The \textit{Essential} Handbook of Memory Disorders for Clinicians

\textit{Edited by}

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In editing the first edition of *The Handbook of Memory Disorders*, our principal aim was to inform practicing clinicians about the extensive developments that had occurred in the study of memory and its disorders. We were pleased to discover in due course that the resulting handbook also proved to be very useful to non-clinicians with interests in both research and teaching in the field of human memory. When the opportunity to revise the handbook was offered, we opted to respond to this extended range of readers by increasing the scope of the handbook, including a wider field of topics, not all of which were equally likely to be of direct interest to the busy clinician. This resulted in a much more comprehensive handbook, as we had hoped, but also in a heftier and more expensive book, which might well be seen as less directly relevant to clinical practice. For that reason, it was suggested that a more clinically focused selection from the original 35 chapters might be desirable, decreasing the weight and cost, and resulting in a greater probability of reaching our initial target readership of forward-looking practising clinicians. The selection of chapters was made with this in mind. Authors were given the opportunity to make modifications, although the time constraints discouraged the possibility of major re-writing. We were pleased to find that all the authors were happy to agree to republication in this form, which we have titled *The Essential Handbook of Memory Disorders for Clinicians*. We are grateful to Vivien Ward for suggesting this revised edition and to Ruth Graham for making its prompt publication possible.

ADB
MDK
BAW
In this chapter I will try to provide a brief overview of the concepts and techniques that are most widely used in the psychology of memory. Although it may not appear to be the case from sampling the literature, there is in fact a great deal of agreement as to what constitutes the psychology of memory, much of it developed through the interaction of the study of normal memory in the laboratory and of its breakdown in brain-damaged patients. A somewhat more detailed account can be found in Parkin & Leng (1993) and Baddeley (1999), while a more extensive overview is given by Baddeley (1997), and within the various chapters comprising the Handbook of Memory (Tulving & Craik, 2000).

THE FRACTIONATION OF MEMORY

The concept of human memory as a unitary faculty began to be seriously eroded in the 1960s with the proposal that long-term memory (LTM) and short-term memory (STM) represent separate systems. Among the strongest evidence for this dissociation was the contrast between two types of neuropsychological patient. Patients with the classic amnesic syndrome, typically associated with damage to the temporal lobes and hippocampi, appeared to have a quite general problem in learning and remembering new material, whether verbal or visual (Milner, 1966). They did, however, appear to have normal short-term memory (STM), as measured for example by digit span, the capacity to hear and immediately repeat back a unfamiliar sequence of numbers. Shallice & Warrington (1970) identified an exactly opposite pattern of deficit in patients with damage to the perisylvian region of the left hemisphere. Such patients had a digit span limited to one or two, but apparently normal LTM. By the late 1960s, the evidence seemed to be pointing clearly to a two-component memory system. Figure 1.1 shows the representation of such a system from an influential model of the time, that of Atkinson & Shiffrin (1968). Information is assumed to flow from the environment through a series of very brief sensory memories, that are perhaps best regarded as part of the perceptual system, into a limited capacity short-term store. They proposed that the longer an item resides in this store, the greater the probability of its transfer to LTM. Amnesic patients were assumed to have a deficit in the LTM system, and STM patients in the short-term store.
By the early 1970s, it was clear that the model had encountered at least two problems. The first of these concerned the learning assumption. Evidence suggested that merely holding an item in STM did not guarantee learning. Much more important was the processing that the item underwent. This is emphasized in the levels-of-processing framework proposed by Craik & Lockhart (1972). They suggested that probability of subsequent recall or recognition was a direct function of the depth to which an item was processed. Hence, if the subject merely noted the visual characteristics of a word, for example whether it was in upper or lower case, little learning would follow. Slightly more would be remembered if the word were also processed acoustically by deciding, for example, whether it rhymed with a specified target word. By far the best recall, however, followed semantic processing, in which the subject made a judgement about the meaning of the word, or perhaps related it to a specified sentence, or to his/her own experience.
This levels of processing effect has been replicated many times, and although the specific interpretation proposed is not universally accepted, there is no doubt that a word or experience that is processed in a deep way that elaborates the experience and links it with prior knowledge, is likely to be far better retained than one that receives only cursory analysis. The effect also occurs in the case of patients with memory deficits, making it a potentially useful discovery for those interested in memory rehabilitation, although it is important to remember that cognitive impairment may hinder the processes necessary for such elaboration. Indeed, it was at one point suggested that failure to elaborate might be at the root of the classic amnesic syndrome, although further investigation showed this was not the case (see Baddeley, 1997, for further discussion).

A second problem for the Atkinson & Shiffrin model was presented by the data on STM patients that had initially appeared to support it. Although such patients argued strongly for a dissociation between LTM and STM, the Atkinson & Shiffrin model assumed that STM was necessary, indeed crucial, for long-term learning, and indeed for many other cognitive activities. In fact, STM patients appeared to have normal LTM, and with one or two minor exceptions, such as working out change while shopping, had very few everyday cognitive problems.

This issue was tackled by Baddeley & Hitch (1974), who were explicitly concerned with the relationship between STM and LTM. A series of experiments attempted to block STM in normal subjects by requiring them to recite digit sequences while performing other tasks, such as learning, reasoning or comprehending, that were assumed to depend crucially upon STM. Decrement occurred, with the impairment increasing with the length of the digit sequence that was being retained, suggesting that STM and LTM interact. However, the effect was far from dramatic, again calling into question the standard model. Baddeley & Hitch proposed that the concept of a simple unitary STM be replaced by a more complex system which they termed “working memory”, so as to emphasize its functional importance in cognitive processing. The model they proposed is shown in Figure 1.2.

Working memory is assumed to comprise an attentional controller, the central executive, assisted by two subsidiary systems, the phonological loop and the visuospatial sketchpad. The phonological (or articulatory) loop is assumed to comprise a store that holds memory traces for a couple of seconds, combined with a subvocal rehearsal process. This is capable of maintaining the items in memory using subvocal speech, which can also be used to convert nameable but visually presented stimuli, such as letters or words, into a phonological code. STM patients were assumed to have a deficit in this system, whereas the remainder of working memory was assumed to be spared (Vallar & Baddeley, 1984). Subsequent research, based on STM patients, normal children and adults, and children with specific language impairment, suggest that the phonological loop system may have evolved for the purpose of language acquisition (Baddeley et al., 1998). A more detailed account of this system and its breakdown is given by Vallar & Papagno (2002).

![Figure 1.2](image-url)  
**Figure 1.2** The Baddeley & Hitch model of working memory. Reproduced from Baddeley & Hitch (1974)
The visuospatial sketchpad (or scratchpad) is assumed to allow the temporary storage and manipulation of visual and spatial information. Its function can be disrupted by concurrent visuospatial activity and, as in the case of the phonological loop, our understanding has been advanced by the study of neuropsychological patients. More specifically, there appear to be separate visual and spatial components, which may be differentially disrupted. A more detailed account of this system and the relevant neuropsychological evidence is given by Della Sala & Logie (2002).

The third component of the model, the central executive, was assumed to provide an attentional control system, both for the subsystems of working memory and for other activities. Baddeley (1986) suggested that a good account of it might be provided by the supervisory attentional system (SAS) proposed by Norman & Shallice (1986) to account for the attentional control of action. They assume that much activity is controlled by well-learned habits and schemata, guided by environmental cues. Novel actions that were needed to respond to unexpected situations, however, depended upon the intervention of the limited-capacity SAS. This was assumed to be capable of overriding habits so as to allow novel actions in response to new challenges. Slips of action, such as driving to the office rather than the supermarket on a Saturday morning, were attributed to the failure of the SAS to override such habits. The problems in action control shown by patients with frontal lobe damage were also attributed to failure of the SAS; hence, perseverative activity might reflect the failure of the SAS to break away from the domination of action by environmental cues (Shallice, 1988).

Both Shallice himself and others have extended their account to include a range of potentially separable executive processes, hence providing an account of the range of differing deficits that may occur in patients with frontal lobe damage (Baddeley, 1996; Duncan, 1996; Shallice & Burgess, 1996). Given the far from straightforward mapping of anatomical location onto cognitive function, Baddeley & Wilson (1988) suggested that the term “frontal lobe syndrome” be replaced by the more functional term, “dysexecutive syndrome”. For a recent review of this area, see Roberts et al. (1998) and Stuss & Knight (2002).

The implications of frontal lobe function and executive deficit for the functioning of memory are substantial, since the executive processes they control play a crucial role in the selection of strategy and stimulus processing that has such a crucial influence in effective learning. (See Baddeley et al., 2002a, Chapters 15, 16 and 17 for further discussion of these issues.)

More recently, a fourth component of WM has been proposed, the episodic buffer. This is assumed to provide a multimodal temporary store of limited capacity that is capable of integrating information from the subsidiary systems with that of LTM. It is assumed to be important for the chunking of information in STM (Miller, 1956). This is the process whereby we can take advantage of prior knowledge to package information more effectively and hence to enhance storage and retrieval. For example, a sequence of digits that comprised a number of familiar dates, such as 1492 1776 1945, would be easier to recall then the same 12 digits in random order. The episodic buffer is also assumed to play an important role in immediate memory for prose, allowing densely amnesic patients with well-preserved intelligence and/or executive capacities to show apparently normal immediate, although not delayed, recall of a prose passage that would far exceed the capacity of either of the subsidiary systems (Baddeley & Wilson, 2002). It seems unlikely that the episodic buffer will reflect a single anatomical location, but it is probable that frontal areas will be crucially involved. For a more detailed account, see Baddeley (2000).
LONG-TERM MEMORY

As in the case of STM, LTM has proved to be profitably fractionable into separate components. Probably the clearest distinction is that between explicit (or declarative) and implicit (or non-declarative) memory. Once again, neuropsychological evidence has proved crucial. It has been known for many years that densely amnesic patients are able to learn certain things; for example, the Swiss psychiatrist Claparède (1911) pricked the hand of a patient while shaking hands one morning, finding that she refused to shake hands the next day but could not recollect why. There was also evidence that such patients might be able to acquire motor skills (Corkin, 1968). Probably the most influential work, however, stemmed from the demonstration by Warrington & Weiskrantz (1968) that densely amnesic patients were capable of showing learning of either words or pictures, given the appropriate test procedure. In their initial studies, patients were shown a word or a line drawing, and subsequently asked to identify a degraded version of the item in question. Both patients and control subjects showed enhanced identification of previously presented items, to a similar degree. This procedure, which is typically termed priming, has since been investigated widely in both normal subjects and across a wide range of neuropsychologically impaired patients (for review, see Schacter, 1994).

It has subsequently become clear that a relatively wide range of types of learning may be preserved in amnesic patients, ranging from motor skills, through the solution of jigsaw puzzles (Brooks & Baddeley, 1976) to performance on concept formation (Kolodny, 1994) and complex problem-solving tasks (Cohen & Squire, 1980); a review of this evidence is provided by Squire (1992). The initial suggestion, that these may all represent a single type of memory, now seems improbable. What they appear to have in common is that the learning does not require the retrieval of the original learning episode, but can be based on implicit memory that may be accessed indirectly through performance, rather than depending on recollection. Anatomically, the various types of implicit memory appear to reflect different parts of the brain, depending upon the structures that are necessary for the relevant processing. While pure amnesic patients typically perform normally across the whole range of implicit measures, other patients may show differential disruption. Hence Huntington’s disease patients may show problems in motor learning while semantic priming is intact, whereas patients suffering from Alzheimer’s disease show the opposite pattern (see Chapters 6 and 7, this volume).

In contrast to the multifarious nature and anatomical location of implicit memory systems, explicit memory appears to depend crucially on a system linking the hippocampi with the temporal and frontal lobes, the so-called Papez circuit. Tulving (1972) proposed that explicit memory itself can be divided into two separate systems, episodic and semantic memory, respectively. The term “episodic memory” refers to our capacity to recollect specific incidents from the past, remembering incidental detail that allows us in a sense to relive the event or, as Tulving phrases it, to “travel back in time”. We seem to be able to identify an individual event, presumably by using the context provided by the time and place it occurred. This means that we can recollect and respond appropriately to a piece of information, even if it is quite novel and reflects an event that is inconsistent with many years of prior expectation. Learning that someone had died, for example, could immediately change our structuring of the world and our response to a question or need, despite years of experiencing them alive.
Episodic memory can be contrasted with “semantic memory”, our generic knowledge of the world; knowing the meaning of the word “salt”, for example, or its French equivalent, or its taste. Knowledge of society and the way it functions, and the nature and use of tools are also part of semantic memory, a system that we tend to take for granted, as indeed did psychologists until the late 1960s. At this point, attempts by computer scientists to build machines that could understand text led to the realization of the crucial importance of the capacity of memory to store knowledge. As with other areas of memory, theory has gained substantially from the study of patients with memory deficits in general, and in particular of semantic dementia patients (see Snowden, 2002).

While it is generally accepted that both semantic and episodic memory comprise explicit as opposed to implicit memory systems, the relationship between the two remains controversial. One view suggests that semantic memory is simply the accumulation of many episodic memories for which the detailed contextual cue has disappeared, leaving only the generic features (Squire, 1992). Tulving, on the other hand, suggests that they are separate. He regards the actual experience of recollection as providing the crucial hallmark of episodic memory (Tulving, 1989). It is indeed the case that subjects are able to make consistent and reliable judgements about whether they “remember” an item, in the sense of recollecting the experience of encountering it, or simply “know” that it was presented, and that “remember” items are sensitive to variables such as depth of processing, which have been shown to influence episodic LTM, while “know” responses are not (for review, see Gardiner & Java, 1993). If one accepts Tulving’s definition, then this raises the further question of whether there are other types of non-episodic but explicit memory.

Once again, neuropsychological evidence is beginning to accumulate on this issue, particularly from the study of developmental amnesia, a rather atypical form of memory deficit that has recently been discovered to occur in children with hippocampal damage (Vargha-Khadem et al., 2002; Baddeley et al., 2001). Such evidence, combined with a reanalysis of earlier neuropsychological data, coupled with evidence from animal research and from neuroimaging, makes the link between semantic and episodic memory a particularly lively current area of research (see Baddeley et al., 2002b, for a range of recent papers on this topic).

Despite considerable controversy over the details, Figure 1.3 shows what would rather broadly be accepted as reflecting the overall structure of long-term memory. It should be

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**Figure 1.3** The fractionation of long-term memory proposed by Squire. Reproduced from Squire (1992)
adequate for navigating through the subsequent chapters. If you are unfamiliar with memory research, however, there are one or two other things that you might find useful, which are discussed in the sections below.

STAGES OF MEMORY

It is often useful to separate out three aspects of any memory system: **encoding**, the processes whereby information is registered; **storage**, the maintenance of information over time; and **retrieval**, which refers to the accessing of the information by recognition, recall or implicitly by demonstrating that a relevant task is performed more efficiently as a result of prior experience. Encoding is typically studied by varying the nature of the material and/or the way that it is processed during learning. The effect of levels of processing is a good example of this, where processing the visual characteristics of a word leads to a much poorer subsequent recall or recognition than processing it in terms of meaning.

Storage is measured through forgetting. Somewhat surprisingly, although learning is influenced by a wide range of factors that compromise brain function temporarily or permanently, rate of loss of information from memory appears to be relatively insensitive to either patient type, or encoding procedures (Kopelman, 1985). While there have been suggestions that patients whose amnesia stems from damage to the temporal lobes forget at a different rate from those with hippocampal damage (e.g. Huppert & Piercy, 1979), this has not been borne out by subsequent research (Greene et al. 1996; Kopelman, 1985), although it would certainly be premature to conclude that patients never forget more rapidly (see e.g. Kapur et al., 1997).

Given that information has been stored, if it is to be used then it must be retrieved, directly in the case of explicit memory, or indirectly in the case of implicit memory, to have an impact on subsequent performance. The two principal methods of memory retrieval involve recall, in which case the subject is required to reproduce the stimulus items, or recognition. This requires the subject to say whether a given item was presented or not (yes/no recognition) or to choose the previously presented item from a set of two or more alternatives (forced-choice recognition). Yes/no recognition performance will be influenced by the degree of caution the subject applies. By saying “yes” to everything he/she can, of course, correctly categorize all the previously presented targets while not necessarily indicating any memory. Such a subject would of course be discounted, but more subtle differences in the level of caution applied in deciding on whether an item was presented before (“old”), or has just been presented (“new”) may also markedly influence performance.

There are a number of procedures for dealing with different degrees of caution among subjects. One is to apply a guessing correction, which assumes that the subject guesses on a proportion of the items that are not remembered. On the assumption that the guess is equally likely to be right or wrong, there are likely to be as many items correctly guessed (“hits”) as those erroneously classed as “old” (“false alarms”). A guessing correction can then be applied by simply deducting the total number of false alarms from the total hit score. An alternative and slightly more complex way of dealing with the criterion is to utilize signal detection theory, which yields two measures, one representing the hypothetical strength of the memory trace, and the other the criterion of degree of caution employed by that subject (Lockhart, 2000). With forced-choice procedures, all subjects are required always to choose one item from each set, with the result that degree of caution does not become relevant. In general, recognition is assumed to place a less heavy load on the retrieval processes than
recall, where it is necessary not only to discriminate “new” and “old” items but also to produce them.

Probably the simplest recall measure is free recall, in which a sequence of items, typically words, is presented, and the subject is required to recall as many as possible in any order he/she wishes. When recall is immediate, the probability of a word being recalled correctly is typically highly dependent on its serial position during presentation, with the first one or two words enjoying a modest advantage (the primacy effect), the middle items showing a relatively flat function, and the final words showing the best recall (the recency effect). Even though recall is immediate, apart from the recency effect, overall performance in free recall is principally dependent on LTM, with variables such as the imageability, frequency and semantic associability of the words all influencing performance.

A frequent variant of free recall is to use groups of words from the same semantic category; e.g. a 16-item list might have four animals, four flowers, four colours and four professions. Even when they are presented in scrambled order, subjects tend to recall the words in semantic clusters, indicating that they are using meaning as a basis for encoding and retrieval. Such effects become stronger when the same list is repeated for several trials. Indeed, even totally unrelated words will tend to be chunked into clusters that are seen as meaningfully related to the person learning (Tulving and Patkau, 1962). In the case of prose, initial level of recall performance tends to be set in terms of the number of word clusters or chunks, rather than the absolute number of words recalled (Tulving, 1962).

The recency effect tends to follow a very different pattern, being insensitive to a wide range of variables that typically enhance LTM, but to be very sensitive to disruption by a brief subsequent delay filled by an activity such as counting (Glanzer, 1972). The recency effect was, and in some models still is, regarded as representing STM. However, recency effects that broadly follow the same principles can occur over periods of minutes or even days or weeks, as for example in the recall of rugby games played, or parking locations over multiple visits to a laboratory (Baddeley & Hitch, 1977; da Costa Pinto & Baddeley, 1991). It is also the case that a concurrent STM task, such as digit span, leaves the recency effect intact, again suggesting the need for a more complex model (Baddeley & Hitch, 1974). One view is that recency represents an implicit priming mechanism which may operate across a range of different stores, some involving STM, others LTM (for discussion of this view, see Baddeley & Hitch, 1993).

A slightly more complex LTM task involves serial recall, whereby the subject is presented with a sequence of items, typically well beyond memory span, and required to recall them in the order of presentation, with testing continuing either for a standard number of trials or until the subject has completely mastered the sequence. The serial position curve in this case tends to be bowed, with maximum errors somewhere just beyond the middle. This method was used extensively in the 1940s and 1950s, but is less common now.

A popular method of testing LTM is through paired associate learning, whereby the subject is required to link together a number of word pairs (e.g. “cow–tree”) and is tested by being presented with the stimulus word “cow” and required to produce the response “tree”. This technique forms a part of many clinical memory tests, which may contain pairs that fit together readily, such as “cow–milk”, together with more arbitrary pairs, such as “dog–cloud”. A particular variant of this of course is involved in learning a new vocabulary word in one’s own (e.g. “lateen”, a kind of sail), or a second language (e.g. “hausrecker”, grasshopper). Finally, more complex and realistic material may be used, as in the recall of prose passages or complex visual scenes. These have the advantage of being closer to the
EVERYDAY MEMORY

For over 100 years there has been a tendency for memory research to be pulled in two somewhat different directions. Ebbinghaus (1885) initially demonstrated that memory can be studied objectively by simplifying the remembering task to that of rapidly repeating back sequences of unfamiliar pseudowords, nonsense syllables. On the other hand, a more naturalistic approach to psychology was advocated by Galton (1883) and subsequently developed by Bartlett (1932), who required his subjects to recall complex prose passages, often involving unfamiliar material, such as legends from North American Indian culture. Open conflict between these two approaches surfaced more recently with the claim by Neisser (1978) that none of the interesting aspects of memory were being studied by psychologists, evoking a counter-blast from Banaji & Crowder (1989), who claimed that most studies of everyday memory were trivial and uninformative. To some extent the controversy was an artificial one, as unfortunately they often are in contemporary psychology. There is no doubt that investigating the detailed nature of memory and producing precise testable models is most readily pursued within the laboratory, with its degree of experimental control. On the other hand, the everyday world and the clinic provide a fruitful source of problems, and a way of testing the generality of laboratory-based theories. A model that can elegantly predict which of two simple responses the subject will make in the laboratory may be of interest to the modelling enthusiast, but unless it can be generalized to more ambitious and important questions, it is unlikely to advance the study of memory. On the other hand, merely observing complex and intriguing phenomena is equally unlikely to generate constructive scientific theory.

There have been two constructive responses to the real world–laboratory dilemma, one being to attempt to generalize laboratory findings to complex real-world situations, and the other being to identify phenomena in everyday life that are not readily accounted for by current memory models. Examples of the first type include the previously described work studying recency effects in the recall of parking locations or rugby games. The attempt to extend laboratory-based recall studies from lists of unrelated words to the oral tradition of memory for songs and poems is another such example (Rubin, 1995).

A good example of identifying a problem in the world that requires solution is that of prospective memory, our capacity to remember to do something at a given time or place. It is typically when we forget to do things that we complain that our memories are terrible. But despite its practical importance, it is far from clear how prospective memory works. It certainly does require memory, since amnesic patients tend to be appallingly bad at it, but young intelligent people are often not particularly good at remembering to do things at the right time either. There is clearly an element of motivation, and almost certainly one of strategy, in successful prospective memory. Elderly people tend to forget fewer appointments than the young, partly because they know their memory is vulnerable and find ways to support it, e.g. by writing things down, or by concentrating on the need to remember and constructing internal reminders. Hence, despite making more prospective memory errors than the young under laboratory conditions, in real life they may often make fewer errors.
For long a neglected topic, prospective memory is now a very active one, with studies based on observational and diary measures now supplemented with a range of laboratory-based methods. There is, I suspect, a danger that the more tractable laboratory tasks may come to dominate this area, suggesting the need for a continued attempt to check their validity outside the laboratory. My current suspicion is that prospective memory represents a type of task that we require our memory system to perform, rather than itself reflecting a single memory system or process. That does not, of course, make it any less important or interesting, but does suggest that we are unlikely to reach any simple unitary theoretical solution to the problems it raises.

One area in which the laboratory-based and everyday approaches to memory appear to work effectively together is in the assessment of memory deficits. Traditional measures of memory have tended to rely on classical laboratory techniques, such as paired associate learning and the recall of complex figures, with measures tailored to patient use and then standardized against normal control subjects. However, patients sometimes complain that their problem is not in learning to associate pairs of words or remember complicated figures, but rather in forgetting appointments and failing to remember people’s names, or the way around the hospital. Sunderland et al. (1983) decided to check the validity of such standard laboratory-based memory tests against the incidence of memory errors reported by patients and their carers. They tested a group of head-injured patients and subsequently a group of normal elderly subjects (Sunderland et al., 1983, 1986). They found that head injury and age both led to a clear reduction in performance on the standardized tests, together with an increase in memory complaints. However, there was no reliable association between reports of memory errors by the patients or carers and performance on most of the objective tests, with the only task showing a significant correlation being the recall of a prose passage.

Concerned with this problem herself, Barbara Wilson devised a memory test that attempted to capture the range of problems reported most frequently by her patients, whose memory deficits typically resulted from some form of brain injury, most frequently resulting from head injury or cardiovascular accident. She developed the Rivermead Behavioural Memory Test (RMBT), which comprises 12 subcomponents, testing such features as the capacity to memorize and recall a new name, recognition of previously presented unfamiliar faces, and of pictures of objects, recalling a brief prose passage immediately and after a delay, and the immediate and delayed recall of a simple route. The test also involves measures of orientation in time and place, and some simple tests of prospective memory. The RMBT proved sensitive to memory deficits and, in contrast to more conventional methods, correlated well with frequency of memory lapses, as observed by therapists working with the patients over a period of many hours (Wilson et al., 1989). In a study following up a group of amnesic patients several years later, Wilson (1991) found that level of performance on the test accurately predicted capacity to cope independently, in contrast to more conventional measures, such as the Wechsler Memory Scale–Revised.

The strength of the RMBT and of other tests using a similar philosophy, such as the Behavioural Assessment of the Dysexecutive Syndrome Test (Wilson et al., 1996), typically stems from their attempting to provide sensitive objective measures that simulate the real-world problems typically confronting a patient. They are excellent for predicting how well a patient will cope, but should not be regarded as a substitute for tests that attempt to give a precise estimate of the various types of memory function. Such theoretically driven tests are likely to be crucial in understanding the nature of the patient’s problems, and hence in providing advice and help (see Chapter 8 on assessment, this volume). It is typically
the case, however, that patients feel more comfortable with material that appears to relate
to their practical problems, and this has led to a development of a number of theoretically
targeted tests that use naturalistic materials. The Doors and People Test of visual and verbal
recall and recognition (Baddeley et al., 1994) and the Autobiographical Memory Inventory
(Kopelman et al., 1990) are two examples.

**CONCLUSION**

The psychology of memory has developed enormously since the days when memory was
regarded as a single unitary faculty. The study of patients with memory deficits has played
a major role in this development, and seems likely to continue to do so.

**REFERENCES**


CHAPTER 2

The Amnesic Syndrome: Overview and Subtypes

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Global amnesia refers to a dense and circumscribed deficit in memory in the context of otherwise preserved intelligence. It encompasses the acquisition of events and facts encountered postmorbidly (anterograde amnesia), as well as the retrieval of information acquired premorbidly (retrograde amnesia). Patients with amnesia are capable of holding a limited amount of information in mind for a very brief period of time, but with increased retention interval or increased interference, their recall and recognition of the information inevitably fails. Anterograde amnesia is usually global, in that memory for all new information is affected—regardless of the nature of the information (i.e. verbal or nonverbal) or the modality in which it is presented (i.e. auditory or visual). In most patients, anterograde amnesia is associated with some degree of retrograde loss, although its extent is more variable. The reverse, however, is not necessarily the case, as some patients have been described who demonstrate relatively focal retrograde amnesia in the absence of anterograde memory loss (Kapur, 1993; Kopelman, 2000).

Although amnesia is characterized by a pervasive and devastating memory loss, it is important to note that some components of memory remain intact. Amnesic patients demonstrate normal performance on tasks of immediate memory and working memory (Cave & Squire, 1992; Parkin & Leng, 1993). This ability to hold and manipulate information “on-line” is critical for performance on a variety of cognitive tasks, ranging from language comprehension to simple arithmetic. Patients with amnesia are also able to retrieve overlearned semantic memories, as evidenced by the fact that their general world knowledge and knowledge of word meanings remains intact. Finally, even within the domain of new learning, some forms of memory are preserved. These include skill learning, classical conditioning and repetition priming, the bias or facilitation in processing a stimulus that results from prior exposure to that same or related stimulus (Squire et al., 1993). These forms of memory have in common the fact that knowledge can be expressed without a need for
conscious recollection, and without awareness of the episode in which learning took place. The dissociation between aware (declarative) and unaware (procedural) memory in patients with global amnesia has guided much research into the neural and functional organization of various components of memory (e.g. Gabrieli, 1999; Verfaellie & Keane, 2001).

The memory problem of the amnesic individual must be differentiated from more common forms of memory loss. In order for an individual to be diagnosed with amnesia, there must be evidence of a marked learning deficit and this problem must exist in relative isolation, so that other aspects of cognition remain intact. The severity of the learning deficit is the cardinal feature distinguishing amnesia from milder memory problems, such as those associated with age-related memory decline, depression or developmental learning difficulties. The preservation of attention, working memory and general reasoning abilities differentiate the amnesic patient from the patient who has memory problems in the context of global cognitive decline (e.g. dementia or delirium). It is noteworthy that some amnesics have superior cognitive abilities, a fact that underscores the relative independence of memory and intelligence (e.g. Cermak & O’Connor, 1983). Other amnesic patients show modest reductions on measures of verbal intelligence, but this decline can sometimes reflect decrements in semantic memory (e.g. Stefanacci et al., 2000).

Many clinical and theoretical insights into global amnesia find their origin in the study of patient H.M., a man who became amnesic following bilateral resection of the temporal lobes for treatment of refractory epilepsy (Scoville & Milner, 1957). Although H.M. still serves as a benchmark for characterizing amnesia, it has also become clear that the syndrome is functionally heterogeneous, comprising a number of different patterns of memory loss and associated processing deficits, which may be linked to distinct etiologies and associated patterns of neuroanatomical damage. In addition, it should be kept in mind that premorbid factors, such as baseline intelligence and personality style, can influence a patient’s clinical presentation, as may associated neurocognitive problems.

Global amnesia occurs as a result of damage to the medial temporal lobes, the diencephalon and the basal forebrain. Such damage can be caused by a broad array of traumatic, vascular and infectious disease processes, the most common of which are anoxia, encephalitis, cerebrovascular accidents, Korsakoff syndrome and rupture and repair of anterior communicating artery aneurysms. In these conditions, amnesia is usually of a permanent nature. Transient forms of amnesia also occur secondary to seizure activity or temporary disruption of the vascular supply (see Goldenberg, 2002). In what follows, we first review the main etiologies leading to permanent amnesia and their associated neuropsychological profiles. We next consider to what extent each of the main brain regions implicated in amnesia causes a distinct pattern of processing deficits.

NEUROLOGICAL CONDITIONS ASSOCIATED WITH AMNESIA

ENCEPHALITIS

Herpes simplex encephalitis (HSE) occurs as a result of virus-induced hemorrhagic lesions in the brain. In the early stages of the infectious process, patients experience a “flu-like” illness that is often associated with fever, headaches and lethargy. Profound confusion and disorientation may follow and patients often develop other neurocognitive problems,
including aphasia, agnosia and amnesia. For some patients these problems persist so that a broad array of cognitive abilities is compromised. For others, disorientation may be followed by complete recovery. A third group of patients presents with focal memory disturbances in the absence of other cognitive deficits. These are the patients who have been of particular interest to memory researchers, because they typically present with very dense amnesic syndromes, quite similar to that of patient H.M. (e.g. Cermak, 1976; Damasio et al., 1985a; Stefanacci et al., 2000).

Like the clinical presentation, the neuroanatomical damage associated with encephalitis is heterogeneous, but typically centers on limbic regions in the temporal lobe, including the hippocampus and adjacent entorhinal, perirhinal and parahippocampal cortices, the amygdala and polar limbic cortices. Damage frequently also extends laterally, resulting in varying degrees of damage to the anterolateral and inferior aspects of the temporal neocortex. Extension of the lesion anteriorly can result in damage to ventromedial areas, such as the insular cortex and basal forebrain (Damasio & Van Hoesen, 1985).

S.S., a patient we have followed for many years, experienced dense memory loss as a result of HSE (Cermak, 1976; Cermak & O’Connor, 1983). S.S.’s initial presentation was noteworthy for lethargy and headaches followed by a 1 month coma. In the acute stage of his illness, S.S. was aphasic and hemiparetic, but these problems resolved and he was left with a dense amnesia associated with bilateral lesions in anterolateral and medial portions of the temporal lobes, the insula and the putamen. S.S.’s anterograde amnesia is profound. He has not been able to form any new declarative memories for the last three decades. He has not retained any episodic information regarding important family matters and is totally unaware of recent public facts or events. He has also failed to acquire any new semantic knowledge. Strikingly, he has not learned any novel vocabulary introduced into the English language since the onset of his illness, even though he has been exposed to these words repeatedly through television programs and newspapers (Verfaellie et al., 1995a). S.S. also has a very extensive retrograde memory loss for autobiographical as well as personal semantic information that encompasses most of his adult life. Despite this dense amnesia, S.S. is of superior intelligence. Even at age 70, 30 years after the onset of his amnesia, he has a Full Scale IQ of 130. He continues to perform in the superior range on tasks of working memory, frontal/executive abilities, language and deductive reasoning skills. Like other amnesic patients who have suffered encephalitis, S.S. has insight into his memory loss, a fact that is likely due to the relative preservation of frontal brain regions.

As with all amnesic etiologies, there are variations in the severity of memory loss. While some patients may be totally unable to benefit from repeated exposure to new material or to benefit from extended study time, others are able gradually to acquire a limited amount of information (e.g. Haslam et al., 1997). This likely reflects the extent of medial temporal damage (Stefanacci et al., 2000). Lesions may be asymmetrical and, as expected, the laterality of lesion affects the nature of the neurobehavioral presentation. Greater damage to right temporal regions has a more pronounced effect on nonverbal/visual memory, such as memory for faces and spatial aspects of stimuli (Eslinger et al., 1993), while disproportionate damage to left temporal regions has a more pronounced effect on verbal memory (Tranel et al., 2000).

The distribution of the encephalitis-induced lesion also affects the nature and severity of the remote memory loss. Patients with extensive retrograde amnesia typically have lesions extending into lateral temporal regions (Damasio et al., 1985a; O’Connor et al., 1992; Stefanacci et al., 2000). Damasio and colleagues attribute the profound loss of remote
memories in these patients to the destruction of convergence zones in anterior temporal areas (Tranel et al., 2000). Asymmetrical patterns of damage can result in distinct patterns of remote memory loss. Several case studies have indicated that damage to right anterior temporal regions severely interferes with retrieval of autobiographical memories (O’Connor et al., 1992; Ogden, 1993). Patient L.D., who has been studied extensively by our group, demonstrated a dramatic loss of personal episodic memories, whereas her knowledge of semantic aspects of past memories was preserved. This dissociation took place in the context of pervasive damage to her right temporal lobe vs. much more restricted damage to her left temporal lobe. L.D.’s remote memory was evaluated using various tests of autobiographical memory and public events. Her recollection of personal experiences from childhood years was devastated: she was unable to produce any episodic memories of personal events in response to verbal cues or upon directed questioning. Interestingly, L.D. demonstrated better recall of factually based information (e.g. the name of her first grade teacher, the fact that she owned a poodle). However, she was unable to elaborate upon these facts with experiential information. L.D.’s nonverbal memory and visual imaging problems were examined in relation to her pronounced episodic memory impairment. It was hypothesized that L.D.’s nonverbal memory and imaging deficits augmented her autobiographical memory impairment because visual images provide an organizational framework for retrieval of experiential information.

The reverse pattern, a disproportionate loss of semantic knowledge, occurs in the context of mainly left temporal cortex damage. An illustrative case is that of patient L.P., described by De Renzi and colleagues (1987a). Following an episode of encephalitis, L.P. demonstrated greatly impoverished knowledge of the meaning and attributes of words and pictures. She was severely anomic and unable to define or classify either verbal concepts or their pictorial referents, while non-semantic aspects of language and perception were preserved. Her lesion was centered in the anterior inferotemporal cortex. While L.P. demonstrated semantic difficulties for all types of information, other patients have been described with category-specific deficits. Although such category-specific impairments are rare, a number of cases have been described with differential impairments for concrete vs. abstract concepts, and for animate vs. inanimate concepts (for review, see McKenna & Warrington, 2000).

**Anoxia**

Anoxic brain injury occurs as a result of reduced oxygen to the brain, due to decreased vascular perfusion or reduced oxygen content in the blood. This may be caused by a variety of conditions, such as cardiac arrest or respiratory distress, which in turn may be a result of severe allergic reactions, strangulation or near-drowning episodes. When the brain is deprived of oxygen, excitatory neurotransmitters are released which are accompanied by increased sodium, cell swelling and neuronal damage. Persistent oxygen deprivation leads to neuronal excitation, which results in increased calcium, and to increased free radicals—events that cause significant cell damage (Caine & Watson, 2000). Specific brain areas are vulnerable to anoxic injury, in part due to their physical location and in part due to their biochemical make-up. Peripheral blood vessels are particularly sensitive to reductions in oxygenation (Brierley & Graham, 1984). Also sensitive to damage are areas with high metabolic demands (Moody et al., 1990). In addition, the neurochemical properties of