THE EFFECT OF ENCODING AND RETRIEVAL MANIPULATIONS ON THE RETENTION OF 'SUBJECT-PERFORMED TASKS' IN NORMAL AGING AND ALZHEIMER'S DISEASE

A Thesis presented in partial fulfilment of the requirements for the degree of Master of Arts in Psychology at Massey University.

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ABSTRACT

This research examined a technique termed the 'Subject-Performed Task' (SPT) in which subjects physically enact a verbal instruction and are subsequently adminstered recall tests to determine what information is retained. SPT is consistently found to produce superior recall to verbal instruction alone in several populations which experience memory difficulties with standard memory tasks, such as older adults and those with Alzheimer's Disease (DAT). The present study examined three issues, the first of which concerned what type(s) of information encoded in SPTs might be responsible for this effect. The second concerned the manner in which SPT was thought to instigate automatic activation of semantic category information. Finally, a comparison was made between DAT and older adult subjects to examine the ability of both groups to retain SPT information in memory.

A total of 112 subjects (56 DAT subjects and 56 older adults) were presented with a series of 25 SPTs. The SPTs were presented visually and auditorally and were also demonstrated by an actor. Following presentation, subjects either performed the SPTs (motoric encoding condition) or verbally rehearsed (multisensory encoding condition) the randomly presented SPTs. Examination of automatic activation of semantic category information was assessed by comparing a relational recall condition which required categorisation of the SPTs into five semantic categories, with a free recall condition.

DAT group subjects showed very low levels of recall and no significant effects of encoding or recall manipulations were found. The older adults showed higher levels of recall and both motoric encoding and relational recall enhanced performance. Reasons for the failure of DAT subjects to benefit from SPT are discussed, and the re sults obtained by the DAT group and the older adults are evaluated in the context of three predominant theories of SPT and memory.

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INTRODUCTION

Overview

The past ten years have seen increasing interest in memory performance and the aging process. Many older adults experience a variety of memory problems, which create an unfortunate impact on their everyday lives. Other older adults experience similar problems, compounded by various disease processes which affect this age group predominantly. One serious disorder is Alzheimer's Disease or DAT (Dementia Alzheimer's Type). The introduction (section 1 and 2) presents literature detailing memory problems and their possible sources in both older adults and those with DAT.

There is some evidence that in spite of the presence of impaired memory performance, other areas of memory demonstrate preserved function. For example, while memory for verbal information may be affected adversely by the aging process, memory for sensory and motor information may be somewhat resistant. Furthermore, these preserved areas can be used to help compensate for impaired functioning. The present study examined preserved memory performance in older adults and those with DAT using a technique termed the 'Subject-Performed Task' (SPT).

In SPT, subjects are required to physically enact a verbal instruction. For example, when the verbal instruction of "fold your arms" is given, the subject is required to move their arms accordingly. The SPT can also involve the use of objects, the subject being asked in this case to "button the coat", or "lift the cup" and so on. After performing these actions, verbal recall tests are given to determine how much of the information in the SPT is remembered. Recall using SPTs is consistently found to be quantitatively superior to verbal instruction alone, in both DAT subjects and older adults. This is known as the SPT effect and section 3 presents a literature review of studies utilising SPT. These research findings are evaluated in the context of three predominant theories of SPT and memory. These are the multi-code model developed by Zimmer and Engelkamp (1989); the multi-modality model proposed by Backman, Nilsson & Chalom (1986), and the common-code model of Helstrup (1987).

The present study had three goals. The first was to determine more precisely the locus of the SPT effect. From other studies, it was not clear whether the locus of the effect was due to the total amount of information encoded in an SPT or whether a smaller set of motor features, perhaps those involved in movement, was responsible. The second goal was to determine if the retention of SPTs could be improved by the addition of advance semantic category information (relational processing). Results of other studies had found that category cues given at recall increased the level of recall. The third goal was to compare recall performance between DAT subjects and older adult subjects to examine the ability of both groups to retain SPT information in memory. Section four presents the rationale and design of the present study.

Memory Performance in Older Adults

The ability to process incoming information effectively depends on many interrelated variables. Basic to all information processing tasks are the operations of 'encoding' when information first enters memory and forms a trace, and 'retrieval' when stored information is accessed through recall procedures. Although these definitions of encoding and retrieval stress the independence of both operations, in reality they are highly interdependent. The type of information and manner in which it is encoded determine which retrieval operation will be most effective (Tulving, 1983). For example, if the information encoded about a word is a physical characteristic such as the presence of a capital letter, the best retrieval operation is one which probes memory for that physical characteristic (Tulving, 1983). It is the compatibility between the encoded information and the retrieval operation used that determines the level of recall performance.

One prominent line of reasoning suggests that older adults have most difficulties with encoding and retrieval operations requiring cognitive effort (Botwinick & Storandt, 1974; Craik, 1977; Graf, 1990). One 'effortful' encoding task occurs, for example, when new incoming items are integrated with other contextual information with which they are encountered. Another occurs when new information is related to or clarified by comparison with pre-existing knowledge structures in memory. In this case, cognitive effort is required to allow the formation of associations between different sources of information in memory, thus making the incoming information more meaningful and hence more memorable. An effortful retrieval operation occurs when a previous episode from memory is voluntarily recollected. Effortful tasks such as these are thought to involve 'working memory' which can be conceptualised as a temporary workspace where information is kept in a special active state (Baddeley, 1986). The maintenance of this state is thought to require substantial amounts of processing resources or attentional capacity (Rabinowitz, Craik & Ackerman, 1982). The aging process may reduce this capacity and thus the ability that older adults have to manage effortful tasks (Salthouse, 1985; Salthouse, Mitchell, Skovronek & Babcock, 1989).

One consequence may be the deterioration of inhibitory attentional operations controlling the processing of task-irrelevent information (Gerard, Zacks, Hasher & Radvansky, 1991; Hartman & Hasher, 1991; Shaw, 1991). As a result, older adults maintain and process too much irrelevant information in working memory. This is revealed by higher rates of irrelevant intrusions in both speech (Gold, Andres, Arbuckle & Schwartzman, 1988), and in free recall of previously remembered information (Stine & Wingfield, 1987). Failure to inhibit the encoding of irrelevant information may result in a trace which is comprised of general, superficial features lacking in detail and distinctiveness.

It is thought that successful retrieval of information in memory depends on the degree of compatibility between the encoded material and the retrieval strategy used. If compatibility is high, some of the information can be given at retrieval to assist access of the encoded information. In this case, the information given at retrieval is termed a 'cue'. When general traces are formed, retrieval cues which are general are successful. However, better recall performance is found if encodings are distinctive and retrieval cues used are based on these distinctive features. For example, Mantyla and Nilsson (1988) gave young subjects 40 nouns and manipulated the manner in which they were encoded by inducing 'distinctive encoding' or 'spontaneous encoding'. Distinctive encoding was accomplished by instructing subjects to write down the personally meaningful information that the word conveyed. In this way the encoding would contain the contextual and idiosyncratic features thought to enhance distinctiveness. In the 'spontaneous encoding condition' subjects wrote down the information which first came to mind on presentation of the noun. These written descriptions were used as retrieval cues. Distinctive encoding with distinctive retrieval cues produced superior recall both in immediate and delayed recall conditions.

It appears that older adults characteristically utilise encoding strategies most similar to the spontaneous strategy just described. For example, Mantyla and Backman (1990) (Experiment 1) found that older adults' encodings of verbal information were less idiosyncratic and contained more general information than younger subjects. In an experiment similar to Mantyla and Nilsson (1988), older adults were required to distinctively encode 40 nouns. It was found that their descriptions were more variable than younger subjects. When at a later session, the same subjects were again required to distinctively encode the same 40 nouns, these desriptions were found to deviate more from their previous descriptions than was found with younger subjects. A second experiment with a different group of both older and young subjects revealed the same pattern as in Experiment 1. In addition, when descriptions generated in the spontaneous condition were used as retrieval cues, recall performance was lower in the older adult group. Similarly, Bruce and Herman (1986) have found that non-verbal information was not encoded in a distinctive manner by older adults compared with young subjects. In this case, not as many distinctive physical features of buildings were encoded by older adults.

One line of reasoning suggests that distinctive encoding entails the integration of a newly encoded item with pre-existing knowledge structures. These structures have been termed 'schemata' and usually refer to an integrated body of general knowledge possessed about a particular domain area. It is thought that schemata when activated, structure the process of encoding so that more meaningful features are extracted from ongoing events. One study has shown that while schemata are present in memory in older adults, impairment in effortful processes impairs utilisation of this information (Arbuckle, Vanderleck, Harsany & Lapidus, 1990).

Another study has demonstrated the relationship between encoding processes and the ability to interpret ongoing events. When new information is encountered, such as when reading a book, the new information is interpreted on the basis of the information previously encoded. The previously encoded information must be transferred into working memory so that 'inferences' based on what has just happened can be generated. Because older adults encode too much irrelevent information interference is created so retrieval of relevant information into working memory is impaired. As a result, inference generation is not successful. However, one study has shown that when older adult subjects were given the relevant information they could not retrieve into working memory, appropriate inferences were generated at comparable levels to young subjects (Light, Zelinski & Moore, 1982).

The failure to encode distinctively is also revealed by studies showing that older adults do not take advantage of contextual information to the same extent as younger subjects (Rabinowitz et al., 1983). For example, Spilich and Voss (1983) compared older adults and younger subjects on a sentence comprehension task. In the strong-context condition subjects were presented with a to-be-remembered sentence in a thematically well connected three sentence phrase. In the no-context condition one isolated sentence was presented, and in the weak-context condition the thematic connection between the sentences was weak. Older adults recalled less than younger subjects in the strong-context condition.

Automatic memory processes and older adults

In spite of these difficulties there is evidence that some aspects of memory are less vulnerable to the aging process. For example, older adults perform at comparable levels to young subjects on tasks which require less cognitive effort. These are termed 'automatic' and include both encoding and retrieval operations. At present there are no definitive criteria that allow a clear distinction to be made between automatic and non-automatic processes. Several approachs to the subject converge on the notion that automatic encoding occurs relatively passively without conscious awareness or voluntary intention. As well, automatic retrieval operations do not require an active search of memory, in contrast to effortful retrieval, in which subjects must recall to mind a previous episode. Automatic retrieval can occur with 'recognition', in which subjects are presented with the episode and asked if they recognise that the episode had occured previously. Generally, older adults do not recall as much information as young subjects when effortful retrieval operations are required, but do so if recognition testing is used (Graf, 1990).

Automatic processes are considered very fast, not involving conscious awareness and difficult to modify once initiated. Examples include the processing of visual attributes such as location, size, shape and colour (Neisser, 1967). Older adults have been found to perform some types of automatic processes at comparable levels to young subjects. For example, they were able to process both the frequency of word occurence in a list (Attig &

Hasher, 1980) and temporal information (Musgrove, 1989). In one study involving temporal information, subjects were exposed to seen or heard to-be-remembered items which were embedded within a list of distractor math problems, and then required to recall the items. The temporal information was shown to be useful as a retrieval cue at recall. In other studies, it has been shown that older adults benefit to the same degree as young subjects when effortful processing loads of tasks are reduced over time They are thus able to develop automatic responses to tasks (Madden & Nebes, 1980). In addition, older adults perform the automatic task of perceptual identification at comparable levels to young subjects (Long, 1987).

Older adults consistently demonstrate another automatic task termed 'priming' with verbal information. In a typical verbal priming task, a series of words are presented during the study episode. Later, a series of three letter word stems is given such as 'cha.....' or 'fla....'. Priming is said to have occured when word stems representing words presented before are completed faster than word stems not seen before. According to one model of semantic memory termed 'network theory', priming is thought to invoke automatic activation throughout a semantic network (Chang, 1986). In this model, concepts are represented by 'nodes' each of which is integrated by a number of relationships. Some of these might be categorical relationships, which designate that an item is a member of a category by virtue of possesing a number of typical features, and functional relationships. When the item is encountered it is thought that the corresponding node in semantic memory is activated, and activation spreads automatically to other related nodes, thus making them accessible to processing. Although verbal priming occurs in older adults and at comparable levels to young subjects, it occurs at a slower rate (Howard, Shaw and Heisy, 1986; Abbenhuis, Raaijmakers, Raaijmakers & van Woerden, 1990). As well, non-verbal priming has been demonstrated with pictorial material (Rohling, Ellis & Scogin, 1991).

<u>Summary</u>

The aging process may have the most detrimental effects on working memory. As a result, older adults experience most difficulties with effortful memory tasks. These include effortful encoding operations, when for example an item is related to other items, and integrated with contextual or prior knowlege. Impairment also occurs with effortful retrieval operations which require a self-initiated search of memory for a particular episode (Macht & Buschke, 1983 cited in Kausler, 1985). One result of these deficiences is that encodings are not distinctive or easily accessible from memory (Hess & Higgins, 1983; Hunt & Elliot, 1980). In contrast, some forms of automatic processing appear to be relatively spared by the aging process. However, evaluation of this assumption is difficult at present because there are no definitive criteria that allow a clear distinction to be made between processes which are automatic or not.

Compensatory techniques to assist memory performance in older adults.

Item-specific / relational framework of memory.

One way of assisting older adults to improve their memory performance might involve inducing distinctiveness in the encoded material. This could involve either manipulating the type, or processing characteristics, of to-be-remembered information. Hunt and Einstein (1981) suggest that this can be accomplished by combining different types of information with specific processing operations. The greatest degree of distinctiveness in encoded information, and hence recall, is thought to be a function of both the distinctive attributes unique to an episode, and the shared relations among these attributes (Marschark & Hunt, 1989). Item-specific information is that which denotes a specific instance or unique episode, and remains relatively isolated from other information in memory. More than one item, for example phrases or sentences can function in an item-specific manner. Item-specific information is thought to undergo a type of processing which occurs within the item/s (Ritchey & Beal, 1980). When item-specific information is subjected to 'relational processing', a high degree of distinctiveness results. Relational processing refers to processing which occurs between items. Relational processing of item-specific information occurs for example, when a number of items are subjected to an orientating task which requires the separate items to be integrated or organised around some common theme or feature. Conversely, when relational information is to be remembered, an orientating task which induces item-specific processing can be used. In this case, subjects do not think about the common features, instead attention is drawn to some difference between them. In both cases there is a synergistic effect because recall is better when item-specific information is combined with relational processing and vice-versa (Einstein & Hunt, 1980; Hunt & Einstein, 1981; Hunt & Seta, 1984). One study has shown the striking effect that a combination of distinctive encodings and appropriate retrieval cues can have, with subjects recalling over 90 percent of a 600-word list (Mantyla, 1986).

Both item-specific information and relational processing are thought to contribute to the distinctivness function. However, each affects the retrieval process in different way. Retrieval can be seen as a two-stage process of "...increasingly fine discrimination" in which relational information first guides the reconstruction process by delineating the to-be-remembered information from other information in memory (Hunt & Seta, 1984, page 462). This serves to outline the general class of events from which the item-specific information is to be found. The second stage involves the identification of the target item from within the class. While both item-specific information and relational processing may result in distinctiveness, their combined effect is required for optimal recall performance.

Einstein and Hunt (1980) presented subjects with a list of either unrelated or related words, with or without item-specific and relational processing. The related word list was comprised of nouns belonging to a number of common categories. This list of words was subjected to individual-item (item-specific) processing. This was achieved by having the subjects rate the pleasantness of each item on a five point scale (Bird, 1980). Recall of this combination of relational information and item-specific processing was compared to a free recall condition. Recall level was lower in the free recall condition.

Another group of subjects were presented with a list of unrelated words, that is, they belonged to very general over-inclusive categories. This list of words was subjected to relational processing which involved sorting the words into categories provided by the experimenter. Recall in this condition was again compared with free recall and recall was lower in the free recall condition. Nearly identical recall levels were achieved with the item-specific information/relational processing condition and relational information/item-specific processing condition. As well, their combined effects produced additive effects in recall levels. Item-specific plus relational was better than either item-specific or relational alone.

The item-specific/relational framework can be utilised with non-verbal information as well. For example, one study has found that recall of pictures was greater with relational processing than without (Ritchey, 1980). In this case, each picture was considered a unit of item-specific information. When pictures where combined with a 'category sorting procedure' (relational processing) recall improved relative to the non-relationally processed condition. In another study, no advantage was found in recall with pictures in a categorised list (Ritchey & Beal, 1980). However, when line drawings were substituted for pictures the advantage of categorised list structure was again found (Ritchey, 1982). These results suggest that the level of item-specific processing varies with instructions to attend to particular aspects of the stimulus. When more attention was directed to the details contained in the pictures, the item-specific effect was not produced and relational processing did not affect recall (Ritchey & Beal, 1980). These findings raise the possibility that item-specific processing of non-verbal information is more variable than when verbal items are used. The item-specific affect appears to be reduced when the level of complexity of picture stimuli is increased. The discovery of such variability suggests a need for the development of independent quantitative measures of item-specific processing.

The item-specific/relational framework may prove useful in generating techniques which can assist older adults with memory difficulties. It will be recalled that older adults do not spontaneously utilise distinctive encoding strategies. However, they may be assisted to improve the degree of distinctiveness in encoded material and hence their recall level. For example, some techniques already in use appear to involve creating an item-specific effect. This effect is gained by requiring subjects to 'self-generate' a to-be-remembered word, instead of just reading it. This has been found to reduce or eliminate age differences in recall (Dick, Kean & Sands, 1989 (b); Mitchell, Hunt & Schmitt, 1986). Pleasantness ratings given to individual to-be-remembered items have also been found to improve recall (Eysenck, 1974).

Other studies have found that inducing relational processing assists recall performance. For example, one technique involves imposing an organisational scheme on to-be-remembered items (Kausler, 1982). Another approach involves generation of contextual information about particular items (Burke & Light, 1981). The item-specific/relational framework would predict that the combination of both item-specific information and relational processing (or conversely, relational information and item-specific processing) would produce better recall than either alone.

In summary, older adults may not spontaneously utilise distinctive encoding strategies, thus impairing subsequent retrieval operations. This may result from the deleterious effects of the aging process on working memory. Most difficulties occur with effortful memory tasks when, an item is related to other items, and integrated with contextual or prior knowlege. Difficulites also occur with effortful retrieval operations which require a self-initiated search of memory for a particular episode (Machte & Buschke, 1983, cited in Kausler, 1985). In contrast, some forms of automatic processing appear to be relatively spared by the aging process because they may not require the same degree of effortful encoding or retrieval operations.

Introduction to DAT

Alzheimer's Disease, (dementia Alzheimer's Type or DAT) is a serious disorder producing profound deficits in memory and cognitive skills. Women aged 65 years and older are most frequently affected, but it also has been found in both men and women as young as 35-40 years. In the USA, DAT has an estimated prevalence of 15% in the 65 years and above age group, and 36% in those aged 80 years and over (Davis, Morris & Grant, 1990). In New Zealand, estimation of the prevalence of the disorder is difficult because as yet it is not separated for statistical purposes from other forms of dementia. A rise in the level of DAT in New Zealand is expected, as the number of older people in the population will increase

(Heenan, 1979). In addition, people with DAT are living longer than previously (Blessed &Wilson, 1982).

The most obvious outward signs of the disorder are lapses in everyday memory, and characterological changes in which passive, agitated and self-centered behaviours appear and become more frequent as the disease progresses (Rubin, Morris & Berg, 1987). Variation is marked in both the severity of deficit and rate of deterioration, with survival rates of from five to fourteen years recorded (LaBarge, Rosenman, Leavitt & Cristiani, 1988). Recent studies have identified subgroups of DAT sufferers displaying specific clusters of symptoms (Chui, Teng, Henderson & Moy, 1985; Mayeux, Stern & Spanton, 1985). Although much progress has been gained in identification of the chemical and structural pathology of DAT, aetiological factors remain largely unknown.

However, while it adversely affects many functions, DAT may leave some functions relatively intact, even in the final stage. For example, the areas of the brain which process motor and sensory information appear to be relatively spared (Brun & Englund, 1981; Cutler, et al., 1985; Mayeaux, Stern, & Spanton, 1985). As well, DAT subjects appear to be physically healthier than non-DAT elderly (Wolf-Klein, et al., 1988).

Memory Performance in DAT

While older adults with DAT experience similar memory problems to those unaffected by the disorder, the magnitude of impairment is greater and increases as the disease progresses. There is much evidence to suggest that DAT subjects respond poorly to effortful tasks (Botwinick and Storandt, 1974; Craik, 1977). Impairment in attentional processes may be a primary reason and has led to the hypothesis that working memory is profoundly affected by the DAT process (Baddeley, Logie, Bressie, Dela-Sala & Spinnler, 1986; Kopelman, 1991). There is also heightened susceptibility to the effects of interference (Baddeley et al.,1986), and an inability to inhibit the processing of irrelevant information (Helkala, Laulumaa, Soininen & Riekkinen, 1989). Another consequence of impaired effortful processes is the failure to initiate a self-directed search of memory and recollect various types of information (Nebes, 1989). Due to the severity of the impairment in these areas, DAT subjects do not benefit from many types of instructions concerning the encoding of incoming information, which are found to help memory performance in unaffected older adults (Lezak, 1983; Martin & Fedio, 1983). For example, they are no better at recalling categorized than uncategorized word lists (Weingartner, Kaye, Smallberg, Ebert, Gillian, & Sitaram, 1981) or when organizational instructions are given at encoding (Diesfeldt, 1984). They also do not benefit from attempts to manipulate depth of processing in which the encoding of a stimulus is directed by specific task instructions (Corkin, 1982).

Preserved memory performance in DAT

In contrast, there is evidence that some information in semantic memory remains relatively spared by the disease. For example, concrete knowledge about common objects and the categories to which they belong persists, however much of it is not accessible due to severely impaired effortful processes (Nebes, 1989). Although DAT subjects are poor at object naming, (Appell, Kertesz & Fisman, 1982; Kirsner, Webb & Kelly, 1984) and answering direct questions about objects, (Skelton-Robinson & Jones, 1984) they are able to identify objects necessary for a household chore (Flicker, Ferris, Crook & Bartus, 1987). Similarly, most studies of verbal fluency, in which subjects are given a category and then asked for examples, show impairment in DAT (Lezak, 1983). However, when they are given examples of common objects, DAT subjects can sort them into categories and name the categories (Nebes, 1989).

The difficulties that DAT subjects have with access to information in semantic memory can be overcome to some degree by the use of specific compensatory strategies. Although DAT subjects do not benefit from advance instructions which affect encoding only, they do benefit if both encoding and retrieval processes are supported. One strategy involves giving categorical information both at the time of encoding and retrieval. For example, Buschke (1984) found that a 'search procedure', in conjunction with cued recall, improved recall of objects in ten mixed dementia subjects. The search procedure involved identification of each of the to-be-remembered items which were outline pictures of common objects.

Categories from which these items were drawn were given and subjects were required to search and point to the picture which was associated with the category.

In another study, Diesfeldt (1984) found that a similar procedure improved recall of words in DAT subjects. In this case, organizational instructions were given during the learning situation in conjunction with cues given at recall. The organisational instructions involved presentation of two cards, each of which showed the name of a different category. Next, the to-be-remembered words were presented one by one, and subjects were required to indicate the category to which each successive item belonged by naming the category and pointing to the category name on one of the cards. After this procedure was completed, the subject was then presented again with the to-be-remembered words and they were reminded that these were the items they were required to remember.

DAT subjects also demonstrate the ability to perform automatic tasks, however findings in this area are not consistant. Stem-completion priming is found (Grosse, Wilson, & Fox, 1990; Perfect, Downes, DeMornay, Davies & Wilson, 1991; Randolph, 1991). As well, two other types of verbal priming; repetition and semantic priming are found (Gabrieli, 1989; cited in Nebes, 1989; Nebes, Huff & Brady, 1989; Ober & Shenaut, 1988). In 'repetition priming' subjects are exposed to a series of letter strings and are required to decide if the string constitutes a legal word. After a delay, the strings are presented again, and priming occurs when the time elapsed between exposure and decision is less for strings that have been presented before, than for those not previously presented. In 'semantic priming' the time taken for a subject to process a stimulus is measured in two conditions. In the first, the item being processed is related in some way to the prime; for example, the relationship may involve both item and prime being members of the same category. In the other condition, the prime is not related to the target item. The time needed for processing is compared between the two conditions. Ifa decrease in time occurs when a stimulus is preceded by a related prime when compared to an unrelated prime then semantic priming is said to have ocurred. It has been suggested that the lack of consistancy DAT subjects demonstrate in performance across priming tasks, reflects impairment in two broad areas.

First, there is evidence of selective erosion of some forms of information in semantic memory, and second, activation processes while present do not last as long for DAT subjects as for unaffected subjects (Nebes, 1989).

In summary, DAT subjects like unaffected older adults experience most difficulties with effortful tasks. They are unable to voluntarily organise incoming information to relate it to other information in memory which would make it meaningful, and have difficulty searching for and retrieving information already estabished in memory. In addition, there is erosion of information in semantic memory, resulting in difficulties with the meaning of some verbal concepts. Categorical information may be preserved in semantic memory to some degree in DAT and this can be used to improve recall. However, the relationship between the category and the to-be-remembered information must be made explicit at the time of encoding.

An Introduction to the Subject-Performed-Task or SPT.

SPT refers to a procedure involving motoric enactment of a verbal instruction (Cohen, 1983). For example, when the verbal instruction of "fold your arms" is given, the subject is required to move their arms accordingly. The SPT can also involve the use of objects, the participant being asked in this case to "button the coat", or "lift the cup", and so on. After performing these actions, verbal recall tests are given to determine how much of the information in the SPT is remembered.

Research has highlighted a number of findings. Recall using SPTs is consistently found to be superior to verbal instruction alone in older adults and younger subjects. This facilitation of recall performance is known as the SPT effect. In a typical experiment, subjects are presented with the verbal commands contained in the SPTs (verbal encoding condition), without the requirement of physical enactment. In the other condition subjects are required to physically enact the verbal commands (motoric encoding condition). Comparison is then made of recall between the conditions. It has been found that while verbal encoding in older adults is associated with low recall in comparison to younger subjects, similar recall levels are achieved between the groups with motoric encoding. For example, Dick, Kean & Sands (1989a) found that 24 older adult subjects (mean age 71 years) achieved a free recall level of approximately 60% with motoric encoding. This was not statistically different from a group of 24 college students (mean age 22 years). In another experiment by the same authors, recognition testing was performed with a different group of subjects. In this study there were 24 older adult subjects (mean age 73 years) and young subjects (mean age 21 years). Again motoric encoding produced superior recall to verbal encoding in both groups and no differences in recall between groups.

Karlsson et al., (1989) tested 38 older adults (aged between 73 and 82 years). This study deviated from the others because the SPTs belonged to five semantic categories. While a free recall performance of 62% was found, when the categories from which the SPTs were drawn were given as retrieval cues, recall improved to 70%. Similar results were found with 10 older adults (mean age 63 years) with cued recall level in this case, 85% (Herlitz et al., 1991).

Those with DAT also show this pattern but their recall performance is much lower than older adults and category cues are necessary at recall. One study with DAT subjects did not demonstrate the SPT effect. Dick, Kean and Sands, (1989a) gave 18 DAT subjects 12 SPTs and used both free and recognition recall procedures but found no difference between the verbal condition or SPT condition. In contrast, Herlitz, Adolfsson, Backman & Nilsson, (1991) tested a group of 30 DAT subjects comprised 10 mild, moderate, and severely impaired groups. The highest recall level was found with motoric enactment and semantic category cues at recall. Karlsson et al., (1989) utilised a group of 43 DAT subjects comprised of mild, moderate and severely impaired groups. In all groups motoric enactment in conjunction with semantic category cues at recall produced superior recall to verbal encoding with category cues.

SPT may be performed well by older adults and those with DAT because it is predominantly a motor task and the ability to process and retain motor information appears to be relatively spared by both the aging (Hashtroudi, Chrosniak & Schwartz, 1991) and DAT process (Dick, Kean & Sands, 1988). For example, older adults have been found to demonstrate memory for motor movements at a comparable level to young subjects (Toole, Pyne & McTarsney, 1984). As well, memory for everyday type activities appears to be relatively spared (Kausler, 1985).

DAT subjects may have a propensity for processing information in motoric form because the primary motor and sensory areas of the brain are relatively spared the disease (Brun & Englund,1985). They are often able to physically demonstrate or 'mime' the use of many objects they cannot name (Harrold, 1988, cited in Nebes, 1989). DAT subjects also demonstrate the ability to learn a number of motor skills (Eslinger & Domasio, 1986). For example, in 'rotor-pursuit' subjects are required to keep a stylus in contact with a small disk on a rotating turntable (Butters, Heindel & Salmon, 1990). Evidence of learning the task is revealed by longer periods of time in which the stylus is kept in contact with disc. In another study, improved performance in a finger maze was found over a number of trials (Grosse-Fleishman, 1988). DAT subjects learned an embedded repeated sequence in a serial visual reaction time task and retained a practise effect for one week (Knopman & Nissen, 1987). In addition, they are able to retain memory for a number of independent movements (Dick, Kean & Sands, 1988).

Furthermore, motor information, when associated with to-be-remembered items has been found to improve recall of those items. In older adults, it has been suggested that the kinesthetic information encoded when motor actions are performed, and objects are handled, activates additional sources of information about the episode which augments recall. In DAT subjects, Barker and Lawson (1968) have observed that the ability to name objects improves if they are handled, or their use demonstrated. In another study, a program of 'planned walking' improved the verbal content of conversation in a group of DAT subjects. It was suggested that motor activity improved the content of communication primarily because of the activation it produced in the motor cortex. The neurons that mediate the physical acts of communication are located in the motor cortex as are those that control walking. The authors suggest that the neuronal activity generated by the motor cortex during walking activated the motor systems involved in communication (Friedman & Tappen, 1991).

Summary

Older adults and those with DAT demonstrate the SPT effect. This may be because SPTs are motor tasks predominantly, and the ability to process motor information may be relatively spared by the ageing and DAT process. The SPT effect may be attributable to the combination of motoric encoding which is thought to produce an item-specific effect (Zimmer & Engelkamp, 1989) and relational processing. Relational processing was induced by the provision of semantic category cues at recall. These two components, item-specific information and relational processing, are each hypothesised to have differential effects in three of the major perspectives in SPT research. These will now be presented.

Multi-code model

Zimmer and Engelkamp (1989) suggest that SPT is recalled better by older adults and DAT subjects because motoric enactment automatically activates 'motor programs', in contrast to verbal information. Handling an object, for example, provides the subject with direct access to motor action programs associated with the objects. As well, the information contained in the motor program is item-specific in character which means that the motor information undergoes item-specific processing. The information contained in the motor program is thought to remain isolated from verbal and other types of information involved in the SPT. This quality is revealed in one study examining memory and typing. Skilled typists were given a diagram of an empty keyboard and asked to fill in the correct letters. It was found that the typists could do this correctly only if they tried to actually type the to-be-recalled letter. Looking at the empty keyboard did not facilitate recall. Instead, the motor action of typing was necessary to recall the correct location of the letters, suggesting that location information was only activated by the motor action of typing. For this reason, it was concluded that location information was stored in the motor program along with instructions to enable the correct movements for typing, and this was different than the location of verbal information (Posner, 1973).

Motor programs are thought to provide a general plan for movement, and once activated are run off or triggered without alteration by peripheral feedback or conscious awareness. For example, many studies have shown that certain motor acts can be carried out correctly in the absence of feedback from outside the central nervous system (Bizzi, 1980). In cases of 'deafferentation' subjects are able to perform movements correctly in spite of not being able to feel any any peripheral feedback during performance. Learning motor skills has been termed a form of 'passive abstraction' in which complex patterns between environmental stimuli are learned without any conscious awareness of the processes involved in learning (Lewicki, 1986; Lewicki, Hill & Bizot, 1988). Knowledge of the skill is expressed in behaviour in the form of improved performance. (Lewicki, 1986) or as habit (Mishkin, Malamut & Bechevalier, 1984, cited in Saint-Cyr, Taylor & Lang, 1988).

Zimmer and Engelkamp (1989) propose that motor and verbal information are contained in separate stores or 'codes' and are processed differently. Motor information is automatically encoded and retrieved in SPT. In support of this notion, Engelkamp and Zimmer (1984) found differences in processing characteristics between the verbal and motor components of SPTs. In one study, similarity judgements between two movements were made more quickly after motoric encoding than after verbal encoding or imagining the performance of the action. As well, in a two-trial learning task, verbal phrases were learned better if subtle differences were introduced in the second trial. In contrast, if verbal phrases were learned by motoric encoding, subtle differences in the movements performed in the second trial reduced subsequent recall performance.

The multi-code perspective is supported by findings from several other sets of studies. First, primacy and recency effects are found in the recall of verbal information, whereas only recency is found with SPT (Cohen, 1983). It has been suggested that recency is associated with an item-specific effect (Zimmer & Engelkamp, 1989). Recency occurs when items encountered last are remembered more often than any others. It is thought that these items are in a short-term store such as working memory and have not yet been subjected to relational processing (Marshall & Werder, 1972; Paul & Whissell, 1992). However, there is disagreement regarding the precise qualities of such a store (Klapp & Netick, 1988). Primacy occurs when the items encoded first are recalled better than any others. Explanations for this effect vary, but it is commonly held that greater relational processing occurs to items encountered first, which is thought to place them into long-term memory.

Second, levels of processing effects are found with verbal tasks but not SPT (Dick, Kean & Sands, 1989a). In one study (Cohen, 1983), orientating tasks were used to affect the level at which SPTs were processed. This involved either inducing shallow or deep (relational) processing of SPTs and verbal items. Deep processing involved asking subjects such questions as, "How often is this task performed in everyday life ?"; "How occupation specific is this task ?" Shallow processing involved questions such as "How much noise is involved in doing this task ?", and "How much body movement is involved in doing this task ?" In another study, Cohen (1983) asked subjects to deem some SPTs and verbal items more important to remember than others. It was found that verbal items deemed more important were recalled better than those deemed unimportant, in contrast to SPT recall which was not affected by the type of instructions.

Third, the developmental differences which affect recall of verbal information do not affect recall of SPTs. For example, comparison of 9, 11 and 13 year olds revealed no differences in recall levels of SPTs, in contrast to recall of verbal information (Cohen and Stewart, 1982). Other studies have shown that older adults and the young demonstrate comparable recall levels of SPTs in contrast to verbal tasks (Backman, 1985; Backman & Nilsson, 1984; Backman & Nilsson, 1985).

Fourth, intention to learn does not appear to affect recall of SPTs (Kausler & Hakami, 1983; Kausler, Lichty, & Freund, 1985). In these studies, one group of subjects were given 'intentional instructions' in which they were told that after performance of a number of SPTs they would be required to recall them. Recall achieved in this condition was compared with another involving 'incidental instruction', in which subjects were not told in advance of presentation of SPTs that a subsequent recall test would be given. Instead, a surprise recall test was given. No differences were found in recall level of SPTs as a result of these manipulations.

Fifth, Cohen (1985, cited in Zimmer & Engelkamp, 1989) attempted to remove the potential for relational processing of SPTs by increasing the presentation rate of SPTs thereby reducing the amount of encoding time. This manipulation affected recall of verbal information but not recall of SPTs. In this case, recall of verbal information was reduced in contrast to the number of SPTs recalled.

Finally, Cohen and Bean (1983) found that educable mentally retarded adults performed at comparable levels to unaffected adults in immediate free recall of SPTs, in contrast to verbal tasks. A similar finding was reported with severely head-injured subjects (Wilson & Moffat, 1984). These groups are presumed to be impaired predominantly in cognitive tasks requiring effortful processes.

Common code model

Another approach to SPT is taken by Helstrup (1987) who suggests that motoric information is neither represented nor processed any differently from the verbal information contained in the SPT. In this 'common code' approach, only one abstract code is responsible for the representation of verbal and motor information, hence there is 'cross-talk' between the different sources of information. At encoding, incoming information undergoes first a primitive type of processing termed 'differentiation'. Then it is subjected to relational processing to enable the new information to be integrated with exising information, thus making it more meaningful. Relational processing ultimately results in the extraction of common features. The unitary encoding which results contains the combination of all information processed and it is highly organised around these common features. The level of relational processing determines the organisation between the different sources of information, and is responsible for the SPT effect, not the unique or distinctive encoding which results from item-specific motor information. The higher the degree of organisation in the encoding, the more meaningful and hence memorable the encoding will be. The locus of the SPT effect in this case is due to the presence of relational processing, rather than to any particular type of encoded information.

Support for this view rests on findings that demonstrate similarities in processing operations between verbal and motor information. Helstrup (1987) has found that SPTs can be subjected to relational processing. In this case, subjects were required to memorise the location of individual SPTs in the list. With lists of up to 8 items, primacy effects were found indicating that location information had been encoded. In two other studies conducted by Helstrup (1987), the addition of motoric information did not improve recall. In this case, subjects were given instructions to imagine an organised sequence or scripted action event such as "Imagine that you are buying foodstuffs in a supermarket and then go home for a meal". Another group of subjects were given identical instructions but in addition, were required to symbolically perform the actions involved. No differences in recall level were detected between these two conditions.

Multimodality model

The third and final approach to be discussed is termed 'multimodality' and shares elements with both previous conceptualisations (Karlsson, Backman, Herlitz, Nilsson, Winblad, & Osterlinds, 1989). Like the multi-code model, the multimodal view stresses that different types of information are encoded in SPT. However, in addition to the motor element, other multisensory information is involved. This may be kinesthetic information for example, which is encoded as a result of watching a seen movement performed. As well, sensory information is encoded which refers to the texture, weight, colour and sound of objects used in performance of SPTs.

Motor and multisensory information are each represented and processed in a similar manner, but differently to verbal information. Motor actions form part of the internal representation of many verbal concepts in memory. For example, as one can kick or throw a ball, the concept ball may be associated with specific arm or leg movements. One study has shown that specific hand movements can be reliably primed from verbal descriptions of different types of objects (Klatzky, Pellegrino, McGloskey & Doherty, 1989). Thus when SPTs are performed, the actions involved may activate other information associated with the object. The SPT effect, in this perspective, arises from the combination of the different types of information activated. This combination creates a high degree of distinctiveness or specificity in the encoded material. Each SPT is therefore a unit of highly integrated item-specific information. There is no assumption in this approach that item-specific information is confined to the motor program exclusively, as is the case in the multi-code model.

Support for the notion of an item-specific effect of each SPT is derived from the finding of superior cued recall performance with motoric encoding of SPTs, in both DAT and older adults (Backman et al., 1986; Herlitz et al., 1991; Karlsson et al., 1989). Cued recall is found to benefit the recall of item-specific information, more than the recall of relational information (Hunt & Seta, 1984). In addition, motoric encoding appears to be more item-specific in character than the verbal encoding because cued recall in the former case (with SPT), is superior to the level of cued recall achieved with verbal encoding. The item-specific nature is further revealed by the finding that improved cued recall performance is found only in DAT subjects with motoric enactment (Herlitz et al., 1991; Karlsson et al., 1989). In contrast, DAT subjects can only utilise cued recall with verbal encoding with the addition of a search procedure at the time of encoding (Buschke, 1984: Diesfeldt, 1984). This suggests that SPT might produce some benefit which is not achieved with verbal encoding, except when verbal information is combined with a search procedure. It is likely that motoric encoding overcomes the need for a search procedure because it results in the same high degree of distinctiveness that the search procedure achieves.

It was suggested that SPT activated semantic category information in memory, which was revealed by the superior level of cued recall performance (Backman, Nilsson & Chalom, 1986). The cues utilised represented the semantic categories from which the objects used in the SPTs were drawn. This represents one form of relational processing which can be used successfully with SPT. However, because objects represent a rich source of information, they may offer many other, non-semantic features upon which categorisation may also be based (Backman et al., 1986; Karlsson et al., 1989). These sources include kinesthetic information, sensory information such as the colour, shape, texture, and size of objects, and information concerning functional attributes. Any or all of these sources of may be activated by SPT. Activation of this type of categorical information may be relatively automatic. For example, non-semantic categorisation processes can be performed on objects by very young, pre-verbal children in whom effortful processes are not well developed (Roskinski, Pellagrino and Siegal, 1977).

Another type of relational processing which is more effortful in character has also been shown to improve recall of SPTs. Herlitz et al. (1991) utilised an SPT task which required DAT and older adult subjects to determine what actions would be appropriate with an object. One condition (semantic encoding) required generation of verbal descriptions of actions, with the other condition (semantic/motoric encoding) requring generation and performance of motor actions that would be appropriate. In this case, the experimenter asked such questions as," What does one do with a pistol ?". Subjects were required to generate and perform the appropriate action. This was very similar to the manipulation shown to improve the recall of independent movements (Dick et al. 1988). Subjects were required to 'self-select' independent movements prior to execution and an improvement was found in recall. Self-selected movements have been found to produce greater reproduction accuracy and retention of movement information than constrained movements (Smyth & Wing, 1984). This may be so because constrained movements are thought to rely more on 'efference'. Efference is produced when a motor program is activated, and refers to the trace formed from outgoing motor commands. It is stored and when a movement is made, the actual motor commands produced as outflow are checked against the motor commands stored as efference. The essential difference in self-selected and constrained movements is that the information encoded is considered to be more abstract and conceptual in nature than efference. In the Herlitz et al. (1991) study, recall level achieved in moderate and severely impaired DAT groups did not benefit from the self-selection effect, relative to the standard motoric encoding condition, in which the experimenter first performed the SPT then required the subject to do the same. In contrast, mildly impaired DAT subjects and older adult control subjects achieved the most advantage in recall from the semantic/motoric condition. This would indicate that the DAT process differentially affects the ability to utilise self-selection with SPT. Mild subjects appear to benefit most.

Summary and conclusions

In each of the three major perspectives presented, the SPT effect is accounted for in a different manner. In the multicode model it is suggested that motoric encoding activates motor programs and this accounts for the SPT effect (Zimmer & Engelkamp, 1989). The information contained in motor programs is item-specific in character, and is represented and processed separately from verbal information. As a result, it cannot be subjected to relational processing in the same way as can verbal information. As motoric enactment will always result in the activation of motor programs, it will always produce superior recall to tasks not requiring enactment.

In contrast, in the common-code approach, the amount of relational processing and subsequent organisation in the encoding is the crucial factor, not any particular source of information (Helstrup, 1987). The amount of organisation in an encoding is thought to be determined by the degree of relational processing to which it is subjected. Therefore, a highly organised encoding and hence superior recall may not necessarily involve motoric enactment. In fact, motoric enactment may impair recall, particularly if it disrupts the organisational cohesiveness in the encoding.

While the multi-code model stresses the importance of item-specific information and the common-code model emphasizes relational processing, the muli-mode model offers a synthesis view which stresses the combined effects of both. This is compatible with the framework developed by Hunt and Einstein (1981). It will be recalled that older adults and those with DAT have difficulties with effortful memory processes resulting in failures to utilise distinctive encoding strategies. SPT may be performed well by these groups because it contains item-specific information which can be subjected to relational processing in a number of ways. For example, the provision of semantic category cues at recall (Karlsson et al., 1989) and self-relevent information have been shown to improve recall of SPTs (Herlitz et al., 1991). In addition, self-relevent information improved recall relative to cued recall. This was seen in the Herlitz et al. (1991) study in which self-relevent information plus semantic cues at recall (semantic/motoric encoding condition) improved recall relative to the motoric encoding condition which included semantic category cues at recall. This improvement was localised to older adults and mildly impaired DAT subjects.

Although many questions emerge from consideration of these perspectives, two are central. First, it appears that motoric encoding plays an important role in the SPT effect as was suggested by Zimmer and Engelkamp (1989). However, other types of sensory information may also play a role. These include both kinesthetic information and sensory information such as the colour, shape, texture, weight and size of objects (Backman, et al., 1986; Karlsson et al., 1989). Thus, it is not clear whether the SPT effect is due to activation of motor program information, or the combination of motor program and other types of sensory information.

Second, the manner in which relational processing may be involved in the SPT effect is not clear. Zimmer and Engelkamp (1989) suggest that motor information cannot be subjected to relational processing. In this case, the SPT effect is achieved because activation of motor programs provides excellent distinctiveness. The addition of relational processing would not be expected to further improve the distinctiveness of motor information, however the extra processing may improve the retention of the verbal commands, and thus improve recall. Thus the locus of relational processing is not clear.

As well, more than one type of relational processing has been shown to improve the recall level of SPTs. One type involves the addition of semantic category cues at recall (Karlsson et al., 1989). Another type of relational processing which required subjects to self-select SPTs prior to execution also was found to contribute to the SPT effect (Herlitz et al., 1991). This required subjects to generate and then perform actions when presented with a number of objects. In this case only older adults and mildly impaired DAT subjects appeared to benefit. Both older adults and mildly impaired DAT subjects achieved a higher level of recall with this provision than was found with the provision of cues at recall in the Karlsson et al.(1989) study. These findings suggest that several types of relational processing may contribute and it is not clear which type contributes most to the SPT effect.

Clarification of these questions is difficult for four major reasons. First, the magnitude of the cued recall advantage is not clear. There are only two studies which have investigated the use of semantic cues at recall and SPT. In both the Herlitz et al. (1991) and the Karlsson et al. (1989) studies cued recall was not measured independently of free recall. In these studies the same group of subjects were exposed to both free and cued recall conditions. Thus estimation of the advantage gained from cued recall was difficult, as was determination of the degree to which advance semantic processing conferred an advantage over cued recall.

The second difficulty concerns the method used to classify DAT subjects into mild, moderate and severely impaired groups. In both the Herlitz et al. (1991) and Karlsson et al. (1989) studies, the 'Mini-Mental State Examination' (MMSE; Folstein, Folstein & McHugh, 1975) was the only criterion utilised. Because of the marked variability in memory performance and behaviour that DAT subjects display (LaBarge et al., 1988; Chui et al., 1985), when estimation is made of the level of severity of impairment of DAT subjects, the MMSE is usually accompanied by other neuropsychological testing procedures. For example, in the Dick et al. (1988) study, DAT subjects were classified according to much more rigourous criteria. In addition to the MMSE, the Brief Cognitive Rating Scale (Reisberg, 1983); the Verbal Scale of the Weschler Adult Intelligence Scale-Revised; and two tests of functional competence, the Activities of Daily Life (Katz, Ford, Moskowitz, Jackson & Jaffe, 1963); and Instrumental Activities of Daily Life (Lawton & Brody, 1969) were used. As a result, it is not certain which level of severity of DAT is associated with benefits from relational processing.

Third, estimation of the SPT effect is difficult because of the small sample of DAT subjects included in both studies. The Herlitz et al. (1991) study included 30 DAT subjects and 10 older adults; the Karlsson et al. (1989) study included 43 DAT subjects and 32 older adults. The Dick et al. (1989a) study used 18 DAT subjects and 24 older adults.

Finally, a lack of consistancy was found between studies concerning the number of SPTs used in DAT and older adult groups. The Herlitz et al.(1991) study included 15 SPTs for the older adults and 9 SPTs for the DAT subjects. The Karlsson et al. (1989) study included 25 SPTs for both DAT and older adult groups. The Dick et al. (1989a) study used 18 SPTs for both older adults and DAT groups. The manner of presentation in theDick et al. (1989) study varied between both groups of subjects. In the case of DAT subjects, the presentation of SPTs was spread over several sessions, and more practise was given with each SPT. This was used in conjunction with an extremely lenient scoring procedure. For example, if the original SPT imperative had been roll the ball, either "bounce the ball" or "a ball is something round" were accepted as correct (Dick, Kean and Sands, 1989a).

Study rationale

The present study was designed to investigate two questions. The first question involved examination of the locus of the SPT effect. From other studies it was not clear whether the SPT effect was due to the total amount of encoded information or whether a smaller set of features, perhaps those involved in motor movement was responsible. A method was devised in which motoric information was differentiated from other multi-sensory information contained in SPTs. Motoric encoding was achieved by requiring motoric enactment. The encoding of multi-sensory information was achieved by exposure to the same motoric information, but without the requirement of enactment. It was hypothesised that the locus of the SPT effect would be associated with the condition which produced the highest recall level. If motoric encoding was the locus of the effect, the highest level of recall was expected where this was required. Conversely, if a wider locus was implicated, no differences in recall would occur between conditions. Evidence of item-specific processing would be revealed by this finding as well as a pattern of recency in free recall of SPTs.

The second question concerned the degree to which semantic relational processing contributed to the SPT effect. As cued recall confered an advantage relative to free recall, it was assumed that semantic relational processing contributes to the SPT effect. Uncertainty arose from the Herltiz et al. (1991) study, concerning the extent to which advance semantic processing contributed to the SPT. In the present study, this question was addressed by the development of an advance relational processing condition. This was achieved by providing subjects with advance semantic information, in the form of the semantic categories from which the SPTs were drawn. This was referred to as the relational cued recall condition. This procedure was very similar to the technique used by Einstein & Hunt. (1980) and Hunt & Einstein (1981) to achieve relational processing of item-specific information. It was hypothesised that the relational cued recall condition would be associated with the highest recall level. Conversely, if semantic relational processing was not involved in the SPT effect, the additional source of semantic relational information provided would not produce any benefits in recall. Thus there would be no difference between the recall level achieved in the relational cued recall condition and the free recall condition. Evidence of relational processing would be revealed by this pattern and by the presence of primacy in recall.

Method

Subjects

There were a total of 112 volunteer subjects in this study forming two groups with 56 subjects in each. One group was comprised of DAT subjects (DAT group), the other was comprised of unaffected older adults (control group). A total of 12 subjects dropped out prior to completion of the second session, of which 6 withdrew, 5 died, and one could not be traced. All were subsequently replaced. The DAT group was comprised of 38 females and 18 males, with a mean age of 72 years, a range of 65 to 83 years and a standard deviation of 7 years. The older adult group was comprised of 31 females and 25 males, with a mean age of 75 years, a range of 65 to 99 years, and a standard deviation of 9 years.

All subjects resided within the Manawatu-Wanganui Area Health Board area. DAT participants were recruited from two gerontologists and one geriatric psychiatrist, all of whom were employed at Palmerston North Public Hospital. In addition, information about the study was published in the local Adards newsletter in the hope of attracting participants from the community. Potential control subjects were approached through local voluntary organisations such as Senior Citizens Centers and also through Rest Homes.

All subjects were treated in accordance with the ethical standards of the NZPsS. The study received approval from the Massey University Ethics Committee and the Manawatu-Wanganui Area Health Board Ethics Committee (Ethics register 46/91).

Apparatus and Materials

The Rivermead Behavioural Memory Test (RBMT) was used to pretest all subjects to enable classification as unimpaired in the case of the older adult group, or moderately or severely impaired in the DAT group (Appendix 1). This was to ensure that variance in subject characteristics between conditions was controlled for. The RBMT is a neuropsychological test containing questions that provide data on the same aspects of memory and orientation as the

MMSE. In addition, the RBMT allows evaluation of aspects of memory which are required for competence in everyday tasks. The RBMT also incorporates a selective reminding procedure, in which subjects are cued if they fail to recall information. Responsiveness to this form of support can thus be assessed. All subjects were tested individually.

A colour videotape which contained twenty SPTs drawn from five categories and presented in random order was viewed by all subjects. In it, subjects saw a 65 year old man perform all the SPTs. Each SPT was comprised of an action, in some cases involving an object (lifting a cup), or in other cases a body movement (clapping). As they viewed the performance of each SPT, subjects heard the verbal instruction describing the task. This was a three word phrase such as "lift the cup" or "clap your hands". Subtitles of each instruction also accompanied each SPT so subjects could read the verbal instruction while they viewed each performance. The exposure time of each SPT was 10 seconds. At the completion of each exposure, the screen was blank for 20 seconds, in which subjects either verbally rehearsed or performed the SPT. All SPT information is presented in Appendix 2.

A 12 inch colour Technica television monitor was used with a Mitsubishi M24 videoplayer/recorder (VCR). A movable trolley was used to allow adjustments in viewing distance to the monitor. All objects required for performance of the SPTs were screened from view prior to exposure to each SPT, and removed from view afterwards.

Sample information sheets and consent forms are included in Appendix 5 and 6. Both information sheets and consent forms were printed in large type to help compensate for visual difficulties which are common in older adults.

Procedure

Recruitment

Potential DAT participants were contacted by the doctors involved, who gave them the researcher's name and contact number. When the researcher was contacted by those interested, she visited them at a place of their choosing. At the first meeting, enquiries about the study were answered and potential problems concerning suitability for participation were assessed. At the completion of this meeting, an appointment time for the pretesting session was arranged.

Potential older adult participants were approached directly by the researcher in one of two ways. The researcher was invited to speak about the study to older adults who visited a local senior citizens center, and those interested then contacted the researcher. Others, who lived in rest homes, were first approached by the nursing supervisor of the home about participation. The nursing supervisors were contacted by the researcher. If interested, these persons either contacted the researcher or gave their permission for the nursing supervisor to notify the researcher.

Pretesting Session

At this time, the researcher met with potential DAT and older adult subjects and answered questions not addressed by the information sheets. If participation was desired, consent was arranged. The majority of DAT subjects were not of testimonary capacity, therefore consent from a relative was obtained.

It was determined at this time that subjects were 65 years of age and over, had sufficient corrected or uncorrected vision and hearing to enable reasonable viewing of television, and that they had sufficient use of hands and all limbs to ensure adequate performance of the SPTs.

The researcher then administered the RBMT to the subject in a place which maximised the subjects' concentration. For rest home residents this involved either the residents' own room or a special area set aside for the purpose of the study. With community dwelling subjects, testing was carried out in their own homes or at a place which they designated.

As DAT subjects sometimes become quite anxious and can develop 'catastrophic reactions', a protocol was devised for this situation. Under no circumstances would the experimental procedure continue if distress was apparent. The researcher was trained to detect this occurence and testing was abandoned on two occasions for this reason.

In the case of older adult subjects, the same procedure was followed, however there were two differences. First, all of these subjects were able to give consent. Second, subjects were to indicate in the consent form whether or not they wished the results of the RBMT to be forwarded to their GP. This proviso was included because of the possibility that some community dwellers with memory problems would be detected. It was felt that this could be a way of protecting them from any future risk to their safety due to undetected memory problems. In the consent form, participants also had the option of indicating whether they wished to receive a written summary of relevant findings. It was hoped that this attempt to share the findings of the study, would highlight the importance of their participation and help put the experience into a more meaningful context.

As knowledge of scores obtained in the RBMT could not be denied to subjects, and there was a potential for distress caused by this knowledge in both groups of subjects, a protocol was devised to deal with any enquires about scores and their significance. Such situations did not eventuate, and the protocol was not used.

At the completion of the pretesting session, subjects were grouped depending on scores obtained. In DAT subjects this involved assignment to either moderate or severe categories. Older adult subjects were categorised and placed into two different groups, high and average. Those who did not score in the normal range were not excluded but their data was discarded. Equal numbers of moderate and severe subjects (DAT) and high and average (control) subjects were assigned to four experimental conditions.

<u>SPT Presentation and Recall Session</u>

Subjects were randomly assigned to one of four groups obtained by crossing the mode of encoding and the mode of recall. Thus four conditions were created: motoric encoding with free recall, motoric encoding with relational cued recall, multisensory encoding with free recall, and multisensory encoding with relational cued recall. In all four conditions, subjects were shown the videotape and then recalled the SPTs. However, there were differences between conditions, as described next.

In the motoric encoding mode, subjects were required to perform a motoric enactment of a verbal instruction. The subject and experimenter were seated across the table from one another. The subject was not able to see a second table which held the twenty objects for use in the SPTs. Subjects watched a practice SPT at which time the researcher was able to adjust the monitor distance and volume to ensure that the SPT actions, spoken instructions and subtitles could be seen and heard. Four practice SPTs were given first, to ensure that subjects understood when to perform the action, for how long, and what to remember. Subjects were told they would see four SPTs and that they should try to remember the actions that the man performed, along with any objects that were involved. To help them remember, they would have a chance to practice the actions themselves. After exposure to the practice SPTs, subjects were required to recall the items to ensure that they had understood the procedure. They were then told that they would see 20 different SPTs and that they should try to remember these. There was an interstimulus interval of 20 seconds to allow the researcher to clear the object from view of the subject and prepare the next item.

In the multisensory encoding condition, subjects were exposed to the videotape but there was no requirement of motoric enactment. Subjects were asked to verbally rehearse the verbal instructions out loud for a longer period of time (15 seconds) in an attempt to equalise the level of processing used in this mode relative to the motoric encoding condition. At the end of this time period subjects were told to stop by the experimenter.

The relational recall condition involved, at the time of exposure to SPTs, the presentation of the categories from which the SPTs were drawn. All five categories were typed in large font and bold print on an A4 size sheet of white paper. This remained in view while subjects were exposed to the videotape. In the practice exercises, instructions were given to subjects to think about which of the five categories each SPT belonged to. At recall they were reminded to utilise the categories to help them remember.

The free recall condition involved no instructions being given to older adults. DAT subjects sometimes display 'perseverative' behaviour and repeat the answers they have already given. To reduce this possibility, the process of recall was structured, with the researcher prompting subjects with "next answer" after each completed attempt.

At the end of the second session, subjects were thanked for their participation. In the consent form, participants had the option of indicating whether they wished to receive a written summary of relevant findings.

Results

The dependent variable in this study was the number of SPTs correctly recalled, with a maximum possible score of twenty. A lenient procedure was used in which answers were considered correct if the true meaning of the SPT was conveyed. For example, with a SPT of "pull on gloves", an alternative such as "put on your gloves" was accepted as correct.

The overall mean score obtained by the DAT subjects was .50. The overall mean score obtained by the older adult group was 10.68. Scores as a function of subject group, type of encoding, and type of recall test are shown in Table 1.

Due to the very low level of variability in the recall scores obtained by the DAT group, the plan to conduct a three way analysis of variance was abandoned, and two separate analyses were performed. Data for the DAT group were analyzed using the chi-square statistic, whereas data for the control group were entered into a two way analysis of variance.

In order to conduct the chi-square analysis on the DAT data, subjects were classified into two groups: those who had moderate recall (scores of 2 or more) and those who had low recall (scores of 0 or 1). Data for subjects in the multisensory relational recall group were discarded because all scores were 0. The distribution of subjects according to this classification is shown in Table 2. Manipulation of encoding and retrieval conditions did not affect SPT recall, 2 (2,n = 42) = 4.68 ns.

Data for the control subjects were entered into a two way analysis of variance, with both type of encoding (multisensory, motoric) and type of recall (relational, free) as between subject factors. Performance was better following motoric encoding than following multisensory encoding, F (1,52) = 45.159, $p < 0.0001$ *, and better with relational cued recall than free recall, F (1,52) = 34.230, $p < 0.0001$ *. The interaction between encoding and recall was not significant, F (1,52) = 1.362, $p > 0.05$. Data for control subjects also revealed a recency pattern in all four conditions (Table 3). In addition primacy was found in both motoric and multisensory cued relational recall conditions.

Table 1. Mean number of SPTs recalled as a function of subject type, encoding condition, and recall condition.				
	DAT Subjects		Older Adult Subjects	
	Encoding Condition		Encoding Condition	
Recall Condition	Motoric	Multisensory	Motoric	Multisensory
Free Recall	1.00	0.42	10.60	7.30
Relational Cued Recall	0.57	0.00	14.70	10.10

Table 2. Distribution of recalled SPTs in DAT subjects using the Chi Square Statisitic			
Response Category	Motoric Relational	Motoric Free	Multisensory Free
Moderate recall (score 2+)	4	6	1
Low recal (score 1-)	10	8	13

Table 3. Mean number of SPTS recalled as a function of serial position				
	Position of items			
	Block 1 (1-5)	Block 2 (6-10)	Block 3 (11-15)	Block 4 (16- 20)
Motioric relational	5.0	2.3	3.0	4.4
Multisensory relational	4.2	1.4	1.6	2.9
Motoric free	1.35	2.21	2.64	4.35
Multisensory free	1.14	1.5	1.42	3.28

Discussion

The present study was designed to investigate two questions. The first was to examine the SPT effect, to determine if a wider number of multisensory features, or those only contained in motor movement were involved. Motoric encoding was achieved by requiring motoric enactment. Multisensory encoding was achieved by exposure to the same motoric information, but without the requirement of enactment. It was hypothesised that the locus of the SPT effect would be associated with the condition which produced the highest recall level. If motoric encoding was the locus of the effect, the highest level of recall was expected where this was required. Conversely, if a wider locus was implicated, no differences in recall would occur between the motoric and multisensory conditions.

The second question involved the degree to which semantic relational processing contributed to the SPT effect. In the present study, additional relational processing was achieved by having subjects classify SPTs according to the semantic categories from which they were drawn, at the time of encoding. This procedure was very similar to the technique used by Einstein & Hunt, (1980) and Hunt & Einstein (1981) to induce relational processing of item-specific information. It was hypothesised that the presence of semantic relational processing would be associated with the highest recall level. Conversely, if relational processing was not involved in the SPT effect, there would be no difference between the free recall condition and the semantic relational recall condition. Relational semantic processing was termed relational cued recall.

Summary of findings in DAT subjects

In DAT subjects the performance level was low, ranging from a mean of 0 with multisensory encoding and relational recall, to 1.0 with motoric encoding and free recall, out of a possible total correct score of 20. Neither encoding condition nor recall condition reliably influenced performance on the SPT task. The results of the DAT group were treated and analysed separately from those obtained by the older adults.

The results of the present study have similarites and differences to others reported. One methodological difference involves the task used as a comparison to motoric encoding. In other studies, the verbal component of the SPT (verbal command) is encoded and recalled, and in this way functions as a comparison task. The present study used multisensory encoding instead of verbal encoding as a comparison to motoric encoding. Other studies have found that motoric encoding produced better recall than verbal encoding in free recall conditions (Herlitz et al., 1991; Karlsson et al.,1989). In the present study, there were no differences in recall level between the multisensory and motoric conditions. Another methodological difference was the provision of the semantic relational processing condition (relational cued recall). This was included with both motoric and multisensory encoding conditions. Other studies had demonstrated an advantage in recall with provision of semantic recall cues (Herlitz et al., 1991; Karlsson et al., 1989) and advance semantic processing (Herlitz et al., 1991). In the present study, there were no differences between free recall and relational cued recall.

Although the recall level achieved in the present study was low, in some respects it is similar to that achieved in other studies. As all DAT subjects scored in the severe range of the RBMT, comparisons will be made with severe group scores obtained in other studies. For example, SPT free recall scores in the Karlsson et al. (1989) and Herlitz et al. (1991) studies averaged less than 2% for the severe group. The motoric free recall level found in the present study was 2.5%. The relational cued recall level obtained in the present study was less than 1%. This differs markedly from the Karlsson et al. (1989) study, in which cued recall severe group scores were 16% (Karlsson et al., 1989). In the Herlitz et al (1991) study, cued recall severe group scores were 20%.

Two factors which may account for the low recall performance found with the DAT group in this study, in comparison to the recall performance found in other studies involving DAT and SPT, concern differences in procedures used and the sample of DAT subjects obtained. The present study involved two important procedural differences which may have disadvantaged the DAT subjects. The first was the method of semantic relational processing (relational cued recall), in which subjects viewed the categories from which the

SPTs were drawn, at the time of encoding and throughout presentation and recall of the SPTs.

One goal of the present study was to determine the manner in which semantic relational processing assists motoric encoding. It was not clear from other studies whether DAT process differentially affected the ability to utilise advanced forms of semantic processing with motoric encoding. Towards this end, advance semantic information was given. However, the DAT subjects in the present study derived no benefit from this procedure. As the majority of subjects were classified as severely impaired it would appear that in the severe stages of the disorder, motoric encoding does not benefit from the provision of advance semantic processing. The potential benefits of semantic cues at recall may have been masked by this requirement. For example, another study has shown subsequent impairment in a visuo-spatial memory task when advance semantic processing was required (Stuart-Hamiliton, Rabbit & Uddy, 1988). The difficulty with advance processing was anticipated and in the present study another condition involving only semantic cues at recall was desired. However problems with subject recruitment precluded this.

The second procedure adopted was the standardisation of presentation of SPTs. In previous studies, the experimenter demonstrated the to-be-remembered SPTs. In the present study, a videotaped presentation displayed on a television monitor was used to demonstrate the to-be-remembered SPTs. The television medium was chosen to allow more standardisation of the presentation of SPTs, as well as reduce the posibility of inadvertent cuing at recall. The use of the videotape medium may have had the effect of reducing the level of personal involvement with the presented material. A series of studies have shown that one's level of personal involvement with the material at the time of encoding influences both its encoding and retrieval (Rogers, 1983). Additionally, the size of this effect is greater with increasing age (Rogers & Rogers, 1981, cited in Rogers, 1983).

The lack of personal involvement for many subjects in this study may be due to the fact that television was not a medium commonly used, either in the past or present. For example, some remarked that they did not like television and instead preferred to listen to the radio. Hence, subjects may not have been motivated to attend to the stimulus material so that attentional processes were not directed sufficiently to produce optimal encoding. Although there is little information on this subject, one study has shown that both automatic and controlled processes may be involved in memory for televised programs, although these elements have not been differentiated with any rigour (Kausler, 1985). What is known suggests that unaffected elderly must be interested in the content of a television program to direct their attention sufficiently to produce memory performance equal to the young (Levin, Petros & Filippi, 1980).

Other studies have shown an advantage in recall of motoric encoding over verbal encoding. However, the present findings did not demonstrate a difference between motoric and multisensory presentation. The very low level of recall may be due to standardisation of presentation. As such, the presence of an intervening variable may be indicated. It is possible that the interaction with the presenter of the SPTs may have provided a degree of learning support which was not obtained in this study and DAT subjects may need a high level of such support if memory tasks are to be performed optimally. For example, it has been found that a 'behaviourist' approach, involving very high levels of prompting and reinforcement, is necessary in learning interventions with demented older adults (Burton, 1980; Jenkins, Felce, Lunt, & Powell, 1977). Additionally, interacting with a real person during a learning episode may reduce anxiety, thus reducing the potential for 'catastrophic reactions', known to be a common feature of DAT and to affect memory performance in deleterious ways (Davis, 1986, cited in Taira, 1986). One study has demonstrated that when anxiety symptoms were controlled through relaxation training, memory performance improved in DAT (Rauzin, 1989). Examination of the role that 'support' plays in SPT in DAT could be accomplished by comparing motoric encoding under two conditions, one of which involved the interaction with the experimenter, and one which involved a videotaped presentation.

The second factor which may account for the present results, are the characteristics of the sample of DAT subjects obtained for this study. All of the subjects in the present sample obtained scores in the severe range of the RBMT. For the purposes of the present study, subjects were classified as either moderate or severely impaired in an attempt to control the level of severity across conditions. Attempts were made to recruit subjects in the milder stages of the disorder, however this failed for a number of reasons. Subjects in the first or mild stage are known to suffer from depression (Dodwell, 1987), and in addition, irritable mood and restless behaviour are common (Rubin, Morris, & Berg, 1987). Potential recruits were screened by conducting an informal interview with relatives. The result of the interviews was that a substantial proportion of people were identified as exhibiting these problems, and were thus discouraged from participating by the experimenter. Furthermore, the present sample maybe less representative of the DAT population than samples obtained in overseas studies, because diagnosis is less rigorous in New Zealand.

In summary, very low recall was achieved under all conditions in the present study, in contrast to the findings of other studies. Two major factors thought to account for this were procedure and sample differences. The sample of DAT subjects obtained for this study may not have been as representative of the DAT population as those found in overseas studies.

Older Adult subjects

The present study has demonstrated a significant difference in recall levels achieved with two different encoding conditions, the motoric and the multisensory. Motoric encoding required subjects to physically perform an SPT. In the multisensory encoding condition, subjects were exposed to the same SPTs as in the motoric condition to ensure that an identical amount of information was received, however physical enactment was not required. Motoric encoding produced superior recall to multisensory encoding, thus supporting findings from other studies that motoric encoding confers an advantage in recall (see for example, Dick et al., 1989a; Herlitz et al., 1991; Karlsson et al.,1989). The present study demonstrates that motoric encoding is also superior to encoding of other types of sensory information.

In the present study, another significant difference in recall performance was achieved under two recall conditions. In the relational cued recall condition subjects were given advance semantic category information. Superior recall performance, relative to free recall, was found indicating an advantage for this type of processing with SPTs. One goal of the present study was to determine if the provision of additional semantic processing would confer an advantage in recall. The recall level achieved as a result of advance semantic processing was 74%. In contrast to other studies cited, the present results were obtained when different groups of subjects were exposed to either motoric encoding or motoric encoding with relational processing. Thus strong support is lent to the assumption that motoric encoding and relational processing each yeild a recall advantage with SPTs. Physical enactment of an SPT appears to be an important component of the SPT effect in older adults.

The relational cued recall condition of the present study produced less recall advantage than 'self-selected' SPTs with semantic cues at recall (semantic/motoric condition with cued recall) used by Herlitz et al. (1991) were recall was 90%. In this case 10 older adult subjects (mean age 63 years) and 15 SPTs were involved. Provision of semantic cues at recall produced a recall level of 70% in the Karlsson et al. (1989) study which included 38 subjects (mean age 78 years) and 25 SPTs. The present study involved 56 older adults (mean age 75 years) and 20 SPTs, and produced a recall level of 74% in the relational cued recall condition with motoric encoding. It can be concluded that while the provision of advance semantic processing does provide a recall advantage with motoric encoding, it is not superior to that obtained with cues at recall, or self-selected SPTs and semantic cues at recall.

The results of the present study are consistent with the item-specific/relational framework (Hunt & Einstein, 1981) in two ways. First, evidence of an item-specific effect of motoric encoding has been found, and second, item-specific information when subjected to relational processing has produced additive effects in recall. This study has provided support for the presence of an item-specific effect of motoric encoding. It was demonstrated that motoric information could be differentiated from other multisensory information contained in SPTs and motoric encoding conferred an advantage in recall relative to multisensory encoding. Item-specific processing has been associated with a recency pattern in recall of verbal information (Marshark & Hunt, 1989) and pictorial information (Ritchey, 1980). In addition recency has been found most consistantly with free recall of SPTs which have not been subjected to any other form of relational processing (Cohen, 1983; Nilsson & Backman, 1989; Zimmer & Engelkamp, 1989). In addition to item-specific processing effects, evidence of relational processing was revealed by primacy in both motoric and multisensory encoding conditions with cued relational recall. Relational processing has been associated with both primacy and clustering in verbal information (Marshark & Hunt, 1989) and pictorial information (Ritchey, 1980). However, in SPT, while primacy is found with relational processing, clustering effects are not as consistant (Backman et al., 1986; Helstrup, 1987). Evidence of additive effects are seen in the recall level of 74% with relational cued recall and motoric encoding. This is greater than the 53% level seen with free recall and motoric encoding or the 51% level seen with relational cued recall and multisensory encoding.

The first aim of this study was to determine more precisely the locus of the SPT effect. The findings of the present study suggest that the locus of the SPT effect results from the combination of item-specific and relational processing. In the multicode model (Zimmer & Engelkamp, 1989) it is argued that motoric information contained in motor programs is necessary and sufficient to account for the SPT effect. Thus the locus of the effect would be found in the item-specific nature of the motor program information. In the context of the present study, it would be predicted that motoric encoding would produce the greatest recall level. The present study has shown that motoric encoding does produce greater recall to multisensory encoding. However, the finding of greater recall in the cued relational recall condition could not be accounted for. It is thus unlikely that the SPT effect is due soley to the item-specific effect of motoric enactment as Zimmer and Engelkamp (1989) maintain. They assume that during enactment, motoric information is passively or automatically encoded. If this was so, free recall of SPTs would have been expected to equal or better the relational condition, and this expectation was contradicted by the results obtained.

The results of the present study indicate that motoric and multisensory information encoded in SPTs, is better retained if subjected to relational processing. This contradicts the assumption of the multi-code model that only verbal information contained in SPTs benefits from this type of processing. However, it could be argued that the verbal commands contained in SPTs, rather than the motor information, benefitted from relational processing. For example, selective interference studies conducted by Nilsson and Backman (1989) have shown that the verbal commands could be differentiated from other non-verbal elements. The idea that only the verbal commands were subjected to relational processing is mitigated by findings from other motor domain studies demonstrating that motor information, when subjected to relational processing subsequently led to better retention.

Relational processing of motor information has involved three main areas, verbal labelling, contextual interference and self-selection. In verbal labelling, a movement is learned in the presence of verbal information which defines it in some way. It may be considered an example of relational processing because the encoding of the movement is structured to some degree by the label. When a movement is labelled it is thought that the verbal label integrates the different types of motor information involved in movement, and it is the integration which enhances recall (Smyth, 1984). In one study subjects were required to remember a number of movements which were labelled according to which aspect of a geometric figure they represented (Girard & Wilberg,1980, cited in Wilberg, 1983). Memory for these was compared to non-labelled movements, with labelled movements recalled better both immediately and at a long retention interval. Similarly, in SPT, it has been found that when irrelevant verbal commands are paired with motoric enactment, recall of SPTs deteriorates (Saltz & Donnenworth-Nolan, 1981).

Another example of the manner in which relational processing can assist the retention of motor information is revealed by contextual interference studies. Learning motor skills under conditions of high contextual interference promotes more relational processing because it is thought to induce more active subject engagement in the task. This results in a more distinctive and well retained memory representation for both verbal (Battig, 1979) and movement information (Lee & Magill, 1983; Shea & Zimny, 1983). Under low contextual interference or blocked conditions, all trials on one particular motor task are completed before the next motor task is introduced. High contextual interference is achieved through the use of random scheduling. Instead of presenting a number of trials requiring performance of one particular task, the motor tasks are interchanged in an unsystematic order across trials. On completion of the learning trials, transfer conditions are introduced in which subjects are required to perform different motor tasks of a similar nature to those learned previously. What is learned in the first instance is measured by performance on the second learning episode, and high contextual interference consistently produces better retention. These findings suggest that retention of motor skills is better if active rather than passive processing occurs.

Finally, the self-selection effect demonstrates that relational processing improves both the retention and the reproduction accuracy of some types of movements (Smyth &Wing, 1984). An essential difference found in subject selected movements is the increased amount of non-motor information available which may be encoded with the movement (Wing, 1984). In contrast, experimenter defined movements may result in the encoding of efference only. In one study with older adults, self selected SPTs were remembered better than those which were experimenter defined (Herlitz et al., 1991). It is likely that some types of motor information benefit to some degree from relational processing while others which are encoded more automatically do not. The influence of one or the other may predominate depending on particular task requirements. SPT represents a task in which the various sources of information are highly integrated and this perhaps accounts for the finding of benefits with relational processing.

The second goal of the study was to examine the degree to which the SPT effect was due to relational processing. It would appear that the SPT effect cannot be explained solely by reference to the relational processing factors suggested by Helstrup (1987). In this case, the SPT effect is not due to any particular type of information being encoded but to the degree to which the information can be subjected to relational processing. In the present study, relational processing benefitted both multisensory and motoric information equally. The finding that motoric encoding led to better recall than multisensory encoding could be accomodated by the assumption that the motoric condition resulted in more processing rather than processing of a specific type of encoded information. Thus the increased level of processing automatically led to better recall. However, this assumption is mitigated by findings from other studies in which attempts to increase the amount of relevent information contained in SPTs did not improve recall (Cohen, 1983; Helstrup, 1987; Nilsson & Backman, 1989).

Examination of this potential criticism is difficult for a number of other reasons. It is known from other motor studies as well as the present study with SPT, that various forms of relational processing appear to affect the retention of motor information. These include verbal labelling, self-selection, and context maniplation. However, at present little is known about the manner in which motor information is represented or retained in memory. Thus quantification of the contribution made to recall of SPTs by motoric encoding, in independence of other types of encoded information is difficult.

Directions for Future Research

Many questions remain concerning the precise nature of the representation and retention of motor information in memory. Several issues have been raised by the findings of the present study concerning the characteristics of relational processing and its effects on motorically encoded information. It was suggested that the degree item-specific processing of non-verbal items varied more than verbal information. Motor information may likewise share this variability. It would be useful to develop an independent measure of item-specific processing to allow more precise evaluation of the quantitative effects this has with relational processing. One way of examining this issue might involve examination of primacy, recency and clustering effects in recall. It would be useful to determine if manipulating the degree of item-specific processing in SPTs was associated with more pronounced recency effects. Likewise, the level of relational processing might be associated with primacy and or clustering in recall, with a higher level perhaps associated with both primacy and clustering.

Findings from the present study indicate that relational processing can benefit motoric encoding. However, because of differences between the present study and the Karlsson et al. (1989) study, estimation of the magnitude of difference between the two types of relational processing is still unclear. Future study could perhaps involve comparing motoric encoding with verbal encoding in three conditions to assess the relative contributions of both types of processing. For example, one condition might combine motoric encoding with relational cued recall. A second condition would require semantic cues only at recall, with a third condition involving free recall. Support for the conclusions drawn from the present study would be derived from findings of a recall advantage when motoric encoding was combined with relational processing, relative to motoric encoding and semantic cues at recall.

Another way of examining the potential benefits of relational processing could involve manipulating the number of SPTs used. Verbal studies have shown that with smaller numbers of item-specific information, less attention is likely to be paid to differences between the items. Thus relational information is unlikely to be spontaneously encoded with small categories and attention to item-specific characterisitics is likely to predominate (Hunt & Seta, 1984). In the present study, categories were on the small side which perhaps made the SPTs more suseptible to the effects of relational processing. Varying the number of items per category might allow more evaluation of the effects of relational processing.

It is possible that relational processing affects verbal and motor information differentially as Zimmer and Engelkamp (1989) suggest. It could be, for example, that verbal information in the SPT commands benefits more from relational processing than does motor information. To examine this assumption one could look more closely at motor rather than verbal information encoded in SPT. A group of SPTs could be developed in which categorisation was based on non-semantic features. These SPTs could be organisable around a movement feature. This feature would then be used as a retrieval cue. A non-semantic recall condition might involve demonstration of the motor information. Both free and cued recall procedures could be utilised. It would be expected that if there were no benefits to be derived from relational processing of motor information, free recall would equal cued recall.

Some related research with older adults has indicated that the degree of distinctiveness of items positively benefited performance in a 'prospective memory' task (Einstein & McDaniel, 1990). Prospective memory refers to memory for items or events which are to be recalled at some future date. The performance of events to be performed at some future time, rather than verbal rehearsal of future events, has been found to improve memory for the event in young subjects (Koriat, Ben-Zur & Nussbaum, 1990). In view of findings that older adults recall of SPTs is of similar levels to younger subjects, the investigation of SPT in conjunction with prospective memory might prove useful.

For DAT subjects, the SPT effect appears to operate in a much more selective manner. It may be that SPT automatically activates other non-semantic category information, and that DAT subjects may be able to process this type of information more easily than semantic information. For example, the objects used in SPT represent much richer sources of information than words, and offer many non-verbal features upon which categorisation may also be based (Backman et al., 1986; Karlsson et al., 1989). These concern kinesthetic information, as well as colour, shape, texture, size and so on. The functional attributes of objects are intimately related to actions that can be performed with them. Knowledge of these attributes may be activated as well through motoric enactment, and thus form a basis for categorisation. It may be that non-semantic categorisiation may proceed without requiring effortful processes. In view of the difficulties that DAT subjects have with effortful memory processes and demonstration of preserved motor learning, it would be useful to examine if other types of information are activated with SPT. The discovery of such information might provide effective retrieval cues for DAT subjects.

Summary and conclusions

This study has provided some support for a motoric locus of the SPT effect. This was revealed by superior recall performance with motorically encoded information in older adult subjects. Support has been provided for the assumption that recall of SPTs can be improved with relational processing. In addition, item-specific and relational processing demonstrated additive effects in recall.

Memory difficulties are very common in older adults and increase as age does. Undoubtedly there are many reasons for this. One suggestion for memory failures which is significant in the present context concerns age-related decreases in the consistency of encoding. In this case, older adults may be less idiosyncratic in encoding processes than are the young resulting in encodings comprised of general and non-distinctive features which do not offer effective retrieval cues (Mantyla & Backman, 1990). As older adults are able to process information presented in motoric form more easily than other types of information, utilisation of motoric encoding in conjunction with relational processing may be a particularly salient method for assisting aging induced impairment in memory function.

The item-specific and relational framework adds a useful perspective through which generation and interpretion of research concerning SPT may proceed. This interactive perspective is especially relevent because SPT has both verbal and motor components, in contrast to other motor tasks in which verbal processes may be optionally applied. The framework may provide a means for addressing a number of questions concerning the beneficial relationship between relational processing and motoric encoding.

REFERENCES

Abbenhuis, M., Raaijmakers, M., Raaijmakers, J., and van Woerden, G. (1990). Episodic memory in dementia of the Alzheimers type and in normal aging: similar impairment in automatic processing. Quarterly Journal of Experimental Psychology. 42 A, 569-583.

Arbuckle, T., Vanderleck, V., Harsany, M., and Lapidus, S. (1990). Adult age differences in memory in relation to availability and accessibility of knowledge-based schemas. Journal of Experimental Psychology: Learning, Memory and Cognition. 16, 305-315.

Appell, B., Kertesz,. S, & Fisman, R. (1982). Loss of Naming Ability in Dementia of the Alzheimer's Type. Brain and Language. 17, 73-91.

Attig, M., & Hasher, L. (1980). Processing of frequency of occurence information by older adults. Journal of Gerontology. 35, 66-69.

Backman, L. (1985). Further evidence for the lack of adult age differences on free recall of subject performed tasks; The importance of motor action. Human Learning. 4, 79-87.

Backman, L., and Nilsson, L. (1984). Aging effects in free recall : An exception to the rule. Human Learning. 3, 53-69.

Backman, L., & Nilsson, L. (1985). Prerequisites for lack of age differences in memory performance. Experimental Aging Research. 11, 67-73.

Backman, L., Nilsson, L., & Chalom, D. (1986). New evidence on the nature of encoding action events. Memory and Cognition. 14, 339-346.

Baddeley, A., Logie, R., Bressi, S., Della Sala, S., & Spinnler, H. (1986). Dementia and working memory. Quarterly Journal of Experimental Psychology Learning, Memory and Cognition. 38 (A), 603-618.

Baddeley, A. (1986). Working Memory. U.K. Oxford : Clarendon Press.

Barker, M., & Lawson, J. (1968). Nominal aphasia in dementia. British Journal of Psychiatry. 114, 1351-1356.

Battig, W. (1979). The flexibility of human memory. In L.S. Cermak & F.I.M. Craik (Eds.), Levels of processing in human memory. New Jersey : Erlbaum.

Bird, C. (1980). The isolation effect as a function of unique processing orientation. Journal of Experimental Psychology, Human learning, Memory and Cognition. 6, 267-275.

Bizzi, E. (1980). Central and peripheral mechanisms in motor control. In G.E.Stelmach & J.Rewuin (Eds.), Tutorials in motor behaviour. Amsterdam: New Holland.

Blessed, H., & Wilson, M. (1982). The Contemporary History of Mental Disorder in Old Age. British Journal of Psychiatry. 141, 59-67.

Botwinick, J., & Storandt, M. (1974). Memory and related functions and age. Springfield Ill. C.C. Thomas.

Bruce, P., & Herman, J. (1986). Adult age differences in spatial memory : Effects of distinctiveness and repeated experience. Journal of Gerontology. 41, 774-777.

Brun, A., & Englund, E. (1981). Regional patterns of degeneration in Alzheimer's Disease: neuronal loss and histopathological grading. Histopathology. 5, 549-564.

Burke, D., & Light, L. (1981). Memory and aging: the role of retrieval processes. Psychological Bulletin. 90, 513-546.

Burton, M. (1980). Evaluation and change in a psychogeriatric ward through direct observation and feedback. British Journal of Psychiatry. 137, 566-571.

Buschke, H. (1984). Cued recall in amnesia. Journal of Clinical Neuropsychology. 6, 433-440.

Butters, N., Heindel, W., & Salmon, P. (1990). Dissociation in Implicit Memory in Dementia, Neurological Implications. Bulletin of the Psychonomic Society. 28, 359-366.

Chang, Tien, Ming. (1986). Semantic memory: Facts and models. Psychological Bulletin. 99, 199-220.

Chui, H., Teng, E., Henderson, V., & Moy, A. (1985). Clinical Subtypes of Dementia of the Alzheimer's Type. Neurology. 35, 1544-1550.

Cohen, R. (1983). The effect of encoding variables on the free recall of words and action events. Memory and Cognition. 11, 575-582.

Cohen, R., & Bean , G. (1983). Memory in eduacable mentally retarded adults: Deficit in subject or experimenter ? Intelligence. 7, 287-298.

Cohen, R., & Stewart, M. (1982). How to avoid developmental effects in free recall. Scandanavian Journal of Psychology. 23, 9-16.

Corkin, S. (1982). Some relationships between global amnesias and the memory impairment in Alzheimer's disease. In S. Corkin, K. Davis, H. Growdon, E. Usdin, E., & R. Wurtman (Eds.), Alzheimer's disease a report of progress in research. New York : Raven Press.

Craik, F. (1977). Age differences in human memory. In J. Birren. & W. Schaie (Eds.) Handbook of the Psychology of aging. New York : Van Nostrand Reinhold.

Cutler, N., Haxby, J., Duara, R., Grady, C., Moore, A., Parisi, J., White, J., Heston, L., Margolin, R., & Rappoport, S. (1985). Brain metabolism as measured with positron emission tomography : Serial assessment in a patient with familial Alzheimer's Disease. Neurology, 35, 1556-1561.

Davis, C. (1986). Behavioral management in victims of Alzheimer's disease. In E.Taira, (Ed.), Therapeutic Interventions for the Person with Dementia. New York : Haworth Press.

Davis, P., Morris, J., & Grant, E., (1990). Brief Screening Tests versus Clinical Staging in Senile Dementia of the Alzheimer's Type. Journal of the American Geriatrics Society. 38, 129-135.

Dick, M., Kean, M., & Sands, D. (1988). The preselection effect on the recall facilitation of motor movements in Alzheimer's Type dementia. Journal of Gerontology. 43, 127-135.

Dick, M., Kean, M., & Sands, D. (1989a). Memory for action events in Alzheimer's Type dementia: Further evidence for an encoding failure. Brain and Cognition. 9, 71-87.

Dick, M., Kean, M., & Sands, D. (1989b). Memory for internally generated words in Alzheimer's type dementia : Breakdown in encoding and semantic memory. Brain and Cognition. 9, 88-108.

Diesfeldt, H. (1984). The importance of encoding instructions and retrieval cues in the assessment of memory in senile dementia. Archives of Gerontology and Geriatrics. 3, 51-57.

Dodwell, D. (1987). Alzheimer's Disease: The clinical picture. In B. Pitt. (Ed.), Dementia. United Kingdom : Churchill Livingston.

Einstein, G., & Hunt, R. (1980). Levels of processing and organisation : Additive effects of individual item and relational processing. Journal of Experimental Psycholgy: Learning, Memory and Cognition. 6, 588-598.

Einstein, G., & McDaniel, M. (1990). Normal aging and prospective memory. Journal of Experimental Psychology: Learning, Memory and Cognition. 16 , 717-726.

Engelkamp, J., & Zimmer, H. (1984). Motor progam information as a separable memory unit. Psychological Research. 46, 283-299.

Eslinger, P., & Domasio, A. (1986). Preserved Motor Learning in Alzheimer's Disease : Implications for Anatomy and Behaviour. Journal of Neuroscience. 6, 3006-3009.

Eysenck, M., (1974). Age differences in incidental learning. Developmental Psychology. 10, 513-546.

Flicker, F., Ferris,V., Crook, T., & Bartus, A. (1987). Implications of Memory and Language Dysfunction in Senile Dementia. Brain and Language. 31, 187-200.

Folstein, M., Folstein, S., & McHugh, P. (1975). Mini-Mental : A practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research. 12, 189-198.

Friedman, R., & Tappen, R., (1991). The effect of planned walking on communication in Alzheimer's disease. Journal of the American Geriatrics Society. 39, 650-654.

Gerard, G., Zacks, R., Hasher, L., & Radvansky, G. (1991). Age Deficits in Retrieval : The Fan Effect. Journal of Gerontology. 46, 131-136.

Grafman, J., Boutelle, W., Kaye, W., & Martin, P. (1983). Forms of Memory Failure. Science. 221, 380-382.

Gold, D., Andres, D., Arbuckle, T., & Schwartzman, A. (1988). Measurements and correlates of verbosity in elderly adults. Journal of Gerontology: Psychological Sciences. 43, 27-33.

Graf, P. (1990). Lifespan changes in implicit and explicit memory. Psychological Bulletin 28, 353-358.

Gross-Fleishman, D. (1988). Preserved Memory in Alzheimer's Disease. Dissertation Abstracts International. 49 , 3440B.

Grosse, D., Wilson, S., & Fox, J. (1990). Preserved word stem completion of priming of semantically encoded information in Alzheimer's Disease. Psychology and Aging. 5, 304-306.

Hartman M., & Hasher, L. (1991). Aging and Suppression: Memory for previously presented relevent information. Psychology and Aging. 6, 587-594.

Hashtroudi, D., Chrosniak, L., & Schwartz, B. (1991). The effects of aging on priming and skill learning. Psychology and Aging. 6, 605-615.

Helkala, E., Laulumaa, V., Soininen H., & Reikkinen, P.(1989). Different error patterns of episodic and semantic memory in DAT and Parkinsons with Dementia. Neuropsycholgia. 27, 1241-1248.

Helstrup, T. (1987) Separate laws for recall of performed acts ? Scandanavian Journal of Psychology. 27 , 1-29.

Heenan, L. (1979). Health system implications of projected population trends for New Zealand 1978-2011. NZ Medical Journal. 89.

Herlitz, A., Adolfsson, R., Backman, L., & Nilsson, L. (1991). Cue Utilization following Different forms of encoding in mildly, moderately, and severely demented patients with Alzheimer's disease. Brain and Cognition 15, 119-130.

Hess, T., & Higgins, J. (1983). Context utilisation in young and old adults. Journal of Gerontology. 38, 65-71.

Howard, D., Shaw, R., & Heisy, J. (1986). Aging and the priming of newly learned associations. Developmental Psychology. 22, 78-85.

Huff, F., Corkin, S., & Growden, J., (1986). Semantic Impairment and Anomia in Alzheimer's Disease. Brain and Language. 28, 235-249.

Hunt, R., & Einstein, G. (1981) Relational and item-specific information in memory. Journal of Verbal learning and verbal behaviour. 20, 497-514.

Hunt, R., & Elliot, J. (1980). The role of non-semantic information in memory: orthographic distinctiveness effects on retention. Journal of Experimental Psychology: General 109, 49-74.

Hunt, R., & Seta, C. (1984). Category size effects in recall: The roles of relational and individual item information. Journal of Experimental Psychology: Learning, Memory and Cognition. 10, 454-464.

Jenkins, J., Felce, D., Lunt, B., & Powell, E. (1977). Increasing engagement in activity of residents in an old persons' home by providing recreational materials. Behaviour Research and Therapy. 15, 429-434

Karlsson, T., Backman, L., Herlitz, A., Nilsson, L., Winblad, B., & Osterlind, P., (1989). Memory Improvement at Different Stages of Alzheimer's Disease. Neuropsychologia. 27, 737-742.

Katz, S., Ford, B., Moskowtiz, R., Jackson, B., & Jaffe, M. (1963). Studies of illness in the aged. The index of the ADL. Journal of the American Medical Association. 185, 914-919.

Kausler, D.H. (1982) Experimental Psychology and human aging. New York, Wiley.

Kausler, D. H. (1985). Episodic memory : Memorizing performance. In N. Charness (Ed.), (1985) Aging and human performance. Toronto : John Wiley and Sons.

Kausler, D., & Hakimi, M. (1983). Memory for activities: Age differences and intentionality. Developmental Psychology. 12, 889-894.

Kausler, D., Lichty, W., & Freund, J. (1985). Adult age differences in recognition memory and frequency judgements for planned activities. Developmental Psychology. 21,

Kelter, S., Grotzbach, H., Freiheit, R., Hohle, B., Wutzig, S., & Diesch, E. (1984). Object identification: The mental representation of physical and conceptual attributes Memory and Cognition. 12, 123-133.

Kirsner, H., Webb, W., & Kelly, M. (1984). The Naming Disorder of Dementia. Neuropsycholgia. 22, 23-30.

Klapp, S., & Netick, A. (1988). Multiple resources for processing and storage in short-term working memory. Human Factors. 30, 617-632.

Klatzky, R., Pellegrino, J., McCloskey, B., & Doherty, S. (1989).Can you squeeze a tomato? The role of motor representation in semantic sensibility judgements. Journal of Memory and Language. 28, 56-77.

Knopman, D., & Nissen, M.(1987). Implicit learning in patients with probable Alzheimer's Disease. Neurology. 37, 784-794.

Kopelman, M.(1991). Frontal dysfunction an memory deficits in the alcoholic Korsakoff syndrome and Alzheimer's type dementia. Brain. 114, 117-137.

Koriat, A., Ben-Zur, H., & Nussbaum, A. (1990). Encoding information for future action: Memory for to be performed tasks versus memory for to be recalled tasks. Memory and Cognition. 18, 568-578.

La Barge, E., Rosenman, L., Leavitt, K,. & Cristiani, T. (1988). Counselling Clients with Mild Senile Dementia of the Alzheimer's Disease Type: A Pilot Study. Journal of Neurological Rehabilitation. 2, 167-173.

Lawton, M., & Brody, M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily life. The Gerontologist. 9, 179-186.

Lee, T., & Magill, R. (1983). The locus of contextual interference in motor skill aquisition. Journal of Experimental Psychology: Human Learning and Memory. 9, 730-747.

Lezak, M. (1983). Neuropsychological Assessment. (2nd ed). New York : Oxford University Press.

Levin, S., Petros, T., & Filippi, K. (1980, September). Memory for television content by young and old adults. Paper presented at the annual meeting of the American Psychological Association, Montreal.

Lewicki, P. (1986). Processing information about covariations that cannot be articulated. Journal of Experimental Psychology: Learning, Memory and Cognition, 12, 135-146.

Lewicki, P., Hill, T., & Bizot, E. (1988). Aquisition of procedural knowledge about a pattern of stimuli that cannot be articulated. Cognitive Psychology, 20, 24-37.

Light, L., Zelinski, E., & Moore, N. (1982). Adult age differences in reasoning from new information. Journal of Experimental Psychology: Learning, Memory and Cognition, 8, 435-447.

Long, J. (1987). Age differences in memory: An attentional capacity account revisited (Doctoral dissertation, New School for Social Research, 1987) Dissertation Abstracts International, 48, 1828B.

Madden, D., & Nebes, R. (1980). Aging and the development of automaticity in visual search. Developmental Psychology, 16, 377-384.

Magill, R.A., & Hall, K.G. (1990). A review of the contextual interference effect in motor skill aquisition. Human Movement Science, 9, 241-289.

Mantyla, T., & Backman, L. (1990). Encoding variability and age-related retrieval failures. Psychology and Aging, 5, 545-550.

Mantyla, T. (1986). Optimizing cue effectiveness: Recall of 500 and 600 incidentally learned words. Journal of Experimental Psychology: Learning, Memory, and Cognition. 12, 66-71.

Mantyla, T., & Nilsson, L. (1988). Cue distinctiveness and forgetting: Effectiveness of self-generated retrieval cues in delayed recall. Journal of Experimental Psychology: Learning, Memory and Cognition. 14, 502-506.

Marshall, P., & Werder, P. (1972). The effects of the elimination of rehearsal on primacy and recency. Journal of Verbal Learning and Verbal Behaviour. 11, 649-653.

Marschark, M., & Hunt Reed, R. (1989). A reexamination of the role of imagery in learning and memory. Journal of Experimental Psychology: Learning, Memory and Cogntion. 15, 710-720.

Martin, A., & Fedio, P. (1983). Word production and comprehension in Alzheimer's disease: The breakdown of semantic knowledge. Brain and Language. 19, 124-141.

Mayeaux, R., Stern, Y., & Spanton, M. (1985). Heterogeneity in Dementia of the Alzheimer's Type: Evidence of Subtypes. Neurology. 35. 453-461.

McEvoy, C., & Patterson, R. (1986). Behavioural treatment of skills deficits in dementia patients. Gerontologist. 26, 475-478.

Mitchell, D., Hunt, R., & Schmitt, F. (1986). The generation effect and reality monitoring: Evidence from dementia and normal aging. Journal of Gerontology. 41, 79-84.

Musgrove, G. (1989) Automatic processing of temporal information. (Doctoral dissertation University of Georgia, 1989). Dissertation Abstracts International. 50, 4800B.

Nebes, R. (1989). Semantic Memory in Alzheimer's Disease. Psychological Bulletin. 106, 377-394.

Nebes, R., Huff, F., & Brady, C. (1989). Automatic and attentional mechanisms of semantic priming in Alzheimer's disease. Journal of Clinical and Experimental Neuropsychology. 11, 219-230.

Neisser, V. (1967). Cognitive Psychology. New York: Appleton-Century-Crofts.

Nilsson, L., & Backman, L., (1989) Implicit Memory and the Enactment of Instructions. In S. Lewandowsky, J. Dunn, & K. Kirsner. (Eds.). Implicit Memory - Theoretical Issues. New Jersey : Lawrence Erlaum.

Ober, B., & Shenaut, G. (1988). Lexical Priming in Alzheimer's Disease. Neuropsychologia 26, 273-286.

Paul, N., & Whissell, C. (1992). Memory for words in a serial list as a function of primacy-recency, frequency, length, order and location in a 2-dimensional emotional space. Perceptual and Motor Skills. 74, 427-432.

Perfect, T., Downes, P., De Mornay, C., Davies, P., & Wilson, K. (1992). Preserved implicit memory for lexical information in Alzheimer's Disease. Perceptual and Motor Skills 74, 747-757.

Posner, M.I. (1973). Cognition : An introduction. Glenview Ill : Scott, Foresman.

Rabinowitz, J., Craik, F., & Ackerman, P. (1982). A processing resource account of age differences in recall. Canadian Journal of Psychology. 36, 325-344.

Randolph, C. (1991). Implicit, explicit and semantic memory functions in Alzheimer's disease and Huntington's disease. Journal of Clincal and Experimental Neuropsychology. 13, 479-494.

Rauzin, W. (1989). Memory Training with Dementia adults : A non-Pharmacologic attempt at improve memory. Dissertation Abstract International. 51,

Reisberg, B. (1983). Clinical presentation, diagnosis, and symptomatology of age-associated cognitive decline and Alzheimer's disease. In B. Reisberg, (Ed.), Alzheimer's Disease. New York : The Free Press.

Ritchey, G. (1980) Picture superiority in free recall : The effects of organization and elaboration. Journal of Experimental Child Psychology. 29, 460-474.

Ritchey, G. (1982) Pictorial detail in recall in adults and children. Journal of Experimental Psychology. Learning, Memory and Cognition. 8, 139-141.

Ritchey, G., & Beal, C. (1980). Image detail and recall : Evidence for within-item elaboration. Journal of Experimental Psychology: Human learning, Memory and Cognition. 6, 66-76.

Rogers, T. (1983). Emotion, imagery, and verbal codes: A closer look at an increasingly complex interaction. In J.C. Yuille, (Ed.), Imagery, Memory and Cognition. Essays in honor of Allan Paivio. New Jersey : Lawrence Erlbaum Associates.

Rohling, M., Ellis, N., & Scoggin, F. (1991). Automatic and effortful memory processes in elderly persons with organic brain pathology. Journal of Gerontology. 46, 137-143.

Roskinski, R., Pellagrino, F., & Siegel, A. (1977). Developmental changes in the semantic processing of pictures and words. Journal of Experimental Child Psychology. 23, 282-291.

Rubin H, Morris J, & Berg L, (1987). The Progression of Personality Changes in Senile Dementia of the Alzheimer's Type. Journal of the American Geriatrics Society. 35, 721-725.

Saint-Cyr, J., Taylor, A., & Lang, E. (1988). Procedural learning and neostriatal dysfunction in man. Brain . 111, 941-959.

Salthouse, T. (1985). A theory of cognitive aging. New York : Elsevier Science.

Salthouse, T., Mitchell, D., Skovronek, E., & Babcock, R. (1989). Effects of adult age and working memory on reasoning and spatial abilities. Journal of Experimental Psychology: Learning, Memory and Cognition. 15, 507-516.

Saltz, E., & Donnenworth-Nolan, S. (1981). Does Motoric Imagery Facilitate Memory for Sentences? A Selective Interference Test. Journal of Verbal Learning and Verbal Behaviour 20, 322-332.

Shaw, R. (1991). Age-related increases in the effects of automatic semantic activation. Psychology and Aging. 6, 595-604.

Shea, J., & Zimny, S. (1983). Context effects in memory and learning movement information. In R.A. Magill (Ed.), Memory and control of action. (1983). Amsterdam: North Holland Publishing Company.

Skelton-Robinson, M., & Jones, S. (1984). Nominal Dyphasia and the Severity of Senile Dementia. British Journal of Psychiatry. 145, 168-171.

Smyth, M.M. (1984). Memory for movement. In M.M. Smyth & A.M. Wing (Eds.), The psychology of human movement. New York : Academic Press.

Smyth, M. M., & Wing, A.M. (1984). Movement, action and skill. In M.M. Smyth & A.M. Wing (Eds.), The psychology of human movement. New York : Academic Press.

Spillich, G., & Voss, J.F. (1983). Contextual effects upon text memory for young, aged-normal, and aged-impaired individuals. Experimental Aging Research. 9, 45-49.

Stine, E., & Wingfield, A. (1987). Process and strategy in memory for speech among younger and older adults. Psychology and Aging. 2, 272-279.

Stuart-Hamilton, I.A., Rabbit, P.M.A., & Huddy, A. (1988). The role of selective attention in the visuo-spatial memory of patients suffering from dementia of the Alzheimer's type. Comprehensive Gerontology. 2, 129-134.

Toole, T., Pyne, A., & McTarsney, P. (1984). Age differences in memory for movement Experimental Aging Research. 10, 205-210.

Tulving, E. (1983). Elements of episodic memory. Oxford, England: Oxford University Press.

Weingartner, H., Kaye, W., Smallberg, S., Ebert, M., Gillian, J., & Sitaram, N. (1981). Memory failures in progressive idiopathic dementia. Journal of Abnormal Psychology. 90, 187-196.

Wilberg, R.A. (1983). A little history. In R. Magill (Ed.), Memory and the control of action. Amsterdam : North Holland Publishing Company.

Wilson, B., & Moffat, B. (1984). The clinical management of memory problems. London : Croom-Helm.

Wolf-Klein, S., Silverstone, F., Brod, M., Levy, A., Foley, C., Termotto, V., & Bruer, J. (1988). Are Alzheimer's patients healthier ? Journal of the American Geriatrics Society, 36, 219-224.

Zimmer, H., & Engelkamp, J. (1989). One, two or three memories : Some comments and new findings. Acta Psycholgica, 70, 293-304.

(Appendix I)

Instructions for administering the Rivermead behavioural memory test[1]

Items 1 & 2 Remembering a name

The subject is shown a photographic portrait and told the first and second name of the person in the photograph.

Say: 'What I want you to do is to remember this person's name (show photograph). Her name is Catherine Taylor. Can you repeat the name? Later on I am going to ask you what her name is.'

The photograph is then placed face downwards on the table.

Item 3 Remembering a hidden belonging

A possession belonging to the subject is borrowed and secreted (e.g. in a drawer or cupboard). The subject is requested to ask for the belonging at the end of the test session and to remember where it has been hidden. The possession should not be valuable. For in-patients we ask for their rehabilitation timetable which is printed on a small card. For others we usually select a comb, pencil or handkerchief.

Say: 'What I am going to do now is to put something of yours away, and see if you can remember to ask me for it when I say we have finished this test. I also want you to remember where I put it. Can you let me have a personal item such as a comb or pencil or handkerchief?'

On receiving the item the therapist hides it, ensuring that the subject observes where the item is hidden.

Item 4 Remembering an appointment

The alarm is set for 20 minutes time and the subject is told to ask a particular question relating to the near future.

Say: 'I am going to set this alarm to go off in 20 minutes (demonstrate alarm and set). When it rings I want you to ask me about your next appointment. Say something like *"Can you tell me when I have got to see you again?"*, or words to that effect.'

Item 5 Picture recognition *(Snodgrass and Vanderwart, 1980)*

Line drawings of 10 common objects are shown, one at a time, for five seconds each. The subject is required to name each picture and after a filled delay, to select the original 10 from a set of 20.

Say: 'Now I am going to show you some pictures that I want you to remember. Look at each one carefully and tell me what object is pictured. I shall show you each one for 5 seconds to give you a chance to memorise it. Later on I am going to show you more pictures and I want you to pick out the ones I have just shown you.'

Item 6a Immediate prose recall

The subject is asked to listen to a short passage of prose being read out and to remember as much of it as possible.

Say: 'Next I am going to read you a passage of about 5 or 6 lines. Listen carefully, and when I have finished, tell me back as much as you can remember. Ready –
"Mr. Brian Kelly, a Security Express employee was shot dead on Monday during a bank raid in Brighton. The four raiders all wore masks and one carried a sawn-off shotgun. Police detectives were sifting through eye-witness accounts last night. A police spokesman said, 'He was a very brave man. He went for the armed raider and put up a hell of a fight.' "
Now tell me back as much of the story as you can.'

Item 5 Test pictures

The subject is required to recognise the original 10 pictures from 10 distractors.

Say: 'Now we are going back to those pictures I showed you earlier. For each picture I want you to tell me whether you saw it before or not.'

Then present 20 pictures comprising the 10 seen before and 10 new ones in prescribed order. Presentation is unpaced, but the subject is encouraged to guess if unsure.
To obtain the total score deduct the number of false positives from the number correct.

Item 7 Face recognition

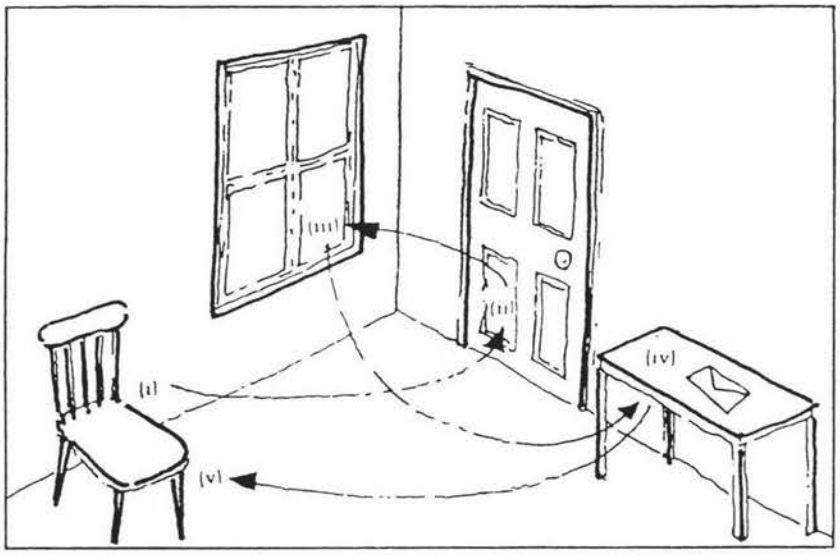
The subject is shown pictures of 5 faces, one at a time.

Say: 'This time I am going to show you some faces. I want you to look at each one carefully, and tell me if the person is male or female. Also tell me if the person is under or over 40 years old. This is just to help you concentrate since you will have to remember them later on.'

Then show the 5 faces, one at a time for 5 seconds each.

Item 8a Remembering a short route

The tester traces a short route within the room. The route comprises 5 sections. The subject is required to reproduce the route immediately. (We use a room with a table, window, door and desk. The route taken is illustrated below.)



(i) chair (ii) door (iii) window (iv) table (v) (return to) chair

This is an example of how the room might look, but obviously instructions should be adapted to suit the room in which you are working. The important specification is that the route has 5 sections which include a chair, a table, a window, a door, and a suitable place to leave the message.

Say: 'What I am going to do now is to trace a short path around this room. I want you to watch what I do, and when I have finished, do the same thing. I am going to start from this chair, and take this envelope with me. (The envelope is marked MESSAGE and should be placed somewhere in front of the subject. Show envelope to subject.) From here I am going over to the door. (Go to door.) And from the door to the window. (Go to window.) From the window to the table. (Go to table.) I am going to leave this envelope on the table, and from here I am going back to the chair.' (Return to the chair.) (Fetch the envelope back and place in original position in front of the subject.) 'Now what I would like you to do is to start where I started and follow the same path.'

Count the number of stages on the route that the subject follows correctly. Patients in wheelchairs should have no difficulty in following this route.
Score 1 point for each stage on the route followed *in the correct order*. If, for example, the subject goes to the second stage in the third order, s/he scores 0, but if s/he then goes to the fourth stage in the correct order, s/he scores 1 point.

Item 9 Delivering a message

If the envelope is spontaneously picked up and left in the correct place in *both* the immediate and delayed routes, score 1 point. Otherwise score 0 points.

Item 10 Orientation

Score 1 point if the subject is correct on *all* of the following questions: year, month, day of week, place and city of location, age, year born, present Prime Minister and present President. Otherwise score 0 points.

Item 11 Date

Score 1 point if the subject gives the correct date. Otherwise score 0 points.

The maximum number of points = 12, obtained as follows:

First name	1 point
Second name	1 point
Belonging	1 point
Appointment	1 point
Picture recognition	1 point
Story recall – immediate and delayed	1 point
Face recognition	1 point
Immediate route	1 point
Delayed route	1 point
Message – immediate and delayed	1 point
Orientation	1 point
Date	1 point
TOTAL	12 points

APPENDIX 2

LIST OF SPTs IN ORDER OF PRESENTATION

PRACTICE SPTs	CATEGORY	NUMBER
Verbal instruction		
1. open the envelope	Household objects	(1)
2. roll the bowling ball	Games	(2)
3. buckle a belt	Articles of clothing	(3)
4. grind the pepper	Objects found in the kitchen	(4)
5. cross your legs	Body movements without objects	(5)

EXPERIMENTAL SPTs	CATEGORY NUMBER
1- "fold your arms"	5
2- "tune the radio"	1
3- "put the lid on the pot"	4
4 - "button a jersey"	3
5- "turn on the torch"	1
6- "clap your hands"	5
7- " open the tin"	4
8- "move the draft" (checker)	2
9- "wave to someone"	5
10- "tie a scarf"	3
11- "thread the needle"	1
12- "shake the dice"	2
13- " lift the mug"	4
14- "put on a hat"	3
15- "finish the puzzle"	2
16- "wind the clock"	1
17- "shuffle the cards "	2
18- "blink your eyes"	5
19- " wrap the sandwich"	4
20- "pull on gloves"	3

(Appendix 3 DAT)

MEMORY FUNCTION IN OLDER ADULTS STUDY
INFORMATION SHEET

Dear ....

Thank-you for your interest in this study. Your Doctor has indicated that you have considered becoming a participant. This study is an investigation into areas of memory which may be unaffected by Alzheimer's disease.

If you decide to become a participant, you will be asked to complete a small number of memory tasks, in 2 sessions of 30 minutes each, spaced approximately 1 month apart. The study venue will be your place of residence. A requirement for participation is that your vision and hearing whether corrected or otherwise, are of a standard that you can see and hear information presented on television. In addition, you will need to have the use of all your limbs and your hands. I will be asking you about this in the first session. You will also be asked to complete an everyday memory test.

In the second session, you will be asked to do one of several different tasks such as watching a video, or participating in some simple activities. You may bring a partner or friend along should you wish. This person can accompany you while you complete the various tasks. Please be assured that you are free to withdraw from the study at any time.

If you are interested in participating in this study, please indicate this to your care-giver. If you have any questions or concerns about the study, or would like further information before making a decision, please contact me at your earliest convenience on 359-2106 between the hours of 7 and 10 PM. Outside of these hours please leave your contact number or address on the answer phone and I will contact you as soon as possible.

I am a Registered Nurse and specialise in the needs of people with memory difficulties. This research is being carried out in partial fulfillment of the M.A. degree (Rehabilitation Psychology) at Massey University. My supervisors are Dr. Julie Bunnell and Dr. Janet Leathem of the Psychology Department at Massey University.

Once again, thank you for your interest in the Memory Function and Older Adults study.

Yours sincerely,

Peggy Sironen

(Appendix 4 DAT)

MEMORY FUNCTION IN OLDER ADULTS STUDY

CONSENT FORM

Peggy Sironen has explained to me the reasons for this study and the procedures involved in it. I have read the information sheet and my questions have been answered to my satisfaction.

I understand that I am able to ask further questions at any time during the study.

I understand that I am free to withdraw from the study at any time, and that this will not adversely affect any further care I receive.

I understand that information collected during the course of this study will be treated in strict confidence and will be known only to the researcher and her supervisors, (Dr. Bunnell & Dr Leathem) and Dr. Hirst, Dr.Simons and Dr. Seaman of the Manawatu-Wanganui Area Health Board.

I agree/do not agree to take part in this study.
Signed..(participant) Date................

I ....(print name) consent for
..(print name of participant)
my ....(relation) to be a participant in this study.
Signed.. Date......................

I wish to receive information concerning the outcome of the study. Yes/No............
Signed.. Date......................
Address...

Statement by Investigator:
I have discussed with........................... (participant's name) the aims of, and procedures involved in this study.
Signed...(investigator)

MEMORY FUNCTION IN OLDER ADULTS (APPENDIX 5)
INFORMATION SHEET

Dear ....,

Thank-you for your interest in becoming a participant in this study. The primary purpose involves comparing the memory performance of adults like yourself who are unaffected by Alzheimer's Disease, with the performance of people with this condition.

If you decide to become a participant, you will be asked to complete a small number of memory tasks, in 2 sessions of 30 minutes each, spaced approximately 1 month apart. A requirement for participation is that your vision and hearing whether corrected or otherwise, are of a standard that you can see and hear information presented on television. In addition you should have the use of all your limbs and your hands. I will be asking you about this in the first session. You will also be asked to complete an everyday memory test. In the second session, you will be asked to do one of several different tasks such as watching a video, or participating in some simple activities. Please be assured that the test and activities are not used to diagnose Alzheimer's Disease.

Both sessions will be held at your place of residence or alternatively at a place were you conduct your meetings, in an area which has been set aside for the study.

If you are interested in participating in this study, please contact me at your earliest convenience on 359-2106, between the hours of 7 and 10 pm. Outside of these hours please leave your contact number or address on the answer phone and I will contact you as soon as possible. If you prefer you may complete the enclosed form and mail it to me in the envelope provided. If you have any questions or concerns about the study, or would like further information before making a decision, please contact me as above. Please be assured that you may withdraw from the study at any time.

I am a Registered Nurse and specialise in the needs of people with memory difficulties. This research is being carried out in partial fulfillment of the M.A. degree (Rehabilitation Psychology) at Massey

University. My supervisors are Dr. Julie Bunnell and Dr. Janet Leathem of the Psychology Department at Massey University.

Once again, thank you for your interest in the Memory Function in Older Adults study.

Yours sincerely,

Peggy Sironen

MEMORY FUNCTION IN OLDER ADULTS (Appendix 6)

CONSENT FORM

Peggy Sironen has explained to me the reasons for this study and the procedures involved in it. I have read the information sheet and my questions have been answered to my satisfaction.

I understand that I am able to ask further questions at any time during the study.

I understand that I am free to withdraw from the study at any time, and that this will not adversely affect any health care I receive.

I understand that information collected during the course of this study will be treated in strict confidence and will be known only to the researcher and her supervisors (Dr.Bunnell & Dr. Leathem). Arrangements can be made so that results obtained in the everyday memory test can be forwarded to my Doctor.

I agree/do not agree to take part in this study.
Signed..(participant) Date...............

I do/do not wish the results of the everyday memory test to be forwarded to my Doctor.
Signed..(participant)
Date..................

I wish to receive information concerning the outcome of the study. Yes/No...........
Signed... Date....................
Address..

Statement by Investigator:
I have discussed with.............................(participant's name) the aims of, and procedures involved in this study.
Signed.......................................(investigator)
(print name)................................... Date....................