

CHAPTER 9

Functional amnesia

Daniel L. Schacter and John F. Kihlstrom

Amnesia and Cognition Unit, Department of Psychology, University of Arizona, AZ, U.S.A.

Introduction

Neuropsychological analyses of memory have traditionally relied on studies of patients with organic amnesias that are produced by lesions to specific brain structures. The general goals of this research have been to decompose memory into component processes and systems by documenting selective patterns of deficit across different kinds of memory tests, and to make inferences about the neural organization of memory on the basis of such observations. Research concerning organic amnesias has yielded a rich harvest of empirical findings and has led to important new insights about the nature and composition of memory (for review, see Cermak, 1982; Hirst, 1982; Smith, Ch. 4 of this volume; Schacter, in press; Squire, 1987).

Not all amnesias, however, result from brain damage. Amnesia may be produced by severe emotional trauma, psychological illness, hypnotic suggestion, or naturally occurring changes in state or arousal. These kinds of memory impairments are referred to collectively as *functional amnesias*. This chapter is concerned with functional amnesias, and has two main purposes: (1) to review data and ideas concerning the various functional amnesias that have been studied, and (2) to argue that functional amnesias can provide important insights into memory which are complementary to, and no less revealing than, insights gained from study of organic amnesias.

Before proceeding further, we should clarify some of the terminology that is used frequently in

the chapter. *Functional amnesia* will be defined as memory loss that is attributable to an instigating event or process that does not result in damage or injury to the brain, and produces more forgetting than would normally occur in the absence of the instigating event or process. Of course, we recognize that functional amnesias are no doubt accompanied by correlated changes in brain state, and also recognize that it is not always a straightforward matter to determine what constitutes 'normal forgetting' in a particular situation. The purpose of the foregoing definition is to distinguish functional amnesia from organic amnesia on the one hand, and from 'ordinary' forgetting on the other.

We also find it useful to distinguish further between *pathological* and *non-pathological* functional amnesias. The former refers to cases in which amnesia is either a diagnostic symptom of psychopathology, or occurs within the context of a diagnosable psychological disorder. We will discuss two main kinds of pathological functional amnesias, which will be referred to as *functional retrograde amnesia* and *multiple personality amnesia*. Non-pathological amnesias, in contrast, either occur in the course of everyday living or are induced by psychological procedures (i.e., hypnotic suggestion) in people who are free of any diagnosable psychopathology. Under this general rubric we will consider *childhood amnesia*, *sleep and dream amnesia*, and *hypnotic amnesia*.

One further terminological distinction that will be used frequently merits brief introduction: the

distinction between explicit and implicit forms of memory (Graf and Schacter, 1985; Schacter, 1987). Explicit memory refers to conscious recollection of previous experiences and is typically assessed by standard tests of recall and recognition, which require intentional retrieval of a prior experience. Implicit memory, on the other hand, refers to unintentional retrieval of previous experiences in the performance of tests that do not make explicit reference to those experiences. Implicit expressions of memory need not involve any conscious awareness of remembering on the part of the subject. It is now well established that patients with organic amnesia can show robust implicit memory for recent experiences despite severely impaired explicit memory (for review and discussion, see Schacter, 1987; Shimamura, 1986; Squire, 1987; Weiskrantz, 1987). One of the main points of the present chapter is that the dissociation between explicit and implicit memory can also be observed and profitably studied in cases of functional amnesia.

Pathological functional amnesias

Functional retrograde amnesia

Perhaps the most dramatic and frequently popularized form of memory loss, functional retrograde amnesia entails loss of personal identity and large sectors of one's personal past. The amnesia is usually precipitated by a severe emotional or psychological trauma (Abeles and Schilder, 1935; Thom and Fenton, 1920), and consists of several stages. Following the traumatic episode, patients enter a fugue state during which they may wander for variable periods of time, ranging from minutes to months (Abeles and Schilder, 1935; Abse, 1987; Fisher, 1945; Nemiah, 1979), and are unaware of any memory loss. The fugue, but not the amnesia, typically ends when patients are asked questions about their identity or past which they cannot answer (Stengel, 1941). Since the fugue is defined as that period during which patients are unaware of memory loss, it almost never comes to the atten-

tion of appropriate professionals until awareness is achieved, and is therefore virtually impossible to study while it is occurring. Information about fugue states is thus necessarily based on retrospective accounts. Because patients generally remain amnesic for the events of the fugue even after its termination, in most cases such retrospective accounts can only be obtained through hypnosis or administration of appropriate barbiturates (Abse, 1987; Fisher, 1945). The reader is referred to the reports of Fisher (Fisher, 1945; Fisher and Joseph, 1949), Geleerd et al. (1956), Luparello (1970) and Stengel (1941) for careful retrospective analyses of fugue states. More recent discussions of issues concerning diagnosis of fugue states are provided by Akhtar and Brenner (1979), Freedman and Kaplan (1975) and Keller and Shaywitz (1986).

Some patients emerge directly from the fugue into a state of full recovery (Pratt, 1977), whereas others proceed from the fugue to a second stage that is characterized by awareness of loss of personal identity and large sectors of the past. (What we refer to as the first and second stages of functional retrograde amnesia can be viewed as distinct clinical entities – fugue and psychogenic amnesia – as they are in DSM-III. We do not take exception to this characterization, and wish only to emphasize the continuity between the two that exists in many cases.) The second stage typically lasts for several days, although durations of weeks and months have been recorded (Abeles and Schilder, 1935; Akhtar et al., 1981; Christianson and Nilsson, in press; Kanzer, 1939; Lyon, 1981; Suarez and Pittluck, 1975). In some cases, the amnesia clears in response to the appearance of a relative or to a cue that is related to the emotional trauma that precipitated the amnesia (Abeles and Schilder, 1935; Christianson and Nilsson, in press; Jones, 1909; Schacter et al., 1982), whereas in others hypnotic procedures or sodium amytal treatment help to alleviate amnesia (e.g., Eisen, 1989; Fisher, 1945; Kaszniak et al., 1988; Kennedy and Neville, 1957; Sargant and Slater, 1941; Suarez and Pittluck, 1975). In many cases, however, recovery of memory and identity is

'spontaneous' in the sense that no salient external cues are present when patients suddenly recover memory function (Abeles and Schilder, 1935; Gillespie, 1937; Gudjonsson and Taylor, 1985; Kanzer, 1939). In the third stage, after patients have recovered their identity and personal past, the events of the second stage are accessible to conscious recall whereas the events of the first stage (fugue) are not (Fisher, 1945; Nemiah, 1979; Pratt, 1977).

Features of functional retrograde amnesia. What can be said about the characteristics of memory loss during stage two of functional retrograde amnesia and the nature of recovery in stage three? As pointed out by Schacter and Tulving (1982), surprisingly few studies have analysed the nature of memory processes during functional retrograde amnesia. Instead, many investigators have focussed on issues of psychiatric and clinical concern including the psychodynamic functions of amnesia and its relation to different forms of psychopathology (Berrington et al., 1956; Eisen, 1987; Geleerd et al., 1945; Keller and Shaywitz, 1986; Kennedy and Neville, 1957; Stengel, 1941; Wilson et al., 1950), the time course of recovery and the most effective treatment methods (Abeles and Schilder, 1935; Kennedy and Neville, 1957; Lyon, 1981; Sargant and Slater, 1941; Wilson et al., 1950), and the nature of the traumatic events that produce amnesia (Abeles and Schilder, 1935; Kanzer, 1939; Thom and Fenton, 1920). These clinical issues will not be considered here, and the reader is referred to discussions by Akhtar et al. (1981), Nemiah (1979) and Pratt (1977).

Despite the psychiatric orientation of much of the literature, several issues directly concerned with the nature of memory loss during functional retrograde amnesia have been addressed. Consider first the extent of patients' amnesia for their personal past. Clinical reports suggest that most patients present with amnesia for their entire personal past, although some show 'spotty' recollection of particular incidents or autobiographical facts (Abeles and Schilder, 1935; Jones, 1909; Wilson et al., 1950). Thus, for example, Jones

(1909) studied a patient who could recall nothing of his personal past except that he had recently been aboard a steamboat named 'Corona', and that he had spent a lot of time at sea; Keller and Shaywitz (1986) described an adolescent male who knew his age but nothing else about himself; and Akhtar et al. (1981) reported a case in which the only item of personal information the patient could supply was her name. Unfortunately, most clinical reports – which constitute the bulk of the literature on functional retrograde amnesia – provide virtually no information concerning the procedures used to probe memory, so they are of limited value when attempting to assess the extent of amnesia.

Quantitative information on this point has been provided in a study by Schacter et al. (1982) which used controlled cueing procedures for exploring autobiographical memory in a case of dense functional retrograde amnesia. The patient (P.N.) was a 21-yr-old man who was admitted to hospital complaining of excruciating back pains. When questioned about his identity, P.N. became aware that he did not remember his name or anything else about his personal past. The only piece of information that he could recall on his own was that he had once been given the nickname 'Lumberjack'. The amnesia had apparently been precipitated by the death and funeral of P.N.'s grandfather, to whom he had been extraordinarily close. To investigate autobiographical recall systematically, Schacter et al. used a cueing procedure that involved presenting the patient with a word and asking him to retrieve a specific personal experience related to it (Crovtz and Schiffman, 1974). P.N. was able to come up with episodic memories in response to 22 of the 24 cues presented, but 86% of them derived from the four days which intervened between the onset of amnesia and the test session; these memories concerned events that had transpired in the hospital where he was staying during this period. By contrast, when P.N. was given a similar cueing task several weeks later, after the amnesia had cleared, 92% of the retrieved memories predated the onset of the amnesia. Schacter et al.

included a second cueing condition in which P.N. was instructed to try to retrieve only memories that predated the onset of the amnesia. Under these conditions, the patient was able to come up with autobiographical episodes in response to 17 of the 24 cues. Several of these memories concerned isolated childhood experiences, but the majority of them derived from an extremely happy period of his life, one year prior to the amnesia, when he worked for a courier service. This preserved 'island' of autobiographical memories was accessible at a time when P.N. did not know his name, where he came from, or almost anything else about his personal past. Significantly, however, the nickname 'Lumberjack' – which was accessible from the time that P.N. entered the hospital – had been given to him when he worked for the courier service. These observations indicate that cueing procedures can be useful in uncovering preserved islands of autobiographical memories, and also suggest that the accessibility of such memories may depend on the availability of some sort of identity information (i.e., a nickname).

A second issue that has received some systematic investigation concerns whether functional retrograde amnesia is restricted to personal, autobiographical information or whether it also entails impaired access to general knowledge or semantic information on the one hand, and well-learned skills on the other. Some clinical observers have noted that general knowledge is preserved in patients with dense amnesia for personal information (Akhtar et al., 1981; Jones, 1909; Suarez and Pittluck, 1975; Wilson et al., 1950), but others have reported that it is impaired (e.g., Coriat, 1907; Kanzer, 1939). Abeles and Schilder (1935) noted that some of their patients “. . . retained an adequate fund of general information” (p. 595) whereas others “. . . professed no knowledge at all” (p. 595). One again, however, methodological inadequacies limit the usefulness of such statements because the empirical basis for them is unclear.

Several studies are somewhat more informative with respect to this issue. In the aforementioned

case study by Schacter et al., P.N. was given a test in which pictures of famous people from the past several decades are presented and the patient is required to identify them (Albert et al, 1979). On this test, P.N. performed about as well during the amnesia as he did after it cleared, and performed similarly to a matched control subject during both test sessions. In addition, P.N.'s vocabulary, as assessed by the Wechsler Adult Intelligence Scale (WAIS), was identical during and after the amnesic episode. These data suggest that general or semantic knowledge was preserved in this case. Similar observations were reported in the case of a male patient (M.R.) who became amnesic after homosexual rape (Kaszniak et al., 1988). M.R. exhibited an impressive spontaneous vocabulary while experiencing dense amnesia for all personal information, and performed similarly on the WAIS-R vocabulary subscale during the amnesia and after it cleared. Consistent with these findings, Gudjonsson and Taylor (1985) reported that the WAIS vocabulary performance of a man who developed a 20-yr retrograde amnesia for personal information following a series of stressful events showed little change during and after the amnesia. Note, however, that each of the foregoing studies sampled only a limited range of tests that probe semantic knowledge. Accordingly, caution must be exercised when interpreting the apparent preservation of semantic or general knowledge observed in these studies, especially in the light of clinical reports that some functional retrograde amnesia patients exhibit severe deficits in gaining access to semantic knowledge (Abeles and Schilder, 1935; Kanzer, 1939). These observations suggest that functional retrograde amnesia may be a non-unitary syndrome characterized by a variable pattern of performance across patients.

Most clinical observers concur that previously acquired skills are preserved during episodes of functional retrograde amnesia (e.g., Abeles and Schilder, 1935; Gillespie, 1937; Kanzer, 1939; Nemiah, 1979). Yet despite this generally accepted view – or perhaps because of it – we know of no systematic empirical studies of skill retention or

utilization in patients with functional retrograde amnesia. It seems clear that careful testing of patients' ability to execute acquired skills is needed to provide an empirical foundation for evaluating this issue.

A related issue that also requires more systematic investigation concerns whether functional retrograde amnesia is accompanied by generalized impairments of cognitive function. Clinical reports suggest that cognitive deficits may be observed in some patients and not others (Abeles and Schilder, 1935; Akhtar et al., 1981; Kanzer, 1939; Kennedy and Neville, 1957; Wilson et al., 1950). Studies that provide pertinent quantitative information have yielded varying results. Schacter et al. (1982) reported that their patient showed unchanged WAIS verbal IQ during (99) and after (98) his amnesic episode, whereas performance IQ was substantially lower during the amnesia (107) than after it (120). Since only three weeks separated the two test sessions, this latter improvement was attributed partly to practice effects, which are known to influence WAIS performance tests (e.g. Lezak, 1983). However, Kaszniak et al. (1988) found that their patient showed improvements on both WAIS-R verbal IQ (88 during amnesia, 95 after) and performance IQ (89 during amnesia, 110 after) with a 15-month separation between the two tests. Similarly, Gudjonsson and Taylor (1985) reported a 27-point improvement in full-scale WAIS IQ in a patient who was tested during an amnesic episode and again eight months later. These findings suggest some deterioration of intellectual function during the amnesic episode. More extensive investigation of cognitive function during functional retrograde amnesia is clearly required.

An issue of longstanding concern in the literature is whether patients with functional retrograde amnesia also exhibit some degree of anterograde amnesia. Several clinical observers have contended that little or no anterograde amnesia is observed: patients appear to remember reasonably well day-to-day events that occur while they are suffering from retrograde amnesia (e.g.,

Abeles and Schilder, 1935; Akhtar et al., 1981; Fisher and Joseph, 1949). By contrast, formal testing of anterograde function has revealed the existence of mild-to-moderate deficits on the Wechsler Memory Scale and laboratory tests of recall and recognition of recently presented materials (Gudjonsson and Haward, 1982; Gudjonsson and Taylor, 1985; Schacter et al., 1982). Yet even in these instances, it is not entirely clear how to interpret the observed anterograde deficits. For example, the patient studied by Schacter et al., P.N., showed significant impairment on the logical memory and paired-associated subtests of the Wechsler Memory Scale during amnesia relative to his performance several weeks later in a normal state. However, this patient showed excellent recall of day-to-day events while he was amnesic, as documented by his previously discussed performance on the Crovitz autobiographical cueing task. Thus, it would be inappropriate to assert that this patient suffered from clinically significant anterograde amnesia, even though Wechsler Memory Scale performance was low. It is possible that subtle anterograde impairments observed during functional retrograde amnesia may be secondary to cognitive deficits or to depressed mood.

The striking deficit in gaining access to autobiographical information that is the hallmark of functional retrograde amnesia is observed when patients are queried *explicitly* about their personal past. An important question concerns whether these patients can show *implicit* memory for autobiographical information that is inaccessible explicitly. Although this issue has received scant attention, several intriguing observations have been made. For example, Coriat (1907) used a procedure in which patients focussed attention on a monotonous stimulus and reported whatever came to mind; no explicit reference was made to the patient's personal past. He found that under these conditions, a patient with apparently complete functional retrograde amnesia produced bits and pieces of information about her past, but was entirely unaware of their autobiographical nature. As Coriat related, "These memory automatisms

. . . are not looked upon as memories, but as strange, unfamiliar and isolated phenomena, which Susan N. [the patient] well expressed by the term 'wonderments' . ." (1907, pp. 106–107). Similarly, Jones (1909) observed that a densely amnesic patient who could not explicitly remember either his wife or daughter produced their names correctly – without any conscious experience of familiarity – when asked to guess what names might fit them.

More recent observations are consistent with this early evidence of implicit memory in functional retrograde amnesia. Gudjonsson and Haward (1982) found that a young woman who had threatened to commit suicide before the onset of amnesia showed a preoccupation with death-related themes on a Rorschach test, even though she did not explicitly remember her suicide threat or the circumstances that produced it (see Gudjonsson and Taylor, 1985, for similar observations). In an earlier report concerning this patient, Gudjonsson (1979) reported that she showed heightened electrodermal responses to some, but not all, items of personal relevance at a time when she was amnesic for them. In their study of functional amnesia following male rape, Kaszniak et al. (1988) found that patient M.R. experienced severe distress when shown a TAT card which depicted one person attacking another from behind. He then left the testing session to go to his room, and attempted unsuccessfully to commit suicide – yet was unable at the time to remember explicitly the rape incident. In addition, M.R. produced under hypnosis images that he later confirmed were from his personal past, but were not experienced as memories when they were retrieved. Christianson and Nilsson (in press), in a study of a woman who developed amnesia after an assault and rape, observed that she became extremely upset when taken back to the scene of the assault, even though she did not explicitly remember what had happened or where. Lyon (1985) described a case in which a patient's implicit memory proved therapeutically useful. This patient was utterly unable to retrieve explicitly any autobiographical information. But

when asked to randomly dial numbers on the telephone, she unknowingly dialed the number of her mother, who then identified the patient.

The foregoing observations were made under clinical testing conditions that necessarily lack experimental rigor, and thus can be viewed as no more than suggestive. Nevertheless, they clearly support the idea that explicitly inaccessible autobiographical information can be expressed implicitly, and thereby encourage serious investigation of the phenomenon.

One further issue that merits brief mention concerns the role played by organic factors in the genesis of functional retrograde amnesia. By definition, organic brain damage is not the *immediate* cause of this form of amnesia. However, several investigators have reported a prior history of head injury or other kinds of brain damage in functional retrograde amnesia patients (e.g., Abeles and Schilder, 1935; Kanzer, 1939; Schacter et al., 1982). These observations suggest that in some cases, subtle pre-existing neurological dysfunction may interact with emotional trauma to produce functional retrograde amnesia.

Theories of functional retrograde amnesia. In view of the fact that there have been relatively few controlled empirical attempts to delineate the characteristics of memory loss during functional retrograde amnesia, it is perhaps not surprising that there is a corresponding lack of well developed theories concerning the nature of the phenomenon. Nonetheless, because functional retrograde amnesia is a *reversible* disorder, all theoretical attempts begin with the assumption that it represents a temporary loss of access to stored information. An early account was put forward by Janet (1904), who argued that amnesia is produced by a process of *dissociation*, whereby traumatic mental contents are split off from the ego into a separate subconscious mental domain, and are thus rendered inaccessible to awareness. In Janet's view, dissociation is an automatic, pathological process of genetic origin that occurs in individuals without sufficient ego energy to accommodate the stress of emotional trauma. An important implication of

Janet's view is that consciously inaccessible information is still expressed in the patient's behavior, via pathological symptoms, hallucinations and the like – subconscious 'fixed ideas' which, in the terminology adopted here, constitute implicit memories of the amnesic patient's past. Prince (1916) put forward a similar view, except that he did not view dissociation as an exclusively pathological process. Modern developments of these ideas, referred to as *neodissociationist* theories, have been put forward by Hilgard (1977) and Kihlstrom (1984, 1987).

Freud and Breuer (1966), in contrast, argued that functional amnesia is attributable to an active process of *repression* in which the ego works to inhibit the conscious expression of emotionally threatening traumata. This view has been widely accepted among psychiatric investigators of functional amnesias, although the concept of repression remains controversial (e.g., Erdelyi and Goldberg, 1979). A somewhat different approach was taken by Schacter et al. (1982), who argued that functional amnesia represents a selective failure of an episodic memory system together with sparing of semantic memory. They suggested further that the 'control elements' of episodic memory – higher order units of information such as one's name – can be inhibited as a result of psychological trauma and prevent conscious access to the lower levels of autobiographical information nested under them. Unfortunately, however, there are no strong empirical grounds for distinguishing between these alternative accounts of functional retrograde amnesia. A critical challenge for future research is to construct and implement empirical tests to discriminate between the different theories.

Limited amnesia. Not all cases of functional retrograde amnesias entail loss of personal identity and large sectors of the personal past. In some instances, amnesia is restricted to a single traumatic event or episode. This kind of memory loss, referred to elsewhere as *limited amnesia* (Schacter, 1986a), is frequently observed in conjunction with the commission of violent crimes (e.g., Hopwood and Snell, 1933; Taylor and Kopelman, 1984; see

Schacter, 1986a, for discussion). Little scientific information exists concerning the properties of limited amnesia. For example, it is not known how often people remain permanently amnesic for traumatic episodes and how often they recover them. Some evidence suggests that amnesia for emotionally traumatic episodes is state dependent, inasmuch as the forgotten episode may become accessible when an amnesic individual re-experiences the emotional state that prevailed during the trauma (e.g., Bower, 1981; Watkins, 1949). In addition, early clinical observations provide some evidence of implicit memory for consciously inaccessible episodes. Janet (1904), for example, reported cases in which the contents of the traumatic episode were experienced as involuntary and unfamiliar 'hallucinations' by the patient. Accordingly, there is some reason to believe that limited amnesia, like full-blown functional retrograde amnesia, represents a reversible access failure. Further investigations will be required to provide a firmer basis for understanding limited amnesia.

Multiple personality amnesia

Psychologists and psychiatrists have recently displayed growing interest in multiple personality disorders, in part because the syndrome is not as rare as was once believed (e.g., Bliss, 1986; Boor, 1980; Putnam et al., 1986). Yet ever since the earliest case reports of the phenomenon, amnesia between personalities has been recognized as one of the most striking features of these patients (Coriat, 1916; Janet, 1907; Mitchell, 1816; Prince, 1910; Sidis and Goodhart, 1898; Taylor and Martin, 1944). Most contemporary investigators, too, view between-personality amnesia as a cardinal symptom of multiple personality disorder (Abse, 1987; Coons, 1980; Greaves, 1980; Ludwig et al., 1972; Silberman et al., 1985; Sutcliffe and Jones, 1962), and there is solid evidence to support this notion: Putnam et al. (1986) found evidence for amnesia in 98% of a sample of 100 cases. In fact, the occurrence of unexplainable memory lapses in everyday life is a frequent presenting symptom of

patients who are subsequently given a diagnosis of multiple personality. Such lapses can produce confusion and even bewilderment in both patients and others. For instance, Osgood et al. (1976) described a case in which the main personality earned a substantial income, yet was continually surprised to find that she had no money in her bank account at the end of each month. The money had been withdrawn and used by another personality, yet the main personality lacked any conscious recollection of the withdrawal or spending of the money. In a case reported by Bliss (1986), the patient had a personality named 'Willow' who worked as a prostitute. This personality's experiences, however, were inaccessible to the main personality, who was understandably perplexed when she encountered former customers: "People approach me and say they know me but I don't know them. Men say 'Hi, Willow, when are you going back to work?' They sometimes say shocking or insulting things which I don't want to repeat. I don't like forgetting things" (p. 140).

Features of multiple personality amnesia. Despite a general agreement that between-personality amnesia constitutes an integral aspect of multiple personality disorder, there has been remarkably little investigation of memory function in these patients (Schacter et al., in press). Clinical observations, however, point toward two possibly important features of between-personality memory impairment. First, the amnesia appears to be *asymmetrical*: although at least one personality shows dense amnesia for the experiences of the others, one or more typically has relatively unimpaired access to the experiences of some or all other personalities (e.g., Bliss, 1986; Coriat, 1916; Prince, 1910; Thigpen and Cleckley, 1957). Second, even when a particular personality lacks explicit memory for what has happened to others, some implicit memory can be observed. For instance, in his classic description of the case of Miss Beauchamp, Prince (1910) reported that personality 'B IV' had involuntary 'visions' that depicted the experiences of personality 'B I', but "... the visions were pure automatism, excrescences in her

mind, without conscious association with the other experiences of the life which they pictured. When seeing a vision she [B IV] did not recognize the pictorial experiences as her own, even though it was of B I's life; there was no sense of memory connected with it" (p. 265). Similarly, B IV experienced strong emotional reactions to people and places that had affective significance for B I; B IV, however, had no conscious recollection of the people or places that elicited the emotion and could not understand why she felt it. Similar observations of implicit memory across personalities were made by other early clinical observers (Coriat, 1916; Janet, 1907; Sidis and Goodhart, 1898).

More recently, a few experimental investigations of multiple personality amnesia have been reported; they confirm and extend the foregoing observations. In the first quantitative study of memory function in multiple personality, Ludwig et al. (1972) described a case in which there was a core personality, Jonah, and three other personalities, Sammy, Usoffa Abdulla and King Young. Jonah was completely amnesic for the other three personalities, who in turn had varying degrees of memory for Jonah and each other. Ludwig et al. examined whether information acquired by one personality could influence the performance of another on various learning and conditioning tasks, despite the existence of cross-personality amnesia for each other's experiences. For example, using the paired-associate learning tests from the two alternative forms of the Wechsler Memory Scale, they found that having either Jonah or Usoffa Abdulla study a particular list facilitated learning of that same list by each of the other personalities. Similarly, exposing either Jonah or Usoffa Abdulla to one of the WMS stories facilitated subsequent memory for that story in the other personalities. Evidence for transfer of classical conditioning (pairing of shock with a light or tone) from each of the personalities to some of the others was also obtained, as was evidence of cross-personality facilitation of performance on the WAIS block design test. In two additional paradigms, however, transfer was observed

only from Jonah to other personalities, and not vice versa. One of these involved study of paired-associates and subsequent free association performance; the other involved GSR responses to words that had emotional significance for each of the personalities.

Based on these observations, Ludwig et al. suggested that affectively charged material transferred only from Jonah to other personalities, whereas affectively neutral material transferred among all personalities. This explanation is not entirely satisfying, however, because there are no strong reasons why the paired associate task showing asymmetrical transfer should be considered emotional while the one yielding symmetrical transfer should be viewed as neutral. Nor it is clear why a shock-conditioning procedure – which produced symmetrical transfer between all personalities – ought to be considered non-emotional. Whatever the explanation of the asymmetrical transfer, these instances of transfer can all be interpreted as implicit memory phenomena: a particular personality's performance is facilitated by the experiences of another personality under conditions in which conscious recollection of those experiences is not required and is in all likelihood precluded. Note, however, that Ludwig et al. did not distinguish between implicit and explicit memory and thus did not actually test whether any of the personalities could consciously remember what another had studied.

Similar considerations apply to a more recent study by Dick-Barnes et al. (1987). They tested three different personalities out of a total of 16 that had been identified in a 28-yr-old female patient. Like Ludwig et al., they found that having one of the personalities study a paired-associate list facilitated learning of that same list by any of the other personalities. Moreover, the amount of between-personality facilitation was roughly comparable to the amount of within-personality facilitation. A similar pattern of results was observed with a perceptual-motor learning task: acquisition of skill at the task by one personality facilitated skill acquisition by the others. Although

these observations can be viewed as implicit memory phenomena, Dick-Barnes et al., like Ludwig et al., did not make an implicit/explicit distinction and provided no data on whether the various personalities could explicitly remember the information studied by the others. Evidence on this point is provided in a study of cross-personality interference by Silberman et al. (1985) that included nine multiple-personality patients. They selected two personalities in each patient who were mutually amnesic, and examined performance in two different conditions: (1) similar categorized lists were studied successively by two different personalities, and (2) the lists were studied successively by the same personality. If information acquired by one personality does not interfere with performance in another, recall of individual list items should be higher in the first condition than in the second. However, Silberman et al. reported evidence of retroactive and proactive interference across personalities: recall was lower in the first than the second condition. Nevertheless, Silberman et al. found that "Subjectively, all MPD patients reported that all the words they remembered had been heard in the same personality state" (p. 257). Thus, it seems reasonable to interpret the observed interference effects as implicit expressions of memory by one personality for the experiences of another.

A study that specifically contrasted implicit and explicit memory across personalities has been reported recently by Nissen et al. (1988). They studied a 45-yr-old woman with a rather remarkable 22 diagnosed personalities. One personality has extensive awareness of and explicit memory for the experiences of the others, three receive 'advice' from some of the others, and the remaining 18 are densely amnesic for all experiences except their own. Nissen et al. focussed on eight mutually amnesic personalities that could each be elicited in response to an appropriate request by the experimenter. Target materials were studied by one personality (which was elicited by the patient's psychiatrist) and after retention intervals of approximately 5–10 minutes, another personality

was elicited for memory testing. Little or no evidence of between-personality explicit memory was observed on a variety of tests. Thus, when the personality named Alice studied a list of words, and Bonnie was subsequently given a Yes/No recognition test and asked to pick out the words shown previously to Alice, she circled none of them. By contrast, evidence of cross-personality implicit memory was observed on several tests. For example, on a word fragment completion test in which personalities were required to try to complete graphemic fragments with a single correct solution (e.g., A__A__L_ for ASSASSIN; Tulving et al., 1982), Bonnie's performance was facilitated or primed by prior exposure of a word to Alice. Similar cross-personality implicit memory effects were observed on tasks that required identification of briefly exposed words (Jacoby and Dallas, 1981), and learning to respond to a sequential pattern of lights (Nissen and Bullemer, 1987). Significantly, however, no evidence of cross-personality transfer was observed on several other implicit memory tasks, including solution of semantically ambiguous sentence puzzles (McAndrews et al., 1987) and pictures (Bransford and Johnson, 1972), and free association to word stems with more than 10 possible completions (Graf et al., 1984). Moreover, repeated administration of the WMS logical memory passages did not yield any evidence of cross-personality facilitation of learning, as had been observed in the Ludwig et al. (1972) study. These data indicate that testing memory implicitly was a necessary but not sufficient condition for observing cross-personality transfer in this patient. Nissen et al. argued that the implicit tasks in which transfer was not observed required extensive semantic interpretation of stimulus material (e.g., solving ambiguous sentence puzzles, comprehending a story). Such interpretive activities may have drawn on prior knowledge idiosyncratic to each personality. Since this personality-specific knowledge would have been available only when the same personality performed at both study and test, cross-personality implicit memory may be observed only with tasks

and materials that do not tap personality specific knowledge.

Theories of multiple personality amnesia. Several ideas have been proposed to account for multiple personality amnesia. Janet (1904) and Prince (1910) applied their dissociation theories to the phenomenon, arguing that alternative personalities represent complex systems of subconscious ideas that are split off from, and function independently of, the central ego. This basic proposal has been developed and modified by Hilgard (1977) and Kihlstrom (1984). Bliss (1986) suggested that multiple personalities are hypnotic virtuosos who are victims of spontaneous self-hypnosis and suffer from a form of hypnotic amnesia. Bower (1981) portrayed multiple personality amnesia as an extreme manifestation of the phenomenon of state-dependent retrieval, whereby information acquired in one emotional state is inaccessible in another. Adopting a social psychological perspective, Kenny (1986), Sarbin and Coe (1979) and Spanos (1986) depicted multiple personality disorder as a kind of role-playing activity in which amnesia constitutes part of the role to be played.

As was the case in previous sections, there is little empirical evidence on which to base an assessment of alternative theoretical accounts of multiple personality amnesia. Accordingly, we can do no better at the present time than to register a plea for more systematic studies of the amnesic phenomena observed in multiple personality disorders.

Non-pathological functional amnesias

Infantile and childhood amnesia

Parents often remark that their offspring remember surprisingly little of the events of their early years – even events that would seem highly memorable. In *The Psychopathology of Everyday Life* (1901), Freud drew popular attention to the paucity of adult memories for the events of early childhood. He asserted that an infantile and childhood amnesia covered the first five to eight years of life, with only a few isolated fragments of

experience – referred to as screen memories – remaining accessible to adult recall (see also Freud, 1899).

This developmental phenomenon was also appreciated by members of the first generation of experimental psychologists (Hall, 1899; Henri and Henri, 1895; Titchener, 1900), as well as by a number of literary figures (see De Mare, 1935; Salaman, 1972). Nevertheless, infantile/childhood amnesia has been virtually ignored by cognitive and developmental psychologists – perhaps because convincing empirical documentation has been so difficult to obtain. Consider, for example, the methodological problems attendant on demonstrating that 20-year-olds forget more events occurring from birth to age 5 than 50-year-olds do of events occurring from ages 30 to 35 – while controlling for adequacy of encoding, the number of events during the intervening retention interval, and the like.

Features of infantile and childhood amnesia. Prima facie evidence for infantile and childhood amnesia comes in two forms: surveys of subjects' earliest recollections (for a review, see Kihlstrom and Harackiewicz, 1982); and more extensive samplings of autobiographical memory (for a review, see Kihlstrom, 1981; Wetzler and Sweeney, 1986a; Rubin et al., 1986). For example, Kihlstrom and Harackiewicz (1982) found that high-school and college students' earliest personal recollections tended to be of events occurring between the third and fourth birthday – a figure that concurs with the findings on earlier generations of subjects (e.g., Dudycha and Dudycha, 1941). As another example, Waldfogel (1948) asked college students to freely recall *all* of their recollections up until their 8th birthday: relatively few memories were recovered before the 4th or 5th birthday, and almost nothing from the first three years of life (see also Crovitz and Harvey, 1979).

Evidence of a different kind comes from studies employing the cued recall procedure developed by Crovitz, which was discussed earlier in the chapter with respect to functional retrograde amnesia (1970; see also Crovitz et al., 1980; Crovitz and

Quina-Holland, 1976; Crovitz and Schiffman, 1974; Robinson, 1976). Wetzler and Sweeney (1986a), reanalysing data collected by Rubin (1982), concluded that subjects produce fewer memories from before age 5 than would be expected given the power function that describes the distribution of autobiographical memories across the lifespan. In that sense, then, the relative poverty of memory for events occurring before age 5 would seem to qualify as a true amnesia. Furthermore, it may be heuristically useful to distinguish between *infantile* amnesia, covering the first two years of life (i.e., before linguistic representations of memory are possible), and *childhood amnesia* covering the remaining period.

Theories of infantile and childhood amnesia. A remarkable feature of the literature on childhood amnesia is the vast proliferation of theories to account for the phenomenon before it had ever been convincingly established (see Wetzler and Sweeney, 1986b). For example, Freud (1901) argued that childhood amnesia resulted from the repression of conflict-laden sexual and aggressive ideas and impulses, occurring at the resolution of the Oedipal crisis at about age 5. This approach would be classified as a relatively pure retrieval theory, inasmuch as the repressed contents remain available in the memory store, if not accessible to conscious recall. More recently, White and Pillemer (1979) offered an encoding theory of the phenomenon, arguing that young children do not possess the information-processing capacity to encode memories well enough to make them accessible later on. Their viewpoint is congruent with psychobiological studies of nonhuman animals (e.g., Campbell and Coulter, 1976; Campbell and Spear, 1972; Coulter, 1979; Nadel and Zola-Morgan, 1984; Spear, 1979) and human neonates and infants (Nadel and Zola-Morgan, 1984; Schacter and Moscovitch, 1984) that relate infantile amnesia to the myelination of neural tissue, development of hippocampus and other medial-temporal structures, or maturation of the cortex in general.

Other approaches may be classified as 'encoding

specificity' theories, in that they emphasize the relations between encoding and retrieval processes. An early example is Schacter (1947), whose theory represented an eclectic combination of Freud and Bartlett. He proposed that memories encoded in terms of pre-oedipal, primary process schemata were incompatible with the retrieval schemes characteristic of post-oedipal, secondary process thought. In a similar vein, Neisser (1962, 1967) combined Bartlett with Piaget and suggested that memories encoded by means of sensorimotor and preoperational schemata characteristic of early childhood were incompatible with the modes of retrieval characteristic of concrete or formal operations. In either case, the incompatibility between encoding and retrieval operations renders memories of early childhood that are available in memory storage inaccessible to adult recall – much in the manner of the state-dependent memory deficits produced by psychoactive drugs (Eich, 1980, 1989b).

At the same time, it is possible that infantile and childhood amnesias have less to do with the biological maturation and cognitive development of children than they do with the environments in which children live. Neisser (1962) has pointed out that the same period (ages 5 to 7) associated with such internal events as the development of the hippocampus, resolution of the oedipal crisis, shift from preoperational thought to concrete operations, and the acquisition of sophisticated strategies for memory processing is also marked by a major event in the external environment: the child goes to school. The onset of formal schooling provides the child, for the first time, with the temporal and spatial structures (weekdays vs. weekends; home vs. school) that permit one episode to be reliably distinguished from another. In the final analysis, the source of infantile and childhood amnesia is likely to be found in the interaction between the information-processing capacities of young children, and the information that their environment gives them to process.

At the same time as we consider theoretical explanations of infantile and childhood amnesia, we

must remember that even neonates are capable of learning, and that a great deal of information acquired during childhood is retained by adults. Procedural and semantic knowledge, whose use does not require recollection of the specific circumstances under which it was acquired, is apparently unaffected by the amnesic process(es) that impair infants' remembering of specific events (Nadel and Zola-Morgan, 1986; Schacter and Moscovitch, 1984). Even within the domain of episodic memory, it may prove to be the case that infantile and childhood amnesia affects only explicit memory – the conscious recollection of past events – and spares the implicit effects of past experience on ongoing experience, thought, and action.

Posthypnotic amnesia

Posthypnotic amnesia occurs when subjects are unable to remember, after hypnosis has been terminated, the events and experiences that transpired while they were hypnotized (for reviews, see Kihlstrom, 1983, 1985; Kihlstrom and Evans, 1979). After the hypnotist administers a prearranged cue to cancel the suggestion, the amnesic subject will typically recover these memories – although some degree of residual amnesia may persist for a short period of time. This disruption in memory rarely occurs unless it has been suggested to the subject. And even with an explicit suggestion, the extent of amnesia is highly correlated with measured hypnotizability: unsusceptible subjects show little if any response to the suggestion, while the very densest amnesias tend to be confined to the most highly hypnotizable subjects (sometimes called 'hypnotic virtuosos').

Features of posthypnotic amnesia. Like the other functional amnesias, posthypnotic amnesia is a phenomenon of episodic memory (Tulving, 1983). That is, amnesic subjects fail to remember specific events and experiences that occurred while they were hypnotized (suggested amnesia can also occur without termination of hypnosis; see Spanos, 1986). When amnesic subjects forget a wordlist that has been memorized during hypnosis, the

vocabulary items themselves remain available for use in conversation, as word associations and category instances, and the like (Williamsen et al., 1965; Kihlstrom, 1980). It should be noted that appropriately worded suggestions can produce aphasias and agnosias as well as amnesia (Kihlstrom, 1985). Thus, subjects given the suggestion that they will be unable to pronounce the word *house* may be unable to understand a semantically related word such as *home* (Hilgard, 1977). In this chapter, however, we are concerned only with the apparent inability of hypnotized subjects to remember specific experiences that occurred while they were hypnotized (nothing systematic is known about the effectiveness of suggestions of amnesia for events occurring outside hypnosis).

Several studies from Hull's (1933) research program illustrate the selectivity of posthypnotic amnesia. For example, Patten (1932; cited in Hull, 1933) gave subjects practice in complex mental addition for 18 days; on Days 7–12, the practice took place in hypnosis. After termination of hypnosis the subjects were unable to remember the practice sessions which occurred in hypnosis; nevertheless, the learning curve for these sessions was continuous with that derived from the preceding and following nonhypnotic sessions. Similar findings were obtained by Coors (1928; cited in Hull, 1933) with subjects learning a stylus maze; and by Life (1929; cited in Hull, 1933) with subjects learning paired associates. Apparently, subjects retained procedural knowledge acquired in hypnosis, in the form of certain cognitive and motor skills; however, they were unable to remember the experiences through which they acquired that knowledge. The dissociation between procedural knowledge and episodic memory – the former spared, the latter disrupted – is characteristic of posthypnotic amnesia.

Another dissociation has been observed in posthypnotic source amnesia (Evans, 1979a; Evans and Thorn, 1966). In source amnesia experiments, hypnotized subjects are incidentally taught some items of obscure factual knowledge while they are hypnotized, and subsequently receive a suggestion

to forget what happened during hypnosis. When tested posthypnotically, many subjects appear ignorant of this new factual information, just as they are unaware of the learning experience and other events of hypnosis. However, a substantial minority of subjects will forget the various hypnotic experiences, but nonetheless will correctly answer the questions whose answers they learned while hypnotized. When queried, these subjects seem unaware that they learned these facts while they were hypnotized, and may even attribute their knowledge to some nonhypnotic context – a tendency which gives the phenomenon its name. The factual information itself may be considered part of the subject's fund of semantic knowledge, the use of which is not impaired by the amnesia suggestion. Although Evans' experiments have been criticized on the grounds of demand characteristics (Spanos et al., 1985), it may be noted that a similar dissociation has been observed in cases of the amnesic syndrome due to brain damage (e.g., Schacter et al., 1984; Shimamura and Squire, 1987).

A further dissociative feature of posthypnotic amnesia is also illustrated by experiments in which subjects are asked to memorize lists of familiar words (Kihlstrom, 1980; Williamsen et al., 1965). If the acquisition phase is followed by suggestions of amnesia for the learning experience, hypnotizable subjects typically will be unable to remember the contents of the lists they have recently memorized. Nevertheless, they remain able to use the constituent items as word associations and category instances. Giving word associations and category exemplars are prototypical semantic memory tasks. These functions are unimpaired by suggestions for amnesia, although they may be affected by suggestions of other types (Bertrand and Spanos, 1987; Spanos et al., 1982a).

Theories of posthypnotic amnesia. The fact that amnesia does not occur spontaneously with the termination of hypnosis, and can be reversed without the reinduction of hypnosis, distinguishes posthypnotic amnesia from instances of state-dependent memory (e.g., Eich, 1980, 1989b). And the fact

that it can be reversed at all distinguishes it from other forms of instructed forgetting (Kihlstrom, 1983). Moreover, reversibility clearly marks posthypnotic amnesia as a failure of memory retrieval: the critical memories are adequately encoded, and remain available in storage, but amnesic subjects seem to have trouble gaining conscious access to them. Nevertheless, the precise nature of this retrieval disruption has been subject to some controversy. Viewed from a psychoanalytic perspective, for example, posthypnotic amnesia may be attributed to the motivated repression of unwanted memories (for reviews, see Kihlstrom and Hoyt, 1988). From a social-psychological perspective, on the other hand, amnesia has been construed as a product of self-distraction and strategic self-presentation (e.g., Coe, 1978; Sarbin and Coe, 1979; Spanos, 1986; but see Kihlstrom, 1985). This chapter adopts the perspective of contemporary information-processing views of memory, which characterizes posthypnotic amnesia as a disruption in memory retrieval (for a more detailed account, see Kihlstrom, 1985).

On the basis of studies such as those described above, Kihlstrom (1980, 1984, 1985) has suggested that posthypnotic amnesia is characterized by dissociations between episodic memory and both procedural and semantic knowledge. However, the available literature is not completely organized by these distinctions. McKoon and her colleagues (McKoon et al., 1986) have pointed out that retroactive inhibition, in which memory for one wordlist impairs retrieval of another wordlist learned previously, is not affected by posthypnotic amnesia. For example, Graham and Patton (1968) asked subjects to learn two lists of adjectives; for some, the second list was learned in hypnosis. Those who received a suggestion to forget the second list were able to recall very little of it; nevertheless, they showed a level of retroactive interference on the first list equivalent to that displayed by subjects who remembered the interpolated list perfectly. Dillon and Spanos (1983) made similar observations in an experiment on proactive interference. The problem posed by

studies of interference in posthypnotic amnesia is that the interfering memory is episodic in nature, reflecting the residual trace of the subject's particular encounter with the interfering wordlist. Thus, the amnesia cannot be adequately characterized as reflecting a dissociation between episodic and semantic memory (Kihlstrom, 1985).

A finding with similar implications was obtained by Kihlstrom (1980) in two experiments originally intended to illustrate the dissociation between episodic and semantic memory. In the first experiment, subjects memorized a list of unrelated words, and then received a suggestion that they would not be able to remember the words they had learned. On an initial test of recall, the subgroup of 'virtuoso' hypnotic subjects remembered virtually none of the words they had previously memorized. At this point, the subjects were asked to give word associations to various probes. The critical probes had a high a priori probability of eliciting the items of the previously memorized wordlist; the neutral probes targeted carefully matched items that had not been learned. As noted earlier, the suggestion did not disrupt the word-association performance of the amnesic subjects: the items from the memorized wordlist remained available for use as vocabulary items. More important, there was a semantic priming effect observed in the word-association performance, such that the subjects were more likely to give the targeted response to critical as opposed to neutral probes. Most important, there was no difference in priming between amnesic and nonamnesic subjects. These findings were confirmed in a conceptual replication in which amnesic subjects memorized a categorized wordlist and were subsequently asked to provide instances of critical and neutral taxonomic categories (see also Spanos et al., 1982a).

Like retroactive and proactive interference, semantic priming is an effect of episodic memory; but, unlike free recall, it is not disrupted by suggestions for posthypnotic amnesia. However, while free recall is an expression of explicit memory, interference and priming are manifestations of implicit memory for a prior episode. That is, neither

phenomenon requires that the subject be aware of the prior experience that is the source of the inhibitory and facilitative effects that are observed. In the final analysis, findings such as these suggest that the fundamental dissociation observed in posthypnotic amnesia is between explicit and implicit forms of episodic memory – the latter spared, the former impaired (Kihlstrom, 1987). In some respects, the explicit-implicit distinction subsumes the dissociations between episodic memory and procedural knowledge, and between episodic memory and semantic knowledge, described above. Most procedural and semantic knowledge is acquired through experience. But it is not necessary to remember the circumstances under which this knowledge was acquired in order to employ it in various tasks; nor do we, ordinarily; nor, when we do, does it help us in any way. Thus, the use of procedural and semantic knowledge can be an occasion for the subject to display implicit memory for some previous experience.

Sleep-induced amnesia

A great deal of activity transpires while we are asleep. Some of this activity is external to the sleeper: traffic passes in the street outside the house, the house cat knocks over a lamp in the living room, the couple next door has a marital spat. Other activity is internal: mental activity, including dreams and nightmares, occur in all the stages of sleep (Foulkes, 1985), and some of us sleepwalk or sleeptalk (Arkin et al., 1978). Yet virtually none of it is remembered upon awakening in the morning. This amnesia induced by (or at least associated with) sleep appears to be universally experienced. *Features of sleep-induced amnesia.* Except in the twin cases of memory for dreams (Cohen, 1979; Koulack and Goodenough, 1976), and sleep learning (Aarons, 1976; Eich, 1989a), sleep-induced amnesia has not been the subject of much systematic inquiry (Arkin et al., 1978). Yet the anectodal evidence from the laboratory provides ample evidence to supplement personal experience. Thus, although the typical night's eight hours of sleep encompass four or five full sleep cycles, most

people rarely remember any dreams at all save (perhaps) the one that occurred in the REM cycle out of which they awakened, and little or nothing of the mental activity that transpires during intervening NREM periods (for reviews, see Cohen, 1979; Goodenough, 1978; Koulack and Goodenough, 1976). Attempts at sleep learning are almost uniformly unsuccessful at yielding memory traces that are retrievable after awakening, regardless of the sleep stage during which the material is presented (Aarons, 1976; Eich, 1989a).

Still more evidence concerning post-sleep amnesia, if any were needed, comes from observations of sleepwalking and sleeptalking under both natural and laboratory conditions. Sleeptalkers may engage in fairly complex speech acts, including interchanges with real or imagined conversational partners (for reviews, see Arkin, 1978, 1981). These individuals rarely reveal secrets in their speeches, and this censorship itself would also seem to require extensive analysis of their content. Nevertheless, sleeptalkers typically remember little or nothing of what they have said the next morning. Similarly, sleepwalkers engage in relatively complex and coordinated behavioral activities as they navigate their environments (Gastaut and Broughton, 1964; Kales et al., 1966a; Sours et al., 1963), but display little memory for their sojourns upon awakening.

Additional evidence on memory for sleep episodes may be found in a remarkable series of studies on *sleep suggestion* performed by Evans and his associates (Evans et al., 1969, 1970; Perry et al., 1978; for a review, see Evans, 1979b). In these studies, subjects were administered hypnotic-like suggestions for simple motor responses during REM sleep. The cues were tested under three conditions: in the same REM period as that in which the suggestion had been administered; in a subsequent REM period, without repetition of the suggestion; and on a subsequent night. Although the subjects showed no signs of arousal (as indicated by EEG alpha activity), they responded appropriately to the cues approximately 20% of the time. After awakening, they did not remember the

suggestions or the cues. Nevertheless, upon returning to the laboratory for a subsequent night's sleep, the subjects continued to respond to a significant number of cues even though the suggestions were not readministered. The findings are clearly reminiscent of the state-dependent memory phenomena induced by psychoactive drugs or moods (Eich, 1977, 1980, 1989b).

Theories of sleep-induced amnesia. One explanation of this universally experienced memory deficit is that the higher cortical centers which engage in complex information processing shut down during sleep, with the result that most events occurring while the person is asleep are not noticed and not processed; therefore accessible traces of these events fail to be encoded in memory. Thus, the most commonly accepted explanation of post-sleep amnesia is in terms of 'consolidation failure' (McGaugh, 1966), or, perhaps more properly, poor encoding (Cermak and Craik, 1979). For example, Koulack and Goodenough (1976; see also Goodenough, 1978) have proposed that the low level of cortical arousal characteristic of sleep effectively prevents the sleeper from performing the cognitive operations necessary to encode memory traces of dreams that are accessible in the subsequent waking state (Eysenck, 1976). In this view, dreams are remembered when the sleeper awakens during the dream, permitting retrieval from short-term memory. Alternatively, if the sleeper awakens shortly after a dream has occurred, residual information retrieved from short-term memory may serve as a cue to the retrieval of a highly degraded long-term memory trace of the dream. If retrieval is delayed until all trace of the dream has decayed or been displaced, the long-term memory trace of the dream will be virtually inaccessible.

This arousal-retrieval model of amnesia for dreams is based on classic multistore models of memory (Atkinson and Shiffrin, 1968; Waugh and Norman, 1965), and has been adopted by Arkin (1981) as an explanation of amnesia for episodes of sleeptalking. Goodenough (1978) has also employed the model as an explanation of the general failure of research to find evidence for

learning during sleep (Aarons, 1976; Eich, 1987). Thus, sleepers generally fail to remember information presented during sleep, unless the information was accompanied by evidence of physiological arousal (Simon and Emmons, 1955; Koukkou and Lehman, 1968; Lehman and Koukkou, 1973). It seems that the arousal-retrieval model provides an economical account of a wide variety of memory failures observed in the sleep context. (In passing, it may be noted that a similar explanation has been offered for the amnesia displayed by surgical patients given general anesthesia (Kihlstrom and Schacter, 1989; Trustman et al., 1977). However, more recent experiments, while not definitive, seem to indicate that this amnesia may affect only explicit memory for surgical events, and that under some circumstances adequately anesthetized patients may display memory (without awareness) of events that transpired during their surgery (Bennett, 1987, 1988; Goldmann, 1987; but see Eich et al., 1985).)

Although the hypothesis of encoding failure has the twin appeals of generality and parsimony, the strong view of cortical inactivity during sleep is contradicted by a variety of evidence. Certainly some degree of information-processing occurs during sleep. Anecdotally, it appears that sleepers may awaken readily to novel sounds, or to those that are unexpected or have special meaning (as when parents awaken to their child's cry), even though they remain unresponsive to other sounds of even greater stimulus intensity. Moreover, experimental evidence indicates that low-intensity environmental stimuli reliably evoke cortical, autonomic and behavioral responses in subjects who nevertheless remain asleep (Williams et al., 1964, 1966; for a review, see Williams, 1973), although these responses may not be entirely normal in terms of latency and amplitude. Further, environmental events can be incorporated into the contents of ongoing dreams (Dement and Wolpert, 1958; for a review, see Arkin and Antrobus, 1978). Although it may be the case that more complex information processing is possible in Stage REM than in NREM, these sorts of results indicate that sleepers

remain capable of performing at least some (presumably automatized) information-processing functions.

This possibility raises the question of alternative explanations for the various phenomena of post-sleep amnesia, especially those affecting memory for dreams, that do not involve encoding failure. For example, Freud (1900) argued that memory for dreams was impaired by repression, which may be construed as a motivated failure to retrieve an available memory. However, while some early experimental tests seemed to support the repression theory (Goodenough, 1967), later work has not been persuasive (Goodenough, 1978; Goodenough et al., 1975). A more contemporary approach is represented by Cohen (1974, 1976, 1979), who has interpreted amnesia for dreams in terms of interference theory. While the interference hypothesis is supported by a considerable body of experimental research, most of the empirical data supporting interference are also compatible with the arousal-retrieval model (Cohen, 1979; Goodenough, 1978).

Finally, it has been suggested that the events of sleep may be encoded in long-term memory, but accessible only during the sleep state (Arkin, 1981; Cohen, 1979; Goodenough, 1978; Overton, 1973). Obviously, this hypothesis of sleep-state-dependent memory is difficult to test. However, some supportive evidence is provided by Evans's (1979b) studies of sleep suggestion, described earlier. The sleep suggestion studies indicate that environmental events can be encoded in long-term memory, although access to this information may be dependent on the subject's being asleep at the time. This obviously bodes ill for those entrepreneurs who make strong claims for the effectiveness of sleep learning. From the point of view of accessibility, sleep-state dependency is effectively indistinguishable from consolidation failure or degraded encoding. However, it should be noted that observations of post-sleep amnesia are based mostly on measurements of explicit memory – that is, the subjects' ability to consciously remember episodes that occurred while they were

asleep. It is possible that, if afforded the opportunity to do so, subjects who fail to show explicit memory for such episodes may nevertheless display implicit memory for them – that is, changes in task performance that are attributable to a preserved memory of some prior experience.

Some provocative hints of implicit memory for sleep experiences are provided in accounts of experiments on sleep learning conducted in the Soviet Union and Eastern Europe (for reviews, see Hoskovec, 1966; Hoskovec and Cooper, 1967; Rubin, 1968, 1971). For example, Svyadosch (1962; republished in Rubin, 1968) noted that in some cases the stimulus material was incorporated into dreams reported upon awakening; or it was experienced as entering consciousness unbidden, from an unknown source.

Unfortunately, these experiments generally fail to employ EEG indices of arousal from sleep, so their positive results are equivocal. Nevertheless, they hold open the possibility that material presented during sleep is successfully encoded and available in memory storage, but accessible to retrieval only in circumstances that do not require subjects to consciously remember a particular episode. Demonstration of sleep learning with measures of implicit rather than explicit memory would strengthen the argument that sleep events which do not awaken the subject, the contents of sleep speeches, sleepwalks and dreams, are encoded and available in storage as well.

Interpretation of functional amnesias and the problem of simulation

The material covered in the preceding sections reveals that a rich variety of memory phenomena can be grouped under the general rubric of functional amnesia. It seems clear, however, that our current knowledge of each of the various functional amnesias is rather modest, and that our understanding of the relation between them is even more limited. We do not know, for example, whether fundamentally different mechanisms are

involved in pathological and non-pathological functional amnesias, or for that matter, whether any of the individual amnesias discussed here share common mechanisms with any of the others. One feature that may provide important clues concerning these relationships is the extent to which a particular amnesia is reversible. Functional retrograde amnesia and hypnotic amnesia are both clearly reversible, and the evidence on multiple personality amnesia suggests that it, too, is reversed when personalities are integrated therapeutically (Bliss, 1986). In contrast, there is no compelling evidence that either infantile and childhood amnesias or sleep and dream amnesias are reversible. It is thus possible that different explanatory constructs need to be applied to reversible and non-reversible functional amnesias.

The reversibility/non-reversibility of functional amnesias may also be helpful in understanding their relation to the organic amnesias. For example, the classical amnesic syndromes associated with damage to the temporal lobes or Korsakoff's syndrome are typically stable, chronic disorders (e.g., Cermak, 1982; Squire, 1982). In contrast, some aspects of amnesia observed after closed head injury (Russell and Nathan, 1946; Schacter and Crovitz, 1977), transient ischemias (Fischer and Adams, 1958) and electroconvulsive therapy are reversible, although even these amnesias usually contain a non-reversible component. It is tempting to speculate that some of the mechanisms involved in reversible and non-reversible amnesias, respectively, are similar in functional and organic cases. This speculation must be tempered, however, by acknowledgement of known differences between functional and organic amnesia. For example, although some of the memory loss associated with both functional retrograde amnesia and organic retrograde amnesias produced by head injury and electroconvulsive therapy is reversible, the latter type of amnesia is frequently temporally graded (Squire, 1987) whereas the former is not (Schacter et al., 1982). In addition, there appears to be more variability in the nature of memory loss observed across cases in

pathological functional amnesias than in organic amnesias.

A further issue that must be considered when discussing the relationship between functional and organic amnesias is the occurrence of simulated memory loss. Patients who present with pathological functional amnesias may be attempting to escape from an unpleasant or intolerable situation, such as military service, financial difficulties, or punishment for a crime, and therefore may benefit from simulating amnesia (for a discussion, see Schacter, 1986a, c). The issue of simulation has also arisen with respect to hypnotic amnesias (e.g., Spanos et al., 1982b); Wagstaff, 1982). Although simulation is not unknown following organic brain damage (Wiggins and Brandt, in press; Schacter, 1986c), it is not a serious concern when amnesia is produced by a verifiable lesion of a brain region known to be involved in memory. At the present time, no firm criteria exist for unequivocally distinguishing between genuine and simulated amnesias (Schacter, 1986b, c). Nevertheless, investigators can minimize the possibility of confusing the two by carefully considering the circumstances surrounding each case and determining whether grounds for suspecting simulation exist. As far as we can determine, no such grounds exist in the cases discussed in this chapter. It would also be helpful if investigators examine and report the performance of non-amnesic subjects who are instructed to simulate amnesia, so as to determine whether features of an alleged instance of amnesia are intuitively obvious to naive individuals (e.g., Schacter, 1986b).

Although the interpretive difficulties that can arise when studying functional amnesias must be acknowledged, we think that further investigation of them as memory phenomena will provide new and useful insights into the nature of remembering and forgetting. Study of functional amnesias may be particularly informative with respect to the distinction between implicit and explicit forms of memory. Despite the striking failure of explicit remembering which defines the various functional amnesias we have considered, at least some

evidence for implicit memory was observed with each type. Moreover, since reversible functional amnesias necessarily involve failures of explicit access to available memory representations, these amnesias should provide extremely fertile grounds for investigating implicit memory. More generally, functional amnesias may belong to an emerging class of dissociations, observed in both intact and brain-damaged populations, in which various types of knowledge that are not consciously accessible can be expressed implicitly (Kihlstrom, 1987; Schacter et al., 1988). Viewed within this context, further study of functional amnesias could provide important insights into the nature of both memory and consciousness.

Acknowledgements

Preparation of this paper, and the point of view represented therein, was supported in part by a Biomedical Research Support Grant from the University of Arizona to D.L.S. and a National Institute of Mental Health Grant MH-35856 to J.F.K. We thank Michael R. Berren, Irene P. Hoyt, Susan M. McGlynn, Douglas J. Tataryn, Betsy A. Tobias and James Wood for comments and discussion.

References

- Aarons L: Sleep-assisted instruction. *Psychol. Bull.*: 83, 1–40, 1976.
- Abeles M, Schilder P: Psychogenic loss of personal identity. *Arch. Neurol. Psychiatry*: 34, 587–604, 1935.
- Abse DW: *Hysteria and Related Mental Disorders*. Bristol: IOP Publishing, 1987.
- Akhtar S, Brenner I: Differential diagnosis of fugue-like states. *J. Clin. Psychiatry*: 40 381–385, 1979.
- Akhtar S, Lindsey B, Kahn, FL: Sudden amnesia for personal identity. *Pa Med.*: 84, 46–48, 1981.
- Albert MS, Butters N, Levin J: Temporal gradients in the retrograde amnesia of patients with alcoholic Korsakoff's disease. *Arch. Neurol.*: 36, 311–216, 1979.
- Arkin AM: Sleepwalking, In Arkin AM, Antrobus JS, Ellman SJ (Editors), *The Mind in Sleep*. Hillsdale, NJ: Erlbaum Ch. 15, pp. 513–532, 1978.
- Arkin AM: *Sleep Talking: Psychology and Psychophysiology*. Hillsdale, NJ: Erlbaum, 1981.
- Arkin AM, Antrobus JS: The effects of external stimuli applied prior to and during sleep on sleep experience. In Arkin AM, Antrobus JS, Ellman SJ, (Editors), *The Mind in Sleep*. Hillsdale, NJ: Erlbaum, Ch. 10, pp. 351–392, 1978.
- Arkin AM, Antrobus JS, Ellman SJ (Editors): *The Mind in Sleep*. Hillsdale, NJ: Erlbaum, 1978.
- Atkinson RC, Shiffrin RM: Human memory: a proposed system and its control processes. In Spence KW, Spence JT (Editors), *The Psychology of Learning and Motivation, Vol. 2*. New York: Academic Press, pp. 89–195, 1978.
- Bennett HL: Learning and memory in anaesthesia. In Rosen M, Lunn JN (Editors), *Consciousness, Awareness, and Pain in General Anesthesia*. London: Butterworths, 132–139, 1987.
- Bennett, HL: Perception and memory for events during adequate general anesthesia for surgical operations. In Pettinati H (Editor), *Hypnosis and Memory*, in press, 1988.
- Berrington WP, Liddell DW, Foulds GA: A re-evaluation of the fugue. *J. Ment. Sci.*: 102 280–286, 1956.
- Bertrand LD, Spanos NP: Contextual effects on priming during hypnotic amnesia. Unpublished manuscript, Carleton University, 1987.
- Bliss EL: *Multiple Personality, Allied Disorders and Hypnosis*. New York: Oxford University Press, 1986.
- Bower GH: Mood and memory. *Am. Psychol.*: 36, 129–148, 1981.
- Brandt J, Rubinsky E, Lassen G: Uncovering malingered amnesia. *Ann. N. Y. Acad. Sci.*: 444, 502–503, 1985.
- Bransford JD, Johnson MK: Consideration of some problems of comprehension. In Chase WG (Editor), *Visual Information processing*. New York: Academic Press, 1973.
- Campbell BA, Coulter X: The ontogenesis of learning and memory. In Rosenzweig S, Bennett E (Editors), *Neurobiology of Learning and Memory*. Cambridge: MIT Press, Ch. 13, pp. 209–225, 1976.
- Campbell BA, Spear NE: Ontogeny of memory. *Psychol. Rev.*: 79, 215–236, 1972.
- Cermak LS (Editor): *Human Memory and Amnesia*. Hillsdale NJ: Lawrence Erlbaum Associates, 1982.
- Cermak LS, Craik FIM (Editors): *Levels of Processing in Human Memory*. Hillsdale, NJ: Erlbaum, 1979.
- Christianson SA, Nilsson LG: Hysterical amnesia: a case of aversively motivated isolation of memory. In Archer T, Nilsson LG (Editors), *Aversion, Avoidance, and Anxiety*. Hillsdale, NJ: Erlbaum Associates, in press.
- Coe WC: The credibility of posthypnotic amnesia: a contextualist's view. *Int. J. Clin. Exp. Hypn.*: 26, 218–245, 1978.
- Cohen DB: Toward a theory of dream recall. *Psychol. Bull.*: 81, 138–154, 1974.
- Cohen DB: Dreaming: Experimental investigation of representational and adaptive properties. In Schwartz GE, Shapiro D (Editors), *Consciousness and Self-regulation: Advances in Research, Vol. 1*. New York: Plenum, Ch. 8, pp. 313–360, 1976.
- Cohen DB: Remembering and forgetting dreaming. In Kihlstrom JF, Evans FJ (Editors), *Functional Disorders of Memory*. Hillsdale, NJ: Erlbaum, Ch. 8, pp. 239–274, 1979.
- Coons PM: Multiple personality: diagnostic considerations. *J. Clin. Psychiatry*: 41, 330–336, 1980.
- Coriat IH: *Abnormal Psychology*. New York: Moffat, Yard, and Co., 1916.
- Coriat IH: The Lowell case of amnesia. *J. Abnorm. Psychol.*: 2, 93–111, 1907.
- Coulter X: Determinants of infantile amnesia. In Spear NE,

- Campbell BA (Editors), *The Ontogeny of Learning and Memory*. Hillsdale, NJ: Erlbaum, Ch. 10, pp. 245–270, 1979.
- Crovitz HF: Galton's walk: *Methods for the Analysis of Thinking, Intelligence, and Creativity*. New York: Harper & Row, 1970.
- Crovitz HF, Harvey MT: Early childhood amnesia: A quantitative study with implications for the study of retrograde amnesia after brain injury. *Cortex*: 15, 331–335, 1979.
- Crovitz HF, Quina-Holland K: Proportion of episodic memories from early childhood by years of age. *Bull. Psychonomic Soc.*: 7, 61–62, 1976.
- Crovitz HF, Schiffman H: Frequency of episodic memories as a function of their age. *Bull. Psychonomic Soc.*: 4, 517–518, 1974.
- Crovitz HF, Harvey MT, McKee DC: Selecting retrieval cues for early childhood amnesia: implications for the study of shrinking retrograde amnesia. *Cortex*: 16, 305–310, 1980.
- De La Mare W: *Early One Morning in the Spring: Chapters on children and on childhood as it is revealed in particular in early memories and in early writings*. New York: Macmillan, 1935.
- Dement WC, Wolpert E: The relation of eye movements, body motility, and external stimuli to dream content. *J. Exp. Psychol.*: 55, 543–553, 1958.
- Dick-Barnes M, Nelson RO, Aine U: Behavioral measures of multiple personality: The case of Margaret. *J. Behav. Ther. Exp. Psychiatry*: 18, 229–239, 1987.
- Dillon RF, Spanos NP: Proactive inhibition and the functional ablation hypothesis: More disconfirmatory data. *Int. J. Clin. Exp. Hypn.*: 31, 47–56, 1983.
- Dudycha GJ, Dudycha MM: Childhood memories: a review of the literature. *Psychol. Bull.*: 38, 668–682, 1941.
- Eich JE: State-dependent retrieval of information in human episodic memory. In Birnbaum IM, Parker ED (Editors), *Alcohol and Human Memory*. Hillsdale, NJ: Erlbaum, Ch. 10, pp. 141–158, 1978.
- Eich JE: The cue-dependent nature of state-dependent retrieval. *Mem. Cognition*: 8, 157–173, 1980.
- Eich JE: Learning during sleep. In Bootzin RR, Kihlstrom JF, Schacter DL (Editors), *Cognition and Sleep*. Washington, DC: American Psychological Association, in press, 1989a.
- Eich JE: Theoretical issues in state dependent memory. In Roediger HL, Craik FIM (Editors), *Varieties of Memory and Consciousness: Papers in Honor of Endel Tulving*. Hillsdale, NJ: Erlbaum, Ch. 17, pp. 331–354, 1989b.
- Eich JE, Reeves JL, Katz RL: Anesthesia, amnesia and the memory/awareness distinction. *Anesth. Analg.*: 64, 1143–1148, 1985.
- Eisen MR: Return of the repressed: hypnoanalysis of a case of total amnesia. *Int. J. Clin. Exp. Hypn.*: 37, 107–119, 1989.
- Erdelyi MH, Goldberg B: Let's not sweep repression under the rug: toward a cognitive psychology of repression. In Kihlstrom JF, Evans FJ (Editors), *Functional Disorders of Memory*. Hillsdale NJ: Erlbaum Associates, Ch. 12, pp. 355–402, 1979.
- Evans FJ: Contextual forgetting: posthypnotic source amnesia. *J. Abnorm. Psychol.*: 88, 556–563, 1979a.
- Evans FJ: Hypnosis and sleep: techniques for exploring cognitive activity during sleep. In Fromm E, Shor RE (Editors), *Hypnosis: Developments in Research and New Perspectives*. New York: Aldine, Ch. 6, pp. 139–184, 1979b.
- Evans FJ, Thorn WAF: Two types of posthypnotic amnesia: recall amnesia and source amnesia. *Int. J. Clin. Exp. Hypn.*: 14, 333–343, 1966.
- Evans FJ, Gustafson LA, O'Connell DN, Orne MT, Shor RE: Sleep-induced behavioral response. *J. Nerv. Ment. Dis.*: 148, 467–476, 1969.
- Evans FJ, Gustafson LA, O'Connell DN, Orne MT, Shor RE: Verbally induced behavior responses during sleep. *J. Nerv. Ment. Dis.*: 150, 171–187, 1970.
- Eysenck MW: Arousal, learning, and memory. *Psychol. Bull.*: 83, 389–404, 1976.
- Fisher C: Amnesic states in war neuroses: the psychogenesis of fugues. *Psychoanal. Q.*: 14, 437–468, 1945.
- Fisher C, Adams RD: Transient global amnesia. *Trans. Am. Neurol. Assoc.*: 83, 143–145, 1958.
- Fisher C, Joseph E: Fugue with loss of personal identity. *Psychoanal. Q.*: 18, 480–493, 1949.
- Foulkes D: *Dreaming: A Cognitive-Psychological Analysis*. Hillsdale, NJ: Erlbaum, 1985.
- Freud S: Screen memories. In Strachey J (Editor), *The Standard Edition of the Complete Psychological works of Sigmund Freud. Vol. 3*. London: Hogarth, pp. 301–322, 1899.
- Freud S: The interpretation of dreams. In Strachey J (Editor), *The Standard Edition of the Complete Psychological Works of Sigmund Freud. Vols. 4–5*. London: Hogarth, 1900.
- Freud S: The psychopathology of everyday life. In Strachey J (Editor), *The Standard Edition of the Complete Psychological Works of Sigmund Freud. Vol. 6*. London: Hogarth, 1901.
- Freud S, Brever J: *Studies on Hysteria*. New York: Avon Books, 1966.
- Gastaut H, Broughton R: A clinical and polygraphic study of episodic phenomena during sleep. In Wortis J (Editor), *Recent Advances in Biological Psychiatry. Vol. 7*. New York: Plenum, 1965.
- Geleerd ER, Hacker FJ, Rapaport D: Contribution to the study of amnesia and allied conditions. *Psychoanal. Q.*: 14, 199–220, 1956.
- Gillespie RD: Amnesia. *Arch. Neurol. Psychiatry*: 37, 748–764, 1937.
- Goldmann L: Further evidence for cognitive processing under general anesthesia. In Rosen M, Lunn JN (Editor), *Consciousness, Awareness, and Pain in General Anesthesia*. London: Butterworths, pp. 140–144, 1987.
- Goodenough DR: Some recent studies of dream recall. In Witkin HA, Lewis HB (Editors), *Experimental Studies of Dreaming*. New York: Random House, 1967.
- Goodenough DR: Dream recall: History and current status of the field. In Arkin AM, Antrobus JS, Ellman SJ (Editors), *The Mind in Sleep*. Hillsdale, NJ: Erlbaum, Ch. 5, pp. 113–142, 1978.
- Goodenough DR, Witkin HA, Lewis HB, Koulack, D, Cohen H: Repression, interference, and field dependence as factors in dream forgetting. *J. Abnorm. Psychol.*: 83, 32–44, 1974.
- Graf P, Schacter DL: Implicit and explicit memory for new associations in normal and amnesic subjects. *J. Exp. Psychol. Learn. Mem. Cognition*: 11, 501–518, 1985.

- Graf P, Squire LR, Mandler G: The information that amnesic patients do not forget. *J. Exp. Psychol. Learn. Mem. Cognition*: 10, 164–178, 1984.
- Greaves GB: Multiple personality 165 years after Mary Reynolds. *J. Nerv. Ment. Dis.*: 168, 577–596, 1980.
- Gudjonsson GH: The use of electrodermal responses in a case of amnesia (A case report). *Med. Sci. Law*: 19, 138–140, 1979.
- Gudjonsson GH, Haward LRC: Case report – Hysterical amnesia as an alternative to suicide. *Med. Sci. Law*: 22, 68–72, 1982.
- Gudjonsson GH, Taylor PJ: Cognitive deficit in a case of retrograde amnesia. *Br. J. Psychiatry*: 147, 715–718, 1985.
- Hall GS: Note on early memories. *Pedagog. Semin.*: 6, 485–512, 1899.
- Henri V, Henri C: On our earliest recollections of childhood. *Psychol. Rev.*: 2, 215–216, 1895.
- Hilgard ER: *Divided Consciousness*. New York: John Wiley and Sons, 1977.
- Hirst W: The amnesic syndrome: descriptions and explanations. *Psychol. Bull.*: 91, 435–460, 1982.
- Hopwood JS, Snell HK: Amnesia in relation to crime. *J. Ment. Sci.*: 79, 27–41, 1933.
- Hoskovec J: Hypnopedias in the Soviet Union: a critical review of recent major experiments. *Int. J. Clin. Exp. Hypn.*: 14, 308–315, 1966.
- Hoskovec J, Cooper LM: Comparison of recent experimental trends concerning sleep learning in the U.S.A. and the Soviet Union. *Act. Nerv. Super.*: 9, 93–96, 1967.
- Hull CL: *Hypnosis and Suggestibility: An Experimental Approach*. New York: Appleton-Century-Crofts, 1933.
- Jacoby LL, Dallas M: On the relationship between autobiographical memory and perceptual leaching. *J. Exp. Psychol. Gen.*: 110, 306–340, 1981.
- Janet P: L'amesié et al dissociation des souvenirs par l'émotion. *J. Psychol. Norm. Pathol.*: 1, 417–453, 1904.
- Janet P: *The Major Symptoms of Hysteria*. New York: Macmillan, 1907.
- Jones E: Remarks on a case of complete autopsychic amnesia. *J. Abnorm. Psychol.*: 4, 218–235, 1909.
- Kales A, Jacobson A, Paulson MJ, Kales JD, Walter RD: Somnambulism: psychophysiological correlates. I. All-night EEG studies. *Arch. Gen. Psychiatry*: 14, 586–594, 1966a.
- Kales A, Paulson MJ, Jacobson A, Kales JD: Somnambulism: psychophysiological correlates. II. Psychiatric interviews, psychological testing, and discussion. *Arch. Gen. Psychiatry*: 14, 595–604, 1966b.
- Kanzer M: Amnesia: a statistical study. *Am. J. Psychiatry*: 96, 711–716, 1939.
- Kaszniak AW, Nussbaum PD, Berren MR, Santiago J: Amnesia as a consequence of male rape: a case report. *J. Abnorm. Psychology*: 97, 100–104, 1988.
- Keller R, Shaywitz BA: Amnesia or fugue state: a diagnostic dilemma. *J. Dev. Behav. Pediatrics*: 7, 131–132, 1986.
- Kennedy A, Neville J: Sudden loss of memory. *Br. Med. J.*: 2, 428–433, 1957.
- Kenny MG: *The Passion of Ansel Bourne*. Washington DC: Smithsonian Institution Press, 1986.
- Kihlstrom JF: Posthypnotic amnesia for recently learned material: interactions with 'episodic' and 'semantic' memory. *Cognitive Psychol.*: 12, 227–251, 1980.
- Kihlstrom JF: On personality and memory. In Cantor N, Kihlstrom JF (Editors), *Personality, Cognition, and Social Interaction*. Hillsdale, NJ: Erlbaum, Ch. 5, pp. 123–152, 1981.
- Kihlstrom JF: Instructed forgetting: Hypnotic and nonhypnotic. *J. Exp. Psychol. Gen.*: 112, 73–79, 1983.
- Kihlstrom JF: Conscious, subconscious, unconscious: a cognitive view. In Bowers KS, Meichenbaum D (Editors), *The Unconscious Reconsidered*. New York: Wiley-Interscience, Ch. 4, pp. 149–211, 1984.
- Kihlstrom JF: Posthypnotic amnesia and the dissociation of memory. In Bower GH (Editor), *The Psychology of Learning and Motivation*. Vol. 19. San Diego: Academic Press, pp. 131–178, 1985.
- Kihlstrom JF: The cognitive unconscious. *Science*: 237, 1445–1452, 1987.
- Kihlstrom JF, Evans FJ (Editors): Memory retrieval processes during posthypnotic amnesia. In *Functional Disorders of Memory*. Hillsdale, NJ: Erlbaum, Ch. 6, pp. 179–218, 1979.
- Kihlstrom JF, Harackiewicz JM: The earliest recollection: a new survey. *J. Pers.*: 50, 134–148, 1982.
- Kihlstrom JF, Hoyt IP: Repression, dissociation, and hypnosis. In Singer JE (Editor), *Repression: Defense Mechanism and Personality Style*. Chicago: University of Chicago Press, in press 1988.
- Kihlstrom JF, Schacter DL: Anaesthesia, amnesia, and the cognitive unconscious. In Bonke B, Fitch W, Millar K (Editors), *Awareness and Memory in Anaesthesia*. Amsterdam: Swets, in press, 1989.
- Koukkou M, Lehman D: EEG and memory storage in sleep experiments with humans. *EEG Clin. Neurophysiol.*: 25, 455–462, 1968.
- Koulack D, Goodenough DR: Dream recall and dream-recall failure: An arousal-retrieval model. *Psychol. Bull.*: 83, 975–984, 1976.
- Lehman D, Koukkou M: Learning and EEG during sleep in humans. In Koella WP, Levin P (Editors), *Sleep: Physiology, Biochemistry, Psychology, Pharmacology, Clinical Implications*. Basel: Karger, pp. 43–47, 1973.
- Lezak MD: *Neuropsychological Assessment* (2nd edition). New York: Oxford University Press, 1983.
- Ludwig AM, Brandsma JM, Wilbur CB, Bendfeldt F, Jameson DH: The objective study of a multiple personality. *Arch. Gen. Psychiatry*: 26, 298–310, 1972.
- Luparello TJ: Features of fugue. *J. Am. Psychoanal. Assoc.*: 18, 379–398, 1970.
- Lyon LS: Facilitating telephone number recall in a case of psychogenic amnesia. *J. Behav. Ther. Exp. Psychiatry*: 16, 147–149, 1985.
- McAndrews MP, Glisky EL, Schacter DL: When priming persists: long-lasting implicit memory for a single episode in amnesic patients. *Neuropsychologia*: 25, 497–506, 1987.
- McGaugh JL: Time-dependent processes in memory storage. *Science*: 153, 1351–1358, 1966.
- McKoon G, Ratcliff R, Dell G: A critical evaluation of the semantic-episodic distinction. *J. Exp. Psychol. Learn. Mem. Cognition*: 12, 295–306, 1986.
- Mitchell SL: A double consciousness, or a duality of person in

- the same individual. *Med. Repos.*: 3, 185–186, 1816.
- Nadel L: Down's syndrome in neurobiological perspective. Unpublished manuscript, University of Arizona, 1986.
- Nadel L, Zola-Morgan S: Infantile amnesia: a neurobiological perspective. In Moscovitch M (Editor), *Infant Memory*. New York: Plenum, Ch. 7, pp. 145–172, 1984.
- Neisser U: Cultural and cognitive discontinuity. In Gladwin TE, Sturtevant W (Editors), *Anthropology and Human Behavior*. Washington, DC: Anthropological Society of Washington, 1962.
- Neisser U: *Cognitive Psychology*. New York: Appleton-Century-Crofts, 1967.
- Nemiah J: Dissociative amnesia: a clinical and theoretical recantation. In Kihlstrom JF, Evans FJ (Editors), *Functional Disorders of Memory*. Hillsdale, NJ: Erlbaum Associates, Ch. 10, pp. 303–324, 1979.
- Nissen MJ, Bullemer P: Attentional requirements of learning: evidence from performance measures. *Cognitive Psychol.*: 19, 1–32, 1987.
- Nissen MJ, Ross JL, Willingham DB, MacKenzie TB, Schacter DL: Memory and awareness in a patient with multiple personality disorder. *Brain Cognition*: 8, 21–38, 1988.
- Osgood CE, Luria Z, Jeans RF, Smith SW: The three faces of Evelyn: a case report. *J. Abnorm. Psychol.*: 85, 247–286, 1976.
- Overton DA: State-dependent retention of learned responses produced by drugs: Its relevance to sleep learning and recall. In Koella WP, Levin P (Editors), *Sleep: Physiology, Biochemistry, Psychology, Pharmacology, Clinical Implications*. Basel: Karger, pp. 48–52, 1973.
- Perry C, Evans FJ, O'Connell DN, Orne EC, Orne MT: Behavioral response to verbal stimuli administered and tested during REM sleep: a further investigations. *Waking Sleeping*: 2, 35–42, 1978.
- Pratt, TRC: Psychogenic loss of memory. In Whitty CWM, Zangwill OL (Editors), *Amnesia*. London: Butterworths, Ch. 9, 224–232.
- Prince M: *The Dissociation of a Personality*. New York: Longmans, Green, 1910.
- Putnam FW, Guroff JJ, Silberman EK, Barban L, Post RM: The clinical phenomenology of multiple personality disorder: 100 recent cases. *J. Clin. Psychiatry*: 47, 285–293, 1986.
- Robinson JA: Sampling autobiographical memory. *Cognitive Psychol.*: 8, 578–595, 1976.
- Rubin DC: On the retention function for autobiographical memory. *J. Verbal Learn. Verbal. Behav.*: 21, 21–38, 1982.
- Rubin DC, Wetzler SE, Nebes RD: Autobiographical memory across the lifespan. In Rubin DC (Editor), *Autobiographical Memory*. Cambridge: Cambridge University Press, Ch. 12, pp. 202–224, 1986.
- Rubin F: *Current Research in Hypnopaedia*. New York: American Elsevier, 1968.
- Rubin F: *Learning and Sleep*. Bristol: John-Wright, 1971.
- Russell WR, Nathan PW: Traumatic amnesia. *Brain*: 69, 280–300, 1946.
- Salaman E: *A Collection of Moments: A Study of Involuntary Memory*. New York: St. Martin's Press, 1972.
- Sarbin TR, Coe WC: Hypnosis and psychopathology: replacing old myths with fresh metaphors. *J. Abnorm. Psychol.*: 88, 506–526, 1979.
- Sargant W, Slater E. Amnesic syndromes in war. *Proc. R. Soc. Med.*: 34, 754–764, 1941.
- Schachtel EG: On memory and childhood amnesia. *Psychiatry*: 10, 1–26, 1947.
- Schacter DL: Amnesia and crime: how much do we really know? *Am. Psychol.*: 41, 286–295, 1986a.
- Schacter DL: Feeling-of-knowing ratings distinguish between genuine and simulated forgetting. *J. Exp. Psychol. Learn. Mem. Cognition*: 12, 30–41, 1986b.
- Schacter DL: On the relation between genuine and simulated amnesia. *Behav. Sci. Law*: 4, 47–64, 1986c.
- Schacter DL: Implicit memory: history and current status. *J. Exp. Psychol. Learn. Mem. Cognition*: 13, 501–518.
- Schacter DL: Memory. In Posner MI (Editor), *Foundations of Cognitive Science*. Cambridge, MA: Bradford Books, in press.
- Schacter DL, Crovitz HF: Memory function after closed head injury: a review of the quantitative research. *Cortex*: 13, 150–176, 1977.
- Schacter DL, Moscovitch M: Infants, amnesics, and dissociable memory systems. In Moscovitch M (Editor), *Infant Memory*. New York: Plenum, Ch. 8, 173–216, 1984.
- Schacter DL, Tulving E: Memory, amnesia, and the episodic/semantic distinction. In Isdacson RL, Spear NE (Editors), *The Expression of Knowledge*. New York: Plenum Press, Ch. 2, pp. 33–65, 1982.
- Schacter DL, Wang PL, Tulving E, Freedman M: Functional retrograde amnesia: A quantitative case study. *Neuropsychologia*: 20, 523–532, 1982.
- Schacter DL, Harbluk JL, McLachlan DR: Retrieval without recollection: an experimental analysis of source amnesia. *J. Verb. Learning Verb. Behav.*: 23, 593–611, 1984.
- Schacter DL, McAndrews MP, Moscovitch M: Access to consciousness: dissociations between implicit and explicit knowledge in neuropsychological syndromes. In Weiskrantz L (Editor), *Thought Without Language*. Oxford: Oxford University Press, pp. 242–278, 1988.
- Schacter DL, Kihlstrom JF, Kihlstrom LC, Berren MB: Autobiographical memory in a case of multiple personality disorder. *J. Abnorm. Psychol.*: in press, 1989.
- Shimamura AP: Priming effects in amnesia: evidence for a dissociable memory function. *Q. J. Exp. Psychol.*: 38A, 619–644, 1986.
- Shimamura AP, Squire LR: A neuropsychological study of fact learning and source amnesia. *J. Exp. Psychol. Learn. Mem. Cognition*, in press.
- Sidis B, Goodhart SP: *Multiple personality*. New York: D. Appleton, 1898.
- Silberman EK, Putnam FW, Weingartner H, Braun BG, Post RM: Dissociative states in multiple personality disorder: a quantitative study. *Psychiatry Res.*: 15, 253–260, 1985.
- Simon CW, Emmons WH: Learning during sleep? *Psychol. Bull.*: 52, 328–342, 1955.
- Sours JA, Frumkin P, Indermill RR: Somnambulism: its clinical significance and dynamic meaning in late adolescence and adulthood. *Arch. Gen. Psychiatry*: 9, 400–413, 1963.
- Spanos NO: Hypnotic behavior: a social-psychological interpretation of amnesia, analgesia, and 'trance logic'. *Behav. Brain Sci.*: 9, 449–502, 1986.
- Spanos N: Hypnosis, nonvolitional responding, and multiple

- personality: a social-psychological perspective. In Maher BA (Editor), *Progress in Experimental Personality Research, Vol. 14*. New York: Academic Press, pp. 1–62, 1986.
- Spanos NP, Radtke HL, Dubreuill DL: Episodic and semantic memory in posthypnotic amnesia: a reevaluation. *J. Pers. Soc. Psychol.*: 43, 565–573, 1982a.
- Spanos NP, Radtke HL, Bertrand LD, Addie DL, Drummond J: Disorganized recall, hypnotic amnesia and subjects' faking: more disconfirmatory evidence. *Psychol. Rep.*: 50, 383–389, 1982b.
- Spanos NP, Della Malva L, Gwynn MI, Bertrand LD: Contextual demands and posthypnotic source amnesia. Unpublished manuscript, Carleton University, 1985.
- Spear NE: Experimental analysis of infantile amnesia. In Kihlstrom JF, Evans FJ (Editors), *Functional Disorders of Memory*. Hillsdale, NJ: Erlbaum, Ch. 3, pp. 75–102, 1979.
- Squire LR: The neuropsychology of human memory. *Annu. Rev. Neurosci.*: 5, 241–273, 1982.
- Squire LR: *Memory and Brain*. New York: Oxford University Press, 1987.
- Stengel E: On the aetiology of the fugue states. *J. Ment. Sci.* 87, 572–599, 1941.
- Suarez JM, Pittluck AT: Global amnesia: organic and functional considerations. *Bull. Am. Acad. Psychiatry Law*: 3, 17–24, 1975.
- Sutcliffe JP, Jones J: personal identity, multiple personality, and hypnosis. *Int. J. Clin. Exp. Hypn.*: 10, 231–269, 1962.
- Taylor PJ, Kopelman MD: Amnesia for criminal offences. *Psychol. Med.*: 14, 581–588, 1984.
- Taylor WS, Martin MF: Multiple personality. *J. Abnorm. Soc. Psychol.*: 29, 281–300, 1944.
- Thigpen C, Cleckley H: *The three faces of Eve*. New York: Popular Library, 1957.
- Thom DA, Fenton W: Amnesia in war cases. *Am. J. Psychiatry*: 76, 437–448, 1920.
- Titchener EB: Early memories. *Am. J. Psychol.*: 11, 435–436, 1900.
- Trustman R, Dubovsky S, Titley R: Auditory perception during general anesthesia: myth or fact? *Int. J. Clin. Exp. Hypn.*: 25, 88–105.
- Tulving E: Elements of episodic memory. Oxford: Oxford University Press, 1983.
- Tulving E, Schacter DL, Stark HA: Priming effects in word-fragment completion are independent of recognition memory. *J. Exp. Psychol. Learn. Mem. Cognition*: 8, 336–342, 1982.
- Wagstaff GF: Disorganized recall, suggested amnesia, and compliance. *Psychol. Rep.*: 51, 1255–1258, 1982.
- Waldfoegel S: The frequency and affective character of childhood memories. *Psychol. Monogr.*: 62 (Whole No. 291), 1948.
- Watkins J: *Hypnotherapy of War Neuroses*. New York: Ronald Press, 1949.
- Waugh NC, Norman DA: Primary memory. *Psychol. Rev.*: 72, 89–104, 1965.
- Weiskrantz L: Neuroanatomy of memory and amnesia: a case of multiple memory systems. *Hum. Neurobiol.*: 6, 93–106, 1987.
- Wetzler SE, Sweeney JA: Childhood amnesia: an empirical demonstration. In Rubin DC (Editor), *Autobiographical Memory*. Cambridge: Cambridge University Press, Ch. 11, pp. 191–201, 1986a.
- Wetzler SE, Sweeney JA: Childhood amnesia: a conceptualization in cognitive-psychological terms. *J. Am. Psychoanal. Assoc.*: 34, 663–685, 1986b.
- White SB, Pillemer DB: Childhood amnesia and the development of a socially accessible memory system. In JF Kihlstrom, Evans FJ (Editors), *Functional Disorders of Memory*. Hillsdale, NJ: Erlbaum, Ch. 2, pp. 29–74, 1979.
- Wiggins ES, Brandt J: The detection of simulated amnesia. *Law Behav.*: in press.
- Williams HL: Information processing during sleep. In Koella WP, Levin P (Editors), *Sleep: Physiology, Biochemistry, Psychology, Pharmacology, Clinical Implications*. Basel: Karger, pp. 36–42, 1973.
- Williams HL, Hammack JT, Daly RL, Dement WC, Lubin A: Responses to auditory stimulation, sleep loss, and the EEG stages of sleep. EEG and Clinical *Neurophysiology*: 16, 269–279, 1964.
- Williams HL, Morlock HC, Morlock JV: Instrumental behavior during sleep. *Psychophysiology*: 2, 208–216, 1966.
- Wilson G, Rupp C, Wilson WW: Amnesia. *Am. J. Psychiatry*: 106, 481–485, 1950.