

The Effects of List-Making on Recall in Young and Elderly Adults

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This study examined the effects of list-making, and specific aspects of list-making such as intent (whether one expects to refer back to one's list at the time of recall) and organization, on memory performance in young and old adults. Young and old adults were randomly assigned to a list-making or a non-list-making condition. In both conditions, subjects performed two memory tasks in which they were presented with a word list followed by written recall and recognition tests. On one task, subjects were informed that they would not be allowed to refer to the list at the time of testing (internal-intent). On the other task, subjects were informed that they would be allowed to refer back to the list (external-intent), but actually were not allowed to. Planned comparisons found that list-making significantly improved older adults' performance on the recall tasks. Additionally, while the old performed significantly worse than the young in the non-list-making internal-intent recall task (the traditional memory test condition), these significant differences were not found on either of the list-making recall tasks. Both young and old list-makers who spontaneously organized their lists while studying the words recalled more items than subjects who did not organize their lists. These findings suggest future directions for both theoretical and applied research in the area of memory and aging.

RESEARCH on memory training has traditionally focused on internal memory strategies such as the method of loci, the peg technique, and the name-face association. Recently, however, there has been growing interest in external memory aids such as writing notes, voice mail, timers, or placing to-be-remembered objects in obvious places (Harris, 1980; Intons-Peterson & Fournier, 1986; Leirer, Morrow, Tanke, & Pariente, 1991; Park, Smith, & Cavanaugh, 1990; West, 1985) due to the ease and practical nature of these strategies. Additionally, list-making has been found to be associated with a number of benefits including greater feelings of well-being and internal control (Burack & Lachman, 1992). The present study examines the impact of list-making on recall among young and elderly adults.

The use of beneficial memory strategies may be especially important to the elderly, who often fear both a loss of independence (Willis, 1991) and an increase in memory problems with age (Cavanaugh, Grady, & Perlmutter, 1983; West, 1989). The ability to remember and keep track of information is crucial to everyday maintenance (e.g., such as managing finances, taking medication, and preparing meals); thus, teaching the elderly effective memory strategies may be one way of helping them manage important everyday life tasks. However, in order to teach these strategies effectively it is necessary to determine which components of these strategies are most beneficial.

There are several practical reasons for focusing on list-making as a memory strategy for the elderly. Though mnemonic strategies have been found to improve memory abilities in the laboratory (Stigsdotter Neely & Bäckman, 1993, 1995; Treat, Poon, & Fozard, 1981; Yesavage, Sheikh, Friedman, & Tanke, 1990), there are often problems associated with these strategies in everyday life. For example, when using the method of loci technique the individual must memorize an arrangement of locations in a specific order

(e.g., locations in one's home on the path from the front door to the bedroom). The subject must then associate each of the items he or she is trying to remember with one of the locations. At the time of recall the subject mentally "walks" to the different locations to remember the items. As can be seen, these types of strategies take time and effort to learn and are difficult to generalize to everyday-type activities. Furthermore, people do not spontaneously use these strategies and even after training, people often discontinue using them (Treat et al., 1981).

External memory aids such as written notes, however, are more applicable to everyday usage since they are easy to use and can be modified for a variety of activities. For example, people can use written notes to help themselves plan their schedules, remember to take their medication, or manage their finances. Additionally, people (including housewives, students, memory researchers, and the elderly) report using these strategies in their everyday lives (Harris, 1980; Macan, Shahani, Dipboye, & Phillips, 1990; Moscovitch, 1982; Park et al., 1990). In sum, the use of written notes is an inexpensive strategy that is easy to use and adapt to many different situations. Thus, it is an appropriate strategy on which to focus to aid elders in managing their various needs.

Although one may argue that the most efficient use of written notes is the ability to refer to them, West (1985) points out that external memory aids should not be examined in isolation from internal strategies. Rather, external memory aids can be used to supplement and enhance internal memory abilities. Burack and Lachman (1992) found that people do not always refer to their notes at the time of recall. Indeed, Burack and Lachman found that subjects were more likely to report using lists and schedules because writing down things "helps you to remember things in your head" than because writing down things "means you don't have to remember things in your head." Furthermore, people may

not always have the opportunity to refer back to their notes (e.g., during a test, or if notes have been left at home). Thus, it is important to examine the effects of external memory aids not only as an external memory source but also as a possible enhancer of internal memory processing.

There is evidence that notetaking can enhance recall even when the notes are not referred back to later (Barnett, Di Vesta, & Rogozinski, 1981; Di Vesta & Gray, 1972; Intons-Peterson & Fournier, 1986; Intons-Peterson & Newsome, 1992). Intons-Peterson and Fournier (1986) found that writing down a list of items improved later recall in young adults even when the list was not provided at the time of recall. Similar results have been found in studies examining the effects of notetaking on later recall among college students. Students who were instructed to take notes were found to perform better on recall tests than students who were not instructed to take notes, even when the notes could not be reviewed (Barnett et al., 1981; Di Vesta & Gray, 1972).

There are a number of ways that written notes may help later recall. West (1985) asserts that writing down things may focus one's attention on the target information. Additionally, writing notes provides multiple cues, both from the act of writing, and from visualizing what has been written (West, 1985). The likelihood of remembering the information may be increased due to these multiple cues. Another possibility is that notetaking may lead to the reorganization of the information and therefore more effective encoding (Intons-Peterson & Fournier, 1986). This may be especially beneficial for older adults, who have been found to use less effective organizational strategies when memorizing information than the young (Hultsch, 1969; Sanders, Murphy, Schmitt, & Walsh, 1980). Sanders et al. found that when memorizing information, the elderly were less likely than the young to actively reorganize the information while they were more likely to use nonstrategic rote strategies. Thus, if writing notes facilitates organizational strategies, the elderly in particular may benefit from its usage.

A study by Intons-Peterson and Fournier (1986) explored the various aspects of list-making which influence memory among college age students. In their study, subjects were presented with a list of words for later recall and assigned to either an internal memory aid condition (e.g., imagery) or an external memory aid condition (e.g., list-making). In both the internal and external conditions half the subjects were instructed to use memory aids that would facilitate encoding of information (imagery or list-making), and half the subjects were instructed to use aids that would not facilitate encoding (mental retracing or a timer). Additionally, half the subjects were told they would have to remember the list items at a later time, and half were told that they would not need to remember the information. Intons-Peterson and Fournier (1986) found that subjects who used memory strategies that facilitated the encoding of information remembered more items than subjects who used strategies that did not facilitate encoding. Additionally, they found that while subjects who made lists to aid future recall remembered more items than subjects in any of the other conditions, subjects who made lists without the intention of recalling the items recalled fewer items than subjects using internal facilitative strategies.

These results indicate that list-making aids recall when it is used to enhance internal memory strategies but may be less effective than other strategies if there is no intent to memorize the information. It is important to point out, however, that subjects who did not expect to be tested on the list-items most likely copied over the words without attending to them. In real life, however, people generally write things down with the intention of using the information later. Thus, even if people expect to refer back to their lists, the intent to use the information later may lead to more focused attention on the task and greater encoding.

Two processes may be operating during list-making. On the one hand, writing things down may help one remember information regardless of whether or not the individual expects to refer back to the list at the time of recall. In this scenario list-making acts to reinforce internal memory processing. On the other hand, it is possible that when a person expects to refer back to his or her notes the person may not put as much effort into memorizing the information, which may interfere with recall. In this case list-making may negatively affect recall if the list is absent. Thus, depending on the intended use of the list-making strategy, list-making could be either helpful or detrimental to the memory performance of the elderly.

The purpose of the present study was to examine whether list-making differentially affects older adults' ability to remember information and whether the intent to refer back to one's list affects memory performance.

In the present study, young and old subjects were assigned to either a list-making or a non-list-making strategy condition. In both strategy conditions subjects were given two memory tasks in which they were presented a list of categorizable items. On one task subjects were told that they would have to memorize the list-items for later recall (internal-intent). In this situation it was expected that subjects would use lists to enhance internal memory strategies. On the other task subjects were led to believe that they would be allowed to refer back to their lists at the time of testing (external-intent). This task was designed to facilitate the use of the list as an external storage site. However, on this task as well, subjects were encouraged to attend to the items on the list by telling them that they would need to be familiar with the list-items at a later time. On both tasks subjects were actually not allowed to refer back to the lists.

It was expected that overall young adults would perform better on the recall tasks than old adults. In particular, significant age differences were expected in the internal non-list-making condition since this is the type of recall test typically examined in the laboratory (subjects are given a list of words which they are instructed to memorize for a later recall test). While list-making was expected to aid recall for both age groups, it was predicted that list-making would benefit the old even more than the young. Similar results were expected for recognition memory. Additionally, memory performance was expected to be better on the internal-intent task, when subjects knew they would not be allowed to refer back to their list, than in the external-intent condition. However, even in the external-intent condition, list-making was expected to enhance memory. This was predicted because subjects were encouraged to attend to the list regardless of whether they

expected to refer back to the list later. This was designed to emulate a real-life situation in which individuals expect to use the information they write down.

METHOD

Subjects

The subjects were 24 young adults (15 female), ranging in age from 18 to 30 ($M = 23.67$, $SD = 4.45$) and 24 old adults (15 female), ranging in age from 60 to 77 ($M = 70.21$, $SD = 4.89$). All subjects were recruited at a suburban shopping mall and received a \$10 mall gift certificate for participating in the study. The mean number of years of education for the young and old adults was 14.00 ($SD = 1.89$) and 14.29 ($SD = 3.18$) respectively ($t = .39$, $p > .1$). The mean score on the WAIS vocabulary test for young and old subjects was 51.59 ($SD = 13.81$) and 56.83 ($SD = 13.47$) respectively ($t = 1.39$, $p > .1$). Subjects rated their current health status as compared to others of the same age on a 5-point scale (1 = very poor, 5 = very good). The mean health scores were 4.25 ($SD = .61$) for the young subjects and 4.04 ($SD = .75$) for the elderly subjects ($t = 1.06$, $p > .1$).

Design

The design included three factors: 2 (*age*: young vs old) \times 2 (*strategy*: list-making vs non-list-making) \times 2 (*intent*: internal vs external). Age and strategy were between-subject variables, and intent was a within-subject variable.

Word lists. — The stimuli for this experiment consisted of two word lists of 27 items each. One word list consisted of picnic items, and the other list contained items that could be found in a shopping mall. Word frequencies were matched as closely as possible across the two lists (Francis & Kucera, 1982). Both lists contained six categories of items. The picnic categories were drinks, fruits, meats, utensils, snack foods, and vegetables. The shopping mall categories were art work, electrical appliances, clothing, cosmetics, jewelry, and pets. In each list three categories contained four items and three categories contained five items. The number of items in the different categories were varied to make it more difficult for the subjects to use the number of items in each category as a memory cue. Additionally, varying the number of items in the categories increases the similarity of the task to everyday-type situations. No more than two items from the same category were adjacent to each other. The order of list-type was counterbalanced so that half the subjects received the picnic list first and half the subjects received the shopping mall list first.

Strategy conditions. — Subjects were randomly assigned to one of two strategy conditions: a list-making condition or a non-list-making condition. In the list-making condition subjects were given a pen, piece of paper, and word list. They were then instructed to make their own list of the items on the word-list using the pen and paper provided (this new list was called the subject-generated-study-list). Subjects were allowed to copy the words over in any way that they wanted. Therefore they could vary the order and the spatial

location of the words. Subjects were instructed to include all of the words from the original word list. In the non-list-making condition, subjects were given only the word list and were told to either study the list or become familiar with it depending on the task intent.

Intent tasks. — Subjects in both the list-making and non-list-making conditions completed two memory tasks. On one task subjects were told that they would have to recall the list-items without referring back to either the original word list or the subject-generated-study-list (if the subject was in the list-making condition). This task was called the internal-intent task because subjects were expected to use the list as a way of enhancing internal memory strategies. On the second task, subjects were led to believe that they would be permitted to refer back to the original word list or the subject-generated-study-list (for subjects in the list-making condition) at the time of recall. This was called the external-intent task since subjects were led to believe that they could use the list as an external memory aid.

In order to ensure that subjects attended to the list in the external-intent task, they were told that they would have to search for the items in a simulated blueprint drawing of a grocery store or shopping mall and that even though they would be allowed to refer back to their lists later, it would help them in their search if they were familiar with the list-items. (At the time of recall subjects were not permitted to refer back to their lists on either task.)

The order of the intent tasks was counterbalanced so that half the subjects received the internal-intent task first and half the subjects received the external-intent task first.

The Instructions for the Different Conditions

List-making internal-intent. — “On the next page is the list of items you have to buy [for the picnic/at the shopping mall]. With the pen and paper provided make your own list of the items needed [for the picnic/at the shopping mall]. On this task please try to remember the items on the list as well as you can so that you will know what to buy. You will not be allowed to refer back to your list later.”

Non-list-making internal-intent. — “On the next page is the list of items you have to buy [for the picnic/at the shopping mall]. For this task please try to remember the items on the list as well as you can so that you will know what to buy. You will not be allowed to refer back to the list later.”

List-making external-intent. — “On the next page is the list of items you have to buy [for the picnic/at the shopping mall]. With the pen and paper provided make your own list of the items needed [for the picnic/at the shopping mall]. On this task you will have to search for the picnic items in a simulated blueprint drawing [of a grocery store/at the shopping mall]. You will be allowed to refer back to your list in order to know what to buy. However, since you have a limited amount of time to find the items it may help you in your search if you are familiar with the list.”

Non-list-making external-intent. — “On the next page is

the list of items you have to buy [for the picnic/at the shopping mall]. On this task you will have to search for the picnic items in a simulated blueprint drawing of [a grocery store/shopping mall]. You will be allowed to refer back to the list in order to know what to buy. However, since you have a limited amount of time to find the items it may help you in your search if you are familiar with the list.”

Dependent Measures

Recall and recognition measures. — Following the presentation of the list, subjects were given a recall test and a recognition test. On the recall test subjects were asked to write down all the items they remembered from the list. Recall scores were calculated by summing the correctly remembered list-items.

Incorrect responses on the recall test were classified as intrusions. However, if subjects wrote down words such as category names (e.g., fruit or jewelry), these items were classified as alternatives rather than as either intrusions or correct answers.

On the recognition test, subjects were presented with a list of 54 items. Half of the words were the 27 items from the original list (target items), while the remaining items were distractors. Subjects were then instructed to circle all the items they recognized from the original word-list. The distractors were matched as closely as possible with the test items for category, word length, and word frequency. Word frequencies were obtained from Francis and Kucera (1982). Recognition ability was measured using d' scores (d' was calculated using the Table provided by Hochhaus [1972]). This calculates the number of words the individual correctly recognizes while taking the number of incorrect guesses into account. In the present study, d' scores ranged from $-.25$ to 5.00 , with higher scores indicating more accurate recognition.

Organization. — To examine the extent to which young and old adults organized words into categories at the time of study and at the time of recall, clustering (ARC) scores (Roenker, Thompson, & Brown, 1971) were calculated from both subject-generated-study-lists and the recall tests. ARC scores typically range from 0.00 to 1.00 , with 0.00 representing clustering at the rate of chance and 1.00 representing perfect clustering. Negative scores are possible if the subjects cluster words into categories at a rate of less than chance.

Additionally, to further examine whether subjects reorganized the words into categories while constructing the subject-generated-study lists, two experimenters independently coded the subject-generated-study-lists as either “organized” or “nonorganized.” Nonorganized lists were characterized as words which had been copied over in the same order as the words on the original list. Organized lists were characterized as words which were reordered and grouped together into categories. The words did not have to be perfectly categorized to be considered organized, although it was quite clear whether a list was organized. There was 98% agreement between the two coders. (This analysis could only be done for subjects in the list-making condition.)

Everyday list-making. — After completion of the memory tasks, subjects were given a short questionnaire concerning their everyday list-making practices. Subjects were asked to indicate, on a 5-point scale ranging from (1) “never” to (5) “very often,” how often they write things down to help themselves remember to do things in their everyday lives and how often they refer back to their written notes after they have made them. Additionally, subjects were asked whether they had a planner, calendar, or appointment book with them at the present time.

Procedure

Subjects were tested individually in a quiet office in the shopping mall. At the beginning of each task, subjects were given a copy of the instructions to read while the experimenter read the instructions out loud. After the subjects indicated that they understood the instructions they were given 3 minutes to study and/or copy over the word list. When the 3 minutes were over, the study-list and the subject-generated-study-list (if applicable) were taken away from the subjects in all of the conditions. Subjects were then asked to write down all the words that they could remember from the list. After subjects finished the recall test they were immediately given the recognition test. On this test, subjects were instructed to circle all of the words that they remembered from the original word list including both the words they remembered to write down on the recall test and those they had forgotten. Subjects were allowed as much time as they wanted on the recall and recognition tests. This procedure was then repeated with the remaining task. Following the last recognition task, subjects filled out the questionnaire on their everyday list-making practices and were then given the WAIS vocabulary test.

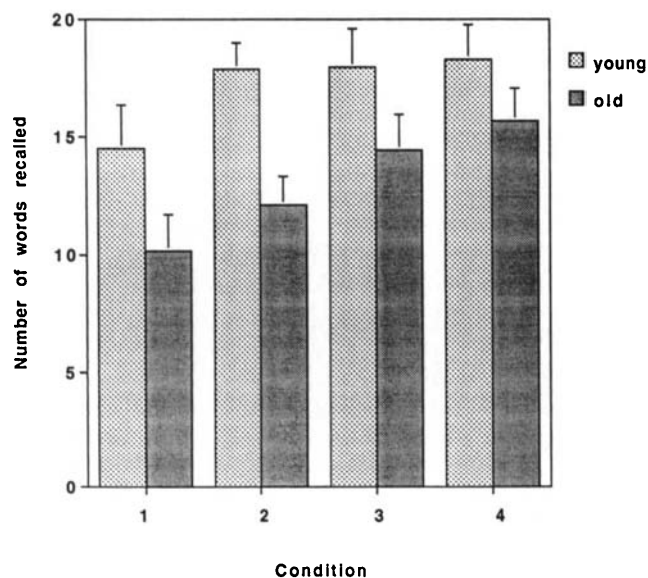
RESULTS

Memory Task Performance

No effects of list-type (picnic vs shopping mall), list-order, or order of intent tasks were found.

Recall. — To examine the effects of age, list-making, and intent on later recall, a 2 (age groups: young vs old) $\times 2$ (strategy: list-making vs non-list-making) $\times 2$ (intent: internal vs external) mixed analysis of variance, with intent as the within-subjects variable, was conducted. See Figure 1 for a breakdown of the mean recall scores by age, strategy, and intent. There were significant main effects of age [$F(1,44) = 10.14, p < .005$], strategy [$F(1,44) = 5.19, p < .05$], and intent [$F(1,44) = 5.56, p < .05$]. Specifically, young subjects ($M = 17.19, SD = 4.32$) remembered more words than old subjects ($M = 13.09, SD = 4.95$); list-makers ($M = 16.61, SD = 4.73$) remembered more words than non-list-makers ($M = 13.67, SD = 5.00$); and subjects performed better on the internal-intent task ($M = 16.00, SD = 5.07$) than on the external-intent task ($M = 14.27, SD = 6.15$).

The predicted Age \times Strategy interaction was not found to be significant [$F(1,44) = .50, p > .05$]. Power analysis (Cohen, 1988) indicated the chance of finding a significant Age \times Strategy effect was 10% for a small effect, 39% for a medium effect, and 77% for a large effect. To examine the



1 = external non-list-making, 2 = internal non-list-making,
3 = external list-making, 4 = internal list-making

Figure 1. Mean recall scores by age and condition.

predicted effects more carefully, planned contrasts were conducted. First, to examine the hypothesis that list-making would be especially beneficial for the old subjects, old list-makers were compared with old non-list-makers using planned comparisons. As expected, old list-makers recalled significantly more words ($M = 15.04$, $SD = 4.71$) than old non-list-makers ($M = 11.13$, $SD = 4.53$; $t(44) = 2.15$, $p < .05$), collapsed across the two intent tasks. Among the young subjects, no difference was found between list-makers ($M = 18.17$, $SD = 4.39$) and non-list-makers ($M = 16.21$, $SD = 4.21$).

Second, we predicted there would be age differences in recall performance for the non-list-making internal-intent condition (the traditional memory recall task), but that in the list-making conditions age differences would be minimized. To test these hypotheses, planned comparisons were conducted to examine age differences in each of the four conditions (internal non-list-making, internal list-making, external non-list-making, external list-making). As expected, significant differences between the young and old were found in the non-list-making internal-intent condition, with young adults ($M = 17.92$, $SD = 3.87$) recalling significantly more words than older adults [$M = 12.08$, $SD = 4.30$, $t(44) = 3.14$, $p < .005$] (see Figure 1). No significant differences in recall were found between the two age groups on the non-list-making external condition (young: $M = 14.50$, $SD = 6.45$; old: $M = 10.17$, $SD = 5.25$), the list-making internal condition (young: $M = 18.33$, $SD = 5.03$; old: $M = 15.67$, $SD = 4.92$), or the list-making external condition (young: $M = 18.00$, $SD = 5.56$; old: $M = 14.41$, $SD = 5.30$).

Intrusions and alternatives. — The mean number of intrusions for the overall sample was .67 ($SD = 1.43$) on the

external task and .48 ($SD = 1.19$) on the internal task. Only a few of the subjects produced alternative answers. Three of the young produced alternative answers on the internal task while none of the young subjects produced alternative answers on the external task. Five of the old subjects produced alternative answers on the external task while three of the old subjects produced alternative answers on the internal task.

Organization. — To examine the extent to which subjects clustered words together at the time of recall a 2 (age groups) \times 2 (strategy) \times 2 (intent) mixed analysis of variance, with ARC scores on the recall test as the dependent variable, was carried out. No significant differences were found for age, strategy, or intent. Additionally, no significant interactions were found. The mean ARC score for the overall sample was .55 ($SD = .40$) on the external task and .54 ($SD = .41$) on the internal task. On both the external and internal intent tasks only six subjects had an ARC score of 0 or less.

Similarly, to examine the extent to which subjects clustered words together at the time of study a 2 (age groups) \times 2 (intent) mixed analysis of variance, with ARC scores for the subject-generated-study-list as the dependent variable, was carried out. Again, no significant main effects and no significant interactions were found. The overall mean ARC score for the entire sample was .38 ($SD = .46$) on the external task and .44 ($SD = .47$) on the internal task. Seven of the subjects on the external-intent task and five of the subjects on the internal intent tasks had an ARC score of 0 or less. (These analyses could only be carried for subjects in the list-making condition.)

The subject-generated-study-lists were also dichotomously coded as either "organized" or "nonorganized." On the external-intent task, 7 of the 12 young list-makers' (58.33%) and 6 of the 12 old list-makers' subject-generated-study-lists (50.00%) were classified as organized, $\chi^2 = 18$, $p > .05$. On the internal-intent task, 5 of the 12 young list-makers' (41.67%) and 5 of the 12 old list-makers' subject-generated-study-lists (41.67%) were classified as organized, $\chi^2 = .00$, $p > .05$. Thus, whether subjects organized their lists in the list-making conditions was not dependent on the age of the subject.

To examine whether subjects who organized their subject-generated-study-lists in the list-making condition had higher recall scores than subjects who did not organize their lists, a separate 2 (age group) \times 2 (organization: organized vs nonorganized) ANOVA with the number of words recalled as the dependent variable was carried out for both the external-intent and the internal-intent tasks for those in the list-making condition.

As can be seen in Figure 2, a main effect of organization was found, on the external intent task, with subjects who organized their subject-generated-study-lists recalling significantly more words ($M = 18.69$, $SD = 5.35$) than subjects who did not organize their lists [$M = 13.27$, $SD = 4.56$; $F(1,20) = 6.40$, $p < .05$]. No main effect of age and no significant interactions were found. Similarly, on the internal-intent task a main effect of organization was found with subjects who organized their lists remembering significantly more words ($M = 19.33$, $SD = 4.12$) than subjects who did not organize their lists [$M = 14.67$, $SD = 4.96$;

$F(1,20) = 8.39, p < .01$. No main effect of age and no significant interactions were found.

As can be seen in Table 1, clustering (ARC scores) at the time of study (on the subject-generated-study lists) was positively related to clustering (ARC scores) at the time of recall on both the internal-intent task and the external intent-task. Additionally, both clustering (ARC scores) at the time of study and clustering at the time of recall were positively related to the recall and recognition scores on both intent tasks.

Recognition. — A 2 (age groups) \times 2 (strategy) \times 2 (intent) mixed analysis of variance, with intent as the within-subject variable, was carried out with d' scores as the dependent variable.

Significant main effects of age [$F(1,44) = 7.18, p < .01$] and intent [$F(1,44) = 7.30, p < .01$] were found. Specifically, younger adults correctly recognized more words ($M = 3.10, SD = 1.03$) than old adults ($M = 2.35, SD = .91$), and subjects performed better on the internal-intent ($M =$

$2.91, SD = 1.02$) task than on the external-intent task ($M = 2.54, SD = 1.25$). No significant effect of list-making strategy [$F(1,44) = 2.57, p > .05$] was found. Additionally, there were no significant interactions.

Performances on the recall and recognition tests were highly correlated with each other on both the internal-intent task ($r = .65, p < .01$) and the external-intent task ($r = .76, p < .01$).

Individual Differences in Memory Performance

Correlational analyses were carried out to examine the relationship between performance on the memory tasks and demographic variables. Self-perceived health was not found to be related to any of the memory task measures. Education was found to be positively related to the number of words both recalled ($r = .43, p < .01$) and recognized ($r = .35, p < .05$) on the internal-intent task. Thus, subjects with a greater number of years of education performed better on the recall and recognition tests for the internal intent condition than subjects with fewer years of education. Similarly, performance on the WAIS vocabulary test was positively related to recall performance on both the internal-intent tasks ($r = .35, p < .05$) and the external-intent tasks ($r = .35, p < .05$) and to performance on the recognition tests on the internal-intent tasks ($r = .34, p < .05$) and the external-intent tasks ($r = .37, p < .01$).

Additionally, education was positively related to clustering of subject-generated-study-lists on both tasks (internal-intent task: $r = .52, p < .01$; external-intent task: $r = .50, p < .05$). Performance on the WAIS vocabulary test was also positively related to clustering of subject-generated-study-lists on both the internal-intent task ($r = .44, p < .05$) and the external-intent task ($r = .50, p < .05$). Thus, subjects who organized their lists at the time of study were more likely to have a greater number of years of education and higher scores on the WAIS vocabulary test.

Because there was a significant correlation between education and organization of words at the time of study, partial correlations were carried out between recall and clustering (ARC) scores for the subject-generated-study-lists while controlling for education and between recall and education while controlling for clustering, for each of the intent tasks. The partial correlation between recall and clustering, on the external intent task, was still significant even while control-

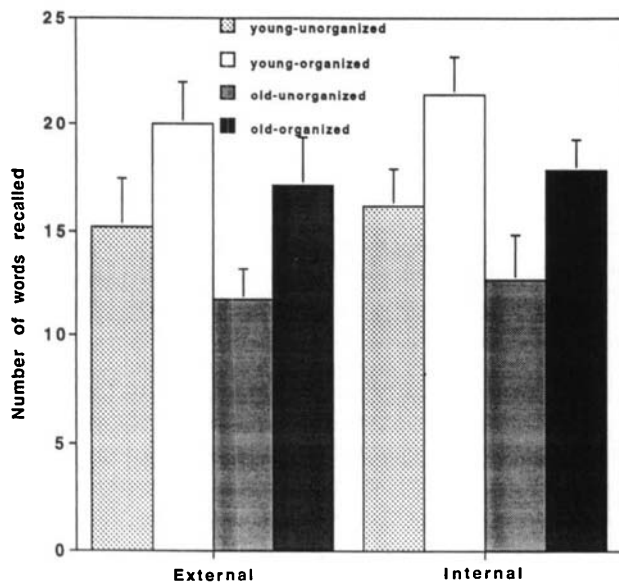


Figure 2. Mean recall scores by age and organization.

Table 1. Correlations of Clustering (ARC) Scores with Performance on Recall and Recognition Tests

	1	2	3	4	5	6	7	8
1. Recall ^a	1.00							
2. Recognition ^a	.76**	1.00						
3. Recall Clustering scores ^a	.36*	.41**	1.00					
4. Study Clustering scores ^a	.58**	.46*	.76**	1.00				
5. Recall ^b	.61**	.59**	.34*	.24	1.00			
6. Recognition ^b	.55**	.66**	.45	.33	.64**	1.00		
7. Recall Clustering scores ^b	.28	.45**	.40*	.36	.53**	.45*	1.00	
8. Study Clustering scores ^b	.62**	.57**	.51*	.62**	.67**	.46*	.70**	1.00

^aMeasures on the external task.

^bMeasures on the internal task.

* $p < .05$; ** $p < .01$.

ling for education ($r = .51, p < .01$). However, the relationship between education and recall was not significant when controlling for clustering ($r = .06, p > .05$).

A similar pattern was found for the internal intent task. The partial correlation between recall and clustering controlling for education was significant ($r = .59, p < .01$) while the partial correlation between education and recall controlling for clustering was not significant ($r = .10, p > .05$).

Everyday Usage of Lists

In the everyday list-making questionnaire, subjects were asked to report the frequency with which they use lists in their everyday life. No significant difference was found in the frequency with which old ($M = 4.04$) and young adults ($M = 3.38$) reported making lists in their everyday lives, or in the frequency that old ($M = 4.04$) and young adults ($M = 3.45$) refer back to their lists after they make them.

Finally, subjects were asked whether they had any type of lists or schedules with them. Nine of the young (37.50%) and 14 of the old subjects (58.30%) reported having a list, daily planner, appointment book, or calendar with them at the time of testing. A chi-square analysis indicated that having lists or written notes was not dependent on the age of the subjects, $\chi^2 = 2.08, p > .05$.

DISCUSSION

In sum the results from this study indicate that list-making is an effective memory strategy for the elderly. List-making appears to improve older adults' ability to recall information even when there is no opportunity for them to refer back to their lists. List-making did not have a beneficial effect for younger adults' performance, perhaps because they were operating at their memory limit even without the use of a list in the internal condition.

As expected, the greatest difference in recall performance between the young and old was found in the internal non-list-making condition. It is interesting to note that this is the type of task that is typically administered in traditional memory experiments (e.g., a subject is given a list of words and told to memorize it for a later recall test without writing anything down). It was somewhat surprising to note that no age difference was found for the external non-list-making task. These findings, however, appear to be due to the poorer performance of the young rather than to an improved performance by the elderly (see Figure 1).

One reason that the difference in performance between the young and old adults was greatest on the internal non-list-making condition may be that the elderly have a harder time than the young manipulating a large amount of information internally. Similarly, it is possible that, although the elderly subjects knew that they had to memorize the lists of words, they did not use internal memory strategies that were as effective as those used by younger adults. This is supported by the findings of Sanders et al. (1980) in which younger adults were found to use active reorganizational strategies to recall word-lists while the elderly were more likely to use nonstrategic rote strategies.

It is possible that the difference in recall performance between the young and elderly subjects was reduced on the list-making tasks because the instructions to make a list of

the items may have been a salient cue to the elderly to organize the information into categories. There were some interesting trends that provide some preliminary support for this, even though there were no age differences in clustering across conditions. The older adults ($M = .41$) had lower clustering scores (at the time of recall) than the young ($M = .52$) in the non-list-making condition, whereas the old ($M = .63$) had higher clustering scores than the young ($M = .59$) in the list-making condition. Additionally, while the elderly have often been found less likely to spontaneously organize information, in this study no age differences were found between the number of young and old subjects, in the list-making condition, who organized the list-items during the study period.

The findings in this study differ somewhat from those of Rabinowitz (1989), who found that the difference in recall performance between the young and old was greater under optimal memory conditions (in which subjects were permitted to study each word for as long as they desired, to take notes, and to use any memory strategies they thought would be beneficial) than under standard memory conditions (in which words were presented for a specified period of time and subjects were not instructed to use various memory strategies). Thus, in Rabinowitz's study there was a larger age deficit under optimal conditions while in the present experiment there was a decrease in age differences in the list-making condition. One reason for this difference may be that in the present study subjects were explicitly told to make a written list, whereas in Rabinowitz's study subjects were permitted to use any memory strategy that they wished, including making written notes. Older adults may not utilize the most efficient memory strategies unless they are explicitly told which strategies to use.

Subjects' intent at the time of encoding did affect later recall, with subjects performing better when they knew they would not be allowed to refer back to their lists. This occurred despite the fact that subjects were encouraged to attend to the information during the external-intent task. It should be pointed out, however, that list-making improved memory performance across both intent conditions (see Figure 1).

The instructions on the external-intent task were designed to encourage the subjects to attend to the lists. Thus, it is unclear from these results whether merely writing down information aids memory. This task, however, was designed to simulate everyday type situations. In everyday life an individual often organizes and attends to the information when making written notes, even when one expects to be able to refer back to one's notes later. (For example, when one makes up a grocery list one considers what foods one has at home, the meals one wants to make, where the items can be bought, etc.) Future studies, however, should examine the effect that copying over the list-items has on memory performance without allowing the subjects to reorganize the information, in order to tease apart these separate processes.

It is interesting to note that no main effect of list-making on recognition was found. This may be because the recognition test actually provides the subjects with the target list of words, embedded within a larger list, at the time of testing, thereby minimizing differences between list-makers and non-list-

makers. Additionally, list-making and organization at the time of encoding may help later retrieval by strengthening the association between items. This may be especially helpful during recall when there is little contextual support provided at the time of retrieval. During recognition, however, because there is more contextual support (the target items are present at the time of retrieval), list-making or organization may not contribute as much to the retrieval process.

While no significant main effects or interactions were found for the amount of words clustered together at the time of recall, it should be pointed out that a high degree of clustering was found for most subjects. Results from this study do indicate that organization of lists, at the time of encoding, however, is related to better recall. Both young and old subjects in the list-making condition who organized their subject-generated-study-lists into categories recalled significantly more words than subjects who did not spontaneously organize their lists. These results were found on both the internal and the external intent tasks. It should be kept in mind, however, that subjects in the present study were not randomly assigned to an organization or a nonorganization category; rather, subjects either spontaneously categorized the lists or they did not. It is possible that this relationship between organization and recall was actually due to a third variable such as education. In order to examine this possibility (since subjects with higher levels of education were also more likely to organize their lists), a partial correlational analysis between recall and clustering scores (on the subject-generated-study-lists) was carried out controlling for years of education. The results indicated that level of education appeared to account for part of the relationship between clustering and recall; however, it did not account for the entire relationship. On the other hand, when controlling for clustering, the relationship between education and recall was significantly reduced, suggesting that this relationship is due, in part, to differential organizational strategy use by more educated individuals. These findings are consistent with previous research that indicates that when subjects are instructed to categorize information they perform better on tests of recall (Hultsch, 1969).

The findings from this study indicate that written notes, such as list-making, are beneficial to later recall. In particular, list-making appears to reduce the difference in recall abilities between the young and old. Additionally, while the ability to recall information was greatest when subjects used notes as an internal strategy (knew they would not be allowed to refer back to their lists later), even subjects who expected to be allowed to refer back to their lists, but could not do so, benefited from the use of lists. Thus simple memory aids such as list-making, which are easy to use, can benefit the elderly with little cost in time and effort. Further research should examine whether these benefits are found in everyday life outside of the laboratory setting.

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