

Chapter 3

Learning and memory in demented patients

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INTRODUCTION

Due to the increase in the standards of living and the successes of medicine in the second half of this century, the life expectancy in the western world has risen substantially. Today, the over-65 population is the fastest growing segment of the population in the United States and other western nations. It is expected that the proportion of people over age 65 will almost double by the middle of the next century (Heckler, 1985). These demographic circumstances will have a number of important consequences, not the least of which is the increase in the number of patients suffering from senile dementia.

Partly because of this, there has been a tremendous increase in the research into the phenomena that accompany aging in general and senile dementia or Alzheimer's disease (DAT, dementia of the Alzheimer type) in particular. An estimated 5 per cent of the population of 65 and over is severely demented. Another 10 per cent may be mildly to moderately impaired. Although these numbers may sound alarming, they also imply that 85 per cent of the aged population does not suffer from this type of mental impairment.

Alzheimer's disease is a diffuse global deterioration of the brain which manifests itself by a loss of cognitive functions. Although the course of the disease is very idiosyncratic and may involve various intellectual and personality disturbances, problems in learning and memory are among the first symptoms. In this chapter we will discuss a number of topics that relate to the assessment of memory impairments seen in normal aging, senile dementia and other diseases that are accompanied by memory deficits.

The distinction between 'learning' and 'memory' is a subtle one. Generally speaking, learning refers to a 'systematic change in behavior or behavioral disposition that occurs as a consequence of experience in some specified situation' (Estes, 1975:9). 'Memory' is a more abstract term referring to some change in knowledge state as a result of experience that is, however, not tied to a specific type of behaviour. Thus, I can speak about a person learning to ride a bicycle but it does not make sense to say

that that person remembers bicycle riding (at least this would mean something quite different). What I could say is that I remember a particular bicycle ride. Thus, 'learning' refers to a change in performance whereas 'memory' refers to a change in knowledge. In this chapter, the emphasis will be on 'memory' because memory processes (such as the storage and retrieval of information) are at the heart of the problems in learning that are observed in these patients.

Proper assessment of the memory functioning is an important aspect of the diagnostic process. Before one starts to subject people to extensive batteries of memory tests, it is vital to consider what the intended purpose is (Miller, 1984). There are a number of possibilities. A core problem is that of differential diagnosis: how to distinguish memory deficits of normal aged people - often called 'benign senescent forgetfulness' - from those of demented patients or from patients suffering from other diseases such as the amnesic syndrome or depression. For instance, the clinical picture of dementia and depression can be very similar, yet distinguishing between the two has important implications for treatment and prognosis.

A second consideration concerns the measurement of changes in performance. The validation of the diagnosis of dementia can only be verified by post-mortem examination of the brain. However, one of the core characteristics of DAT is its progressive nature. If the overall mental condition clearly deteriorates within a certain period of time, this may give some justification for the diagnosis of dementia. Moreover, careful evaluation of the course of DAT can be very important for the development of proper strategies of treatment. This brings to the fore the need for adequate tests of ongoing change.

And finally, proper assessment can have major implications in relating specific deficits of individual patients to specific modes of intervention. Although an effective treatment for DAT is not available as yet, one could strive towards strategies of management that fit the individual needs of the patient in the best possible way. Moreover, if detailed insight can be obtained into the specific impairments of the patient, consultation with the partner or family members may relieve part of the anxiety in coping with the disease. For example, if a patient forgets where he or she has put certain things, being unable to find them may result in suspicious and aggressive behaviour. A partner who does not know that this kind of behaviour has its origins in the memory deficits caused by the disease, might feel personally accused. In such cases, good advice might be of major importance in coping with the consequences of DAT.

THE PROBLEM OF DIFFERENTIAL DIAGNOSIS

One of the most difficult problems in differential diagnosis is to distinguish depression, often called pseudodementia, from DAT. Especially in the early

stages of DAT, when typical symptoms are not yet as prominent as in later stages, the patient may still be aware of his or her impairments and depressive symptoms may result from this. Also, cognitive impairments may be present in a depressive illness (Huppert and Tym, 1986; Tariot and Weingartner, 1986). In the early stages of DAT, learning and memory impairments can superficially resemble those occurring in depression.

Moreover, depressive symptoms can often be observed in normal elderly people, and it can be very difficult to discern them from the apathy, loss of initiative and general decline in performance that is characteristic of the early stages of DAT (Huppert and Tym, 1986).

Another source of confusion might be the memory deficits observed in amnesia. Although several parallels can be observed between amnesia and dementia, the main characteristic of amnesia is that memory problems are the most prominent impairment while other areas of cognitive functioning remain relatively preserved, and, in general, performance on memory tests does not deteriorate over time. However, impairments of DAT patients stretch to other domains of cognitive functioning and an examination of their memory deficits is methodologically more complex than a similar examination in amnesic patients (Albert and Moss, 1984).

In designing experiments to assess memory dysfunctions in DAT patients, it is important to be aware of the possibility that other cognitive deficits may be confounded by or interact with memory factors. If the task instructions are too complicated, poor performance may be the result of not understanding what to do rather than being due to memory deficits. For example, mildly to moderately impaired DAT patients usually display difficulty with naming. Testing memory with tasks that require verbatim responses may be confounded by those naming problems. Tests that use reaction time as the dependent variable may also give cause for confusion. Name-finding problems and a general slowing of responses are relatively common among the healthy elderly.

This issue also attests to the intricacy of finding a proper control group. First, there is the problem of the variation in competence. Within the elderly population this variation is extremely large and tends to increase with aging (Benton and Sivan, 1984). In addition, overlap in performance between a population of supposedly normal elderly people and a population of DAT patients might be due to the inclusion in the former group of subjects that will later prove to be at an early, not yet diagnosed, stage of Alzheimer's disease. All these factors that result in a vague borderline between normal aging and DAT, should be taken into account. One way to avoid heterogeneity in control groups or the healthy elderly is to exclude all people who in the past have suffered from any form of psychiatric disease, trauma, prior surgery, etc. It will be obvious that such a group will not be very representative of the elderly population. In such cases, it will be more likely that differences are found between patients and healthy elderly

people. On the other hand, not using such exclusion criteria may mask the boundaries between morbidity and normality. For example, subjects with chronic conditions such as hypertension or minor cardiovascular disease tend to perform less well than subjects with excellent health condition (Benton and Sivan, 1984). The proper solution, then, is to strive towards a delicate balance between conditions that can be accepted as falling within the limits of normality and the conditions that interfere too much with the purposes of the study.

A second difficulty in research on dementia is the presence of floor and ceiling effects. When the tasks are too easy, ceiling effects can be expected for the control group and their motivation might wane. Conversely, when the tasks are too difficult, floor effects for the DAT group may arise and, as the patients might be aware of their poor performance, especially in the early phase of the disease, unnecessary anxiety may ensue. This can be avoided by equalizing base-line performance of both groups prior to testing (e.g. by manipulating the study time).

And third, there is the problem of interpreting the results. Because of the diffuse nature of the brain deterioration in DAT, deficits in the overall performance are always to be expected. Differences in the pattern of performance across groups of patients and controls might result from quantitative differences in the level of performance and not from qualitative differences. In other words, a selective deficit in one or another stage of memory will manifest itself in qualitative performance differences, but these may be hard to discern among the many quantitative differences. Yet these qualitative differences are what is most important in reference to the above-mentioned purposes of the neuropsychological assessment of dementia.

Although we have painted a somewhat gloomy picture of the research on dementia, we do believe that careful description of the experimental and control groups and of the tasks that are employed, and an agreement with respect to the terminology that is used will eventually lead to a better insight into the specific deficits of dementia.

With this perspective in mind, we will discuss in the next section some traditional views on learning and memory and its relation to dementia. These traditional concepts include the distinction between short-term memory (STM) and long-term memory (LTM), recall and recognition and acquisition, storage and retrieval. Standard psychometric batteries, that are mostly used by clinicians, are largely based on these traditional concepts. We will discuss some of the research employing these concepts in relation to aging and dementia. It will be argued that the traditional concepts may be useful for initial screening purposes but that they are too global to contribute to the differential diagnosis (or, as the case might be, for the evaluation of performance changes or the analysis of individual patterns of performance deficits).

This will be followed by a description of some more recent developments based on contemporary theories of memory. Here a distinction can be made between models that relate to (a) the kind of information that is to be stored in or retrieved from memory (e.g. the episodic/semantic dichotomy) and (b) the different kinds of memory processes involved (automatic vs. controlled processing) and (c) different ways of testing memory (implicit vs. explicit memory tests). In the final section we will discuss some implications of the recent developments in the theories of learning and memory with respect to their use in clinical practice.

TRADITIONAL MEMORY TASKS

Most of the currently used clinical tests for memory disturbances are derived from traditional memory tasks such as recognition, recall, short-term memory, etc. Erickson and Scott (1977) have provided a detailed review of the available clinical tests of memory. They conclude that there is no really satisfactory test of memory for clinical usage. There are several reasons for this unfortunate state of affairs.

The first main factor is that performance on these tests is influenced by a number of factors other than the memory ability *per se*. One of these is the motivational state. Subjects who find the test difficult can often still recognize this and realize that they are making very little progress (Miller, 1984). For example, learning a list of words is not an easy task. Depressed subjects in whom motivational state is very important for good performance, are afraid to fail the test, suffer from anxiety and thus perform often as badly as demented subjects, though from another cause. Furthermore, the instructions and responses required by many memory tasks are quite complex. This complexity alone may prevent a DAT patient who already has problems inhibiting irrelevant responses and focusing on the relevant dimensions of the task, from accurately revealing his or her memory ability (Albert and Moss, 1984).

Another problem in testing older subjects has to do with the fact that some tests rely on speed of responding. As mentioned by Benton and Sivan (1984), the drop in performance level is likely to be particularly marked on tasks in which the speed of responding is a component of the performance level or which make heavy demands on short-term memory. For example, verbal associative fluency, as measured by the Thurstone word fluency test, shows a relatively early onset of decline with advancing age. This test requires the subject to write as many words beginning with a certain letter in a 5-minute period. However, oral-fluency tests do not show a decline before the age of 75.

Much of the research has been based on the familiar multi-stage model of memory (Atkinson and Shiffrin, 1968). In this model, the information processing is divided in three stages: sensory memory, short-term memory

(STM) and long-term memory (LTM). Sensory memory refers to the initial registration of information by one of the senses (the so-called sensory registers). The information is next transferred to short-term memory, also called working memory. This memory store is concerned with the processing of information, as required by the task in hand. As a result of the processing in short-term memory, information is transferred to long-term memory, the permanent repository of information. One of the most important characteristics of short-term memory is its limited capacity: there is a clear limit to the amount of information that can be held simultaneously in working memory.

We will now describe some of these results in order to see what light they shed on the memory deficits of Alzheimer patients. It should be emphasized from the outset that although certain functions are almost universally impaired in the early stages of the disorder, there is considerable heterogeneity among patients with respect to the degree and pattern of dysfunction on certain tasks as it manifests itself as the disorder progresses.

Not much research has been conducted on sensory memory processing in demented patients. Miller (1981) mentions one experiment in which an array of six letters was briefly presented followed by a masking stimulus. It was observed that demented patients were much less able to report the letters than controls. There is some evidence that the peripheral aspects of iconic memory (the visual sensory memory) are preserved and that the impairment is located in the more central aspects of visual processing (see Morris and Kopelman, 1986).

More studies have been conducted with short-term or primary memory tasks. A rather mixed set of results has been obtained. Thus, digit span (a typical measure of STM based on the number of digits that a person can recall immediately after first presentation) is reported by some investigators to be normal in mild to moderate DATs and by others to be impaired (Huppert and Tym, 1986). In general it may be said that DATs show deficits on a variety of primary memory tests. These include the recency component of free recall (the better recall of the final items on a list, a measure of short-term memory), memory span (immediate serial recall of digits, letters and words, and the Corsi block span test) and the Brown-Peterson test (considered to be a measure of short-term forgetting). Morris and Baddeley (1988) present a review of studies using primary and working memory tasks. In most cases, moderate impairments have been observed.

A more severe impairment is generally observed in the performance of DAT patients on long-term memory tests. Deficits have been reported for a wide variety of tasks (see Morris and Kopelman, 1986), including free recall (recall of a list of unrelated items), paired-associate learning (learning associations between pairs of items) and recognition memory (judging whether a given item was presented on a list).

Several attempts have been made to pinpoint the exact nature of the long-term memory deficits in Alzheimer patients. These attempts have not been very successful, however. For example, Miller (1981) describes a number of experiments that were designed to test whether the deficit of DAT patients is caused by an inability to inhibit incorrect responses. The data provided no support for this hypothesis.

Summarizing, DAT patients show an almost universal impairment on traditional measures of memory functioning. This should not be taken to imply, however, that such measures are useful for diagnostic purposes. The problem is that most other memory disorders (Korsakoffs syndrome, pseudodementia) involve similar 'global' deficits on traditional memory tasks. This means that such measures may be helpful for screening purposes and for monitoring purposes but that they are not useful for differential diagnosis or research on drug treatment for dementia. What would be useful is a way of measuring aspects of memory required for everyday functioning. In the next section we will discuss some recent research on so-called implicit tests of memory that could be useful for such purposes.

RECENT DEVELOPMENTS

In recent years there have been a number of new developments in the analysis of the memory deficits of amnesic patients. The distinguishing characteristic of these studies is that a much more detailed approach to memory functioning is taken. We believe that such an approach will also prove to be useful in the case of DAT patients.

For example, Weingartner *et al.* (1983) observed no difference between Korsakoff patients and Alzheimer patients in the early stages of the disorder with respect to the performance on the Wechsler memory scale and a number of other conventional memory tasks. However, in other tasks, aimed specifically at aspects of semantic memory, there was a substantial deficit in the performance of the DAT group while there was no significant difference between the Korsakoff patients and normal controls.

This result is one among many that indicate that the distinction between episodic memory (the memory for personal experiences) and semantic memory (the general knowledge including the knowledge about concepts and the rules of language) may be important for the differentiation between various types of memory disorders. According to a number of investigators (e.g. Kinsbourne and Wood, 1975; 1982) patients suffering from the amnesic syndrome show a deficit in episodic memory but not in semantic memory. Alzheimer patients, on the other hand, do suffer from a deficit in semantic memory (Weingartner *et al.*, 1982; 1983).

A similar conclusion has been advocated by Martin and Fedio (1983). They hypothesized that DAT patients suffer from an impairment in the organization of semantic knowledge. Such a conclusion is in agreement

with the observation that DAT patients are particularly impaired in 'naming' and 'fluency' tasks.

A second distinction that should be mentioned is that between so-called automatic and controlled processing (Shiffrin and Schneider, 1977). Briefly, automatic processes make no demands on processing capacity, that is, they do not have to be consciously monitored; controlled processes, on the other hand, have to be monitored and are thus subject to capacity limitations but are more easily influenced by strategies. This distinction might prove valuable for the differentiation between Alzheimer patients and depressed elderly persons. It might be assumed that the depressed will show deficits on tasks that involve controlled processing but not on tasks that may be executed automatically. A similar hypothesis has been advanced by Weingartner and his associates (Weingartner *et al.*, 1982; 1983). They assume that depressed patients will show deficits on those tasks that require sustained attention or effort, but that deficits are less likely on tasks that only require automatic processing. The reason for this is that their deficits are caused by motivational problems rather than being due to memory factors per se. Demented patients would also show clear deficits on passive or automatic tasks.

Not all results reported in the literature fit such a hypothesis. For example, it does not explain the discrepancies between the results obtained by Nebes *et al.* (1984) and those obtained by Ober and Shenaut (1988). Nebes *et al.* observed no significant difference between DAT patients and controls with respect to the priming effect in a naming task. The priming effect refers to the facilitation observed when a word is preceded by a semantically related word. Ober and Shenaut, on the other hand, observed that DAT patients did not show the expected positive priming effect in lexical decision tasks (i.e. deciding as quickly as possible whether an item is a word or a non-word). Instead, a negative priming effect was obtained. In other words, DATs were slower to decide whether a target was a word when it was related to the prime than when it was not related. According to Ober and Shenaut this difference is due to the fact that the lexical decision task requires more elaborate semantic processing. It is not clear, however, whether the results of Nebes *et al.* can be replicated. A definite conclusion should probably be postponed until this experiment has been replicated.

Tariot and Weingartner (1986) have presented an intriguing hypothesis that ties the automatic/controlled distinction together with the semantic/episodic distinction. They assume that DAT patients, in contrast to other memory disorders, suffer from a deficit in the use of semantic memory. This deficit also affects their performance on episodic memory tasks because effective encoding of an episode requires access to semantic information. The more the task requires semantic processing, the more clearly this shows up. Therefore, the extent to which episodic memory is impaired in patients

with DAT, is directly related to impairments of semantic memory. Tasks that require relatively little semantic processing (such as most priming tasks) will not show significant deficits.

Finally, there has been a recent flurry of research on various types of implicit or unaware forms of memory testing. In such tasks, memory is tested indirectly, that is, through its effects in ostensibly non-memory tasks. This usually involves some sort of repetition priming, e.g. the facilitation obtained in naming words that are repeated in a test session. Such effects may be obtained even though the subject is unaware of the repetition. This distinction between implicit and explicit forms of memory testing has been shown to be quite useful in the analysis of the memory deficits of amnesic patients (see Graf *et al.*, 1984; Jacoby and Witherspoon, 1982).

A natural question to ask is whether Alzheimer patients also show normal performance on implicit memory tasks. Moscovitch (1982) observed a normal repetition priming effect in DAT patients even though they showed severe deficits in normal recognition memory. Similarly, Nebes *et al.* (1984) obtained an equivalent semantic priming effect in Alzheimer patients. Similar results have been reported by Miller (1975) and Morris *et al.* (1983) using a word-stem completion task. That is, the patients were more likely to complete a word when given the first three letters, if that word had been previously presented.

Such results indicate that some basic aspects of memory processing may in fact be spared in Alzheimer patients. To what extent this holds up for other forms of implicit memory remains to be seen. In any event, such sparing will be important for understanding the exact nature of the memory deficits of Alzheimer patients.

EVALUATION AND DISCUSSION

In this review, we have placed a strong emphasis on the issue of differential diagnosis. As we have explained, early diagnosis is important even though no treatment for Alzheimer's disease is yet available. First, diagnostic tools may be used to differentiate between dementia and pseudo-dementia. Second, early diagnosis may avoid family problems due to a lack of understanding of what is wrong. Third, it may lead to the introduction of potential pharmacological treatments at a stage when they are most likely to prove effective.

There are also other reasons why a proper understanding of the memory problems of these patients is important. Decisions about the proper management regime have to be based on some form of evaluation or assessment of the patient. For this purpose it is important to know which abilities are still more or less intact in different subtypes of dementia. The extent of the memory problems has consequences for such decisions as to whether it is advisable to let the patient continue to live in the home

environment (possibly alone and with minimal support from relatives or neighbours) or whether some form of sheltered accommodation is necessary. In addition, it is important to monitor the course of the disease since this may have consequences for the optimal type of management regime.

Finally, a proper understanding of the nature of the disease is important for those that are involved in the care-giving of these patients. This includes not only the family members but also the nursing staff if the patient resides in a geriatric hospital. Both groups may become frustrated over the lack of response to their efforts at trying to improve the patient's condition.

In fact, one of the biggest tragedies of Alzheimer's disease is the often physically gruelling and emotionally exhausting task that it imposes on the care-giver. As the disease progresses, the patient may no longer recognize the spouse (or other family members). In a sense, the spouse has already lost his or her partner even though she/he is still living. In addition, the care-giver has to invest so much time that he/she becomes socially isolated and cut off from the world at large, yet receives little recognition for these efforts. Perhaps, the best advice that can be given is to seek professional help as soon as possible and to join one of the existing associations of family members of Alzheimer patients.

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