Literacy Skill Modulates Age Differences in the Use of Context in Language Processing

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Introduction

- Sentence context can facilitate the processing of upcoming words, but individuals vary in how they use context to enable efficient word processing.
- In behavioral studies, older adults are often found to achieve greater contextual facilitation (e.g., Stine & Wingfield, 1994; Stine-Morrow et al., 2008), but in ERP studies, they typically show reduced contextual facilitation that varies with verbal ability (e.g., Federmeier et al., 2007, 2010).
- Contextual facilitation has been examined primarily among older adults with intact literacy skills, even though many adults in the U.S. read at a level considered below basic (14%; NRC, 2012). Little is known about how variation in literacy skill may modulate age effects in contextual facilitation.
- To examine the extent to which print decoding limits the use of context as a function of literacy skill and age, we examined N400s on target words varying in expectancy during reading and listening comprehension.

Method

Participants. Adults (20-72 years old; 3.7-14.3 reading grade level) were recruited from adult basic education settings and elsewhere in the community. Age and reading level were treated as continuous variables.

Reading	Young High-lit	Young Low-lit	Mid-age High-lit	Mid-age Low-lit
N	11	8	9	12
Age	39 (27-44)	33 (23-44)	56 (45-65)	55 (47-68)
Ed Level	12 (10-15)	12 (9-12.5)	12 (8-14)	12 (8-14)
SORT	11 (9-12.5)	8 (4.7-9.3)	12 (8.3-12.5)	8 (5.3-12.5)
RAN/RAS	12 (8.7-12.7)	7 (1.2-11.42)	11 (3.3-12.7)	8 (4-12.7)
WJ Fluency	10 (5-18)	6 (4.1-9.5)	12 (6.7-18)	5 (3.1-8.4)

Listening	Young High-lit	Young Low-lit	Mid-age High-lit	Mid-age Low-lit
N	8	9	12	11
Age	32 (20-44)	30 (23-38)	54 (48-64)	56 (45-72)
Ed Level	13 (11-14.5)	12 (7-14.5)	14 (12-15.5)	12 (7-16)
SORT	11 (9.5-12.5)	8 (6-8.9)	13 (12.5-12.5)	9 (4.4-12.5)
RAN/RAS	12 (8.4-12.7)	8 (1.2-12.3)	12 (10.6-12.7)	9 (4.8-12.4)
WJ Fluency	12 (8-15.2)	6 (4.1-8.9)	12 (7.1-15.9)	6 (3.7-10)

Stimuli. Texts were short sentences that strongly or weakly constrained a sentence-final target word (underlined below), which was either the expected or unexpected ending. Sentences were constructed so as to be at the appropriate level of difficulty for this sample (mean FK reading level = 2.3; 0.0-4.6).

Sentence type	Mean cloze	Example
SCE (strongly constraining, expected)	0.85	The prisoners were planning their escape. The time was running out.
SCU (strongly constraining, unexpected)	0.01	The prisoners were planning their party. The time was running out.
WCE (weakly constraining, expected)	0.27	He slipped and fell on the floor. He had to go to the hospital.
WCU (weakly constraining, unexpected)	0.02	He slipped and fell on the rock. He had to go to the hospital.

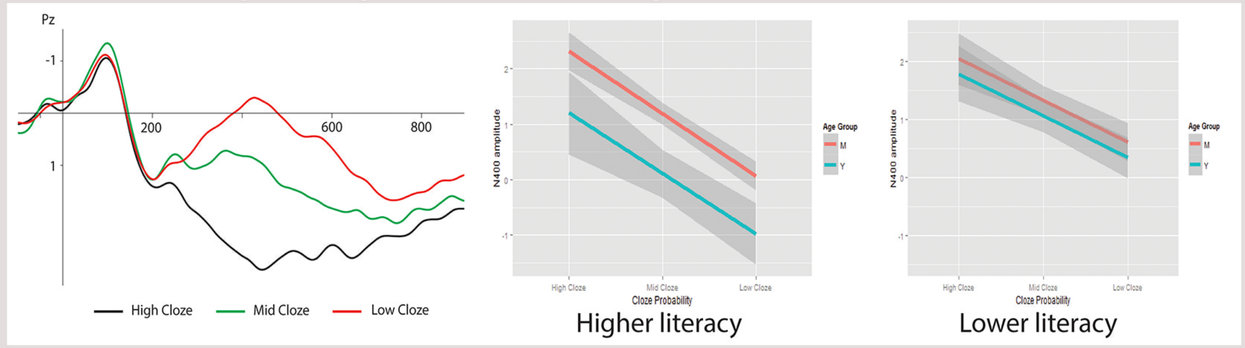
Procedure. ERPs were recorded as participants listened to the sentences or self-paced reading word-by-word, in order to answer subsequent comprehension questions. Comprehension accuracy did not vary with modality, and was good for both high-literacy (90.0%) and low-literacy (84.5%) groups.

Results

- Linear trend analysis was used to examine the effect of cloze on word processing, yielding three levels of word expectancy: high (=SCE), moderate (=WCE), and low (SCU+WCU), as a function of Age and Reading Level (both continuous variables) in a mixed-effects model.

Experiment 1: Reading (N400; 300-600 ms)

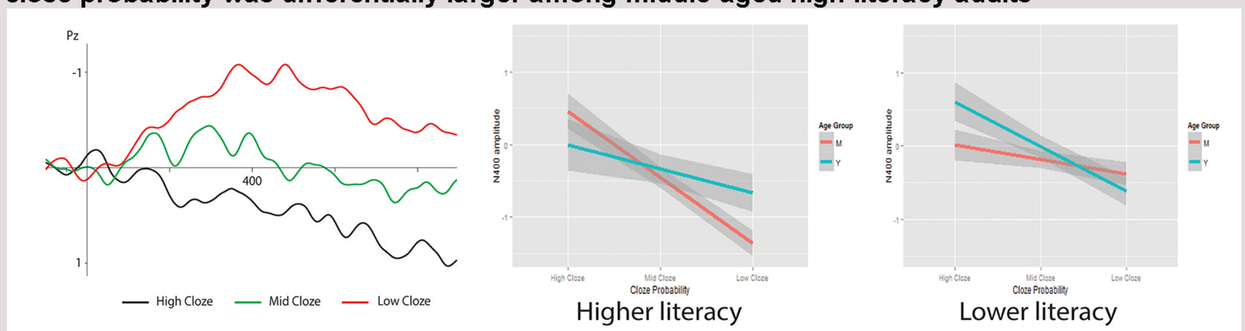
- Literacy skill, but not age, modulated the effect of cloze on N400 amplitude: regardless of age, the effect of cloze probability increased with literacy skill.



Expectancy x Age x Reading Level: t = .45; Expectancy x Age: t = 1.00; Expectancy x Reading Level: t = 1.738, p = .08

Experiment 2: Listening (N400; 200-500 ms)

- Literacy skill and age modulated the effect of cloze on N400 amplitude, such that the effect of close probability was differentially larger among middle-aged high-literacy adults



Expectancy x Age x Reading Level: t = 2.71; Expectancy x Reading Level interaction was significant for MA group, t = 4.078, but not for the YA group, t<1.

Conclusion

- In contrast to more extreme age group comparisons, middle-aged adults did not show a reduced context effect in N400 amplitude, suggesting that deficits in the construction of message-level semantics may be delayed until relatively late in life.
- Poor literacy skill can reduce the ability to use context to constrain upcoming words, even in listening, suggesting that print exposure may afford habitual practice with predictive processing.
- This cost of poor literacy skill may be exacerbated at older ages.

References

Federmeier, K. D. (2007). Thinking ahead: The role and roots of prediction in language comprehension. Psychophysiology, 44, 492-505.

Federmeier, K. D., Kutas, M., & Schul, R. (2010). Age-related and individual differences in the use of prediction during language comprehension. Brain and Language, 115, 149-161.

National Research Council. (2012). Improving adult literacy instruction: Options for practice and research. Washington, DC: National Academies Press.

Stine-Morrow, E. A. L., Miller, L. M. S., Gagne, D. D., & Hertzog, C. (2008). Self-regulated reading in adulthood. Psychology and Aging, 23, 131-153.

Stine, E. A. L., & Wingfield, A. (1994). Older adults can inhibit high-probability competitors in speech recognition. Aging and Cognition, 1, 152-157.

Acknowledgment

We thank the Institute for Education Sciences (Grant R305A130448) for their support.

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