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CHAPTER TWENTY-FIVE

Imagery as a Mnemonic Aid in Amnesia Patients: Effects of Amnesia Subtype and Severity

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ABSTRACT

Thirty five amnesic patients, in four subgroups, were studied using the paired associate task introduced by Jones (1974). Three lists of concrete noun pairs were presented and tested in three learning trials and retention one hour later. The first list was presented under standard conditions, i.e. without requests of any specific strategy. The second list was presented with imagery instructions and illustrative pictures. For the third list the patients were requested to generate their own images.

Improvement under imagery conditions was seen in all subgroups. However, severely amnesic patients benefited minimally from imagery. Patients with moderate deficits improved considerably from illustrative pictures, but less so with self-generated imagery. Mildly amnesic patients improved greatly, and the improvement was maintained with self-generated images.

These results indicate that severity of amnesia may be decisive in determining whether imagery instructions aid amnesics, and this could explain why previous studies have produced conflicting results.

Versions of a dual code hypothesis attributing a dominant role to the right hemisphere in the visual imagery effect are not supported by the results.

INTRODUCTION

Use of imagery was central to the ancient art of memory, which was still taught and used in the middle ages (Patten, 1990). The art may have lost favour with the greater availability of ink and paper during the renaissance, but imagery as a human faculty continued to fascinate, and to Wundt, founder of the first psychological laboratory, images were the constituent elements of ideas, or of consciousness. Other psychologists of the time sought to relate individual differences in recall to vividness of imagery, based on Galton's (1883) observations. Both of these research strategies relied on introspective data, and neither survived the criticisms of the Würzburg school of psychology and behaviourism (Kosslyn, 1980). Imagery itself, derided as "the figment of the psychologist's terminology" (Watson, 1928, p. 76), became a subject largely ignored by psychologists.

When interest in imagery was reawakened, it was at first mainly as an aid to remembering (Miller, Galanter, & Pribram, 1960). Behaviourist approaches to verbal learning were increasingly regarded as too restrictive, and during the 1960s a flurry of studies, summarised by Paivio (1969) and Bower (1972), demonstrated the superior recall when subjects were instructed to use imagery. Both free recall and paired associate (PA) learning were commonly used, but in this paper I shall concern myself only with the latter. In a typical PA task, the subject is presented with a list of word pairs, usually unrelated nouns, and at recall the first word serves as a cue for report of the second word. Subjects may be left to their own devices for remembering, or they might be told before presentation to imagine a visual scene or mentally to picture the two objects interacting in some way. The difference in recall in these two conditions can be quite dramatic in normal subjects, provided lists are sufficiently long to avoid ceiling effects. Although some subjects spontaneously use imagery under standard conditions, a doubling of percentage recalled may be seen with imagery instructions (Bower, 1972).

To account for these and related findings Paivio (1969) assumed that images and verbal processes function as alternative coding systems, or modes of symbolic representation. Imagery improves recall because in this situation the words are doubly coded, and sensory images evoked at recall may serve as mediators to the verbal system. It may be relevant to distinguish between two aspects of Paivio's dual code theory, termed by Marschark and Hunt (1989) dual processing and dual memory. Dual processing refers to separate representations in short-term memory, largely consistent with Baddeley's (1986) working memory slave systems, the visuo-spatial sketchpad and the articulatory loop. This aspect of the theory has been broadly accepted. Dual memory, on the other hand, refers to modality-specific representations in long-term memory. This aspect of the theory has been controversial (Marschark, Richman, Yuille, & Hunt, 1987). Nevertheless, in most of the literature of the imagery effect in learning tasks, Paivio's dual code theory has been generally accepted without consideration of the distinction between the two aspects.

A strong version of dual code theory, linking images and image-mediated verbal learning with the right hemisphere, has also been invoked to explain findings in neurological patients with unilateral lesions (Jones, 1974; Jones-Gotman & Milner, 1978; Patten, 1990). Given the large and well-documented effects of imagery on normal learning, it is natural that clinicians have looked to this technique with some hope for helping their patients with memory deficits. Patten (1972), himself a mnemonist, appears to have been the first to report on its efficacy. He taught the ancient peg-word system to seven patients, reporting good results in four patients with left hemisphere lesions. The three patients who failed to respond were severely amnesic without awareness of their memory defect, and hence uninterested in improving it. Patten's results were based on clinical observation, but replicated by Jones (1974) in a controlled PA study. Patients with removals from the left temporal lobe could benefit from imagery instructions to approximately the same extent as normal controls. Contrary to expectations, however, patients with right temporal lobectomies also improved in the imagery condition. Jones included in her study two amnesic subjects (one of whom was H.M.), who performed at zero level throughout.

The capacity of amnesic patients to improve their verbal learning with imagery in PA tasks has been evaluated in several subsequent studies, with conflicting results. Jones (1974) noted that the failure of her two amnesic patients was not due to a failure to generate images, and Kapur (1978) also demonstrated in Korsakoff patients that generation and inspection of visual images were unproblematic. Yet in two studies (Baddeley & Warrington, 1973; Cutting, 1978) imagery failed completely to improve verbal learning, and Baddeley (1982) has referred to an unpublished study, conducted in association with Brooks, in which amnesic patients sketched on paper generated images to word pairs, yet could not use this to improve retention. Cermak (1975) did find a statistically significant improvement from imagery in six Korsakoff amnesic patients, but later (1980) characterised the effect as fleeting and of doubtful therapeutic value (p.163): "The patients had to be reminded constantly of the specific mnemonic they were using or, for that matter, that a mnemonic had been used at all". Howes (1983) also obtained a significant effect in Korsakoff patients, although with self-generated imagery the effect was quite modest, and indeed smaller than with experimenter-supplied images, and for neither of the two imagery conditions were any carry-over effects to the succeeding baseline phase evident. Only Leng and Parkin (1988) have reported unambiguously positive findings, using this demonstration of imagery effect to argue against (a strong version of) the cognitive mediation hypothesis (Warrington & Weiskrantz, 1982). Leng and Parkin compared PA learning under standard (no strategy) conditions with both imagery and verbal mediation conditions. No improvement was seen with verbal mediation, whereas images, whether provided by the experimenter or self-generated, gave significantly fewer errors than either standard condition or verbal mediation. The results were similar in two subgroups, one consisting of six patients with bilateral mesial temporal lobe lesions, the other seven Korsakoff patients.

How can we account for or resolve these discrepancies in reported effects of imagery on verbal learning in amnesic patients? One possible explanation was suggested by Leng and Parkin (1988). These authors noted that Baddeley and Warrington (1973) had used an imagery procedure that possibly was too complex, and that Cutting's (1978) similarly negative results could be due to floor effects, with Korsakoff scores being virtually zero under all conditions. A recent review (Glisky & Schacter, 1989) pointed to another factor, suggesting that possibly mild-to-moderately amnesic patients can benefit from imagery techniques whereas those with more severe amnesia cannot. This idea is compatible with Wilson's (1987) observations from both group and single case studies of the effects of imagery in various memory deficient patient categories. The reported data on severity in the reviewed studies do not allow any systematic comparison, but it may be noted that the two amnesics in one negative study (Jones, 1974) had a mean IQ-MQ discrepancy of 46 points, whereas IQ-MQ discrepancies in two positive studies (Howes, 1983; Leng & Parkin, 1988) were 14 and 25, respectively. Furthermore, Weiskrantz (1985) has argued that amnesics studied in London (Baddeley & Warrington, 1973—negative results) were generally more severely amnesic than Korsakoff patients studied in Boston (Cermak, 1975—positive results). Both Baddeley and Warrington's, and Cutting's patients were described as being completely disoriented in time and place. None of the studies, however, has provided within-study comparisons of the imagery effect in moderately and severely amnesic patients, nor correlations between individual severity measures and imagery effects.

The present study was initially designed to explore the effect of visual imagery on verbal learning in patients with amnesia following surgery of aneurysms of the anterior communicating artery, compared to patients with amnesia of other etiologies. The data indicate that etiology is not a significant factor, whereas indeed severity is.

METHODS

Patients

Subjects for this study were recruited during a period of seven years (1983-1990) from nine different hospitals. Criteria for inclusion were clinically obvious amnesia and neuropsychological confirmation of memory impairment as either the only cognitive impairment or disproportionately severe relative to other impairments. Clinical data are provided in Table 25.1. The patients were divided into four groups according to etiology.

Patients with amnesic syndrome after surgery for aneurysms of the anterior communicating artery (ACoA). In this group of fifteen patients, five had been identified in a prospective study (Gade, 1982), and the present data were collected when these patients were seen for the third time about six years after amnesia onset. Some of the other test data had been collected two years postoperatively, but all five patients were unchanged in amnesia severity. The other ten patients in this group were seen after the prospective study and tested at varying times after amnesia onset, ranging from three weeks in one case to two years. The patients ranged in age from 23 to 58 years, mean 44.5 years. Like the other groups, their mean educational level was somewhat above average. Only three patients were unskilled.

TABLE 25.1
Background Variables and Background Test Scores[1]
in 4 Groups of Amnesic Patients

	ACoA	DIENCEPHAL.	BITEMP.	MIX.
N	15	7	6	7
Age	44.5 ± 12.1	45.6 ± 11.7	47.3 ± 10.1	33.7 ± 12.8
Education	12.7 ± 2.6	12.8 ± 2.3	13.6 ± 2.3	12.0 ± 1.7
Male/female ratio	9/6	4/2	5/1	4/3
DVIQ	106.1 ± 15.2	110.5 ± 8.9	112.8 ± 12.7	100.0 ± 8.8
Dart	26.6 ± 10.3	32.7 ± 3.3	31.8 ± 8.4	23.0 ± 7.5
Orientation	11.7 ± 3.0	9.9 ± 4.2	12.3 ± 2.0	11.3 ± 2.2
Amnesia rating	32.1 ± 9.2	29.2 ± 7.3	38.8 ± 12.2	30.1 ± 12.5
Independent PA task (15 word pairs: No. correct at criterion of 40 errors)	4.2 ± 3.4	3.1 ± 3.1	5.0 ± 3.0	4.9 ± 5.1
Buschke selective reminding	45.1 ± 12.6	42.0 ± 11.2	38.5 ± 11.4	38.4 ± 20.2
50 words recogn.	35.7 ± 7.8	35.3 ± 3.2	38.3 ± 7.4	35.4 ± 3.6
50 faces recogn.	39.2 ± 8.2	36.5 ± 6.0	37.0 ± 9.3	35.2 ± 5.9
Rey 3 min. recall	4.1 ± 4.6	4.5 ± 7.1	8.0 ± 5.2	6.3 ± 6.6

[1] Higher scores indicate better performance in all tasks except Buschke.

Patients with amnesia associated with diencephalic lesions (Dienceph.). Seven patients, six with Korsakoff amnesia and one patient amnesic after removal of a third ventricle tumour. The demographic characteristics of the group were virtually identical to that of the ACoA group.

Patients with amnesia associated with bilateral lesions of the mesial temporal lobes (Bitemp.). Four of these patients were amnesic secondary to an anoxic episode; two secondary to herpes simplex encephalitis. These patients tended to be slightly better educated than those in the other groups, and by various test criteria (Table 25.1) they were less severely amnesic. In this respect the group was very heterogeneous, however, as it also included the most severely amnesic patient of the study.

Patients with amnesia associated with various other etioloqies (Mix.) Seven patients, including one closed head injury case, one patient amnesic following removal of a pineal body tumour, two patients amnesic after surgery of aneurysms of an internal carotid artery, and three patients amnesic following an encephalitis of unknown type. These patients tended to be younger and slightly less educated compared with the other groups.

One indication of amnesia severity is working capacity. Of the 35 patients included in this study, two patients had been able to maintain employment in their previous jobs, and one recovered after the study to resume previous employment. Five patients had secured employment at lower job levels. Twenty seven patients were either in sheltered employment or unemployed with disablement pension. Only three were in nursing homes at the time of testing or subsequently.

PROCEDURE

Paired Associate Learning Task with Imagery

This task is in all essential details identical to that used by Jones (1974). Three lists of each 10 word pairs were prepared (listed in appendix 1). In each list, seven pairs consisted of concrete, high imagery words, and three pairs were abstract and presumably difficult to image visually. The stimuli were common nouns, and the lists were matched on number of words with a frequency of at least 16 per million (11 or 12 of the 20 words in each list were included in the Maegaard and Ruus (1981) word

frequency count). For use with the concrete pairs of the second list, a set of cards with colored, cartoon-like illustrations were prepared. The illustrations were clearly drawn, and very simple, showing the two items of each pair in interaction. The words for the three abstract pairs were printed on cards. Examples of the drawings and printed words were shown by Jones (1974, Fig. 1).

The first list provided a baseline of associate learning ability. The second list was a demonstration or teaching list, where the patient was introduced to the idea of visual images as a memory aid and, by the example, was shown how to use it. In the third list the patient was requested to use this method with self-generated images. The following conditions were common for all three lists. Each list was presented in three learning trials, each followed by a test. The first presentation of each list was at a rate of one pair every 10sec.; the second and third readings were at a rate of one pair every 5sec. Immediately following each reading, cued recall was tested by providing the first word of each pair to the patient, who was to respond with the second word. If the patient failed to respond within 15sec. or gave a wrong response, he was told the correct word. On each presentation and each recall trial a different order of presentation was used. This order was the same in each of the three lists. A minimum of four items separated presentation and recall of the same word pairs.

The first list was presented to the patients with standard PA instructions, i.e. as pairs of words to be remembered together, with an explanation of the recall procedure, but without any indication of how remembering could be achieved. List II was presented in trial 1 together with the drawn pictures, preceded by imagery instructions (see appendix 2). The abstract word-pairs were presented in a similar manner, with the explanation that these words had been too difficult to draw, and therefore had been written instead. The cards with pictures or words were shown only during the first reading, but the patients were reminded of the images before the second and third reading, and asked to recreate the images during presentation. Before each recall, the patients were again reminded to use the images for recall.

List III presentation was preceded by an instruction to the patients to generate their own images of each pair of words in interaction, stressing the importance of pictorial vividness. They were not asked to describe their images, but after presentation they were briefly asked to indicate the approximate number of images formed. Between trials they were again reminded to recreate or use the images.

A delayed recall of all three lists was obtained without warning approximately one hour after termination of the learning trials. In the delay period the patients were engaged in unrelated nonverbal tests.

Correct responses to the concrete and abstract word pairs were tallied separately, but to simplify data presentation scores have been collapsed over the three learning trials and delayed recall to yield just one score for each of the three lists for concrete (maximum 28) and abstract (maximum 12) word pairs respectively.

Other Tests

All patients were administered a range of other memory and general cognitive tests—the latter to ensure the specificity of memory deficits.

Results from a separate, independent paired associate learning test (Andersen, 1976) served as a basis for separating the patients into severity groups. The test consisted of fifteen word pairs, eight unrelated and seven with some semantic relationship between cue and response words. The word pairs were printed on cards, cue word on one side, response word on the other. Cards were presented (and turned over for a view of both sides) at a rate of 6sec. per card, followed immediately by several corrected test trials until all cue words had been responded to correctly (at which time that card was removed from the stack), or until a criterion of 40 failed responses. The measure used in this study was the number of correct responses.

Other reported test measures include a prorated verbal IQ (Gade & Mortensen, 1990), the DART reading test of vocabulary (Danish version of NART), and Warrington's (1985) Recognition Memory Test. As two further illustrations of verbal and figural memory in our patients we selected number of errors in a Buschke learning test (10-word list over 10 trials with selective reminding), and retention of the Rey figure 3min. after completion of copying the figure. An orientation score is based on 14 questions concerning knowledge of time, place and personal data, and the scores of four other mental status tests (Strub & Black, 1985) were added to that of orientation to yield an amnesia rating. These other tests were: recall at delays of 10 and 30min. of three words (6 points), and of three hidden objects and their location (12 points), immediate story recall (12 points), and category-cued recall of 30 named pictures (30 points). The maximum score was 74. In a previous study (Gade & Mortensen, 1990) the normal control group (N:28) scored a mean of 54.8 $\pm$ 5.4.

RESULTS

Etiology groups—amnesia severity. Mean performances of the four amnesia groups on measures of severity are shown in Table 25.1. Amnesic patients with bilateral mesial temporal lobe lesions tended to be less impaired than patients in the other three groups, but none of the differences between groups in measures reported in Table 25.1 reached statistical significance in analyses of variance.

Etiology groups—imagery tasks. Mean performances of the four amnesia groups on the abstract word pairs of the three lists are provided in Table 25.2. Performance was very poor in all four groups, and there is obviously no difference between conditions in any of the groups. Comparable values from the three subject groups in Jones' (1974, Fig. 3) study over the three conditions were: normal controls 4.7, 4.6, 7.0; left temporal lobe removals 2.4, 2.3, 3.9; and right temporal lobe removals 6.5, 7.0, 7.8.

The data from the concrete word pairs over the three conditions are shown in Table 25.3. Multivariate analysis of variance (MANOVA) did not indicate any significant intergroup differences ($F(9,93)=0.51$). The condition main effect was highly significant ($F(2,30)=24.0$, $P < 0.0001$),

TABLE 25.2
Mean Performance of the Four Amnesic Patient Groups on the Three Abstract Word Pairs
(Three Learning Trials + Delayed Recall; Maximum Score 12)

Group	*Condition*		
	I	*II*	*III*
ACoA	1.4 ± 2.1	1.0 ± 1.3	1.3 ± 2.5
DIENCEPH.	0.4 ± 1.2	0.4 ± 0.8	0.4 ± 1.2
BITEMP.	1.5 ± 1.8	1.8 ± 2.6	2.2 ± 3.9
MIX.	1.1 ± 1.9	1.0 ± 1.5	2.3 ± 2.9

TABLE 25.3
Mean Performance of the Four Amnesic Patient Groups on the Seven Concrete Word Pairs
(3 Learning Trials + Delayed Recall; Maximum Score 28)

Group	*Condition*		
	I	*II*	*III*
ACoA	4.9 ± 5.7	11.7 ± 8.3	10.1 ± 9.3
DIENCEPH.	1.1 ± 1.1	8.6 ± 5.7	6.1 ± 5.9
BITEMP.	5.5 ± 6.4	14.5 ± 11.3	13.8 ± 10.8
MIX.	5.0 ± 5.5	11.4 ± 8.5	10.1 ± 8.3

but there was no significant group x condition interaction (F(6,62)=0.31).

The amnesic patients here performed at much lower levels than Jones' control subjects (who obtained means of 23, 27, and 27 out of 28 possible in the three conditions) and patients with right and left temporal lobe removals (with means of 18, 27, and 26, and of 14, 24, and 21, respectively, in the three conditions). In spite of these lower levels of performance, the gain of the four amnesic groups in scores from standard to imagery conditions were roughly similar to that of Jones' subjects.

Severity groups—amnesia severity. Based on the amnesia patients' performance in the independent paired associate task, a division into three groups of approximately equal size was made. Patients with zero or one correct response were designated severely amnesic, patients with two-five correct responses moderately severely amnesic, and patients with six or more correct responses mildly amnesic. These severity designations are intended to characterise the patients' paired associate learning ability only. The mean performances of these severity groups on other memory measures are listed in Table 25.4. Severely amnesic patients are indeed severely impaired on all other memory tasks, but the division between moderate and mild amnesia is not general. Mildly amnesic patients score higher than moderately amnesic patients in the amnesia rating, but the two groups do not differ in orientation,

TABLE 25.4
Mean Performance Levels and Approximate Number of Standard Deviations Below Normal Mean on Memory Measures of the Three Severity Groups

				No. of SD's below normal mean		
	Severe	*Mod.*	*Mild*	*severe*	*mod.*	*mild*
Orientation (max. 14)	10.4 (2.5)	12.3 (1.3)	11.6 (3.8)			
Amnesia rating	24.9 (4.9)	32.0 (8.4)	38.8 (10.3)	6	5	3
Word recognition (max. 50)	32.9 (3.9)	36.9 (5.9)	38.1 (7.0)	4	2	3
Face recognition (max. 50)	35.3 (5.1)	39.8 (6.0)	38.0 (9.2)	3	1	2
Buschke errors	47.5 (5.9)	38.8 (16.2)	39.4 (16.0)	4	3	3
Rey 3 min. ret. (max. 36)	1.3 (2.8)	7.1 (6.3)	8.2 (5.1)	2	1	1

recognition memory, or the Buschke or Rey tasks. Following Weiskrantz's (1985) suggestion, Table 25.4 also lists the approximate mean number of standard deviations below normal values on these memory measures of the three groups.

Severity groups—imagery task. Mean performances of the three severity groups on the abstract word pairs on lists I, II and III were: Severe amnesia 0.1, 0.3, 0.0; Moderately severe amnesia 1.7, 0.5, 0.8; and mild amnesia 1.9, 2.1, 3.1.

Results from the concrete word pairs are provided in Table 25.5 for both individual patients and group means. All differences between group means are significant ($P < 0.05$) except between severely and moderately severely amnesic patients in condition I. In MANOVA the main effect of condition is highly significant (F(3,30)=40.10, $P < 0.0001$), and, most importantly, the group x condition interaction is also significant (F(6,62)=4.52, $P < 0.001$). Relative to baseline performance, all three groups improved under imagery instructions. In terms of absolute number of correct responses, the gain with imagery is minimal and clinically insignificant in severely amnesic patients. In moderate and mild amnesia the gain is greater, about 8 and 10 points, respectively, which is comparable to the gain reported by Jones (1974) in patients with unilateral left temporal lobe removals. With self-generated images (list III) patients with moderate amnesia tend to regress towards baseline performance, whereas mildly amnesic patients tend to maintain the imagery gain.

The division into severity groups was based on the patients' performance in a paired associates task, which was different from the dependent measures, yet closely related in its demands on memory functioning. To examine the generality of the effect of amnesia severity for the effectiveness of imagery, a series of MANOVAS were computed with severity defined by each of the six other memory tasks listed in Table 25.1. In each case, the group of amnesic patients was divided into one half with the lowest scores and one half with the highest scores. In MANOVA, the interaction between conditions and severity was not significant with severity defined by errors in the Buschke task (F(2,32)=1.23) or orientation (F=3.04, P=0.06), but did reach significance with severity defined by amnesia rating (F=7.41, $P < 0.01$), face recognition (F=4.29, $P < 0.05$), word recognition (F=3.34, $P < 0.05$) and the Rey task (F=5.43, $P < 0.01$).

TABLE 25.5
Individual Results of Patients in the Three Severity Groups on the Independent PA Task (PA) and the Three Conditions of the Imagery Task

Severe					*Moderately severe*					*Mild*				
Pt. No.	*PA*	*I*	*II*	*III*	*Pt. No.*	*PA*	*I*	*II*	*III*	*Pt. No.*	*PA*	*I*	*II*	*III*
M 28	0	0	0	2	M 23	2	9	12	9	M 20	6	0	13	12
A 22	0	2	11	3	A 27	2	1	13	5	A 17	6	9	17	22
A 24	0	0	0	1	B 30	2	2	1	1	A 25	6	0	7	5
A 33	0	0	6	0	M 9	3	1	14	4	A 16	6	11	20	22
D 22	0	0	8	6	D 41	3	2	18	13	D 43	6	0	5	1
D 36	0	1	9	2	A 23	4	5	13	16	B 42	6	2	23	21
M 27	1	2	0	2	A 30	5	10	20	16	M 40	7	10	20	21
A 15	1	1	2	1	B 39	5	3	16	15	A 19	7	3	19	19
A 31	1	1	1	0	D 47	5	0	0	0	D 29	7	2	13	6
D 32	1	3	7	15						B 44	7	9	21	21
B 33	1	0	0	0						A 34	9	12	25	18
A 35	1	0	2	1						B 37	9	17	26	25
										A 28	10	18	20	23
										M 35	15	13	21	21
$\bar{x}$		0.8	3.8	2.8			3.7	11.9	8.8			7.6	17.9	17.0
SD		1.0	4.1	4.2			3.6	7.0	6.5			6.3	6.3	7.7

Abbreviations in pt. numbers: A = ACoA; D = diencephalic; B = bilateral temporal lobe; M = mix

DISCUSSION

There were considerable individual differences among amnesia patients in their ability to utilise imagery as a mnemonic aid. Part of this variability is related to amnesia severity, and I propose that this has been the main factor underlying previous contradictory findings of imagery effects in amnesia. Wilson (1987) also used Jones' (1974) task in a study of 36 patients with memory impairment, most of them after head injury. Although these patients were not classified as amnesics, and generally performed at a higher level than the amnesic patients in this study, Wilson's results were very similar to those obtained in the present study. Her severely impaired group was as poor on list III (self-generated imagery) as they were when they had no strategy at all. Her moderately impaired group did benefit from self-generated imagery, but modestly and not to the same extent as they were able to benefit from pictures. Mildly impaired patients found pictures and self-generated images equally beneficial.

The present results, like those of Leng and Parkin (1988), indicate that the etiology, and hence lesion localisation, of the amnesic syndrome play little role for the imagery effect in verbal learning. Considering my and Wilson's (1987) results together, this conclusion seems further strengthened. The potential role of other factors, over and above severity, may be informally explored by considering characteristics of cases that are exceptions to the severity group tendencies indicated in Table 25.5. Among severely amnesic patients, the only truly exceptional case was patient D 32, who gave 15 correct responses (out of 28 possible) with self-generated imagery. D 32 was a 42 year old male Korsakoff patient, who was disoriented and severely amnesic across the board, and yet gave a good response to imagery. There is no ready explanation for this. Among moderately amnesic patients, a good response was seen in patients D 41, A 23, and B 39. Case D 41 and A 23 have in common relatively preserved pictorial memory. Their 3min. retention of the Rey figure was 20 and 10 points, respectively, and in both cases face recognition was better than word recognition (42 and 41 correct on faces; 30 and 31 on words).

To check the generality of this finding, I identified three more patients with a significant (at least 10 point) superiority of face recognition over word recognition (Cases A 15, A 28, and M 28). These patients did not benefit from imagery instructions. It may also be noted (Table 25.4) that face recognition and 3min. retention of the Rey figure do not differentiate in general between moderate and mild amnesia. Relatively preserved pictorial memory thus does not seem to predict a good imagery response. The third good responder in the moderately amnesic group was B 39, a 50 year old patient amnesic after cardiac arrest. This patient, although severely impaired in both verbal and pictorial learning and recall tasks, displayed completely intact recognition memory. Five other patients were identified with intact performance on face and word recognition tests (Patients A 16, A 17, A 19, B 37, and A 30). By a number of criteria, these patients could all be characterised as among the most mildly amnesic of those included in the study, and they all responded well to imagery (averaging 9.8, 16.4, and 20.8 correct responses in the three lists). This analysis indicates that intact recognition memory may be a factor of some importance. Non-responders in the moderately and mildly amnesic groups, such as cases D 47, A 25, D 43, and D 29, were—in spite of at least five correct responses on the independent PA task—uniformly rather severely amnesic, and also displayed very poor recognition memory.[1]

Fifteen of the present patients had amnesia following surgery of aneurysms of the anterior communicating artery (ACoA). These patients are presumed to have lesions in midline portions of the basal forebrain (Gade, 1982; Phillips, Sangalang, & Sterns, 1987). Based on single case or small group studies, several unique features of the amnesia with this lesion location have been proposed, but so far no systematic differences from amnesic patients with other etiologies have been verified in large group studies (Corkin et al., 1985; Gade & Mortensen, 1986; 1990). In the present study, the patients with basal forebrain amnesia (the ACoA group) did not differ from the other amnesia groups in their ability to utilise imagery as a mnemonic aid in the experimental situation. Among others, Weiskrantz (1985) has argued for a basic similarity in core deficits of all amnesic patients, irrespective of etiology. Others (e.g. Lhermitte & Signoret, 1972; Parkin & Leng, 1988) have demonstrated differences between amnesic patients with diencephalic lesions and bilateral lesions of the mesial temporal lobes, and taken these differences to reflect qualitatively different syndromes. Whatever differences may exist between groups of amnesic patients of different etiologies, an ability to use imagery with benefit seems not to be one of them.

More intuitively surprising, may seem the fact that the moderately amnesic patients, though functioning at a generally lower level, appeared to benefit as much from imagery as did Jones' (1974) patients with unilateral left temporal removals. Yet it should be recalled that Jones' right temporal lobectomy patients also improved with imagery. Jones (1974) had not expected this result, and in a subsequent study Jones-Gotman and Milner (1978), with a more difficult concrete paired associates task with imagery instructions, purported to show that right temporal lobectomy patients were impaired. In this latter study the

patients did perform significantly below the normal control group, but the difference was not large, and considerably smaller than between right and left temporal lobectomy groups.[2] This issue has been discussed at greater length by Richardson (1990), who draws the strong conclusion from these data (p.358) "that the neuroanatomical basis of mental imagery is not contained within the structures of the right temporal lobe". The amnesic patients may forget the images they formed, or even forget to use imagery at all, but the mechanism subserving the imagery effect in verbal memory is, it seems from the present data, intact, and hence distinct from the mechanisms of memory itself. Goldenberg, Podreka, Steiner, and Willmes, (1987) attempted to study this directly by measurements of regional cerebral blood flow in normal volunteers during learning of lists of concrete nouns, with and without imagery instructions. Additional control tasks involved the learning of meaningless words and abstract nouns. Performance in all memory tasks was associated with increased blood flow in the hippocampal and inferior temporal regions of both hemispheres, but during the learning of concrete nouns greater activation was seen in occipital regions on both sides as well. The explicit instruction to use imagery led to a leftward shift of hemispheric activity, although at the same time more right hemispheric regions were also activated than without the imagery instruction. Goldenberg et al. interpreted these results as a clear contradiction of the assumption of a right hemisphere specialisation for visual imagery. Farah (1984; 1989) has shown, based on analyses of various components of the imagery ability of patients with localised lesions, that at least the process of generating images seems to depend mainly on a region in the posterior left hemisphere.

This mounting evidence suggests a refutation of strong versions of dual code theory linking the imagery effect in verbal learning to either the right hemisphere specifically or to dual long-term memory (cf. Marschark & Hunt, 1989). Weak versions of dual code theory, linking the imagery effect with processes in working memory, do not seem to be in conflict with any of the data. Visual working memory may to a large extent be subserved by the same neural structures as visual perception (Farah, 1989), and both these processes and the occipital brain regions are generally intact in amnesic patients.

So, amnesic patients may benefit from visual imagery in a verbal learning task in the laboratory. Does the method also have clinical utility? Can the patients, or some of the patients, improve their functional memory capacity in daily life with imagery? This study did not attempt to answer these questions, and to my knowledge no relevant hard data exist. I did attempt to teach two of the good responders in this study how to apply imagery in daily memory situations. One of these patients elected not to follow my advice, having developed on his own highly efficient, elaborate external memory aids. The other patient was greatly inconvenienced by his inability to learn the names of fellow clients in his day-centre, and successfully learned and used an imagery face-name association technique (Wilson, 1987).

Like Richardson, Cermak, Blackford, and O'Connor (1987), I am sceptical of the real life efficacy of imagery mnemonics in the large majority of amnesic or other patients with brain damage. Wilson (1987) also commented on the disappointingly little spontaneous use of imagery in her memory impaired patients after otherwise successful training of the method in face-name associations. Yet, there seems to be no reason why mild-moderately amnesic patients without other cognitive deficits and with preserved drive should not potentially benefit to the same extent as other patients, and apart from external memory aids other mnemonic techniques seem unattractive. Imagery effect in a PA task, as here, may be a necessary but not sufficient condition for real life efficacy. It is suggested that future attempts to explore the clinical value of imagery techniques, whether in group or single case studies, include Jones' test before the idea of imagery mnemonics is explained and taught to the patients. Common use of this as a screening test may facilitate the research process of identifying the characteristics of those patients, if any, who may be expected to benefit from imagery mnemonics also outside the laboratory, and hence should receive instruction.

NOTES

1. Ideally factors of predictive significance should be identified using regression analysis, but this would require a considerably larger group of patients than the 35 included in this study to provide robust findings.
2. Milner, Taylor, and Jones-Gotman (1990) have reported an interesting and important study, which came to my attention after completion of the manuscript. They tested eight commissurotomy patients with presumed complete section of the interhemispheric commissures with the original Jones (1974) task. The commissurotomy group performed poorly overall on the learning task, but derived as much benefit as other patient groups from instructions to use imagery. The authors reasoned: "The findings that the disconnected left hemisphere responds normally to imagery instructions was contrary to our prediction, but, in retrospect, it seems that the prediction was based on a failure to analyse the requirements of our learning task. The use of an imagery mnemonic imposes no constraints as to the accuracy or wealth of detail in the image evoked, but only that it function as an adequate mediator between words. There is no evidence that the evocation of such images is critically dependent upon the right hemisphere..." (p.301). These authors' interpretation is thus no longer in disagreement with the interpretation offered in this chapter.

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APPENDIX 1

Word pair lists* used for the three conditions

List I		*List II*		*List III*	
pilot	– magazine	bouquet	– elephant	strawberry	– Chinese
rain	– glass	prison	– frog	fire	– soldier
rat	– bush	snake	– stone	belt	– goat
farm	– lion	mushroom	– rooster	saw	– sledge
blackbird	– bookcase	wagon	– globe	star	– man
match	– doormat	sun	– girl	anchor	– lorry
chair	– fork	mill	– axe	drinking bar	– giraffe
conversation	– happiness	truth	– amount	pain	– lecture
benefit	– song	error	– moment	shout	– work
correction	– boredom	lesson	– flight	belief	– goal

*Some of the words have slightly different connotations in Danish. Word-pair order was not fixed.

APPENDIX 2

Imagery instructions

"Now I will read another list to you, much like the first, but this time—while reading the word-pairs—I will show you a method which you are to use to remember them better. You are to imagine the two things in some kind of interaction, and you are to see this as a picture in your "mind's eye". To show you how literally I mean this, I will—while reading each word pair—at the same time show you a picture of the two things. Later, at recall, I want you to use this image to recall the second word, when I tell you the first".