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Episodic Memory in Dementia of the Alzheimer Type and in Normal Ageing: Similar Impairment in Automatic Processing

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A perceptual identification task was used to provide an implicit measure for automatic memory processes. The facilitation of word identification on repeated presentation is taken as a measure of the automatic retrieval of an episode. In addition, recognition memory was tested. The recognition task is an explicit test of memory and relies mainly on controlled processing. In the first experiment 11 patients suffering from probable Alzheimer disease and 11 normal age- and sex-matched controls were tested. Both groups exhibited a rather small facilitation effect (ca 7%) but did not differ in the size of the effect. However, when tested explicitly, a difference in recognition memory existed between the two groups. In the second experiment the performance of 11 normal young subjects was compared to that of 11 normal elderly subjects. Whereas the elderly group showed a small facilitation effect similar to that observed in the first experiment, a considerable facilitation effect was found for the young group. Also, the elderly group had poorer recognition memory than the young group.

Dementia of the Alzheimer's type (DAT) is generally defined as a clinical syndrome characterized by a global deterioration of cognitive functioning.

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Although the course of the disease is very idiosyncratic, memory deficits develop very early on. However, disturbances in memory are in no way specific to DAT. For example, depressive patients and patients suffering from Korsakoff's syndrome also exhibit deficits on traditional recall and recognition tasks (Ellis, Thomas, & Rodriguez, 1984; Martone, Butters, Payne, Becker, & Sax, 1984).

As problems with memory are among the first symptoms, developing very early in the course of the disease, it is not surprising that much of the research of recent years on DAT has been focussed on this topic. The use of research in this area may be that studying abnormal memory performance may render new insights about normal, healthy memory functioning. In order to determine the specific nature of the memory deficit in DAT or other disorders, it is necessary to investigate new techniques that may lead to enhanced perspicuity of the problems that DAT or other patients encounter in the course of their disease.

Two distinctions have emerged that seem to be important to the understanding of the amnesic syndrome. Recently, new techniques based on paradigms from experimental psychology have been used to characterize the nature of the memory deficit of diseases with different etiology. One distinction is that between episodic and semantic memory (Tulving, 1983). Semantic memory refers to general, organized knowledge, including the rules that govern the use of language and the meaning of words and concepts. It stands in contrast to episodic memory—the autobiographical memory for personal, unique events that are related to specific contexts.

Several studies have been done based on this theoretical dichotomy. Most of this research has involved patients with alcoholic Korsakoff's syndrome or other forms of amnesia. Generally, amnesic patients are believed to be unimpaired on tests that concern semantic memory but to suffer from a major deficit in episodic memory. In a case study, Tulving, Schachter, McLachlan, and Moscovitch (1988) report on a patient with dense retrograde and anterograde amnesia. This patient has gross episodic memory deficits and virtually no semantic deficits. He can remember certain *facts* (i.e. semantic information) about his past but does not remember any of the circumstances of the major events in his life (i.e. episodic information). Given that relevant semantic knowledge is available, he is quite able to make the appropriate inferences from this information, which may sometimes be quite puzzling in interpreting the nature of his disturbances. Another case report is presented by Wilson and Baddeley (1988). Their patient shows an impaired performance on a wide variety of episodic memory tasks but virtually no impairments on semantic tasks. However, in contrast to the patient of Tulving et al. (1988), this patient can recall autobiographical events; moreover, he even shows recollection of the details of the original experience. They argue that the existence of two separate memory systems is not at all clear. Theoretically, it is possible that semantic memory is an accumulation of many episodes (see also McClelland & Rumelhart, 1985). And practically, it is often difficult to distinguish between what is episodic or semantic. For example, striking events and their circumstances may have been recollected often and thus repetition of these events might have resulted in their becoming part of semantic memory.

Although the evidence for a distinction between episodic and semantic memory is still a matter of discussion, it offers a very useful theoretical framework in the research of memory. Weingartner, Grafman, Boutelle, Kaye, and Martin (1982) argue that DAT patients show a deficit in semantic memory that is not found in other forms of amnesia. They propose that semantic structure and organization are preserved but that DAT patients are unable to access and utilize this semantic information. The problem of not being able to gain access to and utilize semantic information then accounts for the memory disturbances DAT patients exhibit on various tests of episodic memory.

A second distinction that seems to be important is that between implicit and explicit forms of memory testing (Schacter & Graf, 1986). In traditional memory testing subjects are well aware of the fact that the task they have to perform concerns memory. With these kinds of tasks subjects are explicitly instructed to remember and reproduce certain information (e.g. recall and recognition). In recent years, evidence has accumulated that amnesic patients show normal retention when memory is tested using procedures that do not involve conscious recall (implicit memory testing: e.g. priming, Cohen & Squire, 1980; Jacoby & Witherspoon, 1982; Shimamura & Squire, 1984). Graf, Squire, and Mandler (1984) report that Korsakoff patients are unable to reproduce information when they are explicitly instructed to remember the presented information on an episodic memory task. However, when implicit instructions are given and attention is not directed at memory functioning, they are well able to remember that same information. Whether the same pattern holds true for DAT patients is not clear. Nebes, Martin, and Horn (1984) tested DAT patients on a semantic priming task. Both the experimental and the control group showed the priming effect, although it was rather small. They proposed that DAT patients may perform normally provided memory is tested under conditions that do not require effortful processing.

This phenomenon of preserved implicit memory and deficits in explicit memory capacity has been explained by a number of dichotomies; for example, automatic vs. controlled processing (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977), or procedural vs. declarative memory (Cohen & Squire, 1980). Which of the dichotomies describes the results best is still a matter of dispute. The purpose of the present study is to investigate whether DAT patients perform normally when episodic memory is tested under implicit task instructions. A suitable task to test memory in an implicit way is

the perceptual identification task (Jacoby, 1983a,b; Feustel, Shiffrin, & Salasoo, 1983). In this task words are presented for a very short duration. Subjects have to identify these words. The only instruction given to the subject is to read the words aloud. Although DAT patients exhibit a number of deficits in language functioning, Cummings, Houlihan, and Hill (1986) found that reading words aloud is preserved until the very last stages of the disease.

The core of the perceptual identification task is that some of the words are repeated. It has been shown that a facilitation effect results due to previous exposure. The second time a word is presented, the probability of correct identification is increased. It is still not clear what kind of activation is responsible for the facilitation effect. Jacoby and Dallas (1981) attribute the facilitation effect to the activation of the episodic memory trace resulting from the first presentation (see also Salasoo, Shiffrin, & Feustel, 1985). Support for this hypothesis comes from the work with normal subjects in which facilitation of pseudowords is studied (Cermak, Talbot, Chandler, & Wolbarst, 1985). They showed that when pseudowords are used as stimulus material (for which no semantic representation exists), normal subjects exhibit a normal facilitation effect. However, in the same experiment amnesic patients did not demonstrate a facilitation effect for pseudowords but did show facilitation for normal words. The results of the amnesic patients support an alternative hypothesis—namely, that facilitation depends upon the activation of pre-existing representations in memory (Diamond & Rozin, 1984; Graf et al., 1984).

If memory deficits of DAT patients on episodic tests are only a result of not being able to access and utilize semantic information and implicit memory is preserved, a possible hypothesis would be that DAT patients will exhibit the same amount of facilitation as normal, age-matched controls. When tested on an explicit memory task, there will be a difference between the two groups. To test episodic memory with explicit task instructions, a forced choice recognition test was given after the perceptual identification task.

EXPERIMENT 1

In the first experiment, the performance of 11 patients suffering from probable Alzheimer's disease was compared to that of 11 normal age- and sex-matched controls.

Method

Experimental Subjects

DAT Patients. From a population of patients with memory problems from the Regional Hospital of Helmond/Deurne (The Netherlands), 11 patients were selected who met the criteria for primary degenerative dementia described in DSM III (*Diagnostic and Statistical Manual of Mental Disorders*, 1980), and the NINCDS–ADRDA criteria for probable DAT (McKahn, Drachman, Folstein, Katzman, Price, & Stadlan, 1984). Patients who came to their physicians with memory complaints were first examined physically and neurologically at the hospital. This assessment consisted of examination of blood and urine, thoraxphoto, EEG, Hachinsky Scale, and Hamilton Depression Scale. If the symptoms could not be attributed to a specific cause, a neuropsychological assessment procedure followed. This consisted of an anamnestic interview with the patient and with the spouse or the child(ren), the WAIS, The Trailmaking Test (version A + B), the Rey Complex Figure Test (CFT), the Bender Gestalt Test, a test of attention (Attention Diagnostic Method), and the 15-Woorden Test (a Dutch standardized test; after learning and recalling a list of 15 unrelated words in five consecutive trials, subjects have to recall the items after a 30-min delay, followed by yes/no recognition). Only if no definite cause of the symptoms could be detected based on the results of the complete physical, neurological, and neuropsychological examination, were patients assigned to the group of probable DAT patients. This resulted in a group of nine women and two men varying in age between 54 and 86 (mean age = 74.7, $SD = 9$); their mean education was 7.2 years. All patients were moderately to severely impaired: one patient with a GDS-score (the Global Deterioration Scale; Reisberg, Ferris, de Leon, & Crook, 1982) between four and five, five patients with a GDS-score five, and five patients with a score of six. Four patients were neuropsychologically re-examined between six and twelve months later and proved to have deteriorated on all tests. One other patient had had a cerebrovascular accident and had developed an aphasia in the meantime, and thus comparable test results could not be obtained. Two patients had moved to a nursing home and were no longer testable according to their physician. The remaining four patients could not be traced.

The Control Group. The control group consisted of nine women and two men varying in age between 62 and 85 (mean age = 74.2, $SD = 7$); their mean education was 7.9 years. These subjects were paid for their participation. Screening of the control group consisted of an amnestic interview, the 15-Woorden Test, the Rey Complex Figure Test, and the Trailmaking Test (version A + B). None of these subjects had complaints concerning their memory or any history of major neurological or psychiatric disease. The two eldest subjects (82 and 85) of the control group were slightly deteriorated on all tests compared to the standards of their age group.

Material

Stimuli were presented via an Apple IIe computer. Attached to it were a second (monochrome black/white) monitor and a button, with which

subjects could start the presentation of a stimulus. Words were presented in lower-case letters. Character size was 5.7 mm × 6.6 mm. The perceptual identification task consisted of two parts: a training session and a test session.

In the training session a list consisting of 50 words of intermediate frequency (6/100,000 < freq. < 90/100,000; Uit den Boogaart, 1975) was presented. During the test session two lists of words, each containing 42 high- and 42 low-frequency words (resp. freq. > 90/100,000 and freq. < 6/100,000) were presented. From each category 14 words were presented once, 14 twice, and 14 three times, resulting in 168 presentations. Repetitions were randomly dispersed across the list. The forced-choice recognition task consisted of 24 choice items of four words each. From each category of the stimulus material of the perceptual identification task (once, twice, three times presented × high and low frequency) four words were selected for use as target items. With each target item three other words were presented to serve as distractors. This was done for both lists of the perceptual identification test.

Procedure

The training session was given to familiarize the subject with the procedure and to determine base-line performance in order to avoid floor or ceiling effects in the test session. All subjects had normal or corrected-to-normal vision. Each was asked to press the button, to look at the screen, and to read aloud the word presented on the monitor. First a frame consisting of lines was generated in the centre of the monitor. This frame stayed on the screen until the test was completed. Stimuli were flashed within this frame for a very short duration. A mask consisting of a row of asterisks immediately followed the stimulus. This mask disappeared 1 sec after the subject had read the word. If the subject could not read the word or made an error, auditory feedback was given. Starting exposure was set at 200 msec. If an individual could not read any of the stimuli at 200 msec, the program was re-initialized, and starting exposure time was increased by 140 msec. After presentation of a block of 10 words, stimulus duration was shortened by 40 msec. When the subject had read all five blocks of 10 words, the presentation duration was taken as base-line duration, which rendered a probability of correct identification that came closest to 40%. This duration remained constant during the test session of the experiment. In this way base-line performance level was more or less equalized for all subjects. (An accurate 40% level could not be reached because the reset cycle of the screen takes 20 msec. This poses a problem for exact base-line determination of stimulus duration time, because of the individual variation in visual capacity.) During the test session, instructions and word presentation were the same as in the training session. After each test session of perceptual identification the (associated) forced-choice recognition task was given. Subjects were instructed to read the words that appeared on the screen and to choose the word they had seen before in the perceptual identification task. If in doubt, they were encouraged to choose the word that seemed most probable. Four words were presented at a time (the target and three distractors). There was no restriction as to the exposure time. After a choice had been made, the answer was registered by the experimenter, and the next choice item appeared.

Results

Two subjects, one in the patient group and one in the control group, could not read the stimuli at 200 msec. Their base-line presentation durations were 320 and 300 msec, respectively. Preliminary analysis revealed no difference between the results of the two lists of perceptual identification and recognition, so data were combined in the final analysis. The third presentations of words that were three times presented added no new information and were not further analysed. Data of the first presentation and the second presentation of words that were presented twice and three times were combined. Data of the perceptual identification test and the recognition test were analysed with ANOVA in a 2 × 2 × 2, Group (DAT vs. controls), Frequency (high vs. low), Facilitation (first vs. second presentation of words) design, with repeated measures on the last two factors. In Table 1 the results of the perceptual identification are represented.

Both groups show a higher percentage of correct identification the second time a word is presented, $F(1, 20) = 24.2$, $p < 0.01$. On average, low-frequency words are less often correctly identified than high-frequency words, $F(1, 20) = 21.2$, $p < 0.01$. However, the critical term group by facilitation is not significant [$F(1, 20) = 0.4$], which means that both groups do not differ in the amount of facilitation in the perceptual identification task. As it is possible that differences in the base-line presentation duration reflect qualitative differences in processing, an analysis of covariance was performed with stimulus exposure time as covariate. The results of this analysis are essentially the same as for the analysis of variance: The two groups do not differ in

TABLE 1
Correctly Identified Words as a Function of Frequency and Repetition

	DAT				*Control*			
	High		*Low*		*High*		*Low*	
	Mean %	*SE*	*Mean %*	*SE*	*Mean %*	*SE*	*Mean %*	*SE*
First Presentation	54.7	4	44.8	4	51.6	4	41.7	4
Second Presentation	63.1	4	50.7	6	58.8	3	52.9	4
Facilitation	8.4	3	5.9	4	7.2	3	11.2	2

SE = Standard error.

the amount of facilitation [$F(1, 19) = 0.2$]. The only difference is a disappearance of the frequency effect [$F(1, 19) = 2.0$]. The results for recognition memory are represented in Table 2. There exists a clear difference in recognition performance between DAT patients and controls, $F(1, 20) = 29.4$, $p < 0.01$. Low-frequency words are more readily recognized than high-frequency words, $F(1, 20) = 5.4$, $p < 0.05$. However, no clear facilitation effect is found for recognition memory [$F(1, 20) = 3.0$]. Analysis of covariance on the data of recognition memory again reveals a disappearance of the frequency effect ($F(1, 19) = 0.8$).

The base-line presentation duration was analysed nonparametrically by a Mann–Whitney test for tied ranks. No difference was found between DAT patients and the control group (mean = 134.6 msec, SEM = 21, and mean = 117.3 msec, SEM = 24, respectively; $z = 0.888$).

The results presented above confirm our hypothesis that, when using a perceptual identification test in which attention is directed to the reading of words and no conscious effort to remember items is involved, DAT patients do perform as well as normal elderly. However, when using a memory test for which subjects are explicitly instructed to search their memory for items previously presented, a significant difference arises between DAT patients and normal elderly subjects. The results of this experiment suggest that, when a minimal contribution of semantic memory is required and when task instruction is implicit, DAT patients can perform normally. Another, more unexpected, phenomenon can be observed in this study. The amount of facilitation of the control group is less than expected (see Jacoby, 1983b). However, we used a slightly different procedure than Jacoby, who presented words in a study list that were repeated in the perceptual identification task. One explanation is that the difference in procedure is responsible for the smaller facilitation effect in this study. An alternative explanation is that the diminishing in the amount of facilitation is age-dependent. Therefore, a second experiment was done to explore the hypothesis that this automatic memory process of episodic memory diminishes as a result of ageing.

TABLE 2
Recognition of Target Items for High- and Low-Frequency Words

	DAT				*Control*			
	High		*Low*		*High*		*Low*	
	Mean %	*SE*	*Mean %*	*SE*	*Mean %*	*SE*	*Mean %*	*SE*
Once Presented	28.4	5	38.6	6	46.6	5	63.6	5
Twice Presented	39.8	5	40.9	8	58.0	4	64.8	4
Facilitation	11.4	10	2.3	8	11.4	8	1.2	6

SE = Standard error.

EXPERIMENT 2

Experimental Subjects

In the second experiment 11 normal elderly subjects and 11 young normal subjects were tested on perceptual identification and recognition. All subjects were paid for their participation. The elderly group consisted of four men and seven women, age varying between 62 and 85 (mean age = 72.8, $SD = 7$); their mean education was 11.2 years. Performance of this elderly group was compared to that of a group of students, consisting of five men and six women, varying in age between 20 and 25, with a mean of 23.3 ($SD = 2$); their mean education was 16.6 years. The base-line procedure was essentially the same as in Experiment 1, with the exception that starting exposure time for the younger group was set at 100 msec. It was reduced by 20 msec over each of the five successive blocks of 10 words. One individual in the elderly group could not read the stimuli even at 340 msec. His base-line presentation duration was finally computed to be 700 msec. It is not clear why this subject needed so much time. The testing procedure was identical to that of the first experiment.

Results

Data were analysed in the same way as in Experiment 1. Results of the perceptual identification task are shown in Table 3, those of the recognition test in Table 4. Both groups show a significant facilitation effect of perceptual identification, $F(1, 20) = 158.8$, $p < 0.01$. In this experiment the critical Group × Facilitation interaction term is significant, $F(1, 20) = 11.6$, $p < 0.01$, which means that the groups differ in the amount of facilitation. The facilitation effect for the elderly group is considerably less than that of the young group. [Percentage identification for the high-frequency words is higher than for the low-frequency words, resulting in a significant frequency effect, $F(1, 20) = 10.5$, $p < 0.01$.]

TABLE 3
Correctly Identified Words as a Function of Frequency and Repetition

	Young				*Old*			
	High		*Low*		*High*		*Low*	
	Mean %	*SE*	*Mean %*	*SE*	*Mean %*	*SE*	*Mean %*	*SE*
First Presentation	43.9	5	37.7	6	50.5	4	40.1	4
Second Presentation	57.8	6	57.0	6	57.4	4	52.3	3
Facilitation	13.9	11	19.4	2	6.9	3	12.2	2

SE = Standard error.

TABLE 4
Recognition of Target Items for High- and Low-Frequency Words

	Young				*Old*			
	High		*Low*		*High*		*Low*	
	Mean %	*SE*	*Mean %*	*SE*	*Mean %*	*SE*	*Mean %*	*SE*
Once Presented	84.1	5	83.4	4	59.1	6	53.4	6
Twice Presented	89.4	3	94.7	2	71.6	8	67.1	7
Facilitation	5.3	6	11.4	4	12.5	7	13.6	6

SE = Standard error.

As in the first experiment, an analysis of covariance was performed on the data with stimulus presentation duration as a covariate. Again we find the same results as with the analysis of variance: The young group exhibits a greater amount of facilitation, $F(1, 19) = 9.5$, $p < 0.01$. High-frequency words are better identified than low-frequency words, $F(1, 19) = 8.2$, $p < 0.01$. Words are more readily identified at second presentation than at first presentation, $F(1, 19) = 109.0$, $p < 0.01$. The stimulus presentation duration was tested non-parametrically by a Mann–Whitney test for tied ranks. Elderly subjects needed longer exposure times than young subjects (mean = 132 msec, SEM = 58, and mean = 27 msec, SEM = 3, respectively; $z = 3.79$, $p < 0.01$).

The young group recognized significantly more words than the older group, $F(1, 20) = 16.2$, $p < 0.01$. Also, a facilitation effect can be observed for recognition memory, $F(1, 20) = 12.0$, $p < 0.01$. However, the interaction between group and facilitation is not significant [$F(1, 20) = 0.7$], which means that both groups exhibited the same amount of facilitation on the recognition test. Recognition of the elderly group in this experiment is slightly higher than those in Experiment 1. This might be caused by a higher educational level. This higher educational level did not influence the perceptual identification task, as this task involves automatic processing (Hasher & Zacks, 1979). Percentage facilitation on perceptual identification is approximately the same for the normal elderly group of Experiment 1 and of Experiment 2.

Analysis of covariance of the data of the recognition test reveals a difference between groups in recognition memory, $F(1, 19) = 10.5$, $p < 0.01$. Also, a facilitation effect can be observed for recognition memory, $F(1, 19) = 12.1$, $p < 0.01$.

Discussion

The most striking result of the present study is that normal elderly and DAT patients are both impaired in their performance on the perceptual identification task. In other words, if episodic memory is tested implicitly, DAT patients were not impaired, compared to normal age-matched controls, but both the elderly groups showed impaired performance in comparison with young subjects. If memory is tested explicitly, as with the forced-choice recognition task, all elderly groups performed worse than young subjects, although DAT patients did so to a greater extent.

Our findings closely resemble those of Moscovitch (1982). He first tested implicit memory by letting young, old, and memory-disturbed subjects read sentences and timing their reading speed. After several delays old and new sentences were presented. Again the reading speed was registered, and the subjects were asked whether or not they had seen the sentence before. He found that the DAT patients read old sentences that were presented twice faster than sentences that they had seen only once. Sentences that had never been presented were read most slowly. This pattern was also found in the normal elderly. Both groups performed worse than the young group. Recognition memory was worst for the memory-disturbed subjects and best for the young adults. Interestingly, in a further experiment he tested the same subjects on repetition priming in a lexical decision task with words and non-words. In contrast to the findings of the previous experiment, he found that the normal elderly participants exhibited unimpaired priming, as did the DAT group.

Sometimes preserved implicit memory in DAT, as in amnesia, is offered as an explanation for the pattern of memory disturbances these patients exhibit (Morris & Kopelman, 1986). For example, Gabrieli (1989) reports preserved perceptual priming in a perceptual identification task of DAT patients. Implicit memory in DAT, however, is not always found to be intact. For example, the findings of Salmon, Shimamura, Butters, and Smith (1988) contradict this hypothesis. They found an impaired performance of the DAT group of lexical priming on a word-stem completion task, in contrast to a preserved performance of Korsakoff patients and patients with Huntington's disease.

Several authors stress the fact that there may be parallels between the memory disturbances that accompany DAT and normal ageing (Corkin, 1982; Moscovitch, 1982; Moscovitch, Winocour, & McLachlan, 1986). On many tests of episodic memory DAT patients as well as normal elderly do not perform as well as young subjects. A possible explanation for the poor performance on episodic tasks is sometimes sought in disturbances in semantic processing. For example, Weingartner, Kaye, Smallberg, Cohen, Ebert, Gillin, and Gold (1983) suggest that the deficit of DAT patients may lie in a lack of access to semantic structures, so that semantic information necessary for good performance on episodic tests does not become available. Rabbitt (1984) offers a similar explanation for the memory impairments of the elderly: Elderly subjects are assumed to suffer from a semantic encoding

deficit. Impairments on episodic memory tasks are attributable to the sensitivity of those tasks for the level of semantic processing (Burke, White, & Diaz, 1987). However, Jacoby and Dallas (1981) have shown that semantic encoding of stimuli or depth-of-processing manipulations do not affect facilitation, in contrast to recognition memory.

Our results suggest that ageing affects automatic processing in episodic memory, but that DAT does not further aggravate the process of decline. This is contradictory to the notion that processes that require little conscious attention are less likely to degrade with age (Hasher & Zacks, 1979). This suggestion, however, is in accordance with two studies (by Lehman and Mellinger, and by Kausler et al.) reported by Reder, Wible, and Martin (1986), and with the results of Howard, Shaw, and Heisey (1986). The latter tested young and old adults on a semantic priming task. They used three different SOAs. The old group showed considerably less priming only at the short SOA, which is presumed to mirror automatic processing. They interpreted their results in terms of a slowing in mental processing of the elderly. This explanation cannot be applied to the present findings, because presentation duration was individually assessed. The issue of preserved or impaired automatic processing in the elderly is not yet settled, as different results have been reported (Craik & Byrd, 1982; Light, Singh, & Capps, 1986). Part of the confusion seems to be due to differing uses of such concepts as automatic and controlled processing. The differential effects of ageing and DAT on perceptual identification and recognition memory might be explained by assuming that recognition memory is much more sensitive to effort and strategies (controlled processing). Older, healthy subjects presumably benefit more from controlled processing than does the DAT group. It is possible that people may actively select among strategies to mitigate specific decrements that accompany old age and as such (partly) compensate for changes that occur with advancing age (Rabbitt, 1982).

Some additional remarks concerning the perceptual identification task are in order. A first remark concerns the base-line procedure. The determination of the base-line presentation duration was rather crude, probably due to, as mentioned earlier, a large variation in visual capacity, especially in the elderly groups. Although variations in visual capacity can influence initial identification, it cannot be responsible for a diminished facilitation effect of the elderly groups, because this is a constant factor at the first and the second presentation. Analysis of covariance with stimulus exposure time as a covariate also reveals no differences in the observed effects on facilitation. However, the refresh-cycle of the monitor takes 20 msec, and this causes a problem that is especially obvious in the young group. Some subjects could read the words too well (rendering a ceiling effect) at 40 msec, but they could not read the stimuli at all at 20 msec (rendering floor effects). It would be appropriate to refine the procedure by, for example, more precise screen-control. Another point is that the range of the facilitation effects was rather small. It is imaginable that in this case the facilitation effect reaches an asymptote, which may be why additional changes as a result of DAT go unnoticed. Increasing the range of facilitation—by giving visual instead of auditory feed-back, for example—might reveal a difference between normal ageing and DAT.

The results of the present study might be summarized as follows: DAT patients and normal elderly exhibit a similar amount of facilitation on a perceptual identification task, but both are impaired compared to young subjects, indicating a loss of automaticity as a result of ageing. However, recognition memory of the elderly is not as poor as in DAT patients. A tentative explanation might be that the normally aged compensate for their loss of automaticity (for example, by relying more on controlled processing and choosing different strategies in recognition judgments), but that DAT patients show an incapacity to compensate, and this is superimposed upon a loss of automaticity.

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