

Aging effect in the processing of homonymy and polysemy in Korean sentence comprehension

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Previous studies have explored the presence of individual differences in the resolution of lexical ambiguity as a function of readers' working memory which might play a role as storage capacity or inhibition controller. We extended this issue by comparing old readers to young readers in the processing of homonymy and that of polysemy. The type of ambiguous words was manipulated as homonymy in Examples (1-4) and polysemy in Examples (5-8). Prior to the occurrence of ambiguous words at W3, context information cued for the words to be interpreted as their dominant senses (1 & 5), subdominant ones (2 & 6), or both senses (3-4 & 7-8). The resolution of lexical ambiguity could be initiated from adverbs (W4) and was definitely completed at sentence-final verbs (W5). 102 Korean native speakers (51 old readers and 51 young readers) participated in the self-paced reading with a judgment task and their cognitive abilities were measured in Reading-span task (storage capacity) and Stroop task (inhibitory processes).

We conducted a series of linear mixed-effect regression models on log-transformed RTs obtained from W3, W4, and W5 while subjects and items were set as random variables. At W3, we found significant effects of AGE (Young, Old) and Word Type (Homonymy, Polysemy) but no interactions, meaning that old readers took longer to read W3 than young readers regardless of word type (*Estimate* = -.29, *S.E.* = .03, *t* = -11.35) and that homonyms were read faster than polysemy regardless of age (*Estimate* = .06, *S.E.* = .01, *t* = 6.42). At W4, the effects of AGE (*Estimate* = -.28, *S.E.* = .02, *t* = -11.83) and Word Type (*Estimate* = .07, *S.E.* = .01, *t* = 5.86) were significant. The interaction was also significant (*Estimate* = -.03, *S.E.* = .01, *t* = -3.82), indicating that old readers, rather than young readers, took much longer RTs for adverbs following polysemy than for those following homonyms. Finally, at W5, we observed a significant three-way interaction among Word Type, Context, and AGE (*Estimate* = -.14, *S.E.* = .05, *t* = -2.52), indicating that RT differences between verbs in the neutral dominant condition than verbs in the neutral subdominant condition were larger in the processing of homonyms than polysemy only for young readers but RT differences across all conditions did not occur for old readers. Young readers' behaviors, but not old readers, support the existing claim that the semantic representation for homonym is discrete but that for polysemy is unitary. Overall, our results indicate that old readers' behaviors had severe difficulty in resolving lexical ambiguity.

We also conducted another series of mixed-effect regression model in which AGE was replaced with cognitive capacities measured through Stroop and Reading-span tasks. The aim of these models was to detect which cognitive aspects of these measurements could account for the variances of RTs in a similar way that models of AGE have captured. The three-way interactions observed at W5 (AGE*Word Type*Context) were marginally significant when Stroop scores were used but not when Reading span scores were used. It is speculated that for successful resolution of lexical ambiguity, it might be important for readers to inhibit irrelevant senses and be safe from semantic interferences at W5 in which a specific sense should be selected over other possible senses. Having a larger storage might be less relevant to account for the readers' behaviors for our study. In sum, our results show that the processing of ambiguous words was more modulated by how efficiently readers were able to inhibit irrelevant information rather than how good readers were able to store/manage information. Crucially, these results are characterized, in part, as the presence of aging effect.

Table 1. a set of example sentences

Context	Example sentences (for Homonymy condition)				
	W1	W2	W3 (ambiguous nouns)	W4	W5 (Verb)
(1) Dominant sense	Geonchukga-ga Architect-NOM	bokjabhan complex-ADJ	gujo-reul structure-ACC	jeongmilhage accurately-ADV	Seolgyehaessda designed
(2) Subdominant sense	Piseogaek-i Vacationer-NOM	Sinsokhan quick-ADJ	gujo-reul rescue-ACC	dageupi urgently-ADV	Yocheonghaessda requested
(3) Neutral dominant	Minji-ga Minji-NOM	eoryeoun difficult-ADJ	gujo-reul structure or rescue-ACC	jeongmilhage accurately-ADV	Seolgyehaessda designed
(4) Neutral Subdominant					Yocheonghaessda requested
Example sentences (for Polysemy condition)					
	W1	W2	W3 (ambiguous nouns)	W4	W5 (Verb)
(5) Dominant sense	Seunim-i Monk-NOM	sangkwaehan fresh-ADJ	achimeul morning-ACC	Himchage vigorously-ADV	Sijakaetda started
(6) Subdominant sense	Abeoj-iga Father-NOM	pujimhan plentiful-ADJ	achimeul breakfast-ACC	Masitge deliciously-ADV	meogeotda ate
(7) Neutral Dominant	Yeji-ga Yeji-NOM	ireun early-ADJ	achimeul morning or breakfast-ACC	Himchage vigorously-ADV	Sijakaetda started
(8) Neutral Subdominant					meogeotda ate

Note. The condition of Context was manipulated depending on whether the contextual information from W1 and W2 cues for which sense the ambiguous word occurring at W3 should be interpreted. The contextual information in Examples (1) & (5) cues the ambiguous words to be interpreted as their dominant sense. In a same way, the contextual information in Examples (2) & (6) indicates for the words at W3 to have their subdominant senses. The contextual information in Examples (3-4) & (7-8) does not provide any prior hint which specific sense of the ambiguous word should be. Thus readers in this condition, so-called neutral context condition, are supposed to keep lexical ambiguity until the occurrence of verbs. At the verbs, the verb at the neutral dominant condition index the sense of the ambiguous word to be dominant, whereas the verb at the neutral subdominant condition reveal that the ambiguous word should be interpreted as their subdominant.