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Exploring the Effect of Action Familiarity on SPTs Recall Performance in Alzheimer's Disease

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Abstract

This study examined the performance of normal controls (NC) and Alzheimer's disease (AD) patients on free recall, semantic cued recall and object cued recall of both subject-performed tasks (SPTs) and verbal descriptions of actions, by controlling familiarity of actions associated to objects. The results showed that both groups performed better after SPT encoding than after verbal encoding, in all three types of recall. In addition, this SPT advantage was greater for AD patients than for NC in the object cued recall test, emphasizing AD patients' sensibility to the congruence of cues between encoding and retrieval conditions. Following verbal encoding, NC showed a better recall for less familiar actions than for highly familiar actions, whereas AD patients exhibited the opposite pattern. These results reflect that AD patients did not benefit from a distinctiveness effect at encoding for improving subsequent retrieval of verbal information, probably due to a reduced level of elaboration during encoding. However, there was no effect of action familiarity on recall performance by both groups following SPT encoding. These results suggest that memory for verbal actions and SPTs is governed by different principles. In addition, they demonstrate the robustness of the SPT effect in AD patients, who were able to improve memory performance in the SPT condition not only with highly familiar actions but also with less familiar actions.

Introduction

The impairment of episodic memory is one of the earliest and most important symptoms of Alzheimer's disease (AD) that has been shown to be present even in the preclinical phase of the disease (Grober, Lipton, Hall, & Crystal, 2000; Hodges, 1998).
Memory impairment in AD affects free recall (e.g., Grober et al., 2000), cued recall (e.g., Buschke, Sliwinski, Kuslansky, & Lipton, 1995; Ergis, Van der Linden, & Deweer, 1994), as well as recognition (e.g., Branconnier, Cole, Spera, & De Vitt, 1982; Wilson, Fox, Kramer, & Kaszniak, 1983). These deficits have been attributed to poor encoding (Corkin, 1982; Karlsson et al., 1989; Weingartner et al., 1981), retrieval difficulties (Bird & Luszcz, 1991; Ergis et al., 1994) or storage impairments (e.g., Welsh, Butters, Hughes, Mohs, & Heyman, 1991; but see Christensen, Kopelman, Stanhope, Lorentz, & Owen, 1998 for opposed results).
Given the importance of the episodic memory deficit in AD, numerous studies have tried to identify which form of cognitive support would improve the memory performance of AD patients (see Backman, Mantyla, & Herlitz, 1990, for a review). In this prospect, some studies have examined AD patients' memory performance on the "subject-performed task" paradigm (SPT; Cohen, 1981). In this paradigm, subjects have to perform simple actions with real objects (i.e., open the book, roll the ball). These SPTs are contrasted with verbal tasks (VTs) in which the same kind of verbal commands are presented without any requirement to perform the actions. Subsequently, the memory performance of SPTs versus VTs is compared.
Research using the SPT paradigm has led to numerous consistent results demonstrating superior recall and recognition performances for SPTs than for VTs in young subjects (see Cohen, 1989, for a review). However, contradictory results have also been obtained. For example, some studies reported smaller age-related memory difficulties after SPT than after VTencoding (Nyberg, Nilsson, & Backman, 1992) while others described similar age effects after both kinds of encoding (Cohen, Sandler, & Schroeder, 1987; Knopf & Niedhardt, 1989; Nilsson et al., 1997). Similarly, some studies did not find level-of-processing effects in SPTs (Cohen, 1981, Helstrup, 1987) while other studies did (Zimmer &

Engelkamp, 1985).

In this context, different interpretations of the superiority of SPT over VT recall have been formulated. Cohen (1989) postulated that the SPT advantage would be due to its nonstrategic nature, compared to the VT, which would require more strategic processes at encoding. The author suggested that SPT encoding improves retrieval by adding a motor component to the memory trace. In the same vein, Engelkamp (1990) also suggested that the key component of SPTs is the involvement of task-specific motor encoding in addition to verbal and imagery encoding. A second interpretation came from Bäckman and Nilsson (1984, 1985), who postulated that the important aspect of SPTs is not simply motor action but, above all, multimodality and richness of its encoding, which involve automatically more systems (visual, auditory, tactual, gustatory and olfactory) than VTs. These additional items of information would be incorporated into the memory trace automatically and could later be useful cues for assessing that trace (Bäckman, Nilsson, & Chalom, 1986; Biickman, Nilsson, & Kormi-Nouri, 1993). Finally, in opposition to previous theories, Kormi-Nouri (1995) suggested that the encoding of action events is strategic. This author postulated that SPTs improve the extend of self-involvement during encoding and reinforce the experiential registration, which in turn would create a better condition for episodic remembering than VT.

Some authors argued that the observed inconsistencies in the results and the various interpretations that followed could be due to methodological differences across SPT's studies and specifically to differences in item characteristics or list characteristics, especially differences in the familiarity of items, the emotionality elicited by an item, and so forth (Norris & West, 1993; see Molander & Arar, 1998, for more details).

Studies exploring the benefit of SPT encoding in the recall by AD patients also yielded some conflictual results. Several studies did not find SPT effect in AD patients (e.g., Dick, Kean, & Sands, 1989). Moreover, other studies did not agree about the encoding and/or retrieval conditions required to improve memory performance in AD (Herlitz, Adolfsson, Bäckman, & Nilsson, 1991; Hutton, Sheppard, Rusted, & Ratner, 1996; Karlsson et al., 1989). A first experiment of Dick et al. (1989; Experiment 1) compared the advantage of SPT upon VT encoding in the free recall performance of young subjects, healthy elderly subjects and mild to moderate AD patients. Although both control groups exhibited a standard superiority effect of SPT, AD patients failed to improve recall performance from VT to SPT encoding. A second experiment by these authors (Dick et al., 1989; Experiment 2) manipulated depth of processing during encoding (by different orientating questions, i.e., how much effort is involved in doing...) in order to ensure that all groups processed the same kind of encoding. Once again, AD patients failed to demonstrate an SPT advantage in free recall and recognition. Karlsson et al. (1989) studied memory for SPTs and VTs in healthy elderly subjects and mild, moderate and severe AD patients, using sentences organizable into semantic categories (i.e., for kitchen utensils: lift the spoon, roll the rolling pin). In this experiment, subjects received free recall and categorical semantic cued recall tests (i.e., kitchen utensils). Although AD patients exhibited a globally lower level of performance than NC, they were able to demonstrate a similar memory improvement as NC in semantic cued recall (compared to free recall), in the SPT but not the VT encoding condition. Comparing the results of these two studies, it appears that AD patients needed support at retrieval in order to benefit from support at encoding. In a follow-up study, Herlitz et al. (1991) replicated and extended these results. In their study, mild, moderate and severe AD patients were compared with a group of elderly subjects in free and cued recall tasks comprising five different types of categorizable materials (words, objects, objects with a semantic orienting task, objects with a semantic/motor orienting task and SPTs). The major findings were that mild and moderate AD patients improved memory by semantic cuing (category names) in all conditions involving the presentation of objects at encoding, and that severely demented subjects were also able to use semantic cues during retrieval, but only in the SPT encoding condition. This latter observation highlighted the importance of enactment during encoding to optimize memory performance of more severely demented patients. More recently, Hutton et al. (1996) explored VT and SPT recall performance of healthy elderly subjects and mild, moderate and severe AD patients in four encoding/retrieval conditions. Contrary to previous studies, there was no free recall testing, but recall was cued either with the name of the object or with the object itself. In the " VT" condition (verbal task), subjects encoded action sentences and recall was cued with the name of the object. In the "SPT/V" condition, subjects performed each task with the object, and recall was cued with the name of the object. The encoding of the "SPT/M" condition (M = motor) was the same as in SPT/V, but recall was cued by the object itself, with the requirement to re-perform the task. Finally, in the "Mime/M condition," subjects mimed each task and recall was cued with the name of the object, with the requirement to mime the task again. The results replicated previous findings, demonstrating that cued recall performance of NC and AD patients was better after SPT than after VT encoding. In addition, NC and AD patients exhibited a better performance in the SPT/M than in the

Mime/M condition, highlighting that the benefits of enactment at both encoding and retrieval could be enhanced by the presence of objects.

Taken together, all these studies have shown that support during encoding in the form of SPTs is not sufficient to improve recall performance of AD patients. Some of these studies claimed that support is needed at retrieval to demonstrate the SPT effect in AD, while others put forward that support is required at both encoding and retrieval (ideally in the form of encoding-retrieval compatibility) to achieve the best optimization in recall performance (Bird & Luszcz, 1991, 1993; Herlitz & Viitanen, 1991).

However, from a methodological point of view, characteristics of items used in these previous AD studies were generally poorly controlled and/or seldom reported. In particular, none of these studies controlled the familiarity level of actions associated to objects in the sentences to be recalled. In studies exploring memory functioning of AD patients, the control of the "familiarity" variable appears to be particularly important. Indeed, some studies in AD showed better memory performance of daily activities when these activities are familiar, compared to nonfamiliar activities (Johnson & Smith, 1998). Similarly, Rusted, Gaskell, Watts, and Sheppard (2000) demonstrated that AD patients are able to use preexisting schematas in order to optimize their memory functioning.

Based upon these considerations, the aim of this study was to re-examine the advantage of SPT over VT encoding in recall performance of NC and AD patients, by controlling the level of familiarity of everyday possible actions associated with objects. This study will explore if this SPT advantage is present for free recall, semantic cued recall (category name) as well as object cued recall (re-enactment with the object) in both groups of subjects. In our study, familiarity did not refer to how often subjects usually performed the actions in question, but rather reflected the level of "prototypical" use of the object. In this sense, familiarity is more closely related to the concept of "semantic integration" (Kormi-Nouri, 1995), although the two concepts are not completely identical. Semantic integration is used to represent the conceptual relation between the verb and noun in each sentence. For example, "read the book" is considered to be a highly integrated item, because the action of "reading" is semantically associated to "book." In the present study, it should be noted that the highest familiarity levels of actions associated to objects (the most prototypical use of the object, i.e., "open the book") did not always reflect a direct conceptual relation between verb and noun. The control of the familiarity variable was used to test the "guessing" influence in the recall of AD patients, by investigating whether the SPT over VT advantage is present in recall performance for highly familiar actions as well as for less familiar actions, in the three types of recall of both groups.

Methods

Participants

Study participants comprised 15 patients (4 males and 11 females) who met the NINCDS-ADRDA criteria for probable Alzheimer's disease (Mc Khann et al., 1984), and 15 normal controls (NC) matched for gender, education and age. The demographic characteristics and the level of global cognitive functioning of both groups are presented in Table 1. The two groups did not differ in age, $t(28) = .024$, $p = .980$ (ranging from 58 to 85 for AD patients and from 59 to 84 for NC) nor in educational level, $t(28)=-.241$; $p=.811$ (ranging from 4 to 17 years for AD patients and from 6 to 20 years for NC). Overall functioning of AD patients was assessed by the Mini Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975; ranging from 16 to 27) and Mattis Dementia Rating Scale (MDRS: Mattis, 1973; ranging from 104 to 139).

The diagnosis was based on a general medical and neurological examination, complete neuropsychological testing and clinical follow-up. At most, CT scans showed mild atrophy. Among the 15 AD patients who participated in the study, 12 of them received some inhibitors of acetylcholinesterase. The AD patients were recruited from the Ambulatory Cognitive Rehabilitation Centre for memory impairments of Liege and the Cyclotron Research Centre, and were tested either in the Memory Rehabilitation Centre or at home.

The NC subjects were recruited by word of mouth and were all tested at home. Exclusion criteria included head injury, psychiatric illness, actual or past history of depression, neurological disorder, alcohol or drug abuse, recent hospitalization, memory complaints, or medication which could influence memory performance (e.g., anticholinergic medication or benzodiazepine). Informed consent was obtained from all participants.

All the participants were strictly right-handed according to the Oldfield Edinburgh Inventory (1971) and none of them manifested upper limb apraxia, as assessed with a shortened version of the "Batterie d'Evalua-tion des Praxies" (Peigneux & Van der Linden, 2000).

Table 1. Demographic Characteristics and Level of Global Cognitive Functioning of NC and AD Patients.

	NC	AD patients
N (male/female)	15 (4/11)	15(4/11)
Age	72.3 (7.3)	72.4 (7.7)
Education	10.9 (3.7)	10.5 (3.8)
MMSE	-	21.4 (4.1)
MDRS	-	120.5 (10.6)

Material and Procedure

Material

A first experimental condition served as a baseline for establishing highly familiar actions and less familiar actions. In this experiment, 50 subjects aged from 20 to 70 years had to produce the first action coming to mind in association with 80 different objects.

The familiarity level of actions associated with objects was calculated according to the production frequency of a same action associated with an object. For example, when the action "sweep" was associated to the object "brush" by 35 subjects, its frequency of production was 35. For the composition of lists, SPTs were selected according to four frequency levels: between 5 and 15, between 15 and 25, between 25 and 35, and between 35 and 45. The two first familiarity levels (between 5 and 25) represented less familiar (LF) actions (e.g., "fold the kleenex"), while the two others (between 25 and 45) reflected highly familiar (HF) actions (e.g., "sweep with the brush"). Because the aim of this study was to explore memory for possible everyday life actions, bizarre actions were excluded in the selection of testing sentences (i.e., "sand down a biscuit"). Finally, 32 possible action sentences of everyday life were selected for the testing. Half of them represented highly familiar actions (prototypical) and the other half represented less familiar actions (possible but not prototypical actions).

These 32 action sentences were divided into two lists (A and B) of 16 sentences (containing each an active verb in the infinitive associated to one real-life object, for example "fold the kleenex"). The 16 sentences of each list were organized on the basis of four different semantic categories: food, toys, household utensils and office utensils for the list A, and kitchen utensils, clothing, toilet utensils and tools for the list B. Each list included two LF actions (e.g., "to turn the bowl over" or "to tickle oneself with the feather duster" have a familiarity rating of 8) and two HF actions (e.g., "to eat the biscuit" or "to make the miniature car roll" have a familiarity rating of 41) for each of the four semantic categories.

Within each list, the mean familiarity level of HF actions was significantly higher than the mean familiarity level of LF actions (for list A, M_{high}=35.5 and M_{low}=15.0, $t(14) = 6.96$, $p< .001$; for list B, M_{high}= 36.3 and M_{low}= 14.2, $t(14) = 6.29$,$p< .001$). Between-list comparisons showed no statistical difference in familiarity level, either for HF actions [U(29); Z= -.316, *p*=.752] or for LF actions [U(27.5); Z=..472, *p*=.636]. Both lists were also equalised for length of sentences, U(125); Z= -.113, *p*=.906, and for word frequency of action verb and name of object to use (Baudot, 1992), U(114); Z= .527,*p*=.598.

Design

All subjects received the two lists, with a 1-week interval between each list. The two lists were then counterbalanced across encoding conditions, such that list A was used for the VT encoding condition and list B for the SPT encoding condition for one subject, and vice-versa for another subject. Encoding conditions were also counterbalanced across time of testing to control for potential order effects, so that VT encoding was administered before SPT encoding (1 week earlier) for one subject, and vice-versa for another subject.

Procedure

Instructions varied according to the type of encoding and retrieval condition. In each encoding condition (VT and SPT), retrieval was tested by free recall, semantic cued recall and object cued recall. In the VT condition, each action event was written on a separate sheet of paper. After the experimenter had read aloud the sentences, subjects were also required to read them aloud, with the aim of a subsequent recall test. In the SPT condition, the procedure was exactly the same as for the VT condition (reading of sentences by the experimenter first, followed by the subject), except that subjects were additionally required to perform the actions described in the sentences, using real objects. In each encoding condition, two examples were previously presented in order to ensure understanding of the task. All action sentences were visually presented for 12 s (which gave the subjects enough time to perform the task in the SPT encoding condition). Following each encoding condition, subjects were first presented with a distractor for 20 s (counting back). This distractor task was followed by a free recall test (max= 16); 4 min were allowed for this task. Immediately after the free recall test, subjects received the semantic cued recall test, in which they were visually presented with the name of each semantic category, one at a time and were asked to recall sentences in which obj ects belonged to the given semantic category.

For the recall of each semantic category 1 min 30 s was allowed. Sentences already given during free recall were asked to be repeated together with potential new sentences in cued recall. Finally, subjects were submitted to the object cued recall, in which they were presented with the real object and were given the possibility to re-enact the action in order to recall target sentences.

Scores corresponded to percentage of correctly recalled sentences. In scoring the recall, an action sentence was accepted as correct if the general meaning was in agreement with the original action sentence presented during study. For example, if the original sentence was "to pile up the draughts," then "to make a tower with the draughts" was also accepted as a correct response.

Results

A mixed four-way ANOVA with Group (NC vs. AD) as the between-subject factor and Encoding (VT vs. SPT), Recall (free recall, semantic cued recall and object cued recall) and Familiarity (highly familiar actions vs. less familiar actions) as the within-subject factor was carried out on the percentage of recalled sentences. A significant Group effect was seen, $F(1,28) = 89.31$, $p< .00001$, with a better performance of NC than of AD patients. There was also a significant effect of Encoding $F(1, 28)= 161.66$, $p < .00001$, showing a better performance following SPT encoding than VT encoding, as well as a significant effect of Recall, $F(2,56) = 425.88$, $p<.00001$, with a better performance in object cued recall than in free and semantic cued recall. Finally, there was a marginally significant effect of Familiarity $F (1,28)=4.06$, $p = .054$.

Effects of Encoding

The analysis revealed a significant Group x Encoding interaction, $F(1,28) = 6.46$, $p < .05$. Planned comparisons demonstrated that the SPT advantage (over the VT condition) was present in both groups of subjects, [$F(1,28) = 51.75$, $p < .00001$, for NC; $F(1,28)= 116.36$, $p<.00001$, for AD patients], although the difference in VT/SPT performance appears more important in AD patients than in NC (see Fig. 1).

Effects of Cuing

There was also a significant Encoding x Recall interaction, $F(2,56) = 57.81$, $p < .00001$. Planned comparisons showed that although the SPT advantage (over the VT condition) was present in all the three types of recall, it was greater in object cued recall than in free recall, $F(1,28)= 119.31$, $p< .00001$, and semantic cued recall, $F(1, 28) = 67.36$,
$p < .00001$, despite no difference between free and semantic cued recall ($p > .20$).

Results also highlighted a significant Group x Encoding x Recall interaction, $F(2,56) = 69.59$, $p<.00001$ (see Fig. 2). Planned comparisons revealed that it was in the object cued recall condition that AD patients exhibited a differential improvement of performance from VT to SPT, compared to NC, $F(1, 28) = 87.14$, $p< .00001$.

In free recall, however, NC tended to show a differential improvement of performance from VT to SPT, compared to AD patients, $F(1,28)= 3.47$, $p = .073$. There was no differential benefit of SPT's encoding across groups in semantic cued recall (p> .40).

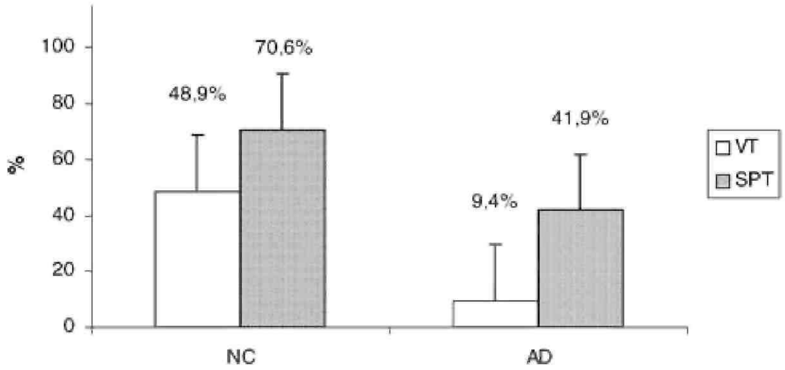

Fig. 1. Mean percentage of action sentences recalled in NC and AD patients according to encoding (VT vs. SPT).

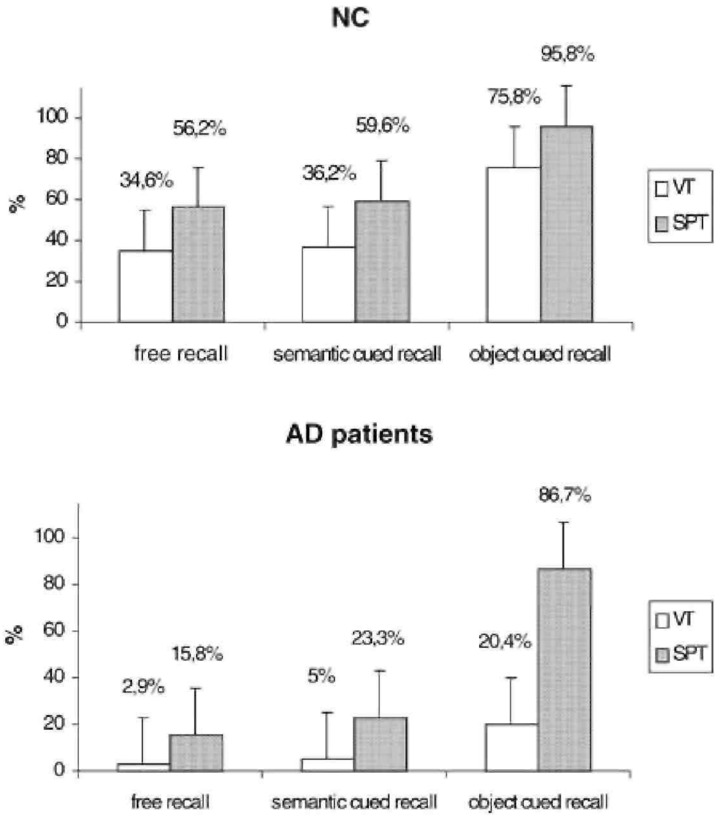

Fig. 2. Mean percentage of action sentences recalled in NC and AD patients according to encoding (VT vs. SPT) and recall (free recall, semantic cued recall and object cued recall).

Effects of Familiarity

When looking for the effect of Familiarity, we first observed a significant Group x Familiarity interaction, $F(1,28)= 17.71$, $p<.0005$. Planned comparisons indicated a better recall performance with less familiar actions (LF) than with highly familiar actions (HF) in NC, $F(1,28)= 19.36$, $p < .0005$, despite no difference in AD patients ($p >.10$). Interestingly, there was also a significant Group x Encoding x Familiarity interaction, $F(1,28) = 4.36$, $p <.05$ (see Fig. 3). Planned comparisons showed that the performance of both groups differed according to the familiarity level of

actions only in the VT condition, but not in the SPT condition *(ps* > .10). In the VT condition, NC had a better recall performance, previously described, of LF actions compared to HF actions, *F(* 1,28) = 20.62, *p* <.0001. For AD patients, despite the absence of familiarity effect in global performance, they exhibited nevertheless a better recall performance of HF actions compared to LF actions in the VT condition, F (1,28) = 5.57, p<.05.
There was also a significant Recall x Familiarity interaction, *F*(2,56)=45.25, p<.0001. Planned comparisons indicated a better performance in free recall and semantic cued recall for LF actions than for HF actions [for free recall, *F*(1,28) = 39.24, p<.00001 and for semantic cued recall, *F*(1,28) = 5.78, *p < .05]*. However, the object cued recall performance was superior for HF actions than for LF actions, *F*(1,28) = 22.92, p<.0001.

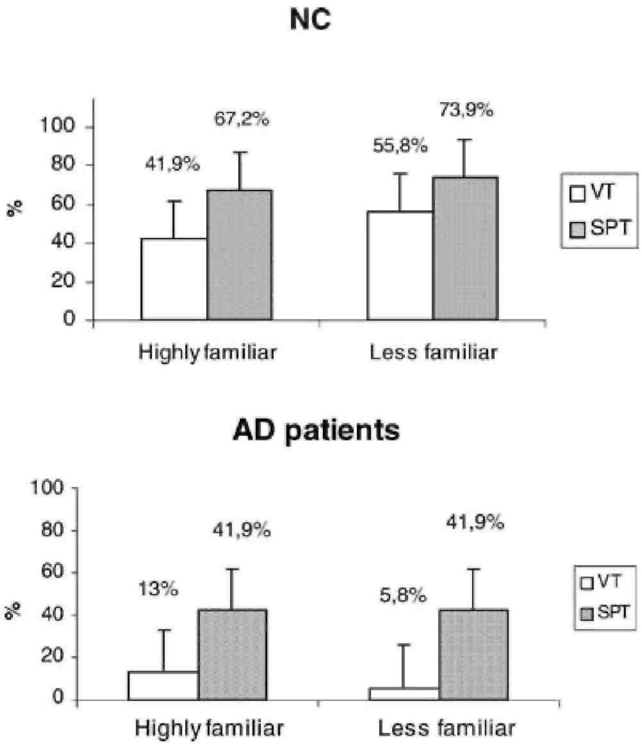

Fig. 3. Mean percentage of action sentences recalled in NC and AD patients according to encoding (VT vs. SPT) and familiarity of actions (highly familiar vs. less familiar).

Finally, there was only a marginally significant Group x Recall x Familiarity interaction, *F*(2,56)= 2.84, *p* = .067, which was due to a better object cued recall performance of AD patients with HF than with LF actions, *F*(1, 28) = 50.19, *p*<.00001, despite no difference in NC *(p* > .70).
The other interactions (between Encoding x Familiarity, Group x Recall, Encoding x Recall x Familiarity and the four-way interaction) did not reach significance (*p*s < .30). Although the Encoding x Recall x Familiarity interaction did not reach significance, *F*(2,56)=1.02,*p*= .366, one can observe a benefit with semantic cuing (compared to free recall) after SPT encoding only for highly familiar actions, *F*(1, 28) = 11.21, *p*< .005, but not with less familiar actions, *F*(1, 28) = .015, p=.902.

Discussion

This study investigated the performance of NC and AD patients on free recall, semantic cued recall and object cued recall of subject-performed tasks (SPTs) and verbal descriptions of actions (VTs), according to the familiarity level of actions associated to objects.
The results clearly demonstrated the advantage of SPT encoding over VT encoding on recall performance both in NC and AD patients. This SPT advantage was present in free recall, semantic cued recall as well as in object cued recall, although it was most important in object cued recall. In addition, this particular SPT advantage in object cued recall was more obvious in AD patients than in NC. Conversely, in free recall, the SPT advantage was more evident in NC than in AD, despite no

difference between groups in semantic cued recall. Moreover, results showed no differential improvement of performance from free recall to semantic cued recall after VT encoding. After SPT encoding, there was a benefit with semantic cuing only for highly familiar actions, but not for less familiar actions. Regarding more specifically to familiarity of actions, results showed that both groups benefited from SPT encoding for improving memory performance with both familiarity levels of actions.

Familiarity level did not differentially affect recall performance of both groups following SPT encoding. However, following VT encoding, NC showed a better recall performance for less familiar actions than for highly familiar actions, while AD patients exhibited the opposite pattern.

It should be noted that the interpretations concerning all these results will have to be taken with cautioun given the small sample of subjects tested in both groups.

Globally, the results are in agreement with some previous findings demonstrating the advantage of SPT over VT encoding in the recall of NC and AD patients (Herlitz et al., 1991; Hutton et al., 1996; Karlsson et al., 1989). In the SPT literature, various interpretations are provided concerning the nature of this advantage. According to Cohen (1989), the SPT advantage, over VT, is related to its nonstrategic component. The position of Engelkamp (1990) is that SPT involves a task-specific motor encoding in addition to verbal and imagery encoding. Bäckman and Nilsson (1984, 1985) postulated that the important aspect of SPT lies essentially in the richness and multimodality of its encoding. Finally, according to Kormi-Nouri (1995), the SPT encoding allows to optimize the episodic remembering by means of a greater awareness of both oneself and the episode, compared to VT encoding. However, our results did not allow to give more importance to one interpretation than to the other. In addition, it should be noted that in our study, like in other studies (e.g., Herlitz et al., 1991), the SPT task involved both verbal processing and object manipulation. Consequently, it is possible that this kind of encoding have favoured a multimodal trace creation. Moreover, one could ask if the advantage of SPT over VT is really specific to motor encoding or if other additional encoding manipulations associated to VT might not improve recall as much as SPT? Our results did not allow to reply this question. In order to test this hypothesis in a new study, it would be interesting to compare recall performance after VT, SPT and other additional encoding manipulation (e.g., imagery, ...).

Contrary to some other studies (Dick et al., 1989; Karlsson et al., 1989) showing no effect of SPT in free recall of AD patients, the present results demonstrated that SPT (compared to VT) improved performance of both groups not only for semantic cued recall and object cued recall, but also for free recall. One possible explanation for this discrepancy could be related to the fact that this study examined mild AD patients. It could be suggested that mild AD would need less support at retrieval in order to benefit from SPT encoding.

Nevertheless, results showing a differential improvement of free recall performance from VT to SPT in NC compared to AD patients, suggested that AD patients are less able than NC to use recollection processes that are normally required to boost free recall performance. This observation is in agreement with studies reporting impairment of recollection processes in AD (Balota et al., 1999; Budson, Daffner, Desikan, & Schacter, 2000; Dalla Barba, 1997; Knight, 1998; Koivisto, Portin, Seinelä, & Rinne, 1998; Smith & Knight, 2002).

However, unlike the study by Karlsson et al. (1989) and that by Herlitz et al. (1991) which found that semantic cuing effects were more important after SPT than after the VT condition, the present study did not find a differential improvement of semantic cued recall performance (compared to free recall) from the VT to the SPT condition, in any group. However, it is important to note that there was a benefit with semantic cuing (compared to free recall) after SPT encoding only for highly familiar actions, but not with less familiar actions. A possible interpretation concerning this finding is that the activation of the semantic category of an object is facilitated in the case of highly familiar actions associated with objects (e.g., to eat the biscuit), but not in the case of less familiar actions (e.g., to tickle oneself with the feather duster). In the case of highly familiar actions, the meaning of the action corresponds to the semantic characteristics associated to the object and to the general category to which the object belongs (e.g., high semantic relation between the action "eat," the object "biscuit" and the semantic category "food"). This is not the case with less familiar actions (e.g., few semantic relations between the action "to tickle oneself," the object "feather duster," and the category of "household utensils"). This finding underlined the importance to control familiarity of action in SPT paradigms.

Both groups exhibited better recall performance in object cued recall compared to free and semantic cued recall, in both encoding conditions. However, SPTs were shown to be more sensitive than VTs to object cued recall. Moreover, this SPT superiority in object cued recall was greater in AD patients than in NC, which enabled AD patients to reach a similar level of performance as NC. It should be noted, however, that the object cued recall performance of NC was near to a ceiling effect (95.8%). It is likely that the object cuing was more powerful than the semantic cuing, because of its more specific and precise nature. Moreover, the objects were presented during the SPT encoding condition, while semantic categories were never given during any encoding condition. Firstly, this observation underlines the superiority of object cuing compared to general semantic cuing to support retrieval in AD patients and NC. Secondly, the superiority of recall in the SPT/Object Cued Recall condition of this study was in agreement with the results of Hutton et al. (1996) that highlighted not only the importance of encoding/retrieval compatibility for improving memory performance, but also underlined the importance of the presence of objects during both encoding and retrieval. Finally, these results in AD patients are in agreement with studies demonstrating a better optimization of memory performance when retrieval cues are congruent with those used during the learning phase (Bird & Luszcz, 1993).

Concerning the effect of the familiarity level of actions associated to objects on memory performance, the results gave a new light on memory functioning of both groups, after VT and SPT encoding, respectively. After verbal encoding, NC showed a better recall performance for less familiar actions than for highly familiar actions, whereas AD patients had the inverse profile. There are two interpretations that could account for this dissociation of performance. A first interpretation focuses on encoding abilities and distinctiveness effect in AD patients. The distinctiveness effect is one of the most robust findings reported in the verbal memory literature and refers to a better recall for stimuli that are in some way unusual than for stimuli that are not (Hunt & Elliot, 1980; Waddill & McDaniel, 1998). The present results could reflect that AD patients did not benefit from a distinctiveness effect at encoding for improving subsequent retrieval of verbal information, probably due to a reduced level of elaboration during encoding. This hypothesis is in line with studies demonstrating a relative insensibility of various encoding manipulations in AD, for example, in terms of frequency of words (Wilson et al., 1983). The second interpretation considers the impaired recollection processes in AD. In NC, the memory trace of low familiar actions would be more distinctive than that of highly familiar actions, facilitating recollection processes to operate efficiently. Based upon studies reporting an impairment of recollection processes in AD (Balota et al., 1999; Budson et al., 2000; Dalla Barba, 1997; Smith & Knight, 2002), we suggested that AD patients would only be able to use automatic processes based upon familiarity, which permit principally to retrieve more familiar actions.

Unlike memory for VTs, global memory performance for SPTs was not affected by the level of familiarity of actions, whether in NC or in AD patients. These results are in agreement with previous findings in young and elderly subjects (Engelkamp, Zimmer, & Biegelmann, 1993; Knopf, 1991; Mohr, Engelkamp, & Zimmer, 1989). These authors explored recognition memory performance of SPTs and VTs following ordinary and bizarre action sentences at study. Ordinary action sentences reflected a congruous relationship between noun and verb (i.e., "open the book"). Bizarre action sentences reflected an incongruous relationship between noun and verb (i.e., "comb the toothbrush"). Results showed a better recognition performance for bizarre sentences than ordinary sentences after verbal encoding, whereas there was no such difference after SPT encoding. All together, these results extended the suggestion of Engelkamp et al. (1993), that not only bizarreness, but also familiarity level of actions, is a component of a verbal episode but not of an action episode. In summary, our findings support the view that VTs and SPTs are governed by different principles (Nilsson et al., 2000). Significantly, the fact that the familiarity level of actions did not influence recall performance of SPTs runs against the "guessing hypothesis" in AD patients. In fact, AD patients were able to benefit from SPT encoding to improve object cued recall performance not only with highly familiar actions (prototypical use of the object), but also with less familiar actions.

An interesting light about the beneficial SPT effect in AD might be provided by some recent data obtained in PET activation studies of normal subjects (Nilsson et al., 2000). These authors showed that retrieval of action sentences after SPT encoding recruited the right motor cortex. This motor cortex activity was greater in the SPT condition than in the verbal condition. In addition, some data indicated that motor and sensory areas are relatively well preserved in AD (Chase et al., 1984; Kutler et al., 1987). In this context, it could be suggested that AD patients are able to benefit from SPT encoding (compared to verbal encoding) due to their relatively intact motor system.

Finally, if confirmed, our results could have useful implications in cognitive rehabilitation of early AD patients. It will be possible to optimize memory performance of AD patients by promoting motor encoding, rather than verbal encoding, and by providing support at retrieval, in situations respecting the encoding specificity principle. Because these findings are described in various SPT studies in AD patients, they should be considered as sufficiently robust to be part of basic principles in AD cognitive rehabilitation. For example, in order to promote the use of a pillbox, motor encoding (opening the box) along with the spaced-retrieval method (Camp, Foss, O'Hanlon, & Stevens, 1996) could be combined to teach the patient to associate an auditory cue (i.e., a bell) with the expected action (to open the pillbox and to take the drug). This principle could be applied to various daily life situations in order to optimize the patients' autonomy.

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