

NOTE

CO-OCCURRENCE OF EXECUTIVE IMPAIRMENT AND AMNESIC SYNDROME FOLLOWING SUB ARACHNOID HAEMORRHAGE: A CASE STUDY

Jonathan Wheatley and Joanna McGrath

(Clinical Psychology Department, Rivermead Rehabilitation Centre, Oxford)

ABSTRACT

This case study presents a 37 year old man, P.P., who shows evidence of both profound executive impairment and diencephalic amnesia associated with two discrete lesion sites following a Sub Arachnoid Haemorrhage. The executive impairment is unusual in type and severity, amounting to a gross impairment in the initiation and organisation of action. The thalamic lesion provides a rare example of diencephalic damage resulting in an extensive retrograde amnesia of the type that is often associated with Korsakoff's syndrome, but which in this case is not associated with prolonged alcohol abuse. Some of the problems caused by the co-occurrence of two such profound and disabling impairments are discussed.

INTRODUCTION

Problems with planning, initiating, and monitoring activity are often seen in clinical practice in association with damage to the frontal lobes (Bianchi, 1922; Luria, 1966; Damasio, 1979; Shallice, 1982; Goldberg and Bilder, 1987). These problems can span a wide range of behaviours. Baddeley (1986) has suggested the term 'dysexecutive syndrome' to describe the functional deficits that can arise as a result of such damage, explaining them in terms of an impairment of the central executive component of working memory. Although there has been much theoretical discussion of these functional deficits (e.g. Duncan, 1986), there have been very few detailed studies of such patients. The studies that do exist have little in common with each other.

Baddeley and Wilson (1988) were the first to apply the term 'dysexecutive syndrome' when describing a patient, R.J., who following a head injury, demonstrated an impaired ability to plan and apply strategies. Since their paper a number of reports have described patients who are said to show executive impairment, and who display a wide variety of cognitive deficits including perseveration, impulsivity, lack of initiation, poor self monitoring, and difficulty shifting set. For example Shallice and Burgess (1991) presented 3 vignettes of head injured patients who are unable to act effectively on their own initiative except in the most routine of activities. Three separate case studies have been made of patients with Herpes Simplex Encephalitis (H.S.E.) whose 'dysexecutive syndrome' underlies their severe behavioural disturbance (Alderman and Ward, 1991; Alderman and Burgess, 1994; Alderman, Fry and Youngson, 1995).

In most of these cases lesion sites were not restricted to the frontal lobes, and each of these patients had very different clinical characteristics, displaying a variety of cognitive deficits and behaviours. For example only two were reported to show perseveration, and whilst the H.S.E. patients were described as showing very disturbed behaviour and poor self-monitoring capacity, R.J. and the patients of Shallice and Burgess did not show behavioural problems, but were thought to be impaired in their ability to plan and apply strategies.

There are so few documented cases, and the clinical pictures are so diverse that it may be more useful at present to speak of a range of executive impairments rather than a single

syndrome. It may be that the term 'dysexecutive syndrome', originally conceived as a provisional descriptive term, has established itself in neuropsychological vocabulary prematurely, in the absence of sufficient empirical evidence. The subject of the present case study shows extensive executive impairment, particularly with regard to the initiation of even routine everyday activities, together with an amnesic syndrome.

In contrast to the 'dysexecutive syndrome', the amnesic syndrome is the subject of a large theoretical and empirical literature. Parkin and Leng (1993) describe the defining characteristics of the amnesic syndrome as follows:

- (1) No evidence of impaired immediate memory as measured by tasks such as digit span.
- (2) Largely intact intellectual functions and semantic memory.
- (3) A severe and permanent anterograde amnesia.
- (4) Retrograde amnesia for information acquired before the brain damage was sustained, the extent of which varies across patients.
- (5) Intact procedural or implicit memory.

It is now accepted that there are a number of critical lesion sites that can give rise to a global amnesic deficit. The syndrome can arise from lesions centred on the midline diencephalic nuclei or the medial temporal lobe, and some authors argue that lesions in different areas can give rise to qualitatively different types of amnesia. Parkin (1984) has suggested, from an extensive overview of the literature, that there are significant differences between diencephalic and temporal lobe amnesics. Most notably, diencephalic amnesics often confabulate and show a lack of insight and concern about their memory disorder, whilst these symptoms are rarely associated with temporal lobe amnesia. Although retrograde amnesia is a feature of both forms, this is more often severe in diencephalic amnesia. The extent of retrograde amnesia associated with temporal lobe amnesia tends to be much more variable. A temporal gradient is also more usually seen following diencephalic damage, with memory for experiences prior to the onset of illness being especially impaired.

The subject of the present case study is of clinical and theoretical interest for the following reasons. First, this case is unusual in the literature as it demonstrates two very severe and disabling neuropsychological conditions, occurring in association with two discrete lesion sites. Secondly, in this case the amnesia results from a rare non-Korsakoff unilateral diencephalic lesion. Finally, the pattern and the extent of the executive impairment to be described here is unlike any presented to date, and potentially makes a significant contribution to the understanding of frontal lobe damage and executive function.

CASE REPORT

P.P., a 37 year old right handed male who has worked previously as a design draughtsman, was admitted for rehabilitation 8 months after suffering a sub-arachnoid haemorrhage which occurred as a complication of a standard transphenoidal hypophysectomy to remove a non functioning pituitary adenoma. Apart from mild weakness in the right arm, his motor ability was left largely intact. In the early stages of recovery staff became concerned that he was withdrawn, confused, and impoverished in his activity. C.T. and M.R.I. scans revealed two separate infarcts in the right thalamus, and the medial aspect of the frontal lobe, bilateral but more extensive on the right, in the region of areas 32, 34 and bordering on area 6 (cingulate premotor and supplementary motor areas).

Evidence of Executive Impairment

Over a two year period P.P. showed profound and persisting difficulty in initiating basic activities of daily living. He did not get out of bed, wash, eat or drink, use the toilet or engage in therapy unprompted. More often than not he was verbally and physically resistant to the nursing staff who attempted to engage him in these activities. When requested to carry out an activity he often agreed and expressed an intention to do it 'in a minute', but appeared to be unable to act on his intention. (It is uncertain as to whether or not he genuinely believed that he could perform these activities unaided). For example he would

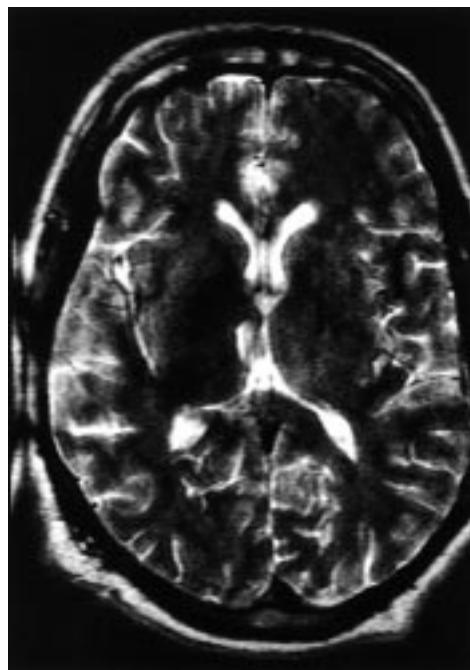


Fig. 1. – *M.R.I. scan of P.P. showing infarcts in the right thalamus and medial aspect of the right frontal lobe.*

hold an electric shaver in his hands and sit in front of a mirror, verbally expressing an intention to shave himself, but apparently unable to initiate doing so. He sometimes asked staff to supply him with the first step towards a goal, for example sitting up in bed before getting out completely. When nursing staff withdrew prompts for controlled experimental periods he would soil his bed daily, and remain in a soiled bed for a number of hours until staff intervened.

P.P.'s motor ability was grossly intact, but he went everywhere in a wheelchair which was pushed by members of staff. Only once in his stay (and for no obvious reason) did he leave his room without a member of staff or a relative prompting and accompanying him. His washing and dressing was mostly carried out by members of the nursing staff, even though he was physically capable of doing this for himself and found intervention from others aversive. His most frequent request was to be left alone. These behaviours became a severe management problem in the rehabilitation centre.

Despite such gross problems with the executive tasks of planning and initiating activity, there was no evidence of either impulsivity or perseveration (which are also often associated with higher order executive impairment) in P.P.'s behaviour. The deficit in planning action appeared to be at a more general level and more pervasive than that normally described as apraxia.

P.P. showed such a poverty of activity that endocrine and psychiatric explanations for his behaviour were considered. P.P. was throughout this period being treated with hormone replacement therapy (testosterone), however careful recording showed no relationship between the administering of this hormone and P.P.'s impoverished behaviour. However, there was some suggestion from direct care staff that H.R.T. related to the degree of aggression rather than passive resistance that P.P. showed in response to being required to

initiate action. In addition he was examined by several psychiatrists who concluded that he did not suffer from depressed mood. In fact, in social situations PP would occasionally appear quite jovial and socially skilled. His behaviour on these occasions suggested mild social disinhibition. It is striking that although he was occasionally very responsive to social stimuli, and at times clearly enjoyed social interactions, he never initiated such interaction himself.

Neuropsychological Investigation

P.P. was extremely difficult to test, as he was often resistant to structured interaction of any kind. There were, however, some few occasions when he was in good humour, talkative, and cooperative, and it was only on these occasions that he could be investigated. He engaged well in testing and appeared to enjoy success; this suggests that his test results are not attributable to poor motivation or lack of engagement. The results of all tests which were attempted are given in Table I.

TABLE I
Neuropsychological Test Results

Test	Raw score	Scaled score	Comments
N.A.R.T.	37	117	Premorbid W.A.I.S.-R. equivalent
Shipley-Hartford vocabulary	68	109	W.A.I.S.-R. equivalent
Raven's Coloured Progressive Matrices	30/36		2 standard deviations below the population mean
Oldfield Wingfield object naming test	36/36		
Verbal fluency (F.A.S.)	1	<1st centile	(P.P. looked perplexed and said, "There must be loads...")
Rey Osterrieth Complex Figure Copy	4/36		(P.P. drew bare outlines only and gave up)
W.C.S.T. (Nelson's version)			
Categories obtained	6		
Total errors	2		
Perseverative errors	0		

P.P.'s relatively good performance on some neuropsychological tests indicate that he does not suffer from global cognitive impairment. However his test performance is also consistent with the presence of profound executive impairment. P.P. was able to respond intelligently when given a framework e.g. a choice between fixed alternatives, but not when a response required planning and initiation. Particularly striking is the contrast between:

1) His above average vocabulary level (N.A.R.T., Shipley-Hartford) and almost total absence of verbal fluency (F.A.S. test). Despite having a well preserved vocabulary evident in his every day conversation and the ability to name low frequency objects to confrontation on the Oldfield-Wingfield test (100% accuracy), P.P. performed poorly on the F.A.S. test of verbal fluency in which he was asked to generate as many words as he could beginning with a particular letter in 60 seconds. He was only able to generate one word in response to the first cue letter, and none for the second or third, saying simply "there must be loads of them". This is a similar response to that of the patient R.J. reported by Baddeley and Wilson (1988).

2) His ability to process complex designs, evident in his relatively good score on Raven's Coloured Progressive Matrices, and the inability to construct a complex design (Rey Osterrieth). The score obtained on the matrices is at the level of an 11 year old of above average ability in terms of the original norms for this test, and below average for a

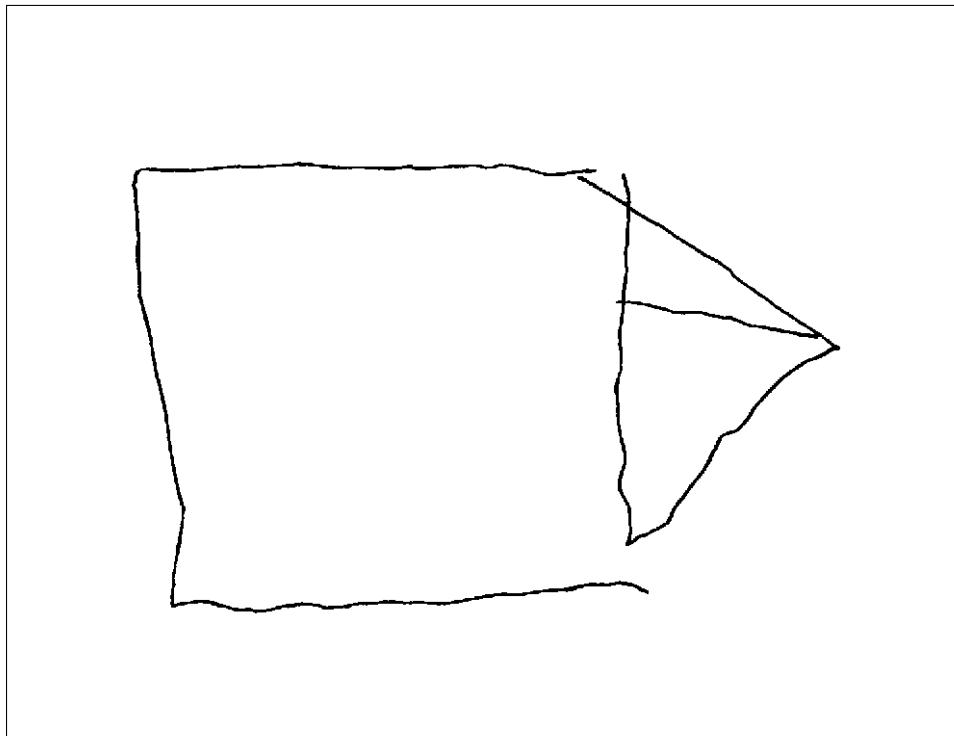


Fig. 2.— *Copy of Rey Osterrieth Complex Figure. After drawing this P.P. said, 'I can't' and put down the pencil.*

normal adult of this age (Yeudall et al., 1986). Nevertheless P.P. persisted with the task and his responses were at well above chance level. Despite this he seemed unable to organise his response to generate a copy of the Rey Osterrieth complex figure. Given unlimited time he could only generate the bare outlines (see Figure 2).

P.P.'s ability to perform the Wisconsin Card Sorting Test with ease can be attributed to this task requiring reactive cognitive flexibility, in contrast to the spontaneous cognitive flexibility required by the verbal fluency test (Eslinger, 1995). This is consistent with the difficulty in initiating action, but absence of perseverative behaviour noted in his everyday life. It is also consistent with P.P.'s ability to respond to strong social cues and structure at times such as a Christmas party, in which he fully participated to the extent of dancing with a member of staff when asked.

In conclusion, clinical observation and neuropsychological testing both strongly suggested that P.P. had an impaired ability to plan and initiate action which is indicative of profound, and selective, executive impairment.

Evidence of Amnesic Syndrome

Nearly two years after the S.A.H., and despite continued attempts to provide him with information about his current situation, P.P. remained disoriented for time and place. He often confabulated, for example stating that he was at college rather than in hospital, and claiming that hospital staff were fellow students. He showed some learning of staff names, but these were out of context with their identities. At other times he told staff that he was staying upstairs at an aunt's house, despite being able to see out of his window that he was

on the ground floor. He consistently thought that the year was in the early 1980s, that his 11 year old daughter was only 5 years old, and that his dog, who died several years ago, was still a puppy. He denied ever having lived in the area that he lived in for three years prior to his illness. When told factual information about recent events he expressed surprise, and minutes later needed to be told the information again. Such severe and persistent disorientation and confabulation is consistent with diencephalic amnesia.

Neuropsychological Investigation

Testing revealed profound anterograde and retrograde amnesia (see Table II). Despite normal forward digit span, recall of the Wechsler Logical Memory paragraphs was minimal under immediate and absent under delayed conditions. Similarly, P.P.'s performance on the Rivermead Behavioural Memory Test (Wilson et al., 1985) indicates severely impaired episodic and prospective memory. The R.B.M.T. is an ecologically valid test of everyday memory tasks, and includes remembering a name, recognising faces, recognising designs, learning a new route, and remembering to perform certain tasks. Despite appearing well motivated and seeming to enjoy the test interaction, P.P. was unable to succeed on even the simplest sub-test.

P.P.'s performance on tests of remote memory was also poor. P.P. scored in the 'definitely abnormal' range on the Autobiographical Memory Interview (Kopelman et al., 1990). As can be seen from Table II his memory was impaired for all three time periods covered, and his amnesia was most severe for his recent life. His poor performance on the Autobiographical Incidents sub scale can be attributed in part also to his initiation difficulties.

P.P.'s memory for public events/figures was investigated using the 'Dead or Alive' test (Kapur et al., 1989). This test requires the subjects to say whether a public figure is dead or alive, and if dead, when and how he or she died. The results revealed the same pattern of remote memory impairment across all time periods, with performance being worst for the

TABLE II
Neuropsychological Assessment of Anterograde and Remote Memory

Test	Raw score	Comments
W.M.S.-R.		
Logical memory, Immediate	3.25	>1 s.d. below population mean
Delayed	0	
Digit Span		
Forward	7	
Backward	4	
R.B.M.T.		
Profile score	3	
Screening score	0	'Severe memory impairment'
A.M.I.		
<i>Personal semantic scale</i>		
Childhood	8.5	
Early adult life	2	
Recent life	2	
Total	23	'Definitely abnormal'
<i>Autobiographical incidents scale</i>		
Childhood	1	
Early adult life	1	
Recent life	0	
Total	2	'Definitely abnormal'
Dead or Alive Test		
Died in 1960s	28/60	
Died in 1970s	34/60	
Died in 1980s	14/60	
Alive	14/60	

most recent facts, and those from the middle time period being relatively spared. The two tests give consistent results as the three time periods covered by the Dead or Alive test roughly correspond to those covered by P.P.'s Autobiographical Memory Interview; P.P.'s childhood occurred during the 1960s, and most of his early adult life in the 1970s.

The results show a clear pattern of impairment for both personal and public information stretching back quite extensively, but with memory being especially poor for the most recent years.

In summary, on testing P.P. conformed to the defining characteristics of the amnesia syndrome in general, and diencephalic amnesia in particular. He showed a severe anterograde amnesia on tests of recall, with extremely rapid forgetting, and an extensive retrograde amnesia. His amnesia was severe and persistent, and no clinical improvement was seen even at two years post onset.

DISCUSSION

On the basis of the evidence given it seems that P.P. demonstrates the co-occurrence of two severe neuropsychological conditions. A similar case has been made by Baddeley and Wilson (1988) in their study of R.J., who seems to display a combination of classic amnesia deficit and executive impairment, which they term 'frontal amnesia'. However R.J.'s impairments were the result of a severe head injury leading to haemorrhage in both frontal lobes, and therefore damage that is likely to have been diffuse and involved other areas. The lesions sustained by P.P. are far more localised, so it can be argued with a greater degree of confidence that he exhibits two distinct impairments of a severity unusual in the literature.

It might be argued that P.P.'s memory impairment can be explained entirely by the presence of frontal lobe damage. However this does not explain the following observations.

1) The severity of the amnesia syndrome shown by P.P. While there is a growing literature on memory problems associated with frontal lobe damage (Shimamura et al., 1991; Kesner et al., 1995) – documenting a wide range of memory deficits themselves possibly secondary to executive impairment, frontal damage alone is not associated with dense amnesia (Stuss et al., 1994).

2) Related to this, P.P.'s ability to recognise was not clearly superior to his ability to recall. Patients with frontal lobe damage and dysexecutive problems are thought to be superior at recognition than recall tasks (see, for instance, Parkin, 1993) because recognition does not require active search and retrieval processes. The limited evidence available for P.P. is from the two easy recognition subtests of the R.B.M.T. Of these, he only just failed a face recognition task, but performed a picture recognition task at chance level.

3) The presence of extensive and persisting retrograde amnesia, which has not been reported in the literature in association with frontal damage unless diencephalic lesions are also present, but which has been reported in association with isolated diencephalic lesions (Becker et al., 1990).

4) P.P. confabulated. This may be associated with primary frontal damage (Stuss and Benson, 1984) but is more usually associated with dorsolateral lesions rather than medial lesions (Shimamura et al., 1991).

Neuropsychological testing, C.T. data, and clinical observation of P.P. indicate the presence of a profound amnesia of the type reported to be associated with diencephalic damage. Particularly striking is the extensive retrograde amnesia. The case is potentially a significant contribution to the study of the amnesia syndrome for two main reasons. First, the lesion is unilateral, right-sided and hence unusual. Severe global amnesia following such lesions has been reported only rarely (Fazio et al., 1992).

Secondly, P.P. acquired damage to the thalamus which is not a result of Korsakoff's syndrome. Whilst there have been many studies of memory impairment in patients with thalamic damage resulting from Korsakoff's syndrome, there have been comparatively few studies of patients with non alcohol related causes of diencephalic damage. Such cases allow evaluation of the possibility that the extensive retrograde amnesia seen in Korsakoff's syndrome might be associated with prolonged periods of alcohol intoxication during which

memories are not laid down, as was once suggested by several authors (Squire and Cohen, 1982; Butters and Albert, 1982). This case provides evidence against this hypothesis as it implicates diencephalic damage as the direct cause of retrograde amnesia. Furthermore, the majority of the neuropsychological studies which do exist of patients with thalamic infarction resulting in persistent amnesia have tended to focus on anterograde memory (e.g. Winocur et al., 1984; Guberman and Stuss, 1983). In this present case the extent of the retrograde amnesia for both public and personal events has also been assessed. Earlier studies have also reported an extensive retrograde amnesia resulting from non-alcoholic damage to thalamic structures (Stuss et al., 1988; Markowitsch et al., 1993; Hodges and McCarthy, 1993). Graff-Radford et al. (1990) reported two bilateral thalamic infarct cases who showed severe anterograde and retrograde amnesia on testing, but whose functional memory deficits were less severe than those shown by P.P. Squire et al. (1989) carried out a detailed study of retrograde amnesia in a group which included one patient with bilateral thalamic infarcts, who is reported as showing a retrograde amnesia of approximately 15 years. As Hodges (1995) notes, this evidence implies that damage to structures within the diencephalon is critical for the production of retrograde amnesia, but further neuropsychological and radiological investigation will be needed to identify these structures.

Thirdly, the executive impairment described in this study is perhaps more severe than any case presented in the literature so far. Like the patients presented by Shallice and Burgess (1991) P.P. was unable to act effectively on his own initiative – but unlike them this extended to even the most basic daily activities. P.P. appeared unable to monitor his own performance and to use feedback from the environment to regulate his behaviour, like the H.S.E. patients described by Alderman et al. (1991, 1994, 1995). However his primary behavioural disorder was a chronic apathy probably related to his initiation difficulties, rather than any motivational deficit, which made him resistant to most interventions from staff. This stands in contrast to the more florid disorders of aggression, sexual disinhibition, lack of social skills and repetitive speech displayed by the H.S.E. cases.

This seemingly specific executive impairment is entirely consistent with the location of the frontal lesion, which although small, affects the areas thought to involve the selection of movements when there is no external cue to tell the subject when to move or what to do, in both monkeys (Passingham, 1993) and humans (Damasio and Van Hoesen, 1983).

P.P.'s inability to plan and initiate action and to generate responses in a test situation implicates damage to the frontal lobes and a severe executive impairment. However he was able to perform the W.C.S.T., a test which also requires executive processes, with ease. Eslinger et al. (1995) state that the W.C.S.T. is a test of reactive cognitive flexibility, whilst the F.A.S. test is a test of spontaneous cognitive flexibility. If P.P.'s clearly profound executive impairment is limited solely to the one aspect of cognitive flexibility and not the other, then perhaps we need to modify our understanding of executive function. P.P.'s performance points to a possible dissociation between initiation and perseveration; between being unable to start an activity and unable to stop it. These two functions are conceptually similar, but may be mediated via different neural sites or circuits. It should also be noted that the dorsolateral rather than orbito-medial frontal area has been implicated in the ability to perform the W.C.S.T. in both lesion and P.E.T. studies (Milner, 1963, 1964; Berman et al., 1995). Thus P.P.'s preserved ability to perform the W.C.S.T. reflects the known site of damage.

The case illustrates that the presentation of executive impairment can be very varied. Rather than referring to a single dysexecutive syndrome, it may be more useful to speak of a range of executive deficits which can sometimes form distinct symptom clusters.

Implications for Rehabilitation

P.P. showed a lack of insight and concern over his disorder which is said to be typical of diencephalic amnesia. The executive impairment left him unable to initiate activity for himself, and the memory impairment left him with no understanding of why he needed help. This might explain why P.P. was uncooperative and often resistant to nursing and therapeutic intervention. Direct care staff, however, saw that P.P. was physically capable of performing activity, whilst the cognitive impairments which were preventing him were less

visible. They also saw that he was apparently of normal intelligence with a good vocabulary, and so his confabulations at times could be misinterpreted as simple lies.

In these circumstances the patient may come to be seen as manipulative or a malingeringer, with behavioural rather than primarily cognitive problems. The results of neuropsychological investigation should be used to educate direct care staff and family members of the extent and practical implications of such impairments, which may otherwise lead to a misperception of the patient.

Reality Orientation Training is a therapy which has been well established in use with the elderly and which has been recommended also for patients with acquired neurological impairment (Godfrey and Knight, 1987; Powell-Proctor and Miller, 1982; Kaschel, Zaiser-Kaschel, Sheil and Mayer, 1994). The therapy focuses on reminding the patient of where they are, what the date is, and what is going on in the world around them. With patient P.P. a programme of prompting orientation information using fading cues was attempted daily over a five month period. This produced only negligible improvement. One reason for this was that P.P. became very distressed when confronted, however gently, by information as to his present situation and condition, to the extent that the therapy session would have to be terminated. Eventually it was decided that this form of orientation training was producing little gain, and was too distressing to the patient to warrant continuing.

Another form of therapy often used with the elderly may well be more productive in such cases, when formal Reality Orientation is too threatening. Reminiscence Therapy (see Merriam, 1980) rather than emphasising the current situation of patients, attempts to link them with their past lives and achievements. This is less distressing as the patient is not forced to focus on what may well be unpleasant truths as to their current situation. Furthermore, the nature of the interaction is less threatening than Reality Orientation Training, in which the therapist holds information which the patient may not have. With Reminiscence Therapy the interaction is more of a collaboration between patient and therapist. Reminiscence therapy focusing on the 1970s and 1980s was attempted with P.P., and he appeared happy and animated when engaged in such sessions. Evidence available on the effectiveness of reminiscence therapy with elderly patients indicates that it does not have a significant effect on memory function and, although pleasurable at the time, does not have persisting positive effects on mood or life satisfaction (Romanuk, 1981; Thornton and Brotchie, 1987). However few of the published studies give precise details of the therapeutic activity involved.

A related but distinct approach is recommended by Baddeley and Wilson (1986). This involves the formal reteaching of autobiographical information as one means of reducing the anxiety that often accompanies amnesia. They argue that self respect demands some coherent concept of the self, which to a great extent relies upon autobiographical memory. As they put it "telling disorientated patients where they are at present and what the date is may not help very much because what they need to establish and maintain is not just *where* they are but *who* they are". This is certainly true of patient P.P., as his diencephalic amnesia and executive impairment left him with no insight into either the nature of his disabilities or of the handicap that is secondary to them.

Acknowledgements. The authors would like to acknowledge the work of the Nursing staff at Rivermead Rehabilitation Centre; Dr. Philip Anslow, The Radcliffe Infirmary Oxford; and Dr. Janet Cockburn for her comments and advice on this paper.

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Joanna McGrath, Rivermead Rehabilitation Centre, Abingdon Road, Oxford OX1 4XD, U.K.

(Received 25 September 1996; accepted 10 April 1997)