CHAPTER 1

The Psychology of Memory

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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.

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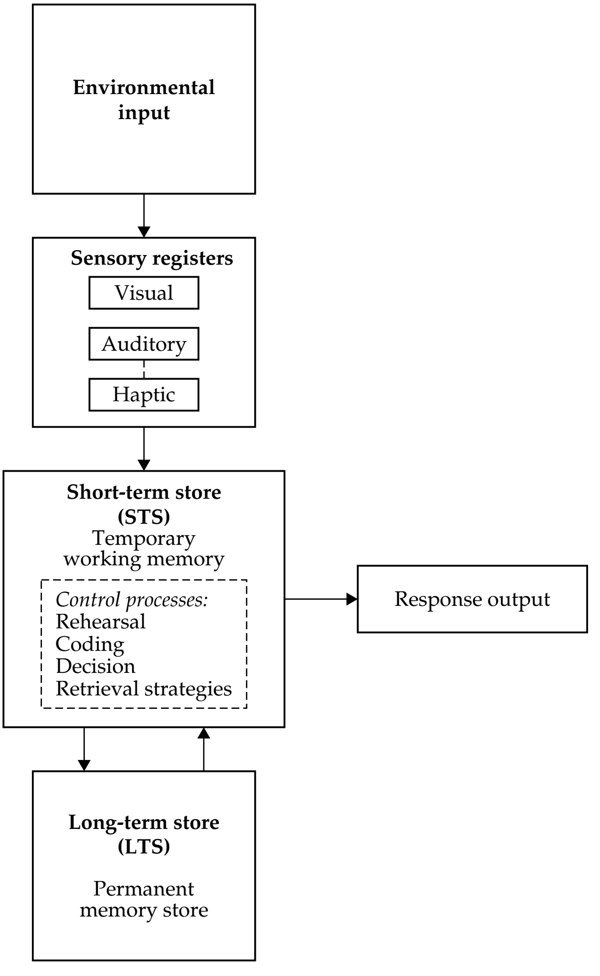

Figure 1.1 The model of human memory proposed by Atkinson & Shiffrin. Reproduced from Atkinson & Shiffrin (1968)

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 everday 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 *did* 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 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

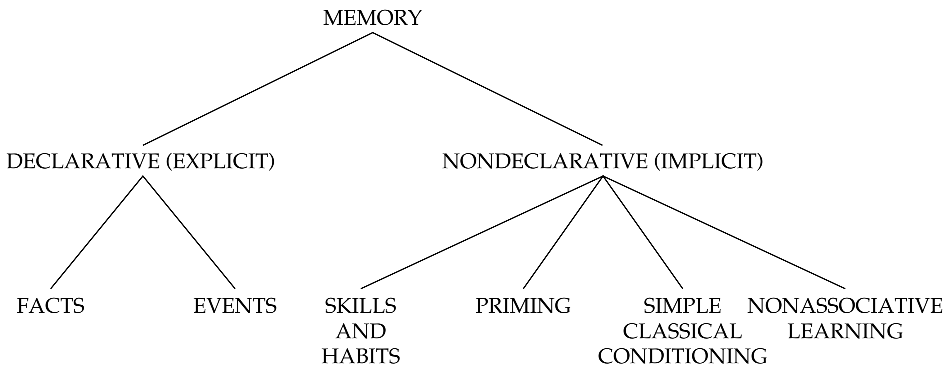

Figure 1.3 The fractionation of long-term memory proposed by Squire. Reproduced from Squire (1992)

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 environment in which a patient might typically need to use memory. This leads on to a final topic, namely that of everyday memory.

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 everday 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 RBMT 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.

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