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# Age Deficits in Retrieval: The Fan Effect

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*The fan effect paradigm was used to investigate age-related changes in the effects of different levels of interference on retrieval. Younger and older adults learned a list of person-activity "facts" in which each person and each activity occurred in 1, 2, or 3 different facts (fan level). A subsequent speeded recognition test required the participants to distinguish the learned facts from foils constructed by recombining the same concepts. On this recognition test, both groups showed an increase in response time and errors as the fan level of the probe increased. For older adults these effects were larger, however, indicating an age-related increase in interference effects in retrieval. These results are consistent with a theoretical framework (Hasher & Zacks, 1988) which proposes an age-related decline in the ability to screen irrelevant information out of working memory. The findings also have implications for age differences in discourse processing and other cognitive tasks that crucially depend on the timely and accurate retrieval of stored information.*

THE ability to rapidly and accurately retrieve information into working memory is central to many complex cognitive tasks. As an example, consider that the online construction of a coherent understanding of a discourse requires that each newly encoded thought be linked to its relevant antecedents (e.g., Just & Carpenter, 1987). The building of such linkages in turn depends on timely access to antecedents from the preceding discourse and/or from general knowledge. To the extent that the retrieval processes which provide access to those antecedents are slowed or less accurate, linkages will not be established and comprehension will suffer. As well, because recall ultimately depends on the cohesiveness of the structure established during encoding, the failure to form linkages also results in the poorer recall of the passage.

We examined the possibility that speeded retrieval processes, even of well-known material, are less efficient in older than in younger adults. The experimental task is based on the fan effect paradigm of Anderson (e.g., 1974, 1983). This paradigm was chosen because it permits the analytic study of retrieval processes under conditions of time pressure and varying levels of interference.

In the basic fan effect paradigm, participants first learn a set of target facts (e.g., "*The doctor took the car for a short test drive,*" "*The judge cut the apple pie into six pieces.*") In a subsequent speeded recognition test, participants are asked to distinguish between the target facts and unstudied foil facts constructed from re-pairings of the subject and predicate phrases of the targets (e.g., "*The doctor cut the apple pie into six pieces.*") Measures are taken of both speed and accuracy at performing this task. When the target facts are arbitrary and unrelated to each other, the typical result is a "fan effect" on retrieval. Specifically, the fan size or level affects performance such that the more facts that are learned about a particular concept (e.g., "*the doctor*"), the longer it takes to retrieve any one of those facts and usually the more errors are made (e.g., Anderson, 1974, 1983). Under these circumstances the potential for interference is maximal and the usual explanation of the basic fan effect is that such interference occurs because facts sharing the same concepts compete with each other at retrieval.

It can be noted that there are conditions under which fan effects are weakened or eliminated. These conditions include the use of thematically related sets of facts (e.g., Reder & Anderson, 1980; Smith, Adams, & Schorr, 1978). However, because age differences in retrieval may be especially pronounced when the potential for interference is high, the use of such materials was avoided in the present study, and the target stimuli were arbitrary, unrelated facts. Three fan sizes were used and both reaction times and errors were measured to determine whether older adults show a greater fan effect than younger adults.

It can be argued that the outcome of the current experiment is important aside from any theoretical considerations which might predict age differences in the fan effect. For example, results demonstrating an age-related increase in interference effects on retrieval performance could contribute to an understanding of age deficits in those cognitive activities for which fast retrieval of target information under conditions of potentially high levels of interference is important for success (as seems to be the case in discourse processing). Nonetheless, the experiment had a particular theoretical impetus which we now briefly describe (see also the Discussion).

The theoretical view motivating this research is a new account of cognitive aging deficits (Hasher & Zacks, 1988) which focuses on developmental changes in attentional processes, in particular, in those *inhibitory* attentional mechanisms which ordinarily prevent irrelevant information from gaining access to working memory and which, should such information gain access, function to quickly suppress it. The assumption is made that these mechanisms become inefficient with aging (see Hasher & Zacks, 1988; Hasher, Stoltzfus, Zacks, & Rypma, 1990). This assumption is motivated by a consideration of a growing body of substantial evidence that suggests that elderly adults have a reduced ability to inhibit competing or irrelevant thoughts. The elderly show increased rates of irrelevant and/or personalistic intrusions in speech (Gold, Andres, Arbuckle, & Schwartzman, 1988), increased rates of intrusions in free recall (Stine & Wingfield, 1987), and increased rates of repeating already produced responses (Koriat, Ben-Zur, & Sheffer, 1988). The semantic memory literature also provides a number of findings consistent with the notion of problems in inhibitory control. Elderly adults seem to have more difficulty than young adults in dampening a thought once it has been activated, and thus they show increased interference effects of irrelevant context in a sentence priming task (Nebes, Boller, & Holland, 1986); also, the elderly show increased false recognition rates to new words semantically related to presented words (Rankin & Kausler, 1979).

Inefficient inhibitory mechanisms may make it difficult for older adults to screen out irrelevant thoughts inadvertently activated by the experimental materials and to focus on one thought at a time. For example, in the present study, while a subject is trying to learn the fact "*The judge cut the apple pie into six pieces,*" the other *judge* and *apple pie* facts and associations from previous experience will tend to become activated as well. Older adults will have more trouble suppressing such activation, and will therefore tend to form more spurious associations with the experimental concepts than will the younger adults. In essence then, at any experimental, or nominal, fan size, the *effective* fan size will be larger for older adults than for younger adults. The effects of a larger effective fan size can be expected to be amplified at retrieval: There correct responding requires the inhibition of experimentally provided, nonprobed-for facts along with any self-generated, irrelevant facts. Thus, the Hasher and Zacks view predicts a larger fan effect among older adults.

## METHOD

*Participants.* — Twenty-seven young adults ($M$ = 19.1 yrs, $SD$ = 1.1) were recruited from the undergraduate population at Michigan State University. The undergraduates received credit for an introductory psychology course requirement or earned $4.00 per hour. Twenty-seven elderly adults ($M$ = 69.1 yrs, $SD$ = 3.1) were recruited from various senior citizens' organizations. The elderly adults were community residents in good health and they provided their own transportation to the university. They earned $8.00 per hour. The participants in both age groups were tested individually in a single session lasting approximately 90 min.

The WAIS-R vocabulary test was given to all participants. The mean vocabulary scores (out of a maximum of 70) were 43.8 ($SD$ = 8.0) for the young adults and 55.3 ($SD$ = 8.4) for the elderly adults, $t(52) = 5.10, p < .01$. Higher verbal ability scores are typically reported for elderly adults participating in cognitive gerontology research, unless specific attempts are made to equate verbal ability (cf. Gick, Craik, & Morris, 1988).

*Design and materials.* — The to-be-learned facts all had the form "*The person* [type of professional] *performed an activity.*" The 9 persons and the 9 activities used to generate the experimental facts learned by each participant are shown in the Appendix. In order to minimize the number of facts a participant had to learn, the critical items on the recognition test represented only three levels of fan. With the first number representing the number of facts for a particular person and the second number representing the number of facts for a particular activity, the fan sizes were 1-1 (small), 2-2 (medium), and 3-3 (large).

The participants learned lists of 18 facts composed of 6 facts at the 3-3 fan level and 3 facts at each of the fan levels 1-1, 2-2, 2-3, and 3-2. This structure was generated by repeating specific persons and activities varying numbers of times across sentences. For example, the persons and activities in 2-2 facts each occurred in two different sentences. Nine different learning lists, all having the same structure, were generated by rotating the persons and activities across fan level. Each of the lists was learned by three younger and three older adults.

The recognition lists included 18 critical probes, half of which were studied facts and half foils. There were 3 studied facts and 3 foils at each of the 1-1, 2-2, and 3-3 fan levels. Foils were created by recombining persons and activities at appropriate fan levels. In addition, the recognition list included 27 filler probes, 18 of which were foils and 9 of which tested noncritical studied facts (i.e., studied sentences with 2-3 and 3-2 fan levels). (A complete listing of the materials can be obtained from the authors.)

*Procedure.* — The experiment had two main parts: a learning session in which the 18 sentences were memorized and a speeded recognition test in which probe items were judged as studied sentences or foils. Both parts of the experiment used an Apple 2e microcomputer outfitted with a Mountain Hardware clock which permitted millisecond timing of presentation and response times. Game paddle buttons were used for responding on the recognition test.

A study-test procedure was used during the fact acquisition phase. During a study trial, the 18 sentences were shown one at a time on a computer screen for 7 sec each. On the test trial which followed each study trial, participants attempted to orally answer questions of the forms, "*Who did some* activity?" and "*The* person *did what?*". The correct answers to these questions required the production of 1, 2, or 3 persons or activities, depending on the fan level of the concept. Each activity and each person included in the study facts was tested once for a total of 18 questions. The correct answer was immediately provided when a participant made an error. A different random presentation order was used on each study and each test trial. Study and test trials continued until a participant answered all 18 questions correctly on two successive trials. Thus, young and elderly participants were required to meet the same acquisition criterion.

In the speeded recognition test, participants judged whether or not a particular sentence was from the study set. Each of the critical probes (9 studied facts and 9 foils) was tested 6 times. Each of the filler probes occurred once. These 135 trials were divided into 3 blocks of 45 trials, each of which included 9 fillers and 2 presentations of each of the critical probes. Three fillers were placed at the beginning of each block of trials. Otherwise, the order of items within blocks was random. The participants were permitted a brief break between blocks of trials.

The speeded recognition test was preceded by 18 practice trials on which participants learned to press quickly the appropriate button to indicate their judgment of whether or not a sentence was from the studied set. The stimuli to which participants responded on these practice trials were the phrases "SENTENCE STUDIED" and "SENTENCE NOT STUDIED." These practice trials and the actual recognition trials began with a 500 ms presentation of a + sign at the screen location corresponding to the first letter of the probe sentence. The probe sentence was then shown and remained on the screen until the participant responded. The instructions asked the participants to respond as quickly as possible consistent with high accuracy. When an error was made, an error message (**ERROR** SENTENCE STUDIED *or* **ERROR** SENTENCE NOT STUDIED) was shown for 1.5 sec. A 500 ms blank screen appeared before the start of the next trial. Following the recognition test, retention of all 18 studied facts was tested by asking the participants to again respond to the 18 recall probes used during the acquisition phase. This cued recall test measured the degree to which the learned facts could be accessed under unpaced conditions.

## RESULTS

### *Acquisition and Retention of the Studied Facts*

The older group required significantly more study-test cycles than the younger group to meet the acquisition criterion, $t(52) = 3.88, p < .01$. The mean numbers of cycles to learn were 7.4 ($SD = 2.9$) and 5.0 ($SD = 1.3$) for the older and younger adults, respectively. Within each age group, a higher vocabulary score was associated with faster learning of the 18 study facts, $r(25) = -0.56$ and $-0.52$ for the older and younger adults, respectively, both $ps < .05$. Because the older group had higher mean WAIS-R vocabulary scores than the younger group, these correlations suggest that the age difference in time to learn the list of facts might have been even larger had the samples been matched in verbal ability.

Ability differences did not, however, have a significant impact on age differences on the critical speeded recognition task. This was true for correlational analyses as well as for ANOVAs which included verbal ability as a factor. [We note the existence of comparable findings in the traditional verbal learning literature: Ability differences frequently influence learning speed but not retention for groups equated for amount learned (e.g., Underwood, 1983).]

The older adults made significantly more errors than the younger adults on the cued recall test of the 18 original study facts which followed the recognition trials, $t(52) = 3.71, p < .01$. However, the absolute size of the difference was small (97.9% and 95.6% correct recalls for the young and elderly groups, respectively), and both groups showed excellent final recall of the original sentences, including those that had not occurred on the recognition test. That is, for neither age group is there evidence of significant loss in the availability in memory of the facts that had been memorized.

Table 1. Mean Correct Response Times and Error Rates on the Recognition Test for Young and Elderly Adults

| | Response Times (in ms) | | | Percent Errors | | |
|---|---|---|---|---|---|---|
| Probe Type | Young Adults | Elderly Adults | *M* | Young Adults | Elderly Adults | *M* |
| Studied Sentences | | | | | | |
| Fan 1-1 | 1688 | 1948 | 1818 | 3.9 | 4.3 | 4.1 |
| Fan 2-2 | 1699 | 1970 | 1834 | 3.3 | 2.9 | 3.1 |
| Fan 3-3 | 1802 | 2175 | 1989 | 3.9 | 8.2 | 6.1 |
| *M* | 1730 | 2031 | | 3.7 | 5.1 | |
| Foils | | | | | | |
| Fan 1-1 | 1661 | 2017 | 1839 | 1.2 | 2.1 | 1.6 |
| Fan 2-2 | 1887 | 2274 | 2081 | 6.6 | 12.3 | 9.5 |
| Fan 3-3 | 2320 | 3210 | 2765 | 19.8 | 33.5 | 26.6 |
| *M* | 1956 | 2500 | | 9.2 | 16.0 | |

### *Fan Effects in Recognition*

The following results are based only on the trials testing critical probes. Data from the filler trials were not included in the analyses.

*Decision times.*— For each participant, correct response times greater than 2.5 *SD*s from that participant's mean in a particular condition were replaced by the 2.5 *SD* value. Few scores were affected by this adjustment, 2.31% and 2.45% in the younger and older groups, respectively. Mean correct decision times and error rates are presented in Table 1 for the younger and older adults separately.

The correct decision times were analyzed in an ANOVA with age as a between-subjects factor and fan (1-1, 2-2, 3-3) and probe type (studied vs nonstudied sentence) as within-subjects factors. The participants were significantly slower to reject nonstudied foils than to accept studied target sentences by an average of 348 ms, $F(1, 52) = 83.08, p < .01$, $MSe = 118002$. The fan effect was significant, $F(2, 104) = 34.18, p < .01, MSe = 259823$, as was the Fan × Probe Type interaction, $F(2, 104) = 28.67, p < .01, MSe = 141778$. Although the interaction indicates that the fan effect was smaller for studied sentences than for foils, separate analyses of the response times for the two types of items showed significant increases in retrieval time with increasing fan in both cases: for studied sentences, $F(2, 104) = 6.90, p < .01, MSe = 69412$; for foils, $F(2, 104) = 37.53, p < .01, MSe = 332188$. For both types of items, Newman-Keuls tests showed that decision times were significantly longer for 3-3 fan items than for 1-1 or 2-2 items, which did not differ from each other. These results demonstrate that our conditions replicate the basic effects of fan on retrieval time (Anderson, 1974, 1983).

The data in Table 1 also reveal considerable differences in the performance of the two age groups. These differences include overall longer response times for the older ($M = 2266$ ms) than for the younger ($M = 1843$ ms) adults, $F(1, 52) = 10.97, p < .01, MSe = 1321308$. Additionally, the older group was especially slow in responding to the foil items, $F(1, 52) = 10.15, p < .01, MSe = 118002$ for the Age × Probe Type interaction. Most important for the prediction that there would be an age-related increase in the fan effect, the Age × Fan interaction was significant, $F(2, 104) = 3.40, p < .05, MSe = 259823$. In fact, collapsed over probe type, the difference between 1-1 and the 3-3 fans was almost twice as big for the older adults as for the younger ones (differences of 710 and 387 ms, respectively). Even so, the fan effect was significant for each age group, taken separately: $F(2, 52) = 21.96, p < .01, MSe = 96495$ for the young group, and $F(2, 52) = 18.07, p < .01, MSe = 423150$ for the older adults. The Age × Fan × Probe Type interaction was also close to significant, $F(2, 104) = 2.69, p \sim .07, MSe = 141777$, indicating that the combination of high fan and foil recognition probes was especially difficult for older adults.

*Errors.* — An ANOVA similar to that carried out on the response times was performed on the errors. There were significantly more errors on foil (12.6%) than on studied (4.4%) sentence trials, $F(1, 52) = 58.88, p < .01, MSe = .009$, and the error rate rose with increasing fan (2.3, 6.3, and 16.3% errors, for fans 1-1, 2-2, and 3-3, respectively), $F(2, 104) = 38.05, p < .01, MSe = .014$. In addition, fan and probe type interacted, $F(2, 104) = 36.02, p < .01, MSe = .010$, such that the effect of fan was considerably smaller (although still marginally significant) for studied sentences, $F(2, 104) = 2.61, p \sim .08, MSe = .005$, than for foils, $F(2, 104) = 24.61, p < .01, MSe = .019$. Newman-Keuls tests showed that for foils, the error rate differed significantly between all levels of fan.

For the most part, the age differences in error rates paralleled those in reaction times. The mean error rate of the older participants (10.6%) was higher than that of the younger participants (6.4%), $F(1, 52) = 7.23, p < .01, MSe = .019$. The interaction of age and probe type was also significant, $F(1, 52) = 6.32, p < .05, MSe = .009$, reflecting a smaller age difference on studied sentence trials (3.7 vs 5.1% for younger and older adults, respectively) than on foil trials (9.2 vs 16.0%). The former difference was not quite significant ($p \sim .08$) whereas the latter was significant, $F(1, 52) = 7.94, p < .01, MSe = .024$.

In addition, the crucial Age × Fan interaction was significant in the error ANOVA, $F(2, 104) = 3.75, p < .05, MSe = .014$. The interaction took the same form as that for the reaction time data: The error fan was significant for each age group [for young adults, $F(2, 52) = 12.71, p < .01, MSe = .010$; for older adults, $F(2, 52) = 25.36, p < .01, MSe = .018$], but it was larger for the older adults: The difference in error rate between 1-1 and 3-3 items was 17.6% for the older group but only 9.2% for the younger group. The Age × Probe Type × Fan interaction was not significant here ($p > .25$) although it was marginally significant for the reaction time measure. This was the sole difference in outcomes between the two measures of the fan effect. Thus, the reaction and error data support each other and, importantly, there is no indication of age differences in speed-accuracy tradeoffs that could account for the age-related increase in the effect of fan on retrieval time.

*Testing effects.* — Because each of the critical recognition probes was tested six times, it is possible that the age differences were not initially present but developed over the course of testing. This might happen, for example, if older adults had increasing difficulty (arising perhaps from deficiencies in source monitoring; Cohen & Faulkner, 1989) distinguishing between studied facts and foils. Supporting this possibility is the high degree of similarity (same persons and activities) between the studied sentences and foils. On the other hand, error feedback was provided throughout recognition testing and both age groups had excellent performance on the final cued recall test. Nonetheless, the reaction time and error ANOVAs were repeated with first half versus second half of recognition testing as an additional factor. None of the interactions involving half of testing was significant. In fact, the only new significant result in these analyses was a finding of faster responding in the second half of testing $F(1, 52) = 40.91, p < .01, MSe = 135786$.

## Discussion

Using a speeded recognition task, both the reaction time and the error data clearly showed that older adults have greater problems with retrieval interference than do younger adults. Consistent with this conclusion is the finding that foil items, which require a more extensive search of memory than do targets (e.g., Anderson, 1983), produced larger age differences on the speeded recognition test than studied sentences.

A study by Cohen (1990) is the only other research we know of that has used the fan effect paradigm or similar procedures to study age differences in interference effects on memory. Her results also showed increased susceptibility to fan effects in older adults. There is, in addition, a collection of studies involving more traditional interference procedures, including studies of negative transfer in learning and of retroactive and proactive interference effects on recall. The fan effect paradigm differs from these methods in that it relies on time pressure to produce effects of different levels of interference on the retrieval of well-learned material.

Some recent studies using the more traditional interference procedures have obtained results consistent with the conclusion that older adults have greater difficulty than younger adults avoiding the effects of interfering associations. One example comes from the work of Kliegl and Lindenberger (1988), whose participants learned successive lists of paired associates in which the same stimulus and response words were repeatedly re-paired (the classic "A-B, A-Br" transfer paradigm). In two studies, the older participants produced significantly more intrusion errors from the preceding list on cued recall tests than did the younger participants. That is, the elderly participants were more likely to give as their response to an A item, the B word that had been paired with it in the preceding, rather than the current, list. Additional data come from Winocur and Moscovitch's (1983) experiments using the "A-B, A-C" (same stimuli, different responses in successive lists) paired-associate transfer paradigm. Compared to their younger group, Winocur and Moscovitch's older group produced greater negative transfer in second-list learning (i.e., slower learning) and a higher proportion of second-list learning errors which were intrusions from the preceding list. These data and others are among the findings which Winocur cites in support of his general claim that older organisms are more vulnerable than are younger ones to the negative effects of associative interference on memory (e.g., Winocur, 1982, 1984, 1988).

Despite these confirmatory results, consideration must also be given to data suggesting the opposite interpretation; that is, to findings suggesting *no* age-related increase in the negative impact of interference on learning and memory. These latter findings are among those that have been used to evaluate Welford's (1958) once-popular hypothesis of greater "interference proneness" or "interference susceptibility" among older adults (for reviews of the relevant literature, see Kausler, 1982; Salthouse, 1982). Early research seemed to support Welford's hypothesis, but this research was faulted for methodological problems, primarily for the failure to equate the degree of initial learning across ages. Experiments in the 1960s and 1970s which attempted to control for such problems tended not to show age differences in interference effects on either learning (negative transfer) or memory (retroactive and proactive interference in recall; cf. Kausler, 1982; Salthouse, 1982).

An at least partial resolution of the conflicting findings on Welford's hypothesis is suggested by a comparison of the studies which have and have not found age-related differences in interference proneness. One important point is that in the negative studies, the primary interpretive emphasis has been on overall recall measures. Analyses of different types of errors and/or of response times (as in the present study) may be more revealing of age differences.

Another important point is that the negative studies have included conditions which tend to reduce retrieval competition and which may even favor the older adults. In particular, most of the studies have used relatively short lists and slow pacing of recall. Furthermore, in order to equate degree of initial learning across ages, the older participants have received even shorter lists or slower presentation rates than the younger participants, or they have been given more trials to learn. (With these conditions, there may be greater overlearning of easy items for older than younger adults.) In combination, such conditions may have made many experiments insensitive to actual age differences in interference effects. When faster recall pacing is used and when the interference potential is high, Welford's predicted age differences tend to be found. For example, Arenberg (1967) found greater retroactive interference among older adults with fast but not with slow pacing of recall. This result is consistent with the findings of the present experiment which measured retrieval interference effects under time pressure. Additionally, Winocur and Moscovitch's (1983) results of greater interference effects among elderly individuals came from experiments using 12-pair paired-associate lists, whereas the negative studies have generally used shorter lists [e.g., 4-pair lists in Wimer & Wigdor (1958) and 7-pair lists in Hulicka (1967)]. It is also probably relevant that the A-B, A-Br transfer paradigm used by Kliegl and Lindenberger (1988) is one which produces a great deal of interference across lists (cf. Underwood, 1983).

Because conditions requiring fast retrieval of specific items from potentially large sets of information are representative of many everyday situations, including discourse comprehension, findings showing age-related increases in interference effects under such conditions are of some significance. The growing number of such findings suggests that it is time for a reconsideration of Welford's (1958) interference proneness hypothesis. It now appears that Welford's view may have considerable validity when applied outside the narrow confines of the experimental conditions which minimize interference effects and/or optimize the performance of older adults.

The question remains of *why* older adults should show increased susceptibility to interference. Any reasonable explanation must provide for an account of the overall pattern of results in the present study. There are two related notions of decreasing mental efficiency with aging that would appear relevant. The rate of mental processing may slow and/or the level of activation among concepts in memory may weaken as we age (e.g., Salthouse, 1982). Although we cannot completely discount these notions, they do not provide full accounts of the present data; for example, they do not suggest why older adults are specifically prone to making more false recognitions of foils.

The theoretical framework (Hasher & Zacks, 1988) which led to our interest in age differences in fan effects may provide a more coherent account of the overall pattern of results in the experiment. In particular, we suggest that while participants are trying to learn the list of facts, older adults' deficient inhibitory mechanisms at the attentional level permit more irrelevant information to become activated and, once activated, to allow it to remain so for longer periods of time. One result of this will be the formation by the older group of additional, essentially "spurious," links among shared concepts. Furthermore, once initially formed, these additional associations may create more problems for them than would similar erroneous connections for young adults. This is because, even with corrective feedback, elderly participants will have trouble inhibiting the recall of the erroneous associations on the test trials during acquisition, a factor which may promote the continued strength of these associations. As a consequence, older adults will be slower than younger adults to attain the acquisition criterion. Additionally, despite the attainment of that criterion, the quality of the encodings of the target facts may well be poorer (e.g., less distinctive) for older adults. This along with the factor of additional associations adding to the nominal sources of interference will result in poorer retrieval performance by older adults, particularly when information needs to be quickly accessed. The competition at retrieval among "spurious" links would manifest itself especially in an elevated false recognition rate for the older adults. In contrast, the disruptive effect of these additional sources of interference and poorer encodings may be less apparent, although still present, when there is little time pressure on performance, such as in the final self-paced cued recall test.

Our account of the experimental effects in terms of age-related inhibitory deficits is strengthened by several recent findings. For one, there is new evidence that attentional inhibitory mechanisms are impaired for older adults (Hasher et al., 1990). There is also evidence that older adults consider more alternative interpretations of a passage than do younger adults and that they fail to quickly abandon interpretations that are no longer appropriate (Hamm & Hasher, 1990). This is consistent with the view expressed here that the functional fan size is larger for older than for younger adults.

Although the present study deals with the retrieval of noncoherent, arbitrary facts, the findings have implications for age-related differences in the handling of everyday cognitive activities, including discourse comprehension. To the degree that older adults are more error prone or slower in the online retrieval of target information into working memory, they will be deficient in their ability to form critical linkages during the actual presentation of discourse. Where the linkages provide critical conceptual information, this deficiency means that older adults will be more likely than younger adults to fail to accurately and completely comprehend text materials (see, e.g., Zacks, Hasher, Doren, Hamm, & Attig, 1987). The present data demonstrate the existence of just such retrieval problems on the part of older adults. We note as well that the present theoretical orientation can be extended to account for individual differences among young adults (cf. Gernsbacher, Varner, & Faust, 1990).

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## Appendix

### *Materials Used in the Experiment*

| Persons | Activities |
|---|---|
| Executive | cut the apple into six pieces |
| Writer | put down a two-month security deposit |
| Pharmacist | took the car for a short test drive |
| Doctor | nervously watched the tightrope walker |
| Minister | ran at least four miles a day |
| Teacher | found a spot to sunbathe at the beach |
| Judge | decided to play chess with a friend |
| Anchorman | got change from the laundry attendant |
| Clerk | arrived at the train station early |