered, in which subjects were specifically instructed to list items from the wordlist they had studied.

Data analysis revealed significant priming effects on each of the implicit memory tasks; that is, significantly more target than baseline words appeared in the subjects' lists. Whereas the strength of the experimenter-supplied cue affected the sheer number of target and baseline words generated, it had no effect on the magnitude of priming observed. Moreover, cued recall was affected by the level of processing at the time of encoding, but priming was not. These results confirmed that we had, indeed, developed implicit-memory analogues of free and minimally cued recall. In the "no cue" condition, subjects are simply presented with a blank sheet of paper and asked to write down the first words that come to mind, without any reference to the study phase. In fact, our minor deception may have actually directed subjects' attention *away* from the study phase. Obviously, this condition reduces to an absolute minimum the influence of potentially competing experimenter-supplied and subject-generated cues.

With an appropriate implicit memory task in hand, we returned to the question of mood effects (Tobias & Kihlstrom, 1990). Happy and sad mood was musically manipulated at encoding and retrieval. In order to strengthen the link between items and mood, we included in the list some words with positive and negative affective valence, as well as emotionally neutral items. Examining only those items that were affectively congruent to encoding mood (the condition where the cue value of mood should be strongest), no mood-dependent memory was observed in explicit memory—another tribute to the unreliability of mood-dependent memory effects. However, a strong mood-dependency effect was seen in the implicit conditions involving free and minimally cued recall. Subjects who were happy at both

encoding and retrieval produced significantly more positive target words than those who were happy at encoding but sad at retrieval. Similarly, subjects who were sad at both encoding and retrieval produced more negative words than those who were sad at encoding but happy at retrieval. No evidence of mood dependency was found for neutral or incongruent items, raising the question of the degree to which strict mood dependency has been contaminated by mood congruence in our study.[3]

MOOD AS MEMORY, AND MEMORY FOR MOOD

It seems that the results of these preliminary experiments need to be confirmed, and the paradigm needs to be explored in more detail. However, taken together with the study of anxiety by Mathews et al. (1989), our preliminary results indicate that mood effects on implicit memory may be greater than those on explicit memory—to the extent that implicit effects are found even when explicit effects are absent. From a theoretical point of view, this outcome is interesting for several reasons.

To begin with, our findings underscore the potential differences between mood and other aspects of context. Like physiological state and environmental surround, mood is a feature of an event that can be encoded along with other aspects of a memory and serve as a potential retrieval cue. Like the physiological states induced by psychoactive drugs, it can affect the deployment of attention towards some features of the environment as opposed to others. Unlike drug-induced states, however, it is probably not something that can alter perception or induce amnesia directly. Mood also may differ from external, environmental context, in that—unless they are exceptionally noisy or otherwise aversive—environments per se do not affect the availability of attentional resources for information processing. Moreover, mood may differ from environmental context in another way, because it can alter the connotative meaning of events, in addition to serving as some kind of passive background. These considerations suggest that moods, drug states, and environments may not have parallel effects on memory.

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[3]Nor were any mood-congruency effects observed in the explicit memory condition. However, there was evidence of mood-congruent retrieval in implicit memory. There was a bias toward generating negative targets when retrieval mood was negative, and positive targets when it was happy—irrespective of encoding mood.

Moreover, these results may shed new and important light on the nature of the relations between these two expressions of memory. Most functional dissociations between explicit and implicit memory are asymmetrical; that is, whereas a number of variables may affect explicit but not implicit memory, relatively few variables (aside from modality shifts) affect implicit but not explicit memory. In the case of mood, the available evidence is of just this type. In the absence of double dissociations, in which a single variable exerts *opposite* effects on explicit and implicit memory (e.g., impairing one while improving the other), the accumulation of single dissociations in which implicit memory is impaired but explicit memory is spared supports the hypothesis of qualitatively different memory processes or systems, rather than mere differences in task difficulty (Schacter, in press; Tulving & Schacter, 1990). Generally, the argument is for two memory systems, one encoding a structural description of perceptual input, the other representing the event itself, in its episodic context. But if, as Leventhal (1980, 1984) and Christianson (Christianson, 1991; Christianson, Loftus, Hoffman, & Loftus, in press; see also chapter 13, this volume) have suggested, emotional memories themselves are supported by a separate memory mechanism or system, concerned exclusively with representing emotional experiences, a question must be raised as to whether two such systems are now necessary, one supporting explicit and the other implicit emotional memories.

Be that as it may, the fact that changes in evaluative judgment and other aspects of emotional response may be dissociated from explicit memory expands the boundaries of what might be considered evidence of implicit memory. The typical implicit memory task involves verbal behavior: The subject lists the first words that come to mind, for example, or makes a judgment about whether a stimulus is a word. Recently, evidence of implicit memory has been found on perceptual tasks involving spatial rather than verbal processing (Musen & Triesman, 1990; Schacter, Cooper, & Delaney, 1990). In the clinical anecdotes and formal research reviewed here, though, evidence of implicit memory comes from feelings rather than words. The patients observed by Claparede, Janet, Bagby, and Levinson are not performing anything like a perceptual-cognitive task. They *feel an emotion* because of what they have previously experienced, even though they do not remember the experience at all.

This fact reminds us that implicit memory can be revealed by a wide variety of alterations in experience, thought, or action that is attributable to some prior episode, regardless of whether the change resembles the kinds of perceptual-cognitive tasks performed under

laboratory conditions. If an assault victim has frequent nightmares or panic attacks when he or she was not prone to them before the crime, this change in behavior may reflect implicit memory even if the contents of the dream do not remotely resemble any details of the incident; and even if—we might say *especially* if—he or she does not remember the event itself. It also reminds us of the insight of Breuer and Freud (1893/1955):

> Hysterics suffer mainly from reminiscences (p. 7), [but] In the great majority of cases it is not possible to establish the point of origin by a simple interrogation of the patient, however thoroughly it may be carried out . . . principally because he is genuinely unable to recollect it and often has no suspicion of the causal connection between the precipitating event and the pathological phenomenon. (p. 3)

What Breuer and Freud meant as unconscious (or repressed) memories, we can substitute implicit ones. If a wide variety of pathological symptoms, not just emotional reactions, can reflect implicit memory, we are afforded a new means of integrating psychodynamic insights with contemporary psychological theory, particularly with respect to the structure of memory. They also stimulate further questions about the relations among cognitive, emotional, and motivational processes, and about psychosomatic interactions.

ACKNOWLEDGMENTS

The point of view presented in this chapter is based on research supported in part by Grants MH-44739 and MH-35856 from the National Institute of Mental Health, and Grant AG-08441 from the National Institute on Aging. We thank Terrence M. Barnhardt, Jill Booker, Jeffrey Bowers, Barbara Church, Suzanne M. Delaney, Elizabeth L. Glisky, Martha L. Glisky, Susan Mineka, Sheila A. Mulvaney, Douglas J. Tataryn, Mindy Tharan, and Michael Valdiserri for their comments at various stages.

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The Handbook Of Emotion and Memory
Research and Theory

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LAWRENCE ERLBAUM ASSOCIATES, PUBLISHERS
1992 Hillsdale, New Jersey Hove and London

Lawrence Erlbaum Associates, Inc., Publishers
365 Broadway
Hillsdale, New Jersey 07642

Library of Congress Cataloging-in-Publication Data

The Handbook of emotion and memory / edited by Sven-Åke Christianson.
p. cm.
Includes bibliographical references and index.
ISBN 0-8058-0704-7
1. Emotions. 2. Memory. 3. Psychiatry. I. Christianson, Sven -Ake.
BF311.H355 1991
153.1'2--dc20 91-26351
CIP

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1