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Sara W. Smith ^a, George W. Rebok ^b, William Ray Smith ^c, Susan E. Hall ^d & Mary Alvin ^e

^a Department of Psychology, California State University, Long Beach, Long Beach, CA, 90840, U.S.A.

^b Department of Psychology, State University of New York Geneseo, Geneseo, NY, 14454, U.S.A.

^c Department of Psychology, California State University, Fullerton, Fullerton, CA, 92634, U.S.A.

^d Department of Psychology, University of Illinois, Chicago, IL, 60680, U.S.A.

^e American Language Institute, University of Southern California, Los Angeles, CA, 90007, U.S.A.

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Adult Age Differences in the Use of Story Structure in Delayed Free Recall¹

SARA W. SMITH,² GEORGE W. REBOK,³ WILLIAM RAY SMITH,⁴
SUSAN E. HALL,⁵ AND MARY ALVIN,⁶

Thirty-six young adults (*M* age = 24.3 years) and 36 old adults (*M* age = 71.8 years) listened to four double-episode stories having either standard, interleaved, or scrambled structure. Two days later they were asked to recall the stories. Analysis of the mean number of nodes recalled revealed no age differences in the recall of standard and scrambled stories with both groups recalling the standard stories equally well and the scrambled stories equally poorly. However, for interleaved stories, young adults followed their pattern of recall for standard stories while old adults followed their pattern for scrambled stories. Also, the age groups differed in their pattern of additions and distortions, with old adults giving more for standard stories and young adults giving more for scrambled stories. Results appear to support models of age-related differences in memory processes and/or strategies when material must be reorganized or hierarchized. Possible metacognitive differences were also discussed; i.e., old adults may aim to tell the story interestingly, while young adults aim to tell it accurately.

There is currently much interest in determining whether and why there are age differences in the way young and old adults process, store, and retrieve verbal materials. While most gerontological researchers have used isolated verbal units, a number of writers in the field have expressed a need for research using more meaningful materials [5]. In cognitive psychology, a topic of recent interest is the effect of the structure of meaningful prose material on memory. Understanding in both areas could be advanced by studying differences in the way adults of different ages use the structure of prose in memory.

Recently there have been several studies on age-related differences in prose recall. Most of these have focused on the question of whether there are differences in the overall amount of prose recall, but thus far no clear answer has emerged. In an early study, Gordon and Clark [4] found that older adults recalled fewer ideas from a prose passage than did young adults. This was demonstrated for both immediate and delayed recall intervals, and the magnitude of the age difference increased over time. In a subsequent study, Gordon [3] found that elderly subjects recalled significantly less material than young subjects, but no differences could be identified in the amount or type of organization of the sentences. However, Taub and Kline [14], using a multi-trial test of learning short paragraphs, found no superiority in recall for young adults until the third trial. More recently, Cohen [1] reported that an older adult group performed more poorly than a young adult group on a story recall task even though both groups were highly educated. In contrast, Meyer and Rice [12] found no evidence to support an age

deficit in total prose recall, although they found differences in the use of the hierarchical organization of the material. Inconsistencies among the above findings are probably due to differences in the materials, procedures, and subjects employed.

One way of attaining a better understanding of potential age-related differences is to look more carefully at the basic processes involved in prose recall, such as the role that the structure of a story plays in memory. Mandler [10] identifies three main functions of story structure in encoding: (a) providing possible frameworks for organizing the story, (b) helping the listener determine which details are relevant, and (c) determining when a particular section of the story is complete. Similarly, the structure can aid retrieval by providing a temporal sequence for organizing recall and for reconstructing missing parts. Researchers have demonstrated that the structure used influences both the overall amount recalled [11] and which segments of the story will be most readily recalled [15].

One approach to the study of story structure is to begin by proposing a "story grammar," i.e., a hierarchy of basic elements or nodes to represent the standard structure of a story. Several story grammars have been proposed, and Mandler's [11] is typical. The first node of an episode is the Setting, which sets the time and place. The Beginning then describes an event which starts the plot. There is a Reaction to the initial event, followed by the formulation of a Goal to deal with it. Next is an Attempt to attain the goal through some behavior, then an Outcome of success or failure. The Ending states the resolution of the episode. Using this set of grammatical rules, Mandler

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²From Department of Psychology, California State University, Long Beach, Long Beach, CA 90840, U.S.A.

³From the Department of Psychology, State University of New York, Geneseo, Geneseo, NY 14454, U.S.A.

⁴From Department of Psychology, California State University, Fullerton, Fullerton, CA 92634, U.S.A.

⁵From Department of Psychology, University of Illinois, Chicago, IL 60680, U.S.A.

⁶From American Language Institute, University of Southern California, Los Angeles, CA 90007, U.S.A.

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developed four simple double-episode stories, with each story having a common setting for the two episodes and each episode having a sequence of events fitting the standard structure [10]. From this standard structure, an interleaved structure was derived which systematically distorted the structure. The common setting was presented first; then the nodes from the two episodes were presented in alternation, keeping the original order of nodes within each episode.

Various studies have shown that stories presented in standard structure are easier to recall than those in nonstandard structure [10; 11; 16]. For example, while young adults showed no difference between standard and interleaved stories when a general measure of recall was used, they gave almost twice as many distortions of the original text when recalling the interleaved stories [10]. Furthermore, younger [10] or learning disabled [16] subjects found the interleaved stories considerably more difficult to recall. Kintsch et al. [9] have studied the effect of an even more extreme distortion of story structure, the scrambled structure. When nodes of a story were randomly ordered, the performance of young adults deteriorated markedly.

An interesting tie can be made between models of memory for prose structures and models of memory and aging. As Mandler described the process of recalling stories [10; p. 17], "the listener must keep previous nodes in mind until one or more subsequent nodes have occurred in order to organize all of the information into an appropriate structure.... If any nodes are omitted or are displaced from the ideal order, the chances of confusion or of encoding the information in terms of an unstable novel structure increase." That is, while the standard structure is designed to focus attention and provide a familiar organization, the interleaved structure seems to require division of attention and reorganization. The subject must attend to two separate episodes simultaneously and reorganize the material into meaningful units. With the scrambled structure, it is even harder to keep track of all relevant nodes and to reorganize them. This analysis suggests that old adults may find nonstandard structures particularly difficult. Several studies using nonprose materials have suggested that old adults may have difficulty with memory only or primarily when division of attention is required or the material must be reorganized for storage and retrieval [2; 13]. Even when they are capable of using organizational aids, they may be less likely to use them spontaneously [6; 7; 8]. If, as suggested by models of memory and aging, there is a greater limitation on the working memory of old adults when division of attention or reorganization is required, and if, as suggested above, the interleaved structure requires more of such processing, the interleaved structure should place a greater burden on old adults. However, old adults may do as well as young adults when little such reorganization is needed (in standard structure) or when the amount required is beyond the capacity of young adults (in scrambled structure).

The present study was designed to investigate the role of story structure in memory for prose in young and old adults. Three degrees of story structure were compared. Mandler's standard and interleaved stories were used, and scrambled versions of the stories were also formed. The major hypothesis was that older adults would be equivalent in performance to young adults when standard structure was used or when no structure (i.e., scrambled) was used, but they would recall less than young adults when nonstandard (i.e., interleaved) structure was used. Free recall was tested after a two-day retention interval so that rote memorization would be minimal and subjects would be forced to use the structure of the story to aid recall. Recall of each node of the story was scored in categories according to level of recall and deviation from the original story.

Method

Subjects and Design

Subjects consisted of 36 young adults (21 females, 15 males, M age = 24.3, range = 18-35) and 36 old adults (28 females, 8 males, M age = 71.8, range = 65-82). The mean years of education was 15.7 for young adults and 14.8 for old adults. Young adults were recruited from lower division classes in psychology at California State University, Long Beach, where they participated as part of a laboratory assignment. Active, noninstitutionalized old adults were recruited or referred from the campus community and community centers in the Long Beach area. Several potential subjects were eliminated because of hearing problems. Potential subjects were asked whether they had problems with hearing or reading; also, the researcher was able to verify the subject's hearing skills when scheduling the sessions by telephone.

A 2 x 3 x 6 design with two between-subjects factors and one within-subjects factor was used. Equal numbers of subjects from each age group (young, old) were randomly assigned to one of three story structure conditions (standard, interleaved, scrambled). Six nodes were scored for each of the two episodes of a story (beginning, reaction, goal, attempt, outcome, ending). Each subject heard and recalled four stories, all in the same structure.

Materials

The four stories developed by Mandler were used, with the standard and interleaved structures being the same as those used by Mandler. The standard structure consisted of two episodes, tied together by a common setting, that followed each other. The interleaved structure was formed by interleaving the nodes of the two episodes, keeping the original order of nodes for both episodes. The scrambled structure was formed by presenting the common setting first, then randomly ordering the remaining nodes of both episodes.

Each version of each story was tape-recorded by an adult male for presentation to the subjects. The orders of stories were counterbalanced for subgroups of subjects to prevent sequencing effects.

Procedure

Subjects were scheduled for two sessions, two days apart. They were told that the researcher was interested in how people recalled stories. During the first session, they were presented the four stories in the version for their assigned condition: standard, interleaved, or scrambled. They were asked not to discuss the stories or the study with anyone else.

Two days later they were asked to recall the stories orally, and their answers were tape-recorded. A list of story titles, arranged in the subject's presentation order, was provided to cue recall and to control the order of recall.

Scoring

After the subject's protocols were transcribed, they were analyzed in terms of the five categories used by Mandler [10]. (See Table 1 for examples of segments scored in each category). A segment was given a rating in Category I, strict recall, if it matched a node from the original story very closely. A segment was rated in Category II, loose recall, if it matched the original node more loosely or represented only partial recall. The combination of categories I and II provided a measure of the total

Table 1

Examples of Use of Scoring Categories
Original text of Beginning node from episode 1 of "The Unlucky Twins": One day Jennifer's parents gave her a dollar to buy the turtle she wanted, but on the way to the pet store she lost it.
Category I—Strict Recall Her parents gave her a dollar to go to the pet store and buy herself a turtle. On the way to the pet store, she lost the dollar.
Category II—Loose Recall And the girl got a dollar, but on the way to the store she lost it.
Category III—Structural Substitutions Somehow the girl got herself into trouble one day.
Category IV—Additions Jennifer very much wanted a turtle so her mother gave her a dollar to go to the pet store and buy herself a turtle. But on the way, as she skipped along, she lost her dollar.
Category V—Distortions The girl found a dollar and then she took it to her mom.

amount recalled. Category III referred to segments that fulfilled the structural requirements of a node but did not match the original content. Category IV included reasonable additions, exaggerations, and repetitions. Category V referred to distortions of the original node. The combination of categories IV and V provided an overall measure of deviations from the original text. Categories I-III were mutually exclusive, but a subject could receive a score in Category IV and/or Category V along with a score in one of the first three categories. All scoring was blind to subject characteristics or group assignment.

Results

Reliability of Scoring

Two independent raters scored each protocol. Raters agreed 96% of the time as to whether a segment should be scored in any category and 78% of the time as to which category and node it belonged in. Most disagreements occurred when a subject combined nodes and the raters disagreed as to whether the segment belonged in one node or the other or both. A second team of three raters resolved the discrepancies.

Design of Analyses

The number of scores given each node in each category was summed over the eight episodes (four stories) presented. For each of the scoring categories, an analysis of variance was performed using age and structure of stories as between-subject variables and node of the story as a within-subject variable.

Category I—Strict Recall

Overall, 7% of the nodes given in recall were scored in Category I. Analysis of variance of Category I scores showed

an overall effect due to age, $F(1,66) = 4.37, p < .05$, and no other significant effects. Although young subjects had higher means for each structure, planned comparisons indicated that the difference was significant only in the interleaved condition, $F(1,66) = 4.71, p < .05$.

Category II—Loose Recall;
Category I plus II—Total Recall

Overall, 45% of the nodes recalled were scored in Category II and 52% were in the combination of Categories I and II. Analysis of variance of loose recall scores and of total recall scores showed the same significant effects. For simplicity, only the analyses of total recall scores will be presented (see Figure 1). There was not a significant main effect due to age, but planned comparisons revealed that young subjects had significantly higher recall of interleaved stories, $F(1,66) = 4.49, p < .05$, while the two age groups did not differ on standard or scrambled stories.

There was a significant effect due to structure of the story, $F(2,66) = 6.88, p < .01$. A Newman-Keuls analysis indicated that standard and interleaved stories were significantly higher in recall than scrambled stories ($p < .05$) but were not significantly different from each other ($p > .05$). There was also a significant effect due to node, $F(5,330) = 58.81, p < .001$, and a significant interaction between structure and node, $F(10,330) = 2.95, p < .01$.

Finally, there was a significant three-way interaction among age, structure, and node, $F(10,330) = 1.86, p < .05$. To aid in interpreting the interaction, Newman-Keuls analyses were performed to compare group performances on each node. There were no significant differences between the groups on three

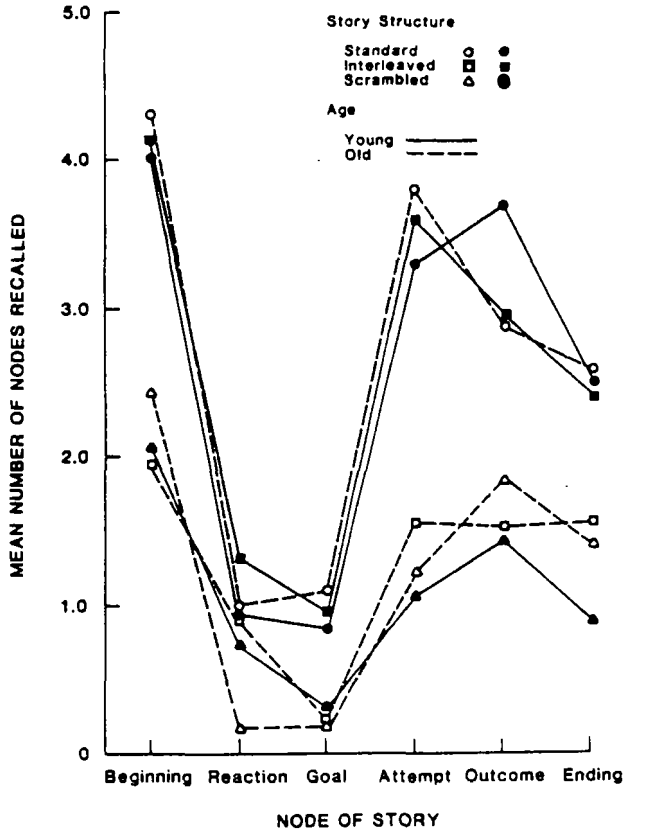


Figure 1. Total recall as a function of age, story structure, and story node.

nodes—Reaction, Goal, and Ending. For the Outcome node, only the extreme groups differed from each other ($p < .05$). However, for the Beginning and Attempt nodes, the analysis revealed an interesting pattern. In each case, the means divided into two groups significantly different from each other ($p < .05$). The high scores came from the standard stories as recalled by both age groups and the interleaved stories as recalled by young subjects, while the low scores came from scrambled stories as recalled by subjects of both age groups and from the interleaved stories as recalled by old subjects. The graphic representation of these results (see Figure 1) is even more dramatic in demonstrating the three-way interaction. The patterns of recall for young and old subjects were highly similar to each other for standard story structures. For scrambled stories, the patterns for both ages were also highly similar. The overall level of recall for scrambled stories was lower than for standard stories, and there was less differentiation across nodes. However, for interleaved stories, there was a striking difference between the two age groups. Recall for the young subjects followed the pattern of recall for standard stories, while recall for old subjects followed the pattern for scrambled stories.

Category III—Structure Substitutions

Overall, Category III accounted for only 3% of the scores. Analysis of variance showed significant effects due to age, $F(1,66) = 13.11$, $p < .001$, node, $F(5,330) = 4.73$, $p < .001$, and the interaction between age and node, $F(5,330) = 2.75$, $p < .05$. Younger subjects had more scores in this category, especially in the Beginning and Reaction nodes.

Category IV—Additions, Category V—Distortions, Category IV plus V—Total Deviations

Overall, 17% of the scores were in Category IV, 28% in Category V, and 45% in the sum of the two categories. The pattern of results was similar for the three analyses; only the results of the analysis of the combined categories will be reported. The only significant main effect was due to node, $F(35,330) = 38.74$, $p < .001$.

However, there was a significant effect due to the interaction between age and structure of the story, $F(2,66) = 10.29$, $p < .001$. The overall means for the two age groups were essentially identical (1.528 for young subjects and 1.526 for older subjects), making the interaction particularly striking. Newman-Keuls analyses indicated that whereas old adults had a significantly higher number of deviations on standard stories, $p < .05$, young adults had significantly more deviation for scrambled stories, $p < .05$. That is, old subjects gave more additions and distortions for the stories which they recalled best as a group, while young subjects gave more for scrambled stories, which they recalled worst as a group. For individual scores, a somewhat similar relationship occurred. Older subjects showed a strong positive relationship between total recall scores and deviation scores ($r = .62$, $p < .001$), while young subjects had a nonsignificant correlation ($r = .25$, $p > .05$). For old subjects, those who had good recall were the ones who added material.

Analyses Involving Sex of the Subject

In order to determine whether age effects might be confounded due to the unequal distribution of the sexes, analyses were performed using sex, age, and story structure as the independent variables. Analyses of total recall scores showed that

the only significant effect involving sex was the three-way interaction, $F(2,60) = 3.18$, $p < .05$. To interpret the interaction, it was decomposed. It was reassuring to find that the age by structure interaction occurred for both female subjects, $F(2,43) = 3.52$, $p < .05$, and male subjects, $F(2,17) = 3.69$, $p < .05$. However, of the four age by sex groups, only old females showed a significant main effect due to structure, $F(2,25) = 5.70$, $p < .01$, even though old males had the same pattern of low recall for interleaved stories. Analyses were also performed on the total deviations given by subjects. There were no main effects or interactions involving sex of the subject.

Discussion

Results of the present study indicate that the scoring criterion used affects the conclusion drawn about age differences in prose recall. When protocols were scored for strict recall, young adults recalled more overall; when they were scored more loosely, the overall difference between age groups disappeared. This supports the suggestion [5] that some of the discrepancies among results in previous research on age differences may be due to the scoring criterion used.

With either criterion for recall, results supported the hypothesis that young adults would recall more than old adults only when a nonstandard or interleaved structure is used. When standard structure was used both groups did equally well, and when scrambled structure was used both groups did equally poorly. However, when the interleaved structure was used, young adults performed as well as in the standard condition while old adults performed as poorly as in the scrambled condition.

Several possible explanations of the difference in recall of interleaved stories are consistent with models developed in previous research. The study appears to add support from the realm of prose research to the model that older subjects have most difficulty when division of attention and/or reorganization of material is required [2; 13]. The standard structure may provide adequate organization for both groups, and the scrambled version apparently exceeds the attentional and organizational capacity of young as well as old subjects. However, the interleaved structure may require a level of reorganization that is within the capacity of young but not old subjects.

Another model consistent with the obtained results is that older subjects may be less likely to use organizational aids spontaneously for encoding and retrieval, even when they are capable of using them [6; 7; 8]. Thus they may be less likely to reorganize the story into standard structure in order to gain efficiency in storage and recall. A further, indirect test of this hypothesis was made by analyzing the frequency with which subjects produced recall protocols of interleaved stories given in the form of the standard structure, with the two episodes presented completely separately. Unfortunately, few subjects of either age group gave protocols in that form; the analysis failed to reveal significant differences between age groups, although the means were in the expected order.

Results also appear to be consistent with Meyer's model of age differences in the use of different levels of importance in the structure of a story. Meyer and Rice [12] showed that, while overall levels of recall were equivalent for young, middle, and old age adults, young adults recalled relatively more of the nodes judged to be at a higher structural level. They interpreted this to mean that young adults were more sensitive to the structural characteristics of the material. In the present study, both groups showed the same pattern of differentiation across nodes for standard stories and showed little differentiation for the scrambled ones. That is, both groups were equally sensitive to the struc-

ture when presented in standard form and equally insensitive when there was no structure. However, as indicated by the three-way interaction, when the interleaved structure was used, young adults demonstrated the same differentiation across nodes as when the story was presented in standard form, but older adults showed no more differentiation than for scrambled stories. Perhaps the prose material used by Meyer and Rice was similar in difficulty to the interleaved structure used in the present study, in that it required some degree of active reorganization on the part of the subject. In contrast, Mandler's standard structure stories were designed to be familiar and to facilitate the use of preexisting structural expectations. Also, Meyer and Rice's passages were longer, demanding more selection of materials for recall.

Several analyses suggest that the age groups may also differ in the way they construe the goal of the task when they are asked to recall stories. For example, analyses of deviations from the original text in the form of additions and distortions revealed interesting patterns that are different for young and old subjects. Both as a group and as individuals, old adults gave most deviations when they recalled the material best, i.e., there were more deviations for standard stories and from subjects with the best recall. Young adults gave more deviations for scrambled stories, the most difficult to recall. A possible explanation is that older subjects may try to tell the most interesting story possible from what they remember, adding and changing material to embellish what they remember. In contrast, young adults may attempt to reproduce the story as accurately as possible. In their attempt to provide the entire standard story structure, they may use additions and distortions to fill in those nodes they do not recall. This model is supported by analyses of two of the other scoring categories and by an additional informal analysis. The finding that young subjects had higher scores when protocols were scored by exact recall could be due, in part, to these subjects' stronger belief that their task is to reproduce the story exactly. An informal analysis is consistent with this interpretation. Raters noted the number of times subjects corrected their own responses during the recall session. Of the 19 times this occurred, 14 were from young subjects. Young subjects also had higher scores in the category representing structural substitutions, that is, in the use of material that was relatively content-free but that served the purpose of maintaining the structure of the story. Apparently young subjects were more concerned with accurately reproducing the content and structure of the original story; older subjects may have been relatively more concerned with keeping the story flowing in an interesting fashion. Such metacognitive differences would be consistent with typical differences between the social and intellectual contexts of each age group [12].

There are many facets of adult age differences in memory for prose that remain to be explored. Differences in memory

processes, in the spontaneous use of organizational aids, in the use of the structural importance of nodes, and in the construal of the recall task may be involved. Further research in each area is needed, and such research could have both theoretical and practical implications.

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