

The Impact of Proactive Interference and Mental Model Processing during On-Line Reading of Text among Younger and Older Adults

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OVERVIEW

Two studies were conducted to determine whether proactive interference in discourse memory is in part attributable to encoding. Using the Wickens paradigm, younger and older adults read a series of computer-presented sentences using the word-by-word "moving window" technique and then recalled the sentences. In both studies, the younger adults' recall performance was greater than that of the older adults. In Experiment 1, resource allocation to conceptual integration decreased across trials and increased when a shift in topic was presented, suggesting that PI may diminish the effectiveness of processing for both older and younger readers. Experiment 2 assessed the effects of PI on processing efficiency but also included a mental model condition, in which all sentences were ordered to create coherent text. An analysis of encoding time (reading time per concept recalled) showed that older adults required relatively more time to take significantly longer to process concepts in the proactive interference condition than in the mental model condition. Collectively, these results suggest that the effects of proactive interference may occur at both encoding and retrieval, but did not show age differences in susceptibility to proactive interference. The results also suggest that both younger and older adults may overcome the effects of PI in reading via organization provided by a mental model.

EXPERIMENT 1

RATIONALE

The goals of this experiment were:

- 1) To assess whether proactive interference (PI) affects encoding processes while reading text, and
- 2) To determine whether this effect varied with age

METHODS

Using the Wickens et al. (1963) paradigm, younger ($N=24$) and older adults ($N=24$) (see Table 1) read 6 blocks of 4 sentences (3 topically related and 1 topic shift) (cf. Dempster, 1985; see Table 2).

Table 1. Participant Characteristics

| | Young | Old |
|--------------|--------------|--------------|
| Age | 18.87 (1.23) | 70.29 (7.20) |
| Education | 12.63 (0.97) | 16.21 (4.40) |
| Vocabulary | 16.34 (6.89) | 27.92 (9.21) |
| WM Span | 5.76 (1.33) | 3.81 (1.31) |
| Stroop Ratio | 0.34 (0.12) | 0.51 (0.13) |

NOTE: Numbers in () are SDs; all age differences were significant, $p < .05$.

Table 2. Sample Passage

- 1) Anxiety is found in those who feel basically inadequate, and who therefore fear disapproval, punishment, and loss of love.
- 2) Withdrawal tendencies may grow progressively worse, until the individual avoids coping with even the simplest challenges of everyday life.
- 3) Depression is characterized by feelings of self-reproach or guilt and complaints of diminished ability to think or concentrate.
- 4) Clans consists of people who believe they descend from a common ancestor who lived in the distant mythological past.

RESULTS

Recall Performance

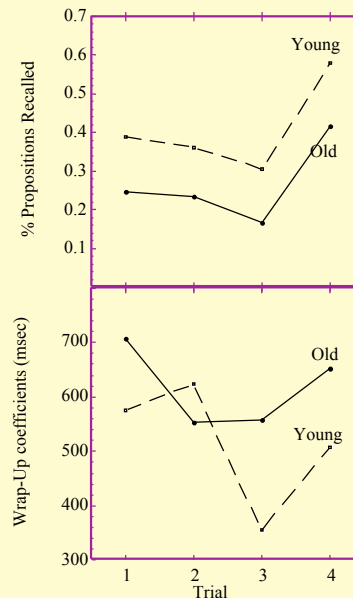
The proportion of propositions recalled (interrater agreement = 0.89) was analyzed in a 2 (Age) x 4 (Trials) ANOVA.

- ◆ Younger adults recalled a higher proportion of propositions than the older adults, $F(1, 34) = 8.00, p = .008$ at all four trials.
- ◆ A 2 (Age) x 3 (Trials) ANOVA indicated that recall decreased across the first three trials, $F(2, 20) = 11.14, p < .001$. Recall increased with a change in topic on the fourth trial, $t(35) = 11.60, p < .001$.
- ◆ The effect of trial did not vary with age, $F < 1$.

Reading Times

Regression analysis was used to isolate the allocation of reading time to conceptual integration at sentence boundaries (cf. Stine-Morrow, 2001). This variable was analyzed in a 2 (Age) x 3 (Trials) ANOVA to isolate interference effects.

- ◆ Time allocation to conceptual integration decreased reliably from Trial 1 to Trial 3, $F(3, 44) = 6.617, p = .001$ for both younger and older adults.
- ◆ The Trial x Age interaction, $F(3, 44) = 4.98, p = .005$ indicated unsystematic differences in this trial effect between younger and older adults.
- ◆ The 2 (Age) x 2 (Trial: 3 vs. 4) showed a reliable release from PI, $F(1, 46) = 8.46, p = .006$. This effect did not vary as a function of age, $F < 1$.



SEGUE

- ◆ Both older and younger adults demonstrated similar patterns of PI build-up in text recall.
- ◆ Both older and younger adults also demonstrated a reduction in the time allocated to conceptual integration, a factor that has been related to decreased recall in earlier research (e.g., Stine-Morrow et al., 2001), suggesting that text encoding processes are diluted by proactive interference.
- ◆ This implies that under conditions of PI, it would take relatively longer to study text for effective recall. This was explicitly tested in Experiment 2. This study also addressed whether the effects of PI on encoding efficiency could be reduced by the coherence created by a mental model.

EXPERIMENT 2

METHODS

Younger ($N=18$) and older adults ($N=17$) (see Table 3) read 15 12-sentence passages in three conditions (mental model (MM), proactive interference (PI), and proactive interference-shift (PIS)) word-by-word using the moving window method (see Table 4).

Table 3. Participant Characteristics

| | Young | Old |
|--------------|--------------|--------------|
| Age | 21.89 (3.10) | 75.06 (5.80) |
| Education | 13.94 (1.66) | 15.23 (2.28) |
| Vocabulary | 19.32 (6.41) | 33.34 (8.89) |
| WM Span | 5.31 (1.59) | 3.60 (0.71) |
| Stroop Ratio | 0.46 (0.19) | 0.30 (0.13) |

NOTE: Numbers in () are SDs; except education, all age differences were significant, $p < .05$.

RESULTS

Encoding Time

To measure the effects of interference, data from the PI and PIS conditions were averaged within each of the first three trials. Encoding time (indexed as time per concept recalled) was analyzed in a 2 (Age) x 2 (Condition; PI/PIS, MM) x 3 (Trial) ANOVA.

- ◆ Older adults required more time per concept for effective encoding than younger adults, $F(1, 33) = 11.95, p = .002$.
- ◆ Encoding time increased across the first three trials, $F(2, 66) = 17.38, p < .001$. This increase was similar across age and condition; for interactions involving the trial effect, $F(2, 66) < 1.78$. From Trial 3 to 4, encoding time showed no change in the PI condition, $t(34) = .008$, whereas encoding time reliably decreased in the PIS condition, $t(33) = 2.025, p = .051$.
- ◆ A Condition x Age interaction, $F(1, 33) = 6.53, p = .015$ showed that older adults required relatively less encoding time in the mental model condition than in the interference conditions.

CONCLUSIONS

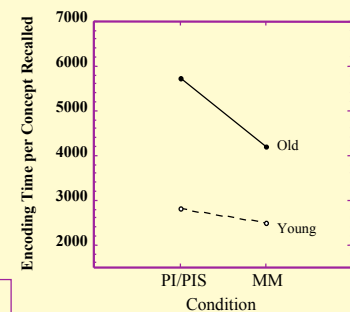
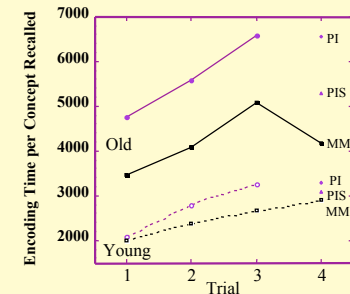
- ◆ Across two experiments, PI reduced the effectiveness of reading time allocation.
- ◆ There was no evidence that age moderated this effect.
- ◆ Encoding effectiveness among older readers was differentially enhanced by the availability of the mental model.

REFERENCES

- ◆ Dempster, F. N. (1985). Proactive Interference in sentence recall: Topic similarity effects and individual differences. *Memory & Cognition, 13*, 81-89.
- ◆ Stine-Morrow, E. A. L., Milinder, L., Pullara, O., & Herman, B. (2001). Patterns of resource allocation are reliable among younger and older readers. *Psychology & Aging, 16*, 69-83.
- ◆ Wickens, D. D., Born, Allen (1963). Proactive inhibition and item similarity in short-term memory. *Journal of Verbal Learning and Verbal Behavior, 2*, 440-445.

Table 4. Sample Passages.

| Mental Model Condition | Proactive Interference Condition |
|--|---|
| PREPARING A FAMILY DINNER | PREPARING A FAMILY DINNER |
| <i>Making the salad</i> The sister shredded the lettuce The husband sliced the tomatoes The nephew peeled the cucumbers | <i>Block 1</i> The uncle offered a blessing The father spread the tablecloth The aunt gathered the family |
| <i>Setting the table</i> The father spread the tablecloth The cousin folded the napkins The grandmother placed the flatware | <i>Block 2</i> The sister shredded the lettuce The grandfather proposed a toast The mother selected the wine |
| <i>Getting the drinks</i> The mother selected the wine The niece uncorked the bottle The brother filled the goblets | <i>Block 3</i> The brother filled the goblets The cousin folded the napkins The nephew peeled the cucumbers |
| <i>Sitting to eat</i> The aunt gathered the family The uncle offered a blessing The grandfather proposed a toast | <i>Block 4</i> The niece uncorked the bottle The husband sliced the tomatoes The grandmother placed the flatware |



ACKNOWLEDGEMENTS / CONTACT

This study was supported by Grant AG13935 from the NIA and from the Division 20 Students Award program.

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