1996

The Effects of Verbal and Pictorial Elaborations on Memory in Younger and Older Adults

Deanna Kathleen Dokey

The Effects of Verbal and Pictorial Elaborations on Memory in Younger and Older Adults

Deanna K. Dokey

Katie E. Cherry

Louisiana State University

Running Head: VERBAL AND PICTORIAL ELABORATIONS, MEMORY AND AGING

Abstract

We examined the mnemonic benefit of verbal and pictorial elaborations on recall in younger and older adults. During acquisition, subjects studied a set of 16 sentences (8 base, 8 elaborated) under one of three encoding conditions: a) sentences only; b) sentences with matching pictures; c) incomplete sentences with matching pictures. At test, subjects were asked questions about the content of the sentences. Results showed that pictures enhanced recall performance for both age groups, relative to the sentences only condition. Recall of base sentences exceeded that of elaborated sentences when a strict scoring criterion was used, but this outcome was reversed when a lenient scoring criterion was used. Implications of these findings for current issues on elaboration effects in adulthood are discussed.

The Effects of Verbal and Pictorial Elaborations on Memory in Younger and Older Adults

Researchers have found that elaborations, which expand on ideas by providing more detailed information, can enhance retention of sentential material. For example, studies with children and young adults have shown consistently that verbal elaborations can serve as a memorial aid when they clarify an arbitrary relationship between the target word and the sentence concept (Stein, Littlefield, Bransford, & Persampieri, 1984; Stein, Bransford, Franks, Owing, Vye, & McGraw, 1982; Stein & Bransford, 1979). Similar results showing improved recall have emerged for older adults (Hashtroudi, Parker, Luis, & Reisen, 1989; Rankin & Collins, 1985, 1986). Given the well-documented declines in memory shown by older adults, they may have a greater potential to benefit from elaboration strategies.

The type of elaboration and the conditions under which elaborations are provided seem to influence the effectiveness of these elaborations for improving recall. Specifically, the experiments of Cherry, Park, Frieske, and Rowley (1993) closely examined these limiting conditions and found that older adults performed best when given

experimenter-provided elaborations during both acquisition and retrieval (see Cherry et al., 1993, Exp. 2). Cherry et al.'s findings suggest that the experimenter should provide elaborations and some form of the original sentence at retrieval to elicit correct recall responses.

In addition to the positive effects of verbal elaborations on recall, researchers have also found that pictures can improve memory if they portray a clear theme or relationship inherent in the sentence material (Stein, Brock, Ballard, & Vye, 1987; Baumeister & Smith, 1979; Haring & Fry, 1979). However, if the relationship within the sentence remained inherently arbitrary, recall performance did not improve, despite the presence of a picture (see Stein et al., 1987). In a study with young children, Pressley, Pigott and Bryant (1982) found that preschoolers' recall was greatest when the elaboration type for the sentence and the picture matched. In studies with older adults, introduction of pictorial and verbal elaborations has been shown to yield significantly lower error rates for older adults in assembly tasks (Morrell & Park, 1993). Moreover, in a simple recall test, the older adults' mean number of correctly recalled adjectives for the condition with only simple sentences nearly tripled when a

matching pictorial elaboration was added (M=.12 to M=.34) (Cherry et al., in press, Exp. 2). And despite the tripling effect, the results still show considerable room for improvement. Together, these findings support the conclusion drawn by Stein and his colleagues that elaborations are most effective when they clarify an arbitrary relationship.

The similarity between the effects of verbal and pictorial elaborations was corroborated by Mayer and Gallini (1990), who found that subjects had to be able to understand the text and the picture to show a recall advantage. This result was best achieved through explanatory elaborations, which provided details that "transfer appropriate processing," a concept adapted by Lyman and McDaniel (1990) and supported by Waddill and McDaniel (1992), says are essential in determining recall responses. Thus, textual information with matching pictures can work together to improve retention.

The primary aim of the present study was to replicate and extend the results of Cherry et al. (in press) by examining more closely the role of pictures in improving recall of sentences in younger and older adults. A secondary aim of this research was to examine the effects of

verbal elaborations present during acquisition on recall performance. Therefore, subjects were presented with both base sentences and elaborated sentences (in blocked order) during acquisition.

The present methodology was designed to enhance the likelihood that subjects would process the pictures during acquisition; therefore, the following three conditions were included. A text only condition (i.e., base and elaborative sentences) was designated as the control. A matched text condition (i.e., sentences and pictures matching in elaboration type) was used to demonstrate the hypothesized picture facilitation effects. It was predicted that the present study would replicate earlier findings for these two conditions by showing an improved recall performance rate for elaborated sentences (Stein et al., 1984) and sentences with pictures (Cherry et al., in press). A significant reduction in age-related differences was also expected for elaborated sentences (Rankin & Collins, 1985, 1986) and sentences with pictures (Cherry et al., in press; Morrell & Park, 1993).

In the third condition, matched text completion, subjects must use the picture content to complete the sentence. We assumed that this manipulation would encourage

subjects to focus more closely on the pictures and sentences presented together. This is important, because other researchers have shown that pictures are most useful when some interaction with the sentential content is required (Digdon, Pressley, & Levin, 1985; Purkel & Bornstein, 1980; Baumeister & Smith, 1979). Baumeister and Smith (1979) found that subjects presented with sentences and pictures performed significantly better on recognition performance than did other subjects who were not shown the matching pictures. This is another example of how important establishment of a clear relationship between sentences and pictures seems to be.

The methodology implemented by Digdon, Pressley, and Levin (1985) showed that students performed significantly better on the cued-recall tests when they had been given a partial picture and an object picture along with the story. By being forced to interact with all of the stimuli, the subjects were encouraged to define a clear relationship for the theme of the stimuli. This clear relationship, in turn, would create the necessary encoding methods required for successful recall. Another study by Purkel and Bornstein (1980) showed that in children, the use of partial pictures, missing only the target objects significantly improved

recall. The experiment also showed that mental images of the target objects are just as important as the object pictures themselves. If this effect could be found in young children who utilize the pictures and only listen to the sentences rather than read them, it is seems reasonable to assume that similar effects would appear for adults, especially if they were allowed to read the sentence. Therefore, upon forced interaction with the picture, older adults should successfully reach a higher level of recall performance than in previous studies (Cherry et al., in press; Hashtroudi et al., 1989; Rankin & Collins, 1985, 1986).

Recall of target phrases was used as the primary dependent measure rather than the target adjectives used in the Stein paradigm, because they represent the main action of the sentence and should better illustrate the picture facilitation effect (Digdon et al., 1985; Purkel & Bornstein, 1980). This modification does not alter predictions issuing from the Stein paradigm. A cued-recall format was used, where subjects were given a series of content questions that directly addressed the target phrases and indirectly inquired about the relationship in the picture (Cherry et al., 1993; Miller & Pressley, 1989; Howe

& Hunter, 1986; Pressley et al., 1982; Purkel & Bornstein, 1980). The cue was derived from the original sentence (e.g., "What did the grimacing man do?").

We expected to observe significant main effects of age, elaboration type, and encoding condition based on prior research with older adults in the Stein paradigm (cf. Cherry et al., 1993; Cherry et al., in press). In addition, we expected that older adults would show a relatively greater benefit from the explanatory elaborations and also from the presence of pictures than do the younger adults.

Method

Research Participants

A total of 96 persons participated in the study. There were 48 younger adults (M = 22.1 years, SD = 6.0) who were undergraduate students at Louisiana State University. They were given course credit in exchange for their participation in the experiment. There were 48 community-dwelling older adults (M = 71.0 years, SD = 4.9) recruited from local church groups and civic organizations in Baton Rouge, LA. Older persons were paid $5.00 each in exchange for their voluntary participation. Subjects' responses to a demographic questionnaire containing a subset of three self-perceived health questions (OARS, Duke University, 1975)

indicated that most rated their health as good to excellent (young, 95.7%, old, 87.5%), most reported that their health was the same or better than that of age-matched peers (young, 89.4%, old, 95.8%), and that their health stood in the way of their activities little to not at all (young, 100%, old, 89.6%). The Gardner and Monge (1977) 30 Point Word Familiarity Survey was given to each subject as a measure of verbal ability. Older adults' mean verbal score (19.5) exceeded that of the younger adults (14.0), a significant difference, $t(93) = 5.342$, $p < .001$. All participants possessed at least 20/30 corrected binocular acuity assessed with a standard Snellen eye chart.

Materials

The stimulus materials included three sets of 16 sentences (8 base and 8 explanatory elaboration sentences) drawn from a larger sentence set used by Cherry et al. (1993). Base sentences were simple statements that contained an inherently arbitrary relationship between the subject and the object (e.g., The grimacing man held the cheese). That is, given the text, there is no obvious reason why the grimacing man would be holding cheese. Explanatory elaboration sentences included the base sentence, along with a phrase that established a reason why

the man holding the cheese would be grimacing (e.g., The grimacing man held the cheese while the mousetrap sprang on his finger). A complete list of the stimuli appears in Appendix A.

Each sentence also had a matching pictorial illustration (cf. Cherry et al., in press). The pictures consisted of black-and-white line drawings that illustrated the content of the sentences, either base or explanatory (see Figure 1).

For each sentence (base, elaborated), the designated information to-be-recalled included the direct object of each sentence, as in Rankin and Collins (1985), rather than the typical adjective recall, as used in other studies in the Stein paradigm (see Stein & Bransford, 1979; Stein, Morris, & Bransford, 1978; Cherry et al., 1993; Cherry et al., in press). For example, the information to-be-recalled for the sentence "The grimacing man held the cheese" would be the target phrase, "held the cheese, " rather than the target adjective, "grimacing." This was done to examine not only the processing of the sentence itself, but more importantly, the processing of the pictorial content, as explained next.

Three different encoding conditions were therefore

structured around the presence of the target phrases. The text only format consisted of one type of complete sentence, either base or explanatory, in which the direct object was clearly stated. The matched text consisted of one type of complete sentence and a complete matching pictorial illustration, with the target word stated in the former and represented pictorially in the latter. The third encoding condition, the matched text completion, had one type of incomplete sentence, where the direct object was replaced by a blank line, (e.g., the grimacing man held the _____), and a complete matching pictorial illustration, with the direct object clearly represented. Pictures contained all of the necessary content and contextual information to prompt the subjects to correctly generate the missing item from sentence.

Acquisition stimuli were assigned to a counterbalance plan to control for potential stimulus effects and order effects (see Appendix B). For example, the sentence "The grimacing man held the cheese" appeared as a base sentence for half of the subjects, and as an elaborated sentence for the other half. In addition, acquisition stimuli were presented in blocks so that half of the subjects studied base sentences followed by elaborated sentences; this order

was reversed for the other half. Because studies have shown that young adults tend to spontaneously generate elaborations whereas older adults do not (Rankin & Collins, 1985, 1986), it is reasonable to assume that testing the elaboration type first could have carryover effects for the base condition. The generation of spontaneous elaborations for base material would nullify the intended purpose of the base stimuli, which is for them to serve as a control for the elaborated stimuli; this confound would unnecessarily contaminate the results of the experiment. Therefore, counterbalancing acquisition order was done to control for carryover effects that could result from spontaneous generation of elaborations for base sentences after exposure to the elaborated sentences. A between-groups design would have controlled for this, but the benefit of the statistical power obtained by using a within-subjects design greatly outweighed the possible consequences of any order effect.

A cued-recall format was selected for this experiment, after Cherry et al. (1993). The retrieval stimuli consisted of questions in the interrogative form of the base sentences, as in Digdon et al. (1985) and Purkel and Bornstein (1980). The questions asked the participant what the main action of a certain sentence was (e.g., What did

the grimacing man do?), as done similarly in Miller and Pressley (1989). This method of testing recall was used because "What?" questions tend to focus more on the recall of the main point of the sentence. Therefore, use of this kind of question attempted to demonstrate the practicality of the theory behind the experiment, which was to see if pictures, by presenting both content and contextual material, would establish an adequate stimulus relationship to improve recall of the content information. A complete list of content questions appears in Appendix C.

All stimuli were presented individually on slides via Kodak Carousel projector. The acquisition stimuli were presented at a rate of 10 s; the questions for the cued-recall test were presented at a rate of 12 s.

Design

The design was a 2 x 3 x 2 mixed factorial with age (young, old) and encoding condition (text only, matched text, matched text completion) as between-group factors and elaboration type (base, elaborative) as a repeated-measures factor. Sixteen subjects were tested in each between-group condition.

This design was chosen in order to accomplish certain goals: 1) to replicate the verbal elaboration effect; 2) to

replicate the positive effect of pictorial illustrations on recall; and 3) to accurately isolate and assess the true effect of pictorial elaborations. Furthermore, the repeated-measures component of the design allowed for a more powerful experiment to better detect the existence of a significant verbal elaboration effect.

Procedure

Initial pilot testing was done to determine the appropriate number of sentences for the acquisition and retrieval tasks. Various studies have shown that the number of sentences may differentially affect recall performance across verbal elaboration conditions. For example, Cherry et al. (1993, Exp. 1A, 1B) found no significant difference in recall performance across verbal elaboration type conditions with 28 sentences, nor did Cherry et al. (in press, Exp. 1) with 24 sentences. However, Stein et al. (1987) found significant effects of elaboration type using 10 sentences. This discrepancy suggests that there may be boundary conditions for verbal elaborations to be most effective as memory support.

Twenty-seven younger adults who did not participate in the experiment proper provided the pilot data. The subjects were presented with 24 sentences (12 base, 12 elaborated),

counterbalanced according to order and elaboration type. Following a distractor task, subjects were presented with questions about what each man did (as in the experiment proper). The results of the pilot study indicated that 24 sentences led to limited recall performance. For this reason, 16 sentences (8 base, 8 elaborated) were used in the experiment proper.

Subjects were tested in small groups of up to four using intentional learning procedures. That is, they were informed that they would be tested on the presented material later, as in Cherry et al. (1993). The subjects in the matched text completion condition were instructed to use the matching picture to mentally fill in the missing word and complete the sentence that was presented. Following these instructions, subjects were given a short practice task to familiarize them with the study and test procedures. For each encoding condition, 4 sample stimuli (counterbalanced for order and elaboration type) were shown individually. Afterwards, a practice cued-recall test was administered.

Following practice, the acquisition stimuli were presented at a 10 s rate. The time interval between the presentation of the different elaboration types (base, elaborated), 10 s, was the same as that between sets within

each condition, so as not disrupt the flow of the experiment. After acquisition, a 2-min distractor task was given. The subjects were asked to continually subtract 7 from 500 on a separate page. After the distractor task was completed, the subjects were given the retrieval task. They were then told to record their answers on the sheet provided. At that time, they were shown a series of "What?" questions, asking them to recall the main action for a certain sentence. The questions were presented in a different random order so that the subjects had to rely on their memory for specific facts, rather than relying on order cues. For the subjects in the matched text and matched text completion conditions, the pictures did not accompany the questions at test, because they were designed to enhance their processing of the pictures during acquisition. After this part of the experiment was completed, subjects were given the verbal ability measure, the vision test, and the demographic questionnaire. Debriefing followed.

Results

Overview of Scoring and Analyses

The number of correctly recalled target "phrases," which answer the question asking what a certain man did,

were counted and expressed as a proportion of the total number of sentences per elaboration type (8). Correct answers were scored using both strict and lenient criteria. A strict scoring required that a correct answer contain the direct object of the base sentence reported verbatim and a verb semantically parallel to the verb in the original sentence (e.g., question: "What did the grimacing man do?" answer: "held the cheese" or "picked up the cheese"). A lenient scoring accepted responses that met one of three criteria: either 1) the correct action of the base sentence was implied (e.g., question: "What did the bearded man do?" answer: "walked out the door," instead of "walked out of the store"); or 2) the base sentence was integrated with the elaboration to imply the correct action (e.g., "What did the blind man do?" answer: "brushed the dog," instead of "held the brush and groomed his seeing eye dog"); or 3) the elaborations were simply substituted for the base target phrase (e.g., question: "What did the grimacing man do?" answer: "caught finger in a mousetrap," instead of "held the cheese while the mousetrap sprang on his finger"). Thus, each condition had two sets of proportion scores, one lenient, one strict, which were analyzed separately.

Performance was also evaluated on the number of error responses made. Errors were counted separately for the base and elaborated sentence types and expressed as a proportion of the number of base (8) and elaborated (8) sentences. Errors were also scored collapsing across elaboration type and expressed as a proportion of the total number of sentences (16) per condition. Errors were classified into three main categories. Omissions were counted for blank answers where subjects did not respond. Intralist errors included "wrong match-ups" in which a certain man was matched with the wrong direct object or action (e.g., question: "What did the grimacing man do?" answer: "stepped on an envelope," instead of "held the cheese"). Extralist errors were counted for responses that did not appear anywhere in the presented list of stimuli (e.g., question: "What did the grimacing man do?" answer: "served ice cream"). For each condition, proportion scores were calculated and analyzed separately.

In the analyses that follow, proportion scores were submitted to mixed 2 x 3 x 2 analyses of variance (ANOVAs), with age and encoding condition as between-group factors and elaboration type as a repeated-measures factor. Results are

described below for analyses of proportion correct (both strict and lenient scoring criteria) and analyses of errors (omissions, intralist, and extralist intrusions).

Principle Analyses

Mean proportion correct (strict scoring) as a function of the independent variables appear in Table 1. A mixed ANOVA conducted on the proportion scores yielded significant main effects of age, $F(1,90) = 75.304$, $MSe = .057$, $p < .001$, encoding condition, $F(2,90) = 3.803$, $p = .026$, and elaboration type, $F(1,90) = 37.105$, $MSe = .024$, $p < .001$.

The age effect occurred because younger adults correctly recalled more target phrases than did the older adults, with means of .49 and .19, respectively. This result replicated the findings from previous research which show that younger adults consistently outperform older adults in recall tasks (Cherry et al., in press; Cherry et al., 1993; Hashtroudi et al., 1989; Rankin & Collins, 1985, 1986).

The second significant main effect was found as expected for the encoding condition, with mean recall in the matched text condition (.40) exceeding that in the text only (.29) and matched text completion (.34) conditions.

Although prior research has shown that there may be certain constraints on the effectiveness of pictures in aiding recall, the present findings provide additional support for the existence of a picture facilitation effect (see also Cherry et al., in press, Exp. 2; Miller & Pressley, 1989; Stein et al., 1987; Digdon et al., 1985; Pressley et al., 1982; Purkel & Bornstein, 1980; Haring & Fry, 1979).

The elaboration type effect was due to greater recall with base sentences (.41) than with the elaborated sentences (.27), which is in the opposite direction of what was expected. That is, Stein and his associates' studies showing the elaboration effect typically find that elaborated sentences lead to better recall than do base sentences (Stein et al., 1984; Stein & Bransford, 1979; Stein et al., 1978). It may be that base sentences enjoyed a recall advantage over elaborated sentences, because base sentences contained relatively less information for subjects to remember. Further discussion of this point will be delayed until the results of the lenient scoring analysis are presented.

The interpretation of the three main effects was qualified by a significant Age x Elaboration Type

interaction effect, $F(1,90) = 11.009$, $MSe = .024$, $p = .001$. For the younger adults, mean recall with the base sentences exceeded that with the elaborated sentences; the means, in order, were .60 and .39. For the older adults, the pairwise difference between the base and elaborated sentences was smaller, with means of .22 and .16, respectively. There were no other significant effects in this analysis (F's < 1.23, p's > .296).

Lenient Scoring

Mean proportion correct (lenient scoring) as a function of the independent variables appear in Table 2. A mixed ANOVA conducted on the proportion scores yielded significant main effects of encoding condition, $F(2,90) = 8.813$, $MSe = .020$, $p < .001$, and elaboration type, $F(1,90) = 75.362$, $MSe = .017$, $p < .001$. Interestingly, the age main effect did not approach significance.

The significant encoding condition effect occurred because the matched text condition had a higher mean recall (.18) than either the text only condition (.15) or the matched text completion condition (.08). The pattern of pairwise mean differences was similar to that using the strict scoring criterion. That is, performance in the

matched text condition was somewhat greater than text only and matched text completion conditions, suggestive of beneficial effects of pictorial elaborations (Cherry et al., in press; Cherry et al., 1993; Hashtroudi et al., 1989; Rankin & Collins, 1985, 1986).

The second significant main effect revealed in the lenient scoring criterion analysis was the elaboration type effect. Under this criterion, the subjects correctly recalled more elaborated sentences (.21) than base sentences (.05). This pattern of results is consistent with the earlier Stein et al. reports (e.g., Stein et al., 1984; Stein & Bransford, 1979; Stein et al., 1978).

The interpretation of these effects was qualified by a significant Elaboration Type x Encoding Condition interaction effect, $F(2,90) = 6.849$, $MSe = .017$, $p = .002$. For the base sentences, floor effects were evident across conditions: mean recall for the matched text condition (.07) was only slightly greater than that for text only and matched text completion conditions (means of .04). For the elaborated sentences, mean recall was highest in the matched text condition (.28) and the text only condition (.26) and lowest in the matched text completion condition (.11).

There were no other significant effects in these analyses (F's < 2.632, p's > .108).

Analyses of Errors

Mean error rates are reported as omissions, intralist intrusions, and extralist intrusions (see Tables 3, 4, and 5, respectively). Separate analyses were conducted on each type of error, collapsed across elaboration type. The results are discussed below.

A mixed ANOVA conducted on the proportion scores for the omissions yielded significant main effects of age, $F(1,90) = 50.835$, $MSe = .036$, $p < .001$, and encoding condition, $F(2,90) = 2.938$, $p = .058$. The interaction was not significant ($F = 1.143$, $p = .324$).

The age effect occurred because a higher incidence of omissions appeared with the older adults (.56) than with the younger adults (.29). This finding was a natural result of the older adults' lower total correct mean recall (.31), relative to the younger adults (.64). Furthermore, the pattern of means for the encoding condition effect was consistent with the patterns in analyses discussed previously. Fewer omissions occurred in the matched text condition (.36) relative to both the text only condition

(.44) and the matched text completion condition (.47).

One significant main effect occurred in each of the intralist and extralist intrusion analyses of proportion error rates. An encoding condition effect was found for the intralist intrusion errors, where the matched text completion condition had a higher error rate (.07) than the text only condition (.04) and the matched text condition (.02), $F(2,90) = 3.404$, $MSe = .006$, $p = .038$. There were no other main effects found for the intralist errors ($F = 1.436$, $p = .243$). For the extralist intrusion errors, a significant main age effect was found because the younger adults had a lower mean error rate for extralist intrusions (.03) compared to the older adults (.08), $F(1,90) = 12.231$, $MSe = .006$, $p = .001$. There were no other effects found for the extralist errors ($F = 1.037$, $p = .359$).

General Discussion

The principle findings that emerge from this research can be summarized as follows. First, the presence of pictorial illustrations during study enhanced recall performance more than sentences alone for both younger and older adults. Second, recall with base sentences exceeded that with elaborated sentences when a strict scoring

criterion was used, but this outcome was reversed using a lenient scoring criterion. Third, follow-up error analyses indicated that while older persons made more omission and extralist intrusion errors than younger adults did, the age groups did not significantly differ on intralist intrusions. These findings and their implications are discussed more fully below.

Picture Facilitation Effects

The first finding of interest concerned the replication of the picture facilitation effect (Cherry et al., in press; Stein et al., 1984; Stein & Bransford, 1979; Stein et al., 1978). Comparison of the mean recall for the matched text and text only conditions clearly demonstrates that the presence of pictorial illustrations does enhance recall performance. However, the matched text completion condition, which was expected to show inflated recall performance due to the deeper level of processing required, proved not to be a significant memory aid under these present testing conditions. This finding was in opposition to the conclusion drawn by Digdon et al. (1985) that the more the subjects can use the picture in conjunction with text, the greater the improvement in performance. In this

study, the complexity of the acquisition task for this condition may not have allowed subjects to adequately encode the sentence material. Nevertheless, the matched text condition conclusively reaffirmed the effectiveness of pictorial illustrations, and this finding cannot be discounted. Furthermore, although the mean recall across the different encoding conditions was expected to be influenced by age-related differences, no significant interaction of the two independent variables was detected.

Verbal Elaboration Effects

The second finding was that elaborated sentences enhanced recall more than base sentences when the lenient scoring criterion was used. However, the opposite pattern of results was obtained when the strict scoring criterion was used. This result is noteworthy because the cued-recall retrieval questions, which targeted phrases rather than adjectives, allowed for closer analysis of how the elaborations were affecting recall performance. Because the retrieval task required subjects to recall more than just one word as in the studies utilizing adjective recall as their dependent measure, there was more room for variation in responses; thus, two levels of scoring, strict and

lenient, had to be implemented. The difference between the means for the strict and lenient scoring suggests that elaborations may be more beneficial for encoding general concepts rather than specific wording. Base sentences were simpler and contained less information to generalize. With that reasoning, base sentences would naturally be more conducive to recall of the exact phrasing, and thus would yield a higher mean with the strict scoring. Elaborated sentences, on the other hand, seemed to allow subjects to encode the meaning of the sentence and store the sentence in a summarized version. As a result, the elaborated sentences would be scored as correct more often with the lenient scoring.

From this perspective, it would seem reasonable to expect that the total proportion correct of elaborated sentences (strict + lenient scores) would yield a higher mean than for the base sentences although this was not the case. However, as suggested by Cherry et al. (in press, Exp. 1; 1993, Exp.2), retrieval task format may contribute greatly to the overall effectiveness of the elaborations. The Cherry studies suggest that elaborations were most effective when presented again at retrieval. The absence of

the elaborations during the retrieval task in this experiment is a potential explanation for why the overall proportion correct for elaborated sentences (M = .49) was not significantly greater than for the base (M = .46).

Another interesting and unexpected trend showed younger and older adults performing at the same level of recall under the lenient scoring criterion (see Table 2). Age-related differences found at the strict scoring criterion reaffirmed the greater capacity of younger adults to recall specific wording. However, this trend suggests that both the younger and older adults generalized the sentence content equally as often.

Analyses of Errors

A third interesting finding resulted from the analyses of errors. Importantly, differences across encoding conditions for omission and intralist intrusion error rates support the picture facilitation effect, since the matched text condition had the least number of errors reported. This finding demonstrates that pictures have memorial benefits for accuracy in recall as well. Furthermore, age-related differences were observed in the omission and extralist intrusion error rates, although not in the

intralist intrusion rate.

Limitations

There are two limitations of the present study that deserve brief mention. First, although the theoretical concepts behind the matched text completion condition were driven by prior research on processing of pictorial stimuli (Digdon et al., 1985), the condition might have placed too much emphasis on the process of completing the sentence and not enough on encoding the content of the sentence. Further research where text completion is varied within-subjects, rather than between-groups as was the case here, may provide a more sensitive test of the hypothesis under investigation. As a second limitation, the matched text completion condition might have been more effective had adjectives been used as the dependent measure instead of direct objects. Future research could be directed toward examining the effectiveness of different types of retrieval tasks on memory performance (e.g., recognition, adjective recall, etc.) to determine whether boundary conditions exist for pictorial facilitation effects.

In closing, the present research established three significant conclusions. Our findings replicated previous

research, demonstrating that pictorial illustrations do provide memorial support that enhances performance for younger and older adults in cued-recall tasks. In addition, as a new finding, verbal elaborations were shown to positively influence recall only when a lenient scoring criterion is imposed. Finally, age-related differences were found to negatively affect recall performance of older adults, who made more omission and extralist intrusion errors than did the younger adults. Further research to explore the generality of these findings seems warranted.

References

Baumeister, A. A., & Smith, S. (1979). Thematic elaboration and proximity in children's recall, organization, and long-term retention of pictorial materials. Journal of Experimental Child Psychology, 28, 132-148.

Cherry, K. E., Park, D. C., Frieske, D. A., & Rowley, R. L. (1993). The effects of verbal elaborations on memory in young and older adults. Memory & Cognition, 21, 725-738.

Cherry, K. E., Park, D. C., Frieske, D. A., & Smith, A. D. (in press). Verbal and pictorial elaborations enhance memory in younger and older adults. Aging and Cognition.

Digdon, N., Pressley, M., & Levin, J. R. (1985). Preschoolers' learning when pictures do not tell the whole story. Educational Communication and Technology Journal, 33, 139-145.

Duke University Center for the Study of Aging and Human Development. (1975). OARS Multidimensional Functional Assessment Questionnaire., Durham, NC: Duke University.

Gardner, E., & Monge, R. (1977). Adult age differences in cognitive abilities and educational background. Experimental Aging Research, 8, 337-383.

Haring, M. J., & Fry, M. A. (1979). Effect of pictures on children's comprehension of written text. Educational Communication and Technology Journal, 27, 185-190.

Hashtroudi, S., Parker, E. S., Luis, J. D., & Reisen, C. A. (1989). Generation and elaboration in older adults. Experimental Aging Research, 15, 73-78.

Howe, M. L., & Hunter, M. A. (1986). Long-term memory in adulthood: An examination of the development of storage and retrieval processes at acquisition and retention. Developmental Review, 6, 334-364.

Lyman, B. J., & McDaniel, M. A. (1990). Memory for odors and odor names: Modalities of elaboration and imagery. Journal of Experimental Psychology: Learning, Memory, & Cognition, 16, 656-664.

Mayer, R. E., & Gallini, J. K. (1990). When is an illustration worth ten thousand words? Journal of Educational Psychology, 82, 715-726.

Miller, G. E., & Pressley, M. (1989). Picture versus question elaboration on young children's learning of sentences containing high- and low-probability content. Journal of Experimental Child Psychology, 48, 431-450.

Morrell, R. W., & Park, D. C. (1993). The effects of age, illustrations, and task variables on the performance of procedural assembly tasks. Psychology and Aging, 8, 389-399.

Pressley, M., Pigott, S., & Bryant, S. L. (1982). Picture content and preschoolers' learning from sentences. Educational Communication and Technology Journal, 30, 151- 161.

Purkel, W., & Bornstein, M. H. (1980). Pictures and imagery both enhance children's short-term and long-term recall. Developmental Psychology, 16, 153-154.

Rankin, J. L., & Collins, M. (1985). Adult age differences in memory elaboration. Journal of Gerontology, 40, 451-458.

Rankin, J. L., & Collins, M. (1986). The effects of memory elaboration on adult age differences in incidental recall. Experimental Aging Research, 12, 231-234.

Stein, B. S., & Bransford, J. D. (1979). Constraints on effective elaboration: Effects of precision and subject generation. Journal of Verbal Learning and Verbal Behavior, 18, 769-777.

Stein, B. S., Bransford, J. D., Franks, J. J., Owings, R. A., Vye, N. J., & McGraw, W. (1982). Differences in precision of self-generated elaborations. Journal of Experimental Psychology: General, 111, 399-405.

Stein, B. S., Brock, K. F., Ballard, D. R., & Vye, N. J. (1987). Constraints on effective pictorial and verbal elaboration. Memory & Cognition, 15, 281-290.

Stein, B. S., Littlefield, J., Bransford, J. D., & Persampieri, M. (1984). Elaboration and knowledge acquisition. Memory & Cognition, 12, 522-529.

Stein, B. S., Morris, C. D., & Bransford, J. D. (1978). Constraints on effective elaboration. Journal of Verbal Learning and Verbal Behavior, 17, 707-714.

Waddill, P. J., & McDaniel, M. A. (1992). Pictorial enhancement of text memory: Limitations imposed by picture type and comprehension skill. Memory & Cognition, 20, 472-482.

Appendix A

Base acquisition sentences used for encoding task.

1. The sitting man untied his shoe.
2. The smiling man stepped on an envelope.
3. The frozen man took the umbrella.
4. The blind man held the brush.
5. The short man held the broom.
6. The scratching man stood next to the tree.
7. The sleeping man sat in the chair.
8. The muscular man watched the television.

Elaborative acquisition sentences used for encoding task.

1. The masked man picked up the can and sprayed the poisonous gas.
2. The fat man read the sign that said the ice was thin.
3. The squatting man held the wrench and fixed the pipe under the sink.
4. The bearded man walked out of the store carrying a can of shaving cream.
5. The grimacing man held the cheese while the mousetrap sprang on his finger.
6. The dusty man held the rope and lassoed the wild calf.
7. The assaulted man pointed a finger at the criminal in the lineup.
8. The windblown man closed the door as the tornado whipped down the street.

Appendix B

Counterbalance Plan

YOUNG SUBECTS:

Text Only -- Tray 1

Ss #	Set	Order
1-4	1	b/e = 1
5-8	1	e/b = 2
9-12	2	b/e = 1
13-16	2	e/b = 2

Matched Text -- Tray 2

Ss#	Set	Order
17-20	1	b/e = 1
21-24	1	e/b = 2
25-28	2	b/e = 1
29-32	2	e/b = 2

Matched Text Completion -- Tray 3

Ss#	Set	Order
33-36	1	b/e = 1
37-40	1	e/b = 2
41-44	2	b/e = 1
45-48	2	e/b = 2

Counterbalance Plan

OLD SUBJECTS:

Text Only -- Tray 1

Ss#	Set	Order
101-104	1	b/e = 1
105-108	1	e/b = 2
109-112	2	b/e = 1
113-116	2	e/b = 2

Matched Text -- Tray 2

Ss#	Set	Order
117-120	1	b/e = 1
121-124	1	e/b = 2
125-128	2	b/e = 1
129-132	2	e/b = 2

Matched Text Completion -- Tray 3

Ss#	Set	Order
133-136	1	b/e = 1
137-140	1	e/b = 2
141-144	2	b/e = 1
145-148	2	e/b = 2

Appendix C

Content questions used for cued-recall retrieval task.

1. What did the muscular man do?
2. What did the assaulted man do?
3. What did the windblown man do?
4. What did the sitting man do?
5. What did the short man do?
6. What did the squatting man do?
7. What did the sleeping man do?
8. What did the bearded man do?
9. What did the grimacing man do?
10. What did the fat man do?
11. What did the smiling man do?
12. What did the scratching man do?
13. What did the frozen man do?
14. What did the masked man do?
15. What did the dusty man do?
16. What did the blind man do?

Table 1 Mean Proportion Correct, Strict Scoring

AGE	Encoding Condition		
Elab. Type	T. O.[a]	M. T.[b]	M. T. C.[c]
Young			
Base	.49 (.34)	.70 (.23)	.60 (.21)
Elab	.30 (.20)	.45 (.18)	.41 (.23)
Old			
Base	.21 (.19)	.28 (.21)	.18 (.13)
Elab	.14 (.11)	.17 (.16)	.17 (.11)

Note. Standard deviations are given in parentheses.
[a]T. O. = Text Only condition.
[b]M. T. = Matched Text condition.
[c]M. T. C. = Matched Text Completion condition.

Table 2 Mean Proportion Correct, Lenient Scoring

AGE	Encoding Condition		
Elab. Type	T. O.[a]	M. T.[b]	M. T. C.[c]
Young			
Base	.06 (.11)	.09 (.12)	.07 (.10)
Elab	.28 (.18)	.31 (.19)	.10 (.12)
Old			
Base	.03 (.07)	.06 (.08)	.02 (.04)
Elab	.24 (.16)	.25 (.20)	.17 (.11)

Note. Standard deviations are given in parentheses.
[a]T. O. = Text Only condition.
[b]M. T. = Matched Text condition.
[c]M. T. C. = Matched Text Completion condition.

Table 3 Mean Error Rates as a Function of Age, Elaboration Type and Encoding Condition

Omission Error Rate

AGE	Encoding Condition		
Elab. Type	T. O.[a]	M. T.[b]	M. T. C.[c]
Young			
Base	.38 (.33)	.17 (.16)	.28 (.19)
Elab	.29 (.25)	.20 (.14)	.42 (.17)
Old			
Base	.62 (.20)	.56 (.25)	.59 (.24)
Elab	.49 (.19)	.52 (.31)	.61 (.22)

Note. Standard deviations are given in parentheses.
[a]T. O. = Text Only condition.
[b]M. T. = Matched Text condition.
[c]M. T. C. = Matched Text Completion condition.

Table 4 Mean Error Rates as a Function of Age, Elaboration Type and Encoding Condition

	n Intralist Intrusions		
AGE	Encoding Condition		
Elab. Type	T. O.[a]	M. T.[b]	M. T. C.[c]
Young			
Base	.05 (.08)	.02 (.05)	.05 (.07)
Elab	.04 (.06)	.02 (.04)	.06 (.10)
Old			
Base	.06 (.11)	.02 (.05)	.10 (.16)
Elab	.01 (.03)	.02 (.05)	.07 (.11)

Note. Standard deviations are given in parentheses.
[a]T. O. = Text Only condition.
[b]M. T. = Matched Text condition.
[c]M. T. C. = Matched Text Completion condition.

Table 5 Mean Error Rates as a Function of Age, Elaboration Type and Encoding Condition

Extralist Intrusions			
AGE	Encoding Condition		
Elab. Type	T. O.[a]	M. T.[b]	M. T. C.[c]
Young			
Base	.02 (.05)	.03 (.06)	.02 (.07)
Elab	.06 (.10)	.03 (.06)	.02 (.04)
Old			
Base	.11 (.14)	.04 (.08)	.10 (.13)
Elab	.10 (.14)	.07 (.09)	.07 (.08)

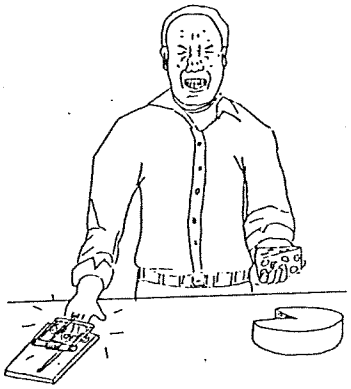
Note. Standard deviations are given in parentheses.
[a]T. O. = Text Only condition.
[b]M. T. = Matched Text condition.
[c]M. T. C. = Matched Text Completion condition.

Figure 1

BASE SENTENCE:

The grimacing man held the cheese.

BASE SENTENCE WITH EXPLANATORY ELABORATION:



The grimacing man held the cheese while the mousetrap sprang on his finger.