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A Study of the Equivalence of Two Word Learning Tests
with Younger and Older Adults

Daniel J. Tupling

Thesis submitted to The Faculty of Graduate Studies and
Research in partial fulfillment of the requirements for the
degree of Master of Arts

Department of Psychology

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August, 1991

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The undersigned hereby recommend to
the Faculty of Graduate Studies and Research
acceptance of the thesis submitted by
Daniel Joseph Tupling
in partial fulfillment of the requirements
for the degree of Master of Arts

A handwritten signature in black ink, appearing to read "Seit", written over a horizontal line.

Chairman, Department of Psychology

A handwritten signature in black ink, appearing to read "T. N. Tambay", written over a horizontal line.

Thesis Supervisor

Carleton University

September, 1991

Abstract

The primary purpose of this study was to compare the acquisition and retention of a word list when two different learning procedures were used. Both younger (mean age = 31 years) and older (mean age = 69 years) adults were used. Buschke's selective reminding procedure of presenting only those words missed on the previous trial was compared to the more traditional procedure where the entire word list is administered on each trial. The two procedures produced comparable rates of learning and amount of information retained following a twenty minute retention interval. Younger adults performed better than older adults on both conditions. The failure to obtain an interaction between type of procedure and age suggests that younger and older adults utilize similar cognitive strategies in learning and remembering information in both procedures.

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INTRODUCTION

Serial learning is probably the most commonly employed paradigm in verbal learning research. Despite its pervasiveness in the study of human memory, it was not until recently that its methodology was challenged and an alternative methodology proposed. This alternative, "selective reminding", was purported to be superior to the traditional procedure in the investigation of memory. However, the assertions made of its superiority have never been adequately validated. While one study found the two procedures yielded equivalent results in a sample of undergraduate students (MacLeod, 1985), no evidence exists that these two procedures are comparable with older adults. Theoretically, there are several reasons that older adults may be expected to perform differently on the two tasks. The primary purpose of this study was to determine the equivalence of these two procedures with a sample of younger and older community dwelling adults.

In serial learning, the ability to learn a list of stimulus items (words, nonsense syllables, letters or pictures) is measured. Typically, a list of 12 to 15 unrelated words is presented to the subject, with an inter-stimulus interval of 1 1/2 to 2 seconds. Then, on a subsequent test trial, the subject is required to recall as many words as possible. Subjects usually are not constrained to recall them in any specific order. Study and test trials alternate in this manner, the number of trials generally varying from 1 to 12 with 4 to 6 being the most frequent. This procedure has been used to examine several factors such as aging and the subjective

organization of words during recall. It also has been useful in evaluating various types of memory disorders such as amnesia, Alzheimer's disease, Korsakoff's disease and depression, as well as those resulting from closed head injuries.

Despite the widespread use of this paradigm in memory research, it was not until relatively recently that its general methodology was challenged. Herman Buschke (1973), a physician specializing in the detection and analysis of memory disorders, outlined three major disadvantages of presenting all stimulus items on each acquisition trial. First, it did not maximize the opportunity to learn. The unlearned items were embedded among those previously learned making them more difficult to focus on and acquire. Secondly, the traditional procedure did not provide the opportunity to determine precisely when an item had been learned. Buschke suggested the criterion for learning should be when the item was first recalled without being presented on the preceeding study trial. According to him, such a determination was not possible in the traditional procedure since all items were presented on every trial. The final disadvantage was that traditional serial learning did not provide a clear understanding of how and when item presentation resulted in initial encoding, facilitation of retrieval or list organization.

As an alternative to the traditional serial learning task, Buschke introduced the selective reminding procedure ("partial list presentation") which he felt was more useful in the analysis of memory and memory deficits. In this procedure, the first trial is the only trial on which all of the list items are presented to the

subject. On all subsequent trials only those words not recalled on the immediately preceding trial are repeated. In contrast to the traditional method ("total presentation"), Buschke believed that items in the partial presentation method were not overlearned and that the procedure aided in maximizing learning by indicating to the individual which items were the most difficult to recall -- those which were not recalled on trial n and which were therefore presented on trial $n + 1$. MacLeod (1985) has also noted that since only unlearned stimulus items are presented on every trial it takes less time to administer. This feature is particularly attractive for memory assessment of the elderly and memory disordered individuals where brevity of testing is an important factor.

Partial presentation also provides the maximal opportunity to demonstrate which items had been learned and during what part of the learning sequence an item had been transferred into long term storage. This is shown by the spontaneous retrieval of the item following the first study trial on which it had not been presented. In addition, partial presentation permits a better understanding of impaired learning and memory by simultaneously analyzing initial storage, retention, and retrieval from the long term store (Buschke, 1973; Fuld & Buschke, 1974).

In order to clearly understand the partial presentation procedure, it is necessary to explain how retrieval from short and long term memory stores is defined. Retrieval from short term memory is defined as the recall of items immediately following their presentation. Retrieval from the long term store is defined as the retrieval of an item without its presentation on the preceding

study trial. For example, a word recalled once from the short term store and spontaneously retrieved on the next trial without an additional presentation is said to have been retrieved from the long term store. Following initial retrieval without presentation, an item is seen as having entered long term storage on the trial during which it was last presented, even though it may not be spontaneously recalled again for two or more subsequent trials (Buschke, 1973, 1974b; Buschke & Fuld, 1974). According to Buschke, the spontaneous retrieval of a stimulus without prior presentation is requisite in demonstrating storage and retention in the long term store and in distinguishing short term from long term retrieval during list learning. This was not possible with the traditional total presentation method due to the confounding of these processes by the presentation of all items on every acquisition trial (Buschke, 1974; Fuld and Buschke, 1976).

The total number of list items retrieved from long term memory ("total" long term recall) is subdivided into two components, consistent long term retrieval and random long term retrieval. This differentiates between those items consistently recalled and those words randomly recalled across trials. A list item is consistently recalled when, after its initial spontaneous retrieval, it is retrieved on all subsequent test trials. Random long term retrieval is the retrieval of an item which has previously entered and is assumed to be in long term storage but is inconsistently recalled across trials. Consistent recall is a measure of organized list learning while random retrieval represents item learning (Buschke, 1974; Fuld & Buschke, 1976). Thus, an estimation

of short and long term storage can be obtained, as can an estimate of total long term retrieval, which is divided into consistent (list learning) and random (item learning) retrieval. It is also possible to determine when an item had initially entered into long term storage, and to provide a measure of retrieval from this store.

In his original publication, Buschke (1973) utilized a list of twenty words from a single semantic category (animals) and twelve acquisition trials. Since that time, the number of stimulus items used in different experiments has varied from 8 to 20, with most studies utilizing twelve items. The number of acquisition trials has ranged from 4 to 15, with most studies having employed 12 trials or an acquisition criterion of two, 100% correct trials. While some studies have used pictures or line drawings as stimuli (Buschke, 1984; Grober & Buschke, 1987; Tuokko & Crockett, 1988), lists of both unrelated and same category words are the most frequently utilized. Normative data on this paradigm, while scarce, has recently been generated (Banks, Dickson, & Plasay, 1987, Ruff, Quayhagen, & Light, 1988).

While the partial procedure has increasingly gained a number of proponents in the field of clinical neuropsychology, Buschke's criticisms of traditional serial learning seldom have been subjected to empirical investigation. Moreover, his claims regarding the benefits and practical utility of partial presentation over the traditional procedure have not, as yet, been clearly substantiated. While one study (MacLeod, 1985) compared the partial presentation method with the traditional procedure in two groups of undergraduate students, no research has compared these procedures

in the memory assessment of older adults. It is important to examine their equivalence in order to determine the validity of making comparisons between studies using the two different procedures. Such a comparison may also be of theoretical importance in evaluating the effects of aging. For example, some researchers have hypothesized that the amount of cognitive resources or "mental energy" that we can allocate to a cognitive task diminishes as we age (Craik & Byrd, 1982; Salthouse, 1980, 1988). Because of this, and for reasons which will be outlined later, it is reasonable to predict that elderly subjects may react differently to the two procedures. Consequently, one of the questions addressed in the current proposal is whether the performance of elderly subjects will differ when the total and partial presentation procedures are employed.

Total List Presentation: Aging and Memory Disorders

The performance of normal elderly subjects on the serial learning task has been well documented with results showing that the elderly generally recall less information than do younger adults. This is well illustrated by the normative data associated with various widely used neuropsychological memory tests. One example is the Ray Auditory Verbal Learning Test (Rey-AVLT). The Rey-AVLT consists of fifteen unrelated words presented on each of five trials. Following each presentation, subjects are required to recall the words in any order. On the sixth trial, a second list of fifteen words is presented in order to assess the effect of interference on subsequent recall of the original list of words. Then on the seventh trial the subject is asked to again recall the words from the original

list. Query and Megran (1983) found that performance on the Rey-AVLT declined steadily with increasing age, particularly between the ages of 40 and 80.

The effects of aging on short term memory (STM) and long term memory (LTM) have also been studied by using the serial position effect. This effect refers to the phenomenon where the the last few items in the list are recalled with the highest probability, followed by recall of those items at the beginning of the list. Mid-list items have the lowest recall probability (Hulse, Egeth, & Deese, 1980). The greater recall probabilities of terminal and initial items are known as recency and primacy effects, respectively. When the probability of recall for list items is plotted against their serial positions in the list, a serial position curve is produced.

The recency effect is assumed to reflect the existence of a short term memory component or store. Items from the end of the series are retained in short term memory at the time of recall and therefore are recalled first before being lost (i.e., they are not rehearsed and transferred to the long term store). The primacy effect is believed to reflect the existence of the long term memory component. The rationale behind this inference is that the primacy effect is a product of the amount of rehearsal that items receive while in the short term store. This rehearsal in the short term store results in the transfer of information into long term storage. Since the amount of rehearsal an item receives decreases progressively from the first item in the list, the first few items receive the greatest amount of rehearsal and are transferred to the long term store resulting in the primacy effect (Atkinson & Shiffrin, 1971;

Kausler, 1974). Mid-list items receive the least rehearsal and are least likely to be transferred to long term memory. Further evidence for the distinction between short and long term memory stores has come from various clinical populations where one component was maintained while the other was not (Milner, 1970; Warrington & Shallice, 1972)

Serial position curves have been employed to study the effects of aging on memory. The majority of studies comparing the recency effect of healthy younger and older adults have concluded that there is essentially no difference between these two populations in short term memory functioning (Craik, 1977; Kausler, 1974). Those few which obtained differences found them to be minimal (Craik, 1977; Kausler, 1974, 1982). The major effect of age has been on the primacy, or long term memory component. The nature of these differences can be categorized as follows: (1) rehearsal deficits of the elderly, both in speed and quality (Salthouse, 1980; Sanders, Murphy, Schmitt, & Walsh, 1980; Schmitt, Murphy, & Sanders, 1981); (2) retrieval deficits -- information about stimulus items does reach the long term store, but the individual has difficulty in searching or retrieving from this store (Craik, 1977; Drachman & Leavitt, 1972; Laurence, 1967; Hultsch, 1975; Perlmutter, 1979; Smith, 1980); and (3) encoding deficits -- items are not efficiently encoded by elderly adults at the time of encoding, resulting in defective or inefficient long term storage (Craik, 1977; Kausler, 1974, 1982; Perlmutter, 1979; Perlmutter & Mitchell, 1982; Rabinowitz & Ackerman, 1982; Waugh & Barr, 1982). Retrieval and encoding deficits are not mutually exclusive but are seen as being

interdependent in determining effective recall (Craik, 1977, 1987; Fisher & Craik, 1977; Rabinowitz & Ackerman, 1982; Smith, 1977, 1980; Till & Walsh, 1980).

Serial position curves also have been employed to compare the performance of normal elderly subjects and those with memory disorders. Most experiments have found the overall performance curve to be lower for dementia patients than for normal elderly subjects (Gibson, 1981; Harris & Dowson, 1982; Martin, Brouwers, Christiane, & Fedio, 1985; Miller, 1971). A second important consideration involves the shape of the serial position curve. Do demented patients show the typical bimodal curve or is it more unimodal (i.e., the absence or attenuation of either the primacy or recency effect)? Much of this research was prompted by the findings of Baddeley and others (Baddeley & Warrington, 1970; Brooks & Baddeley, 1976) who found that the primacy and recency effects obtained with a group of mixed amnesics did not follow the pattern typically found in subjects with normal memory functioning. All of the above studies (with the exception of Martin et al., 1985) reported that the curve for demented subjects lacked a pronounced primacy effect while the recency component remained essentially normal. Other investigators, however, have found both these components attenuated in Korsakoff's patients (Parkinson, 1982; Rubin & Butters, 1981). Harris and Dowson (1982) concluded that the level of dementia significantly influenced which part of the serial curve was modified. They found that mild-to-moderate dementia suppressed the primacy effect while more severe dementia suppressed both primacy and recency.

Partial Presentation: Aging and Memory Disorders

There is a scarcity of data concerning age differences with the partial list procedure. Two reports recently published provide normative data for this task, the previous lack of which has seriously hampered the clinical use of the partial presentation procedure (Banks, Dickson, & Plasay, 1987).

In one normative study, Ruff, Quayhagen and Light (1988) examined the total and consistent long term recall of 392 subjects. Twelve unrelated words and 12 acquisition trials were utilized, followed by a one hour delayed recall test. Subjects were stratified according to age (16-24, 25-39, 40-54, and 55-70 years), gender and level of education. There was only a slight decrement in performance attributable to age and education on both of the dependent measures. Recall was quite consistent up to age 54, with a moderate drop in the 55 to 70 year range. The greatest difference was found for gender, with females out-performing males at all age levels on both total and consistent long term recall.

According to Ruff et al., performance on the partial procedure may have been influenced more by the utilization of organizational strategies than by verbal intelligence or attention. When broken down into "finishers" and "non-finishers", those successfully completing the task (defined as two consecutive 100% recall trials) were more likely than "non-finishers" to employ strategies such as organizing recall output by primacy and recency items or grouping the recalled list items into more associational categories. Thus, successful performance on the partial procedure may then be a function of how successfully subjects organize the recall of

unreminded items, regardless of age. It is, however, difficult to determine if successful completion and enhanced performance on the partial procedure is attributable to subjects being more successful in their ability to organize unreminded items. This is because output organization was not compared across both the partial and total procedures.

In a second normative study by Banks, Dickson and Plasay (1987), the performance of healthy adults aged 65-75 (N=60) was examined across 12 acquisition trials with the identical word list used by Ruff et al (1988). Subjects were stratified according to age (5 year intervals), gender and education. They were tested on short and long term retrieval, long term storage, consistent long term retrieval and total recall summed across trials. Results similar to Ruff et al. were found. Again, no significant differences in recall were found for age or level of education. Perhaps this is not surprising given the fact that their sample was relatively homogeneous in age and education. The only significant differences in recall were related to gender, with females performing at a higher level on all dependent variables except retrieval from long term storage.

The partial procedure has also been utilized in the detection and localization of deficits in a variety of memory disorders such as amnesia, (Peters & Levin, 1977), Huntington's disease (Caine, Ebert, & Weingartner, 1977), Alzheimer's disease (Buschke, 1984; Grober & Buschke, 1987; Tuokko & Crockett, 1989), Korsakoff's syndrome (Buschke & Fuld, 1974), closed head injuries (Levin, Grossman, Rose, & Teasdale, 1979), and depression (Hart, Kwentus, Hamer, & Taylor,

1987). Generally, results with Alzheimer's type dementia show that recall performance is impaired relative to age matched healthy controls, especially on the first four trials. The difference is particularly evident on these trials due to ceiling effects in the normal elderly which attenuate group differences on later trials. In one study, normal elderly controls recalled four times as many list items on the first two trials than did Alzheimer's patients (Weingartner, Kaye, Smallberg, & Ebert, 1981). Several studies have also reported a greater long than short term recall deficit, reflecting a characteristic finding in the locus of impairment in this disorder (Ober, Koss, Friedland, & Delis, 1985; Weingartner, 1981, 1983).

One performance characteristic of Alzheimer's patients is an inconsistent retrieval pattern. These subjects are as likely to recall words not retrieved on the previous trial as they are to recall previously retrieved items. That is, they exhibit a relatively greater proportion of random than consistent long term recall (Grober & Buschke, 1987; Hart, Kwentus, Hamer, & Taylor, 1987; Ober, et al., 1985; Weingartner, et al., 1981, 1983). Generally, this pattern has been interpreted as resulting from a disruption in the efficient encoding of information into the long term store. Alzheimer's patients do not "take advantage" of stimulus attributes that ordinarily are used in the encoding of events and therefore this process (and subsequent recall) is not facilitated by the repetition of unrecalled list items (Weingartner, et. al., 1981). One part of this encoding deficiency was hypothesized by Weingartner et al. to be a difficulty in Alzheimer's patients accessing semantic memory,

thereby decreasing their ability to associate events with one another and to existing structures in semantic memory.

In the study by Grober and Buschke (1987), some demented subjects failed completely in retrieving some items. These findings suggested that two different memory components had been disturbed. The fact that some list items were never retrieved was seen as indicating an encoding deficit -- items were never encoded into the long term store. On the other hand, the inconsistency of recall from trial to trial (i.e., random long term retrieval) was interpreted as indicating that memory impairment in dementia may not be limited to an encoding deficit, but may also involve a deficit in retrieval.

Depression also has been found to exert an effect on performance in this paradigm similar to that found with memory disorders. Hart, Kwentus, Hamer and Taylor (1987) found that depressed subjects, while generally performing at a higher level than an Alzheimer's group, were impaired relative to normal controls. This difference was greater on some dependent measures than on others. Total recall was only mildly impaired, and recognition on the delay trial was equivalent to normal controls. However, unlike the controls, depressed subjects recalled proportionately fewer unreminded items (those not presented on trial n because of recall on trial $n-1$) and were less likely to recall a greater number of high-imagery as compared to low-imagery items. As interpreted by the authors, this pattern of performance is consistent with "psychobiological mechanisms" used to explain the cognitive deficits in a depressive disorder where memory loss has

been "attributed to changes in central motivational state mediated by catecholaminergic systems" (Hart, et al., 1987; p. 114). Presumably, recalling unreminded list items and utilizing high-imagery words for more elaborate encoding may require greater cognitive effort than recalling recently presented words and recognizing words. These latter two measures which are generally assumed to minimize retrieval demands, were not impaired relative to controls.

Total Vs. Partial Presentation: Theoretical and Empirical Differences

As previously mentioned, Buschke (1973) originally asserted that the partial presentation procedure was of greater utility in the investigation of memory. However, there is little empirical evidence to validate his assertions. Does partial presentation actually facilitate or enhance the acquisition of a word list and/or subsequent retention relative to the traditional procedure? Are these two procedures equivalent in what they are measuring, or do they possibly affect memory performance differentially during serial learning? Only one study could be identified in which these fundamental questions were addressed. MacLeod (1985) posed the question of whether partial presentation offered distinctive advantages over traditional serial learning.

He outlined three ways in which these procedures might theoretically differ from each other. First, because items recalled on any given trial are not repeated on trial $n + 1$, partial presentation might result in less overlearning, as Buschke (1973) had originally asserted. This may produce a greater amount of

forgetting on tests of delayed recall because items were better consolidated in the traditional procedure. Inversely, he felt that the specific information provided by partial list presentation about "which items are most difficult may help to structure encoding and retrieval of the list" (MacLeod, 1985; p. 236). Second, there may be differences in the organization of recall during acquisition. Because all items are presented on every study trial in the traditional procedure, particular items might be recalled across trials with greater consistency. Because the partial procedure does not present previously recalled items, response organization might be less consistent resulting in a greater amount of fluctuation across trials. On the other hand, the partial list might promote greater reliance on subjective organization since it does not present the same serial order on each trial. In any case, the consistency during acquisition could be examined by utilizing a measure of list organization such as Tulving's (1962) measure of subjective organization. Lastly, do the two procedures differ in the amount of retrieval information they provided during acquisition? Partial presentation may serve to identify which items are posing the greatest difficulty in acquisition. This information may permit the learner to selectively rehearse those items, and possibly facilitate learning relative to the traditional procedure where no such feedback is provided. The number of trials to criterion and the number of correctly recalled items per trial may be indices of this "retrieval advantage".

To address these questions, undergraduate university students were presented with a list of 20 words in either a total or a partial presentation format. In both conditions, study and test trials

alternated until an acquisition criterion of a 100% correct recall trial was reached. Study and test trials were followed by a three week delayed retention test (unannounced). The results indicated that both the total and partial procedures produced a "virtually identical" number of trials to criterion, number of correctly recalled words across trials and number of items recalled on the delayed test. As well, no difference was found in the manner in which subjects organized their responses nor were any significant differences found in the number of errors, both extra-list intrusions and repetitions, at delay. These results were replicated in a second study which employed a similar set of procedures.

Given that no differences were found on the three ways in which the two procedures had been hypothesized to differ, why were acquisition and retention so similar under both learning conditions? MacLeod (1985; p. 239) postulated that individuals "continually rehearse the remembered words", and each study trial represents an opportunity to "add more words to the remembered set". In the traditional procedure, the subject must locate the "yet to be remembered items in the entire list", while (presumably) "ignoring already learned items". Partial presentation "simply performs this location for the subject, leaving all other processes identical to those in the standard procedure".

MacLeod concluded that if this explanation were correct, then there was clearly a practical implication for his findings. While the performance of subjects receiving the partial procedure was not found to be superior on the dependent measures, it had no "apparent drawbacks" relative to traditional serial learning. Partial

presentation, however, did have the advantage of being shorter in administration time because fewer items were presented on study trials. Therefore, he felt that partial presentation was probably the more efficient serial learning technique and recommended its choice over the traditional procedure.

Total Vs. Partial Presentation: Empirical or Theoretical Differences in an Elderly Population?

While MacLeod's study indicated that these two serial learning procedures were essentially equivalent except in administration time, his results were obtained on a sample of undergraduate students and perhaps cannot, therefore, be readily generalized to the elderly.

Theoretically, several different and sometimes contradictory predictions can be made about how the performance of elderly adults may differ across the two procedures. In some cases, the partial procedure may be expected to produce performance superior to the total procedure. According to MacLeod, the partial presentation of a list might facilitate the identification or localization of items that were difficult to learn, a process which had to be carried out by the subject's search of the entire list in the traditional procedure. Partial presentation was not assumed to result in a greater amount of rehearsal of items which presumably would have enhanced acquisition and retention. It is, possible however, that the partial presentation of previously missed items may serve another function for the elderly, as well as performing a "location" function. Several authors have hypothesized that the age-associated decline in

memory may be attributable to deficits in attentional resources and/or cognitive capacity (Craik & Byrd, 1982; Craik & Simon, 1980; Salthouse, 1980, 1988). This is primarily because the physiological effects of aging result in a general "slowing down" of the organism. This decrease in resources, in turn, affects performance on memory tasks. This inefficiency results not only in less effective and elaborate encoding, but also in a subsequent deficiency in retrieval, a process interrelated to initial encoding (Fisher & Craik, 1977; Smith, 1977). It is possible, therefore, that older subjects may take advantage of the presentation of only those items missed on the previous test trial to differentially rehearse and better consolidate them. Assuming that previously recalled items do not require as much effort to retrieve as those items not yet recalled, partial presentation may allow these limited resources to be diverted from rehearsing learned items and directed toward learning those not yet acquired. Thus, this procedure may be more efficient and result in faster learning for the elderly than the total list procedure.

Partial presentation may also result in a greater amount of information available to older subjects at delay relative to the traditional procedure. Specific information about which list items are posing the most difficulty during acquisition is provided. This specific information, as MacLeod stated, may help to structure encoding and retrieval of the list. Finally, because of the administrative differences between the two procedures, there may be differences in the way they facilitate list organization during acquisition. MacLeod (1985) found that the output organization of the list during acquisition did not differ between the two procedures

in his undergraduate sample. While this may be found to be the case with an older population, it is also possible that partial list presentation may facilitate the list organization and subsequent learning of the elderly by allowing them to concentrate on the organization of selective list items (i. e., those which are posing the most difficulty in recall).

Other findings, however, suggest that the total presentation procedure may yield performance that is superior to that of the partial procedure. For example, MacLeod found that overlearning effects did not occur with the traditional method. That is, subjects did not differentially benefit by the repetition of all words on every trial. Older subjects however, may differentially benefit from the repeated presentation of all list items in order to compensate for their less efficient cognitive processes and/or fewer cognitive resources. Any benefit of repeated presentation of items might be expected to result in faster acquisition. It may also result in greater consolidation of the list during learning and therefore making a greater amount of information available at delayed recall relative to partial presentation.

Another way in which total presentation may be superior to the partial method is in list organization during learning. In the total list procedure, all words are presented consistently in the same order on each trial. This consistency may allow individuals to "focus in" on list organization by using consistent strategies which can be employed in a predictable manner. In this way, organization and list acquisition may be enhanced relative to the partial method. Because a different grouping of items may be presented on each trial

in the partial procedure, it may actually interfere with and inhibit the development of an organizational strategy by older adults.

The matter is further complicated by the fact that there is substantial evidence to suggest that older individuals are less likely than younger persons to spontaneously employ organizational strategies or use them as effectively (Craik, 1977; Kausler, 1982). Thus, it may be that younger individuals may learn more with both procedures merely because they are more efficient.

Lastly, partial list presentation may serve more of a reinforcing function for the elderly adult because of their increased sensitivity to their memory deficits. Just as partial presentation "tells" the individual which items are posing the most difficulty, it also tells them which ones were correct. That is, as the number of presented items decreases, the number of retrieved items increases. This possible reinforcement effect may not only encourage the individual, but in turn may lead to greater concentration on (i.e., extra rehearsal) those remaining "reminded" items which the individual identifies as those posing greater difficulty.

As we have seen, there are several reasons why these two paradigms may differentially facilitate list learning in an elderly sample. Because of this, it is unclear as to which paradigm, if either, will produce superior learning performance. Thus, the primary purpose of the present study was to determine whether the method of administering serial learning (total vs. partial presentation) differentially affected the acquisition and retention of information by younger and older adults.

METHOD

Subjects

Thirty-two younger (mean age = 30.7 years, s. d. = 4.3, range = 24-36) and thirty-two older (mean age = 69.1 years, s. d. = 5.3, range = 61-79) subjects were recruited in the city of Ottawa, Ontario. Participation was voluntary, and all subjects signed an informed consent form (see Appendix A). Subjects were independently functioning residents of the community. Younger subjects were recruited from the community by word of mouth and from an Introductory Psychology night class at Carleton University. In the latter case, subjects received course credit for participation. In the recruitment of older subjects residents of extended care nursing homes or hospital facilities were not approached.

Procedure

Subjects were divided evenly into four groups according to a 2 (Age) x 2 (Procedure) design yielding the four following groups: Younger-Total, Younger-Partial, Older-Total, Older-Partial. Age and level of education were obtained from all subjects. Subjects then received a paragraph learning task followed by a fifteen word serial learning task, a subtest of the Learning and Memory Battery (LAMB) (Tombaugh & Schmidt, 1990). This word list consists of fifteen unrelated words, each of which is a single exemplar of a particular category (see Table 1).

Insert Table 1 about here

Table 1

Word List Exemplars and Categories^a

Words	Categories
<hr/>	
Pistol	Weapon
Dentist	Profession
Potato	Vegetable
Foot	Part of Body
Elephant	Animal
Dish	Kitchenware
Coat	Clothing
Trumpet	Musical Instrument
Floor	Part of Building
Banana	Fruit
Month	Unit of Time
Truck	Vehicle
Bed	Furniture
Yellow	Color
Brother	Family Relative

^a From Tombaugh & Schmidt, (1990).

Prior to the administration of the words, subjects were visually presented with a list of category names corresponding to each of the list words (e.g., the category "fruit" for the exemplar "banana"). This was done to help offset the advantage that the younger subjects might have over the older subjects in generating and employing encoding strategies for retrieval during free recall of the list. These category names were simultaneously read aloud by the experimenter. Then the category list was removed and subjects were given five study trials of the fifteen words, each of which was followed by a test trial (see following section for specific details for the two different procedures). Responses were recorded in the order in which they were recalled. All subjects received a delayed retention trial twenty minutes after acquisition in which they were asked to recall as many of the previously learned list items as they could. Following free recall on this trial, the category words were used as semantic cues for unrecalled items. Finally, a multiple choice recognition procedure was used for any words not retrieved through free and cued recall. During the retention interval all subjects were administered the following tests: forward digit span, supra-span, a paired associate task and a delayed free, cued recall and recognition test of a paragraph learning task which had been presented prior to the word list. To avoid possible rehearsal of the list during the retention interval, subjects were not informed of the retention trial prior to its administration.

Upon completion of the testing protocol, subjects received the Vocabulary subtest of the Weschler Adult Intelligence Scale-Revised

(WAIS-R: Weschler, 1981). This was administered in order to obtain an estimate of verbal intelligence, a factor known to be positively correlated with performance on serial learning tasks.

Total List Presentation. In this procedure, all subjects were initially given the following instructions:

"This is a test to see how well you remember words. I am going to read you a list of fifteen words. After I am finished I want you to tell me all of the words you can remember. The order you remember them does not matter. For example, if I said "trout", "spruce" and "waltz", you could say "waltz", "spruce", "trout", or "spruce", "waltz" and "trout". Each of the words in the list represents a different type of word grouping or category. "Waltz" represents a type of dance, "trout" comes from the fish category, and "spruce" is a type of tree. Each of the fifteen words I will read comes from one of the categories on this list".

Subjects were then presented with a typewritten list of the fifteen categories which were simultaneously read aloud to him or her by the experimenter. Immediately following this, these instructions were given:

"You will be given five times to learn the fifteen words. After I am finished reading the list I want you to tell me as many of the words as you can remember from the list, including the words you gave me on the preceding trial. Each time I will read the entire list.

Immediately following each presentation of the entire list, subjects were asked to "tell me all of the words you can remember".

Partial Presentation Procedure. The initial instructions for this procedure were identical to those for the total procedure, with the exception that following the presentation and reading of the category list, subjects were told that:

"You will be given five times to learn the fifteen words. The first time I will read all fifteen words. This is the only time I will read the complete list. The rest of the time I will say only the words you omitted or said wrong. Then I'll ask you to tell me all the words on the entire list, including the ones you said on the previous trial".

As in the "total" procedure, after the presentation of all words on the first trial subjects were asked to "tell me all of the words you can remember". However, if the subject's recall was less than fifteen words (100%), then the following instructions were repeated:

"I am going to read only the words you missed or were wrong. When I am through, I want you to tell me all of the words you can remember, including those you previously recalled correctly".

RESULTS

Demographic Variables

Following inspection of the data, two subjects were identified as outliers and eliminated from all subsequent analyses. Comparison of their scores (number of words free recalled) to available normative data showed that performance by the last

acquisition trial and at delay fell at least two standard deviations below the norm. Both of these subjects were older males (74 and 69 years) in the partial list condition. Their scores were replaced so as to maintain equal $\bar{x}$'s within the four experimental cells. Means for the variables of age, years of education and WAIS-R Vocabulary subtest scores are shown in Table 2.

 Insert Table 2 about here

A 2 (Age) x 2 (Procedure) ANOVA performed on the WAIS- R raw Vocabulary subtest scores demonstrated equivalence among the four groups on this measure. The F values for age, procedure and the interaction were, respectively, .98, .63 and .80 ($d.f = 1, 60, p > .05$). Analysis of the education variable showed a main effect for age, with the younger subjects having obtained a significantly higher level of education than did the older group, ($F(1, 60) = 6.82, p < .01$). This finding was not unusual, and is consistent with existing normative data. Years of education did not, however, differ between subjects receiving the two procedures ($F(1, 60) = .29, p > .05$), or between either of the two younger and older groups (Age x Procedure: $F(1,60) = .08, p > .05$).

Acquisition

Prior to a trial-by-trial analysis of the acquisition data, a 2 x 2 ANOVA was performed on the number of words recalled by subjects on the first trial only. This was done in order to determine the "pre-treatment" equivalence of the groups on the dependent

Table 2

Descriptive Statistics for Demographic Variables

Condition ^a	Demographic Variables			
	Gender M/F	Age	Education (Years)	Vocabulary
Y/T	6/10			
Mean		29.9	13.4	52.5
(S. D.)		(3.8)	(1.5)	(5.3)
Range		24-36		
Y/P	7/9			
Mean		31.6	13.2	52.7
(S. D.)		(4.6)	(2.7)	(6.0)
Range		25-38		
O/T	4/12			
Mean		68.5	11.6	52.3
(S. D.)		(5.3)	(2.7)	(9.7)
Range		61-79		
O/P	4/12			
Mean		69.7	11.0	49.1
(S. D.)		(5.4)	(4.4)	(8.3)
Range		62-79		

^aY/T = Young/ Total; Y/P = Younger/ Partial; O/T = Older/ Total;
O/P = Older/ Partial; Vocabulary = subtest from the Weschler Adult
Intelligence Scale- Revised (WAIS- R).

variable. Because all subjects received identical treatment on this trial (i. e., all list items were presented), the level of recall on this trial should not differ between subjects with the exception of an age effect. The mean numbers of words recalled by the younger and older groups were 7.1 and 5.7, respectively. This effect was statistically significant (Age: $E(1, 60) = 12.13, p < .001$). Neither the effect of procedure ($E(1, 60) = .23, p > .05$), nor the interaction ($E(1, 60) = .40, p > .05$) approached significance. While younger subjects recalled more words on this trial, the level of recall was similar between the partial and total subjects and between both of the younger and older groups prior to any procedural differences.

The trial-by-trial means of words recalled by each of the four groups during acquisition are illustrated in Figure 1. As is evident in the figure, the performance of the younger subjects was consistently higher than that of the older subjects (Age: $E(1, 60) = 29.7, p < .001$). The type of procedure did not differentially affect acquisition (Procedure: $E(1, 60) = 1.6, p > .05$). For both age groups, the number of words recalled increased significantly across learning trials regardless of the procedure employed (Trials: $E(4, 240) = 227.9, p < .001$). Upon examination of Figure 1, it appeared that the older/partial list subjects were recalling at a lower level than were older/total list subjects on trials two and three. An Age x Procedure x Trials interaction did not, however, occur in the analysis ($E(4, 240) = 1.62, p > .05$). The E values for the remaining interactions were as follows: Age x Procedure, $E(1, 60) = 2.08, p > .05$; Age x Trials, $E(4, 240) = 2.03, p > .05$; Procedure x Trials, $E(4, 240) = .93, p > .05$. These results demonstrate that the rate of list

acquisition was not differentially affected by the type of procedure employed in list learning. While younger subjects recalled a greater number of words than did older subjects, both age groups acquired the list at an equivalent rate regardless of procedure.

 Insert Figure 1 about here

Because the difference in administration between the two procedures occurred first on the second trial, this trial would be expected to be the most sensitive to detecting any differential effect of the procedure variable. Because of this and the initially suspected age x procedure x trials interaction which may have been obscured in the trial-by-trial analysis, a 2 x 2 ANOVA was utilized to examine recall on trial two only. Consistent with the previous analyses, the effect of age was again significant in favour of younger subjects ($F(1, 60) = 13.59, p < .001$). The effect of procedure was not statistically significant ($F(1, 60) = 1.86, p > .05$). A significant Age x Procedure interaction was observed due to the fact that the older subjects receiving the partial procedure recalled significantly fewer words on this trial than did their cohorts who received the entire list (Age x Procedure: $F(1, 60) = 4.77, p < .05$). A 2 x 2 ANOVA performed on the trial 3 data yielded results similar to those obtained in the trial 1 analysis.

Retention

While the two procedures yielded similar results in both age groups during the learning trials, the question remained as to

Figure 1. Trial by trial means of free recall during acquisition by Subjects in each of the four experimental conditions: Y-T = Young/Total; Y-P = Young/Partial; O-T = Older/Total; O-P = Older/Partial.

whether they might differentially affect the retention of list items on a twenty minute delay trial. To address this question, several analyses were performed. In the first, the number of words recalled on the delay trial served as the dependent variable. As can be seen in Figure 1, younger subjects recalled significantly more words at delay than did older subjects (Age: $E(1, 60) = 26.13, p < .001$). The type of procedure employed did not have a differential affect upon the number of words recalled (Procedure: $E(1, 60) = 2.9, p > .05$). These results show that while the absolute number of words available for free recall at delay was higher for the younger subjects, recall on this trial did not significantly differ between procedures or between young and older subjects (Age x Procedure: $E(1, 60) = 1.22, p > .05$).

To examine "true" retention of the list, delayed recall should be compared to recall at the end of acquisition in order to determine the level of retention relative to the level achieved at acquisition. By using such a comparison, it is possible to determine if the two procedures produced different rates of forgetting. To accomplish this, a 2 (Age) x 2 (Procedure) x 2 (Trials) repeated measures ANOVA was utilized. The two levels of the repeated measures factor were the last learning trial and the delay trial, the dependent measure being the number of list items recalled. If type of procedure (or procedure combined with age) differentially affected the rate of forgetting, a significant Procedure x Trials interaction or an interaction between all three factors should occur. Consistent with the previous analyses, younger subjects recalled a greater amount of information than did older subjects (Age: $E(1, 60) = 33.84, p < .001$).

However, the number of words recalled on these trials did not differ as a function of the procedure used (Procedure: $E(1, 60) = 2.59$, $p > .05$). The amount of information available at delay decreased significantly from what had been acquired by the last learning trial regardless of age or procedure (Trials: $E(1, 60) = 55.74$, $p < .001$). None of the interactions approached significance: Age x Procedure, $E(1, 60) = .79$, $p > .05$; Age x Trials, $E(1, 60) = 3.42$, $p > .05$, and Age x Procedure x Trials, $E(1, 60) = 1.36$.

The results of this analysis demonstrate that while subjects recalled less information on the delay trial than on the last acquisition trial, the rate of forgetting was not differentially affected by type of procedure or age. As well, while older subjects recalled fewer words at delay than did younger subjects, they retained as much information relative to what they had acquired by the end of acquisition (trial 5) as did their younger counterparts.

Two other methods were used to more precisely investigate retention results, and to account for the greater baseline amount of learning by younger subjects. One method utilized, "percent retained" scores. These were computed for each subject by dividing the number of words recalled at delay by the number recalled on the fifth acquisition trial and multiplying by 100. The second measure was an "absolute difference score", computed by subtracting the number of words recalled on the delay trial from the number of words recalled on trial five. When the "percent retained" scores were submitted to a 2 x 2 ANOVA, a significant age effect occurred showing the higher performance for younger than older subjects (Age: $E(1, 60) = 5.0$, $p < .05$). No other E approached significance.

The absolute difference scores were also submitted to the same analysis. The means of these scores for younger and older subjects were 1.3 and 2.1 respectively and were found not to significantly differ (Age: $F(1, 60) = 3.42, p > .05$). The procedure (Procedure: $F(1, 60) = 1.69, p > .05$) and the Age X Procedure interaction ($F(1, 60) = 1.36, p > .05$) were not significant. Regardless of the learning procedure employed, both young and older subjects retained an equivalent number of list words relative to what they had initially acquired.

Cued Recall and Recognition

Analysis of cued recall following free recall at retention showed that older subjects recalled a significantly greater number of list items through the presentation of cues than did younger subjects (Age: $F(1, 60) = 33.8, p < .05$). This result was primarily due to the fact that older subjects free recalled significantly fewer words at retention than did younger subjects. Consequently, the older subjects were cued for the recall of a greater number of words than were younger subjects. The procedure used did not, however, effect the number of words recalled following cues (Procedure: $F(1, 60) = .49, p > .05$). As well, the number of words retrieved by cued recall did not differ between procedures for either of the two age groups (Age x Procedure: $F(1, 60) = 2.65, p > .05$).

Upon examination of the number of words recalled by recognition, no significant results emerged. Regardless of age or procedure, the number of words recognized did not differ. The F values for Age, Procedure, and the interaction between the two factors were 2.22, 2.77 and .01 respectively. These findings were

probably due to a ceiling effect. That is, the majority of list items were retrieved via free and cued recall leaving very few words presented in the recognition test regardless of age or the procedure used.

Partial List Measures

The trial-by-trial means and standard deviations of sum recall (SR), long term retrieval (LTR), short term retrieval (STR), long term storage (LTS), consistent long term retrieval (CLTR), and random long term retrieval (RLTR) are presented in Table 3. This was done for only those subjects in the partial condition as this condition is the only one from which these measures can be derived. Given five acquisition trials and a fifteen word list, the maximum value for the long term measures was 75 while that for STR was 45. Each variable was submitted to an independent groups T-test for comparison between the younger and older subjects. SR for the younger subjects was greater than that of the older group, $t(30) = 4.69$, $p < .001$. On all measures of long term retrieval except RLTR, the older subjects performed at a significantly lower level than did their younger counterparts. The obtained t values were as follows: LTR, ($t = 4.17$, $p < .001$); LTS, ($t = 3.73$, $p < .001$); CLTR, ($t = 4.4$, $p < .001$), RLTR ($t = 1.34$, $p > .05$ (all df 's = 30). Finally, older subjects retrieved significantly more list items via STR than did the younger subjects ($t = 2.17$, $p < .05$).

 Insert Table 3 about here

Table 3

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Descriptive Statistics for Partial Procedure Measures by Age GroupSummed across Acquisition Trials

Age Group	Measure ^a					
	Sum R.	LTR	LTS	CLTR	RLTR	STR
Young						
Mean	54.2	44.8	46.7	39.5	5.25	9.4
(S. D.)	(7.1)	(12.3)	(12.4)	(12.9)	(4.0)	(5.6)
Older						
Mean	42.3	28.2	31.8	20.7	7.6	14.1
(S. D.)	(7.3)	(10.0)	(10.0)	(11.3)	(5.6)	(4.0)

Note. Gender distributions (M/ F) and means/ (S. D.s') for age of young and older subjects' were, respectively, 7/9; 31.6 (4.6) and 4/12; 69.7 (5.4).

^a: Sum R = sum recall; LTR = long term retrieval; LTS = long term storage; CLTR = consistent long term retrieval; RLTR = random long term retrieval; STR = short term retrieval.

Total long term retrieval is the sum of CLTR and RLTR. While across trials the average absolute number of list items recalled via RLTR did not differ for the two groups, the proportion of LTR attributable to RLTR was found, upon inspection, to be higher for the older than for the younger subjects (27% and 12% respectively). The corresponding proportions of LTR attributable to CLTR for older and younger subjects were, respectively, 73% and 88%.

Serial Position Curves

In order to examine recency and primacy effects and to determine group equivalence on recall of the list, the probability of recall by subjects of each list item was computed and plotted against its serial position. The curves of Total and Partial groups and for the younger and older subjects are illustrated in Figures 2 and 3, respectively. Curves are shown plotted for the first learning trial only as this trial is the sole trial on which the two procedures are comparable, i. e. the entire list is read to subjects in the same order.

 Insert Figure 2 and Figure 3 about here

Visual inspection of the curves for the total and partial groups shows that the primacy effect for these groups was essentially equivalent, while the recency effect was slightly higher for the partial group. Generally, however, the pattern of these curves is similar. Upon comparison of the curves for the two age groups, it

Figure 2. Serial Position curves for subjects in the Total (upper) and Partial (lower) conditions (n 's = 32).

Figure 3. Serial Position Curves for Young (upper) and Older (lower) subjects (n's = 32).

can be seen, as is typically the case, that primacy was greater for younger than for older subjects. The recall probability of terminal list items was also greater for the younger group. For a more detailed comparison, curves for both of the younger (Figure 4) and older (Figure 5) groups can be found, in Appendices B and C respectively. Except for differences within both age groups on the recall probability of mid list items, and the greater recency of the young partial subjects when compared to their total list cohorts, the curves for both younger and older subjects when compared across procedures are generally similar.

DISCUSSION

The results of the present investigation show that performance during the acquisition and retention of a 15 item word list was similar for the two serial learning procedures, a finding previously reported by MacLeod (1985). However, the fact that this similarity occurred with older as well as with younger adults extends MacLeods previous results to an older group of subjects. Given the relative homogeneity in age of the young subjects in both studies, the replication of MacLeods' finding with the younger group was anticipated. However, it was hypothesized that because of the age associated decline in the cognitive abilities of older individuals, acquisition and retention of this list in this age group might be affected differently by the two procedures. This hypothesis was not substantiated. Although the older partial list subjects consistently recalled less information during acquisition than did younger subjects, the partial and total procedures produced equivalent acquisition effects within each age group. Older individuals did not

appear to benefit more from the repeated presentation of all words on each acquisition trial than the younger group. It also appears that older subjects did not "focus" on and differentially rehearse selectively reminded items, a possible advantage which had been hypothesized to facilitate learning relative to the traditional method. While selective reminding may have served to identify those words which had not been recalled by the subject, a process which had to be self generated with the traditional list, it did not appear to serve any other purpose in this study.

While acquisition was similar for the two older groups, the significantly higher recall for the total list condition on trial two is of some interest. This was the first trial where the administration of two procedures differed. Because the finding was unique to this trial, it cannot be attributed to a generalized effect whereby the partial procedure negatively affects the learning and recall processes of older individuals. A more plausible explanation for this finding is that partial subjects experienced "confusion" because of the procedural shift between these two trials, i. e., from entire list to partial list presentation. At the beginning of the experiment the procedural shift was explained to each subject in the partial group. Despite these instructions, it was observed that a number of subjects became "confused". After recalling selectively presented words recall would often cease, at which point it was necessary to remind the subjects that they also were to recall unreminded words. Unfortunately, the repetition of the instructions may have (1), been disruptive and interfered with the learning process and (2), lengthened the time between word presentation and (the

continuation of) recall on trial two relative to that of their total list cohorts. This may have contributed to the "forgetting" of previously recalled items. Thus, it is likely that these two factors probably combined to produce the lower performance of this group on trial two relative to their cohorts for whom the procedure was consistent.

MacLeod's (1985) finding of equivalence in the amount of information retained under the two procedures was also supported. This finding, originally observed by MacLeod using a three week retention interval, occurred with an interval of 20 minutes in the present study. It was hypothesized that retention of the word list might be differentially affected by the type of procedure employed, particularly by the older subjects. This hypothesis did not bear out under analysis. Although the younger subjects recalled a greater number of words at delay, the two procedures yielded a similar level of retention which did not differ significantly for either age group. As evidenced by the analysis on the absolute difference scores from the last acquisition trial to delay, the procedures also produced a similar rate of forgetting for both age groups. Older subjects retained as much of the word list in relation to what they had acquired as did their younger counterparts, regardless of the method of presentation. It appears that retrieval processes at delay were not affected differently by the procedure employed, independent of procedure or age. Total list presentation did not promote greater consolidation of the list and result in a higher level of retention than in partial presentation. Conversely, as MacLeod (1985) had hypothesized, specific information provided by selective reminding

as to which items were most difficult to recall did not appear to differentially enhance encoding and subsequent retrieval of the list.

It is of interest to note the discrepancy in the findings when "percent retained" scores and "absolute difference" scores were utilized to measure the rate of forgetting from acquisition to delay. When the number of words recalled by subjects on the final acquisition trial and at delay were submitted to analysis it was found that the level of retention was similar for both age groups. This finding was verified when absolute difference scores were used as the dependent measure. When "percent retained" scores were submitted to this analysis, the results indicated that younger subjects had retained a significantly higher percentage of what they had previously acquired than did older subjects, a result contradictory to that of the previous analyses. Upon further examination, it appeared that this finding was attributable to an artifact arising from deriving these scores for two groups with differing baseline levels of acquisition, which were significantly lower for the older group. For example, a younger subject who recalls 14 words on trial 5 and 13 at delay has retained 92.8 % of the list. However, an older subject who has, for example, recalled 9 items on trial 5 and 8 at delay has retained 88 % of the list even though the subject has also "lost" only one item. In view of this, "absolute difference" scores, rather than "percent retained" scores, appear to be the best measure for examining the absolute rate of forgetting when one baseline level of learning is substantially lower than another.

Because of the differences in procedure, sample stratification and the fact that the same measures were not derived in all cases, the results in this investigation on the comparison of the selective reminding measures between the two age groups cannot be interpreted in terms of the previously cited findings (Banks, Dickson, & Plasay, 1987; Ruff, Quayhagen, & Light, 1988;). However, in the present study, younger subjects achieved a higher level on all of these measures than did older subjects with the exception of random long term retrieval and retrieval from the short term store.

While the number of words consistently recalled from long term storage by older subjects was significantly lower than that of the younger subjects, the number of words randomly recalled across trials did not significantly differ for these groups. It will be remembered that total long term retrieval is the sum of consistent and random long term retrieval. Therefore, the finding that the proportion of total long term retrieval randomly recalled was higher for older than for younger subjects (27% Vs. 12% respectively) suggests that the equivalence of random long term retrieval in absolute number of items was due to a ceiling effect in the younger group. Older subjects did in fact appear to randomly recall a greater proportion of the of the list from long term storage. According to Buschke (1973), a list item, once recalled without presentation on a given trial, is considered to have entered the long term store even though it may not be recalled for two or more subsequent trials. Presentation of the item on these trials is seen as a "reminder". It would appear that the necessity for "reminders" was greater for the

older subjects, suggesting a deficit in retrieval from the long term store relative to their younger counterparts.

The number of words recalled from short term memory also differed significantly between the two age groups, this figure being higher for the older subjects. Traditionally, short term memory functioning has been found not to differ greatly as a function of age (Craik, 1977). However, in partial list presentation, recall from the short term store is defined as the recall of a list item immediately following its presentation, i. e., it has not as yet been recalled without having been presented on a given study trial. Given this and the higher level of recall by older subjects on this measure, it appears that the recall of unpresented list items may have posed a greater difficulty than it did for their younger counterparts.

In regard to the serial position curves produced by the different groups in this study, it is difficult to compare their patterns in terms of traditional findings. This is because unlike the present investigation, in studies examining primacy and recency the number of subjects used is generally quite large, the number of list items is greater and a number of word lists are utilized. The recall probabilities of list items in corresponding serial positions are then averaged across lists resulting in a "smooth" curve. Because of the relatively small number of subjects in the present study and the single presentation of one word list, the curves deviated somewhat from the "typical" pattern. For example and in particular, some mid-list items were recalled with a probability much higher than is typically the case. However, the pattern of these curves was generally similar for all comparisons.

Despite the ways in which the performance of older individuals might have hypothetically differed on the two procedures, their learning and retention were equivalent under both learning conditions. MacLeod offered a postulation as to why this might have been the case for younger subjects in his sample. According to him, individuals "continually rehearse the remembered words" and each study trial represents an opportunity to "add more words to the remembered set" (MacLeod, 1985). Individuals must, in the traditional procedure, locate the "yet to be remembered words in the entire list" while, (presumably) ignoring already learned items. The only difference between the two procedures was that selective reminding simply performed this function for the subject, leaving all other learning processes "identical to those in the traditional procedure". Considering the similarity in performance of all individuals in this study despite the procedural difference of the two methods, it appears that this postulation may be plausible not only with younger adults but with older individuals as well. Several authors have theorized that the age associated decline in memory may be attributable to deficits in attentional and/or cognitive resources because of the general "slowing down" of the organism due to the physiological effects of aging (Craik & Byrd, 1982; Craik & Simon, 1980; Salthouse, 1980, 1988). The hypothesis that, for reasons previously outlined, the two procedures might differentially facilitate and enhance performance in an older sample was not borne out. While the hypothesized lesser resources of older individuals may result in a generally lower level of recall as compared to

younger individuals, these resources do not appear to be augmented differentially by either learning procedure.

In summary, the selective reminding procedure of Buschke (1973) and the traditional method of serial learning were found to yield similar levels of acquisition and retention in this study. These findings occurred with both younger and older community dwelling adults and support and extend the previous finding of MacLeod (1985). The comparability of the two procedures provides no evidence to suggest that, as MacLeod had conjectured, the partial procedure may perform the function of locating for the individual previously unrecalled words. While it is possible that this may be the case, the equivalence of these two procedures in the present study indicates that this function, if it does occur, does not provide any additional benefit in the learning and retention of a word list over the total procedure. The results from the two age groups indicate that the selective reminding procedure did not differentially benefit those older adults who have experienced a decline in cognitive abilities, at least not with a cognitively intact sample. Overall, the equivalence of these procedures allows for a more confident comparison of results obtained by the differing administration methods regardless of the age of the participant. Given that selective reminding produced a level of learning and retention equivalent to that of the traditional method without the necessity of having the entire list repeated on each trial, it may, in accordance with the conclusion of MacLeod (1985), be the more efficient technique in terms of its shorter administration time. This is particularly germane in regards to both clinical and

experimental memory investigation with elderly individuals, where brevity of testing may reduce the confounding of results due to fatigue and boredom.

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Informed Consent Form

I agree to participate in the Learning and Memory Battery (LAMB) project. This consists of a series of small tests measuring different aspects of memory. All tests will be administered on an individual basis and will use both verbal and visual material. The test duration is between 1 1/2 and 2 hours long. Participation is strictly on a volunteer basis. No pain or deception is involved in any of the tests. I understand that:

1. There will be no payment of any remuneration.
2. My identity will not be disclosed and the results of the study will be held in the strictest confidence.

The Learning and Memory Project has been approved by the Ethics Committee of the Department of Psychology, Carleton University which adheres to the ethical guidelines set forth by the Canadian Psychological Association.

Name _____
Date _____
Phone _____
Address _____

Witness _____
Date _____

Figure 4. Serial Position Curves for Young subjects in the Total (upper) and Partial (lower) conditions (n 's = 16).

Figure 5. Serial Position curves for Older subjects in the Total (upper) and Partial (lower) conditions (n 's = 16).

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