

Reading methods and referential context effects in L2 ambiguity resolution*

YooLae Kim** · Jeong-Ah Shin***
(Dongguk University)

Kim, YooLae and Jeong-Ah Shin. 2019. Reading methods and referential context effects in L2 ambiguity resolution. *Linguistic Research* 36(Special Edition), 1-23. Second language (L2) learners' syntactic processing is known to be shallow and fragile, but a number of studies have indicated that L2 learners have the potential to overcome their weak syntactic representations and have more concrete syntactic processing under some specific circumstances (Lim and Ahn 2015; Lim and Christianson 2013a, 2013b, 2015; Williams 2006). This study examined L2 learners' ambiguous sentence processing through various factors, and investigated whether the *auditory perceptual simulation* (APS) method induces faster reading times and better comprehension results for an ambiguous sentence such as *The patient presented by the doctor felt embarrassed forgetting all the attention* compared to silent reading, and whether different contextual information affects the learners in processing such ambiguous sentences more effectively. In a self-paced reading experiment, participants read reduced clause or unreduced relative clause sentences preceded by 1-NP-referent contexts or 2-NP-referents contexts through silent reading or APS reading. If the APS reading group were affected by prosodic information, they would have faster reading times and higher accuracy rates than the silent reading group. In addition, if the participants were able to use the referential information from the context, the 2-NP-referents contexts would also show better processing. The results revealed that both the silent reading group and the APS reading group had good comprehension outcomes, indicating that reading methods had no effects in inducing the readers to process ambiguous sentences. However, the reading times for the target region showed the effects of the reading method, the proficiency, the context, and the sentence type, indicating that APS reading enhanced reading of past participles of reduced relative clause more naturally. Especially for the intermediate learners, there was a significant main effect for the APS reading methods, which helped them to have better reading skills for syntactic processing. (Dongguk University)

* We would like to thank the anonymous reviewers of this journal for their valuable comments first. This work is based on the first author's master thesis. The preparation of this work was supported under the framework of international cooperation program managed by the National Research Foundation of Korea (NRF-2016K2A9A2A19939367) awarded to Jeong-Ah Shin.

** First author

*** Corresponding author

Keywords Syntactic ambiguity, L2 sentence processing, auditory perceptual simulation, prosodic information, referential information

1. Introduction

Language comprehension occurs rapidly as the input is received, and readers need to update the given information quickly. However, understanding garden path sentences with syntactic ambiguity requires a great cognitive load for second language (L2) learners. Readers must build partial syntactic constructions, while they process the language initially, but when they encounter an ambiguous section, they tend to slow down and dispose of their initial processing. Moreover, it has been argued that such process is weak and fragile during second language learner's online syntactic processing (Clahsen and Felser 2006a, 2006b; Juffs and Harrington 1995). This is because L2 learners have a tendency to rely on their own general knowledge rather than applying accurate syntactic interpretations since the grammatical process of second language is shallow; even advanced L2 learners seemed to have difficulty to gain native-like concrete syntactic representations and to have an internalized procedure to apply to the structures, compared to the natives' unconscious and automatic process (Shallow Structure Hypothesis, Clahsen and Felser 2006a, 2006b; Cunnings 2017; Jacob and Felser 2016).

Even though L2 learners have difficulties processing ambiguous sentences, many studies have argued that L2 learners can process syntactic representations as accurately as natives (Lim and Christianson 2013a, 2013b, 2015). They asserted if L2 learners were given sufficient time to reflect on the syntactic structure, they would be able to comprehend the syntactic representations correctly. Thus, this can be one possible way to enhance L2 learners' reading strategy to evolve accurate processing, but it also inflates processing times. Spending much time is not an appropriate, natural way to process a language for a suitable interpretation, since the basic purpose of human language usage is rapid and efficient communication.

Furthermore, readers require all kinds of linguistic information to process language such as syntactic, semantic, pragmatic, or phonological information.

This information should be well integrated together to make better and accurate interpretations. While written text can show syntactic, semantic, or pragmatic information, it does not overtly encode any prosodic information. On the other hand, in a spoken language, the sentence contains focus structure and it is strongly connected to its prosodic features. Generally, the sentence structure can be represented by a notable pitch accent, and most people are familiar with simulating the stress and intonation patterns with their inner voice while they are reading a text silently (Ashby and Clifton 2005; Inhoff, Pollatsek, Posner, and Rayner 1989).

However, regarding this implicit prosodic information, it is hard to know how it is linked to sentence structural properties. Therefore, Zhou and Christianson (2016) suggested *auditory perceptual simulation* (APS), which can be an efficient means to improve syntactic processing. They argued that the APS reading method helps learners to gain cues from prosodic representations by actively imagining the inner voice. During the eye-tracking experiment, they compared the silent reading with the APS reading to see if the APS reading affects readers' comprehension. Participants in the APS reading group listened to recordings of an anonymous speaker with a corresponding photograph presented on the monitor. Then they read subject/object relative clauses with plausible/implausible sentences and answered questions. The results showed that native English speakers who used the APS reading strategy showed better accuracy rates and reading times. Thus, the authors argued that the APS reading method provided richer prosodic information during normal reading, and the participants were able to process more accurate syntactic representations.

In addition to the prosodic information, people may use non-grammatical cues such as referential information from the context. The language input continuously moves on as the relevant information must be updated as well. A series of studies have argued that even L2 learners were able to combine syntactic representations with extra discourse information (Spivey-Knowlton, Trueswell, and Tanenhaus 1993; Pan and Felser 2011; Pan, Schimke, and Felser 2015). For example, Spivey-Knowlton et al. (1993) found that native English speakers had a higher accuracy rate and faster reading times with a 2-NP-referents context, with two specific referents in the ambiguous sentence processing. Likewise, the result of Pan et al. (2015) found out that the Chinese

learners chose the correct noun phrase with its own supporting contexts. It seems that L2 learners are also able to use the extra sentential information during the online processing as natives.

Nonetheless, it remains to be examined whether L2 learners can read syntactically ambiguous sentences using prosodic and referential context information to achieve better comprehension. In this regard, this study explored how Korean-English learners deal with the ambiguous sentences in two different contexts depending on two different reading methods, silent reading and APS reading, addressing the following research questions:

Research Question 1: Which of the different types of reading methods (i.e., silent reading or APS reading) can be more effective in L2 comprehension?

Research Questions 2: Do different context types interact with reading methods during L2 learners' online processing?

To investigate these research questions, a self-paced reading experiment was designed and conducted among Korean learners of English. A self-paced reading task allows readers to control their reading speed; an increased time for specific periods would indicate that they noticed incongruities with their initial interpretation, and then tried to reanalyze their original processing caused by the structural relations. If participants resolve the difficulties and interpret the sentence accurately, they would answer the comprehension questions correctly; otherwise, if they fail to resolve it, they would show incorrect answers. Moreover, it was assumed that Korean learners' comprehension would be influenced by the context and the APS reading strategy. If they carried the referential information and could simulate the prosodic features, they would gain higher comprehension accuracy rates, and reading times for APS reading would be faster than those in silent reading.

2. Literature review

2.1 L2 learners' sentence comprehension

It has been argued that online processing of L2 learners does not involve concrete syntactic processing. This is because learners might miss the syntactic information and use non-grammatical cues to solve grammatical problems during the online processing. For example, Guo, Guo, Yan, Jiang, and Peng (2009) noted that L2 processing would be more semantically based than L1 processing, and they found that the brain responses of the English natives and Chinese-English speakers were clearly different from each other. For the natives, a positive ERP effect (P600) was elicited, reflecting the syntactic processing difficulty of sentences such as **Joe's father didn't show him drive the car*, while the Chinese-English speakers showed a negative effect (N400), which shows semantic anomalies. Thus, L2 learners may process a language based more on meaning rather than syntactic structures.

During sentence processing, L2 learners usually fail to integrate syntactic information such as structural relations, subject-verb number agreement, or binding restrictions. Especially for the structural relations, reduced relative clauses are often used due to their ambiguous form to discover the mechanisms of language comprehension. According to Bever (1970), L2 learners have difficulties in understanding the reduced relative clause structures and they prefer to interpret the past participle followed by a noun phrase as a past tense of a verb based on a frequency-based perceptual strategy to predict clause boundaries. Specifically, readers tend to establish the main clause construction first to assign agent role to the noun phrase, considering the past participle as the main verb, but when they encounter the actual main verb later, they become confused and try to process the sentence again.

Moreover, readers initially manage the ambiguous sentences with the minimal attachment strategy (Frazier and Rayner 1982), which is related to the phrase structure strategy (Ferreira and Clifton 1986; Frazier 1987, 1995; Frazier and Rayner 1982), and then they reprocess the sentences if is needed. Therefore, readers postulate subject and verb roles in a main clause via the minimal attachment strategy, but the prepositional "by" after the past participle in the

reduced relative clause leads readers to realize that their initial processing was wrong. Thus, Juffs (1998) claimed that this structure is syntactically complex to process and readers should have other knowledge such as verb morphology, verb argument structure, or the syntax of verb-object noun phrase adjacency requirements to handle the ambiguity. Overall, L2 learners try to integrate every available cue to deal with the sentences correctly.

2.2 The role of prosodic features in ambiguous sentence processing

Most studies have investigated syntactic and semantic processing without prosodic markers, but recently, many researchers have been manipulating the prosodic information during L2 sentence processing. Typical suprasegmental information such as prosodic information can support L2 learners in improving their reading skills, and this plays an important role during the online processing. Readers can activate prosodic information themselves for written or printed sentences, so it can help them to resolve syntactic ambiguities. If readers fail to develop prosodic representations, they often process reading materials in the wrong direction. Moreover, other studies (Blachman 2000; Bradley and Bryant 1983; Kirby, Desrochers, Roth, and Lai 2008; Wagner, Torgesen, and Rashotte 1994) also revealed that prosodic features are strongly related to readers' successful reading. In line with previous findings, while L2 learners' online processing is shallow, a different reading strategy related to the prosodic representations can lead learners to a deeper processing.

As one possible means of facilitating the prosodic features, Zhou and Christianson (2016) suggested an *auditory perceptual simulation* (APS) which involves prosodic elements, whereby readers can imagine a reading voice during silent reading. Zhou and Christianson (2016) assumed that if readers have more prosodic cues to build more specific representations with the APS method, they would successfully construct stronger syntactic structures to comprehend the sentences. Therefore, they conducted an eye-tracking experiment to examine how APS affects natives' syntactic processing. They used subject/object relative clauses with plausible and implausible sentences, and they compared a silent reading group with an APS reading group. The results demonstrated that the

participants were aided by these cues, in that they read faster when they simulated an inner voice during processing.

2.3 The role of context in ambiguous sentence processing

During sentence processing, discourse-based constraints can guide ambiguity resolution, since the discourse continuously updates the relevant information. This phenomenon can be explained by the referential theory (Crain and Steedman 1985), whereby the continuously updated discourse context can change syntactic preferences, and it has an immediate effect on sentence processing. Therefore, a variety of factors including discourse context may affect ambiguity resolution. Pan et al. (2015) explored how the referential information affects native and non-native participants' ambiguous relative clause comprehension, for the sentences like *The journalist interviewed the assistant of the inspector who was looking very serious*. For the context effect, the preceding discourse context was manipulated to provide two potential referents for *the assistant* or *the inspector* of each noun phrase, which could potentially host the relative clause, and thus this can induce a bias for either an NP1 or NP2 modification reading. They conducted both offline and online experiments with natives and non-natives. Both groups were influenced by the referential context during the offline task, while the online task showed that only non-native speakers showed an effect for referential information. Thus, non-native readers' initial analysis of ambiguous inputs is strongly affected by biasing discourse context information. In addition, Pan and Felser (2011) found similar processing patterns in a study of syntactically ambiguous PP modifiers with Chinese-English learners. Taken together, non-native speakers' ambiguity resolution is more strongly related to extra-sentential context information than for natives.

3. Present study

The current study used 2 (reduced relative clause vs. relative clause) × 2 (1-NP-referent context vs. 2-NP-referents context) factorial design as in (a), and participants were randomly divided into two groups: an APS reading group and

a silent reading group as a control group.

Participants received counter-balanced items from each condition. While the experiments were conducted, they read sentences such as in (1), and their reading times were recorded through the *Paradigm Stimulus Presentation* (Perception Research Systems 2007). After each sentence, they were asked to answer a comprehension question related to the sentence. The sentences included a reduced relative clause or relative clause describing the same contents, but the differences in conditions were such that one preceding contexts that one had only one referent and the other had two referents; this was designed to manipulate the ambiguity and the context effect.

(1) a. 1-NP-referent context/Reduced relative clause (relative clause)

Two patients were waiting for their doctor to introduce them to the team of specialists that would handle their case. The doctor presented one of the patients to them but not the other. *The patient (who was) presented by the doctor felt embarrassed for getting all the attention.*

b. 2-NP-referents context/Reduced relative clause (relative clause)

A patient and her son were waiting for their doctor to introduce them to the team of specialists that would handle their case. The doctor presented the patient to them but not the son. *The patient (who was) presented by the doctor felt embarrassed for getting all the attention.*

In the sentence in italics, a reduced relative clause can cause an ambiguity since the past participle *presented* might be interpreted as a past tense verb, while a relative clause is not ambiguous. The 1-NP-referent context contains one referent, *two patients*, followed by *one of the patients but not the other*, which can be ambiguous for connecting with the subject *the patient* in the target sentence. On the other hand, the 2-NP-referents context has two specific referents, *a patient* and *her son*, so that participants could attach the subject *the patient* to the proper referent easily.

With the *auditory perceptual simulation* method, participants can imagine hearing a reading voice while they are reading silently, since the method involves prosodic elements. Therefore, readers can have more cues to build more specific

syntactic representations during normal reading. A series of studies have argued that syntactic structure can interrelate with the prosodic features (Bader 1998; Fodor 2002; Hwang and Schafer, 2009; Steinhauer 2003). For instance, Fodor's (2002) Implicit Prosody Hypothesis (IPH) posited that readers can create prosodic representations such as phrasing, intonation, stress or rhythm during silent reading, so by not involving actual prosodic features, the reading process seems more abstract than overt speech. Thus, APS reading induces auditory imagery processing among readers, who are expected to actively simulate the prosodic information. In addition, other studies (Blachman 2000; Bradley and Bryant 1983; Kirby, Desrochers, Roth, and Lai 2008; Wagner, Torgesen, and Rashotte 1994) revealed that prosodic features are strongly connected to readers' successful reading. According to previous findings, L2 learners online processing is shallow, but with a different reading strategy such as APS reading, we could assist L2 learners to have deeper processing mechanisms while reading English sentences.

This study thus hypothesized that if Korean L2 learners can simulate an inner voice, they could utilize that information to apply more detailed syntactic structures and faster reading times at the past participle region, and better comprehension results would be observed in the APS reading condition compared to the silent reading condition. Additionally, if participants can use the referential information, they will be able to attach the appropriate referent and will also show faster reading times and higher accuracy rate with the 2-NP-referents context relative to the 1-NP-referent context. Therefore, there will be an interaction if the reading times of the reduced relative clause condition shows any differences between the APS reading group and the silent reading group. Moreover, if the reduced relative clause condition differs from each context condition, an interaction will be deduced among these conditions.

For the comprehension questions, the accuracy rate would be lower in the reduced relative clause conditions than in the relative clause conditions when readers misinterpret sentences. However, this consequence can be supplemented by two different factors in our experiment. First, good accuracy can be shown by facilitating participants to activate the prosodic information. If they can simulate those cues during silent reading, they may process the sentences more smoothly. Moreover, a higher rate of correct responses can be shown with the 2-NP-referents context, since it contains specific referents for the target sentences.

In summary, if participants activate an inner voice when processing sentences, there would be a main effect for the method (i.e., APS reading) and the context for the past participle region of reduced relative clause sentences, as the method helps them to construct more detailed syntactic structures. Second, if the readers build concrete syntactic structures through the context, there will be an interaction between contexts and the target sentences. Consequently, if the method and the context affect the readers' processing, accuracy rates will be high enough and reading times will be faster during sentence processing.

3.1 Method

3.1.1 Participants

Forty-five undergraduate students from a university in Seoul, Korea participated in the experiment (age range: 19-30; mean age: 26.78; 26 females and 20 males), all were Korean natives, and they were paid 5,000 won for their participation. Participants were randomly assigned to the silent reading group or the APS reading group. Furthermore, each group was divided into intermediate and advanced levels by participants' proficiency level, as standardized English test scores from the TOEIC were required. Scores over 860 (equivalent to iBT TOEFL 100) were classified as advanced level (24 participants; Mean score=885.20, $SD=24.78$), and scores over 600 to 850 (equivalent to iBT TOEFL 70) were intermediate level (21 participants; Mean score=742.62, $SD=76.93$).

3.1.2 Materials

Sixteen target items were adapted from Spivey-Knowlton et al. (1993). Every item included the preceding context with the target sentence. The target sentences consisted of either reduced relative clauses or relative clauses. There were 22 filler items, also with the same structure as the target items. These conditions were counterbalanced in each list with a 2 (reduced relative clause vs. relative clause) \times 2 (1-NP-referent context vs. 2-NP-referents context) factorial design.

Especially for the APS reading group, participants listened to audio files of an anonymous female American English native speaker. The native speaker recorded several types of narrative passages, was unrelated to the sentences used in the experiments.

Comprehension questions were divided into two types; one asked if the agent of the reduced relative clause or relative clause did the action to the subject (e.g., *Did the doctor present the patient?* for (1a)), but the actual action denoted by the predicate was in the main sentence. The other asked if the action was done to the agent by the subject. The answers were either 'yes' or 'no' to these questions.

3.1.3 Procedure

The experiment was conducted individually in a sound-proof lab. Before the experiment, participants filled out a consent form and were instructed on how to perform the task. A practice session was carried out to become familiar with the self-paced reading task. The self-paced reading experiment was administered on a desktop computer using the *Paradigm Stimulus Presentation*. Stimuli were presented on a monitor, and a keyboard was set up to complete the experiment. When the participant pressed the space bar to begin the trial, a context appeared first, and once they finished reading the context, they pressed the space bar again. Then a row of a dashed sentence appeared on the screen. Each dash replaced each word in the sentence, and one segment was comprised of two words of the target sentence. This dashed sentence was presented in a non-cumulative fashion, from left to right, and the reading times of each segment were recorded. A comprehension question appeared after the target sentence, then participants pressed the designated key (F for Yes and J for No) on the keyboard to answer the questions. Reaction times for answers and response accuracy were measured through the same software. When the participants pressed the space bar after answering questions, the next context sentence appeared. The whole experiment went approximately 25-30 minutes.

The general procedure for the silent reading group was the same as for the APS reading group. However, the APS reading group was instructed to listen

carefully to prosodic cues such as the pronunciation or intonation of the native speaker before reading context and target sentences (see Figure 1 below). The audio file lasted for approximately 4-5 minutes, which allowed participants to become accustomed to the native prosodic information. Moreover, a photograph of an anonymous female native English speaker was presented while participants listened to the audio file. After listening, participants pressed the space bar to move on, the contexts and the target sentences were presented as described above. Furthermore, there was another listening session in the middle of the main experiment to recall the phonological cues.

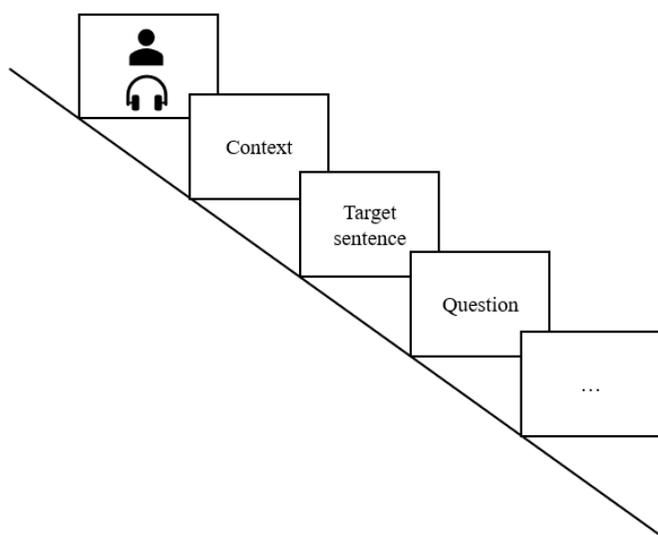


Figure 1. Main experiment procedure of the APS reading

3.2 Results

None of the participants were excluded from the data analysis (24 advanced learners and 21 intermediate learners). Reading times of the interested regions which were abnormally low (under 200ms) or high (over 2000ms) were excluded. In addition, outliers more than 2.5 standard deviations were removed from the analysis. Thus, there was a 0.05% loss from the target region data and 0.06%

from the main verb region data. To analyze both region data, sentences were divided into several segments (Table 1). For analyzing the accuracy and the reading times, a generalized mixed-effect model was used through the lme4 package (Bates, Maechler, Bolker, and Walker 2014) in the R 3.5.3 environment (R Core Team 2019). Separate models were applied for each dependent variable (accuracy and reading times), and each factor such as method (silent and APS), proficiency (intermediate and advanced), reduction (RC and RRC), context (1-NP-referent and 2-NP-referents) was treated as fixed effects of each model. Then all fixed effects were centered to reduce collinearity in the models, and the random effect structure included participants and items.

Table 1. Region of Interests

	Target			Main verb		
RC	The patient	who was	presented by	the doctor	felt embarrassed	...
RRC	The patient		presented by	the doctor	felt embarrassed	...

* RC = Relative clause, RRC = Reduced relative clause

3.2.1 Response accuracy

Comprehension questions were followed by contexts and ambiguous sentences. Figure 2 shows the overall mean accuracy rate on each condition. Sentences with RC and 2-NP-referents contexts, which served as the control condition, had the highest accuracy rate among the conditions (intermediate: 88%, advanced: 87%). RC sentences with the 1-NP-referent context (intermediate: 80%, advanced: 85%) and RRC sentences with the 2-NP-referents context (intermediate: 80%, advanced: 84%) showed similar accuracy rate. Although the intermediate learners showed lower accuracy in the 1-NP-referent with RRC compared to the advanced learners, the difference was not statistically significant and there were no interaction effects ($Z_s < 2$, n.s.). When it comes to the comprehension accuracy, L2 learners showed similar performance to answer the question regardless of reading methods, contexts, RC types, and proficiency.

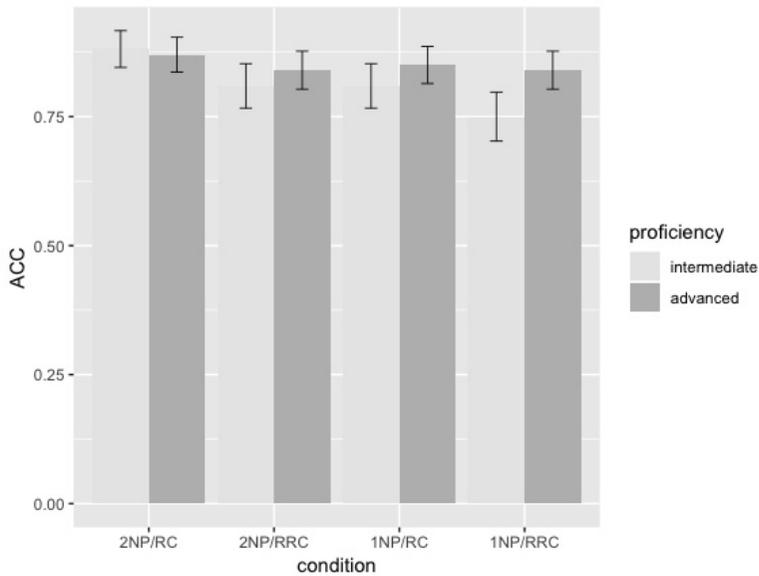


Figure 2. Mean accuracy for each condition

3.2.2 Reading times

3.2.2.1 Target region reading times

At the target region, there was a significant main effect for this reduction ($estimate=86.3621$, $SE=17.112$, $t=5.047$, $p<0.001$), indicating that for reduced relative clause sentences, readers took longer to understand the flow of the sentences (see Figure 3 below). Another significant main effect for context ($estimate=100.4217$, $SE=16.8480$, $t=5.960$, $p<0.001$) indicates that readers needed more time to process the target region with the 1-NP-referent contexts. The method did not show any main effects by itself, but there was an interaction with the context ($estimate=-79.9454$, $SE=37.2222$, $t=-2.148$, $p<0.05$), in that the participants in the APS reading group read the target region with the 1-NP-referent context faster than for the silent reading group. It seemed that the APS reading strategy had an effect for L2 learners during target region processing.

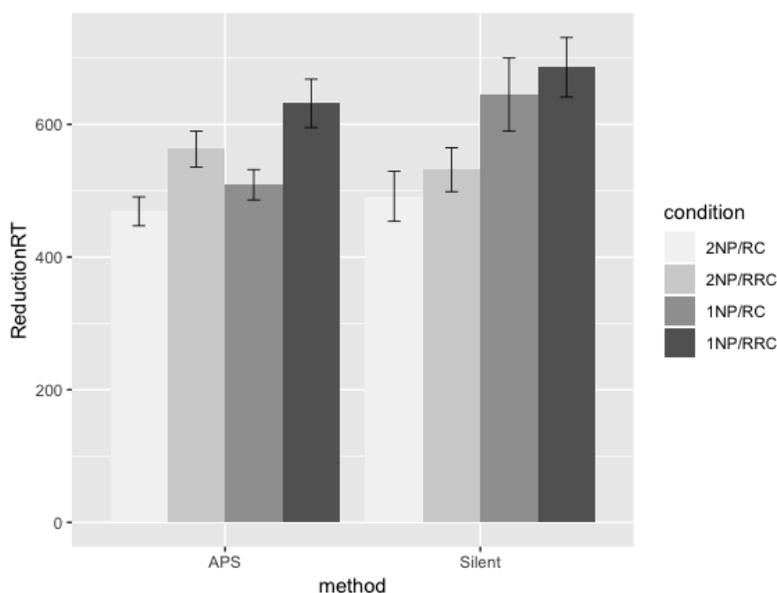


Figure 3. Mean reading time of the target region by each method

In addition, there was a main effect of proficiency ($estimate=-157.7830$, $SE=52.1064$, $t=-3.028$, $p<0.01$), indicating that the advanced learners tended to read faster than the intermediate learners. Also, a marginal interaction was found between proficiency and context ($estimate=-65.5695$, $SE=33.9538$, $t=-1.931$, $p<0.1$). In order to examine the interaction, separate analyses of the intermediate and advanced learners were carried out, and the results of the intermediate learners showed a significant difference in the reduction ($estimate=91.651$, $SE=32.273$, $t=2.840$, $p<0.01$) and in the context ($estimate=136.011$, $SE=31.233$, $t=4.355$, $p<0.001$), indicating that they read the relative clause faster than the reduced one, and the 2-NP-referents context was easier than the 1-NP-referent context. Similarly, the results of the advanced learners also showed a significant difference in the reduction ($estimate=69.491$, $SE=16.084$, $t=4.320$, $p<0.001$) and the context ($estimate=66.745$, $SE=15.981$, $t=4.176$, $p<0.001$). However, the advanced learners had an interaction between the method and the context ($estimate=-87.689$, $SE=38.106$, $t=-2.301$, $p<0.05$); that is, they read the sentences faster when they were cued with the APS method and with the 2-NP-referents context than the other

counterparts.

3.2.2.2 Main verb region times

There were not any significant effects of other factors (method: $estimate=62.4233$, $SE=66.9463$, $t=0.932$, n.s.; reduction: $estimate=33.5076$, $SE=22.9874$, $t=1.458$, n.s.; context: $estimate=31.6535$, $SE=22.4760$, $t=1.408$, n.s.), but only proficiency had a main effect at the main verb region ($estimate=-184.3357$, $SE=61.1597$, $t=-3.014$, $p<0.01$), indicating that the advanced learners were able to recognize the main verb within a short period (see Figure 4 below). In addition, there were no interactions among the factors. Thus, it seemed the prosodic or the referential context information did not induce the readers to process the verb faster.

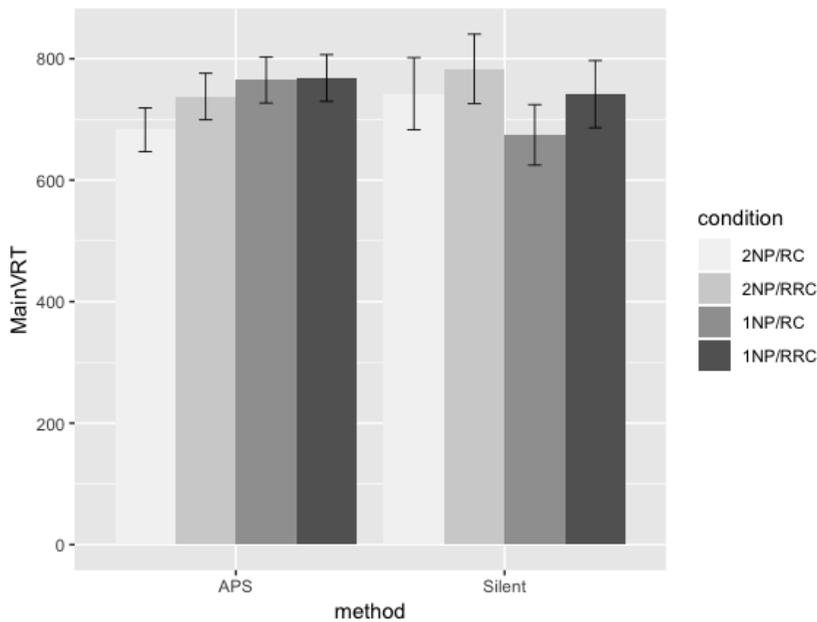


Figure 4. Mean reading time of the main verb region by each method

We expected that if the readers failed to process the reduced relative clause at first, the reading times of the main verb region should take longer for

reanalyzing the past participle and the real verb. However, the reading times between the silent reading and the APS reading group at the main verb regions did not show any significant differences, and only the target region reading times differed. Therefore, the total reading times between the silent reading group and the APS reading group differed from each other, in that the APS reading group processed the target sentences faster than the silent reading group.

4. Discussion and conclusion

This study examined whether various reading strategies integrating with prosodic information and referential information can enhance readers' ambiguous sentence processing. Therefore, we explored which of the different reading methods (i.e., silent reading or APS reading) are more effective in L2 comprehension and whether the different context types interact with the reading methods during the comprehension. Overall, there was no difference in comprehension accuracy between the two different groups, the silent reading group and the APS reading group, showing that most participants were adept at processing the ambiguous sentences such as reduced relative clauses or relative clauses.

According to previous studies, it has been argued that non-native English speakers encounter difficulties when they process syntactically confusing sentences (e.g., Lee and Shin 2016). In order to examine L2 processing difficulties, reduced relative clauses are often used as a sentence material in L2 comprehension experiments. This is because learners initially construct a simple syntactic structure and they are likely to interpret the participle form of the reduced relative clause as a past tense verb. Then when they later encounter the actual main verb, they need to postulate more complex sentence structures to resolve what they have read. If readers recognize the reduced relative clause from the beginning, they will smoothly process the main verb, but if not, they will have to reanalyze both the participle and the main verb. Additionally, readers tend to use other cues such as referential information or prosodic information to comprehend ambiguous sentences because the context might involve potential referents to treat the ambiguity resolution. Also, the prosodic

information can induce readers to read more naturally when they simulate an inner voice during sentence processing.

Based on these, L2 learners completed the comprehension questions fluently with their own capacities. The rate of correct responses to the questions was around 80%. When each accuracy rate and reaction time was compared, the relative clause with the 2-NP-referents context, which was the control condition, showed the shortest reaction time and the highest accuracy rate among the conditions, whereas the reduced relative clause with the 1-NP-referent context presented the longest reactions time and the lowest accuracy. Thus, L2 learners were able to comprehend ambiguous sentences well, but still, they had to take more times to process the reduced relative clause with the ambiguous context.

There were no conspicuous time differences among the four sentence conditions (i.e., 2-NP-referents context RC, 1-NP-referent context RRC, 1-NP-referent context RC, and 2-NP-referents context RRC) at the target region. However, the reading times for these conditions with the APS reading method were faster than for silent reading. For reading method and reading time reduction, APS reading facilitated the participants' reading of both reduced relative clauses and unreduced relative clauses faster than for silent reading. The intermediate group, in particular, exhibited faster reading times for ambiguous sentence processing with the APS strategy. As for a relationship between methods and contexts, there were no differences for the target region reading times with the 1-NP-referent context and the 2-NP-referents contexts in general. Even though each reading method did not show any significant results, there was a gap within each method. The target region with each context in APS reading showed similar reading times, but for silent reading, the 1-NP-referent context showed increased reading times relative to the 2-NP-referents context. This may indicate that APS reading led readers to read ambiguous sentences more naturally without hesitations. Similarly, the intermediate participants in the APS reading group showed faster reading times in the target region for both contexts. Therefore, this reading method could be helpful for intermediate L2 learners in processing a second language more quickly.

For the main verb region, there were no significant differences among the conditions, yet the participants were likely to process the main verb slightly faster with the 2-NP-referents contexts. In comparing the methods and the

reduction, no effects were found for the reduced relative clauses and the relative clauses with the APS reading method relative to the silent reading group. The intermediate group, however, had faster reading times with relative clause sentences with the APS reading strategy, and this suggests that this might cue people to comprehend unambiguous sentences more quickly. Also, there were no significant interactions between methods and contexts, which indicate that the APS reading method was not able to enhance reading times at the main verb region. Although the overall comparison did not show any differences between methods and contexts, the reading times decreased in the 2-NP-referents context condition, while intermediate readers quickly discovered main verbs via the APS reading method. Once again, the intermediate L2 learners were influenced by the APS reading strategy in shortening their processing times.

With these findings, the APS reading strategy can be an effective way to develop second language learners' reading skills by influencing readers to have less of a "good-enough" approach and more syntactic processing because readers were likely to have focused on the structural properties of sentences when the APS is engaged. This argument can be supported by Lee, Song, and Lee's (2019) eye-tracking findings. They found that Koreans learners of English with the APS manipulation were accurate and fast enough to read the plausible/implausible subject/object relative sentences, and especially they recognized the implausible sentences earlier than the silent reading group during the initial processing. Thus, the prosodic features and the syntactic representations can be interfaced while people process sentences. Additionally, when the context and the APS method comes together, it leads readers to have faster reading times because the prosodic cues helped building the online syntactic structure. In line with this, several studies have been asserted that both natives and non-natives showed the effects of prosodic cues and context information. Therefore, people need some disposable resources while they are processing a language. Although the results showed improved reading times with the APS reading strategy, it is not clear how exactly the prosodic information is connected to the syntactic representation. Thus, further research should look for how the prosodic feature can be fully realized in L2 sentence processing.

However, some might say that this APS reading strategy is not clear how exactly the prosodic information is connected to the syntactic representation and

it is true that we cannot predicate the obvious process of the prosodic features in our brain. Even though the way remains to be examined, some studies have been presented that people read faster with a tape recording of a fast talker (Kosslyn and Matt 1977), and readers had faster reading times while they listened to the congruent speaker's dialog (Kurby, Magliano, and Rapp 2009) to claim the prosodic information was being considered during the language processing. Others may also mention that presenting two words in one segment in the experiment is unnatural, but each sentence involved a short length of function words and context words, as readers tend to skip the function words. Therefore, the two-word segment mode here seemed natural and it can support the referential theory. Despite these limitations, the study presented some possible implications for fast and accurate L2 comprehension with contexts and prosodic cues. It explains the prosodic information during silent reading and referential information can interact with syntactic processing to yield better sentence processing. Most second language learners do not easily acquire native-like English, since they do not have enough input from their surroundings. Therefore, L2 readers need to overcome an obstacle, and the APS method could be one such method and other various native materials can be used to provide cues for L2 learners' prosodic and referential representations for more detailed syntactic processing.

References

- Bader, Markus. 1998. Prosodic influences on reading syntactically ambiguous sentences. In: J. D. Fodor and F. Ferreira (eds.) *Reanalysis in sentence processing. Studies in theoretical psycholinguistics* 21. Springer, Dordrecht
- Bever, Thomas G. 1970. The cognitive basis for linguistic structures. In John R. Hayes (ed.) *Cognition and the development of language*, 1-61. New York, NY: Willey.
- Blachman, Benita A. 2000. Phonological awareness. *Handbook of reading research* 3: 483-502.
- Bradley, Lynette and Peter E. Bryant. 1983. Categorizing sounds and learning to read — a causal connection. *Nature* 301: 419-421.
- Clahsen, Harald and Claudia Felser. 2006. Continuity and shallow structures in language processing. *Applied Psycholinguistics* 27(1): 107-126.
- Clahsen, Harald and Claudia Felser. 2006. Grammatical processing in language learners.

- Applied Psycholinguistics* 27(1): 3-42.
- Crain, Stephen and Mark Steedman. 1985. On not being led up the garden path: The use of context by the syntactic processor. In David Dowty, Lauri Karttunen, and Arnold Zwicky. (eds.), *Natural language parsing: Psychological, computational and theoretical perspectives*, 320-358. New York, NY: Cambridge University Press.
- Cummings, Ian. 2017. Parsing and working memory in bilingual sentence processing. *Bilingualism: Language and Cognition* 20(4): 659-678.
- Felser, Claudia, Mikako Sato, and Nicholas Bertenshaw. 2009. The on-line application of Binding Principle A in English as a second language. *Bilingualism: Language and Cognition* 12(4): 485-502
- Ferreira, Fernanda and Charles Clifton Jr. 1986. The independence of syntactic processing. *Journal of Memory and Language* 25(3): 348-368.
- Fodor, Janet Dean. 2002. Psycholinguistics cannot escape prosody. *Proceedings of Speech Prosody*: 83-90.
- Frazier, Lyn and Keith Rayner. 1982. Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. *Cognitive Psychology* 14(2): 178-210.
- Frazier, Lyn. 1987. Syntactic processing: evidence from Dutch. *Natural Language and Linguistic Theory* 5(4): 519-559.
- Frazier, Lyn. 1995. Constraint satisfaction as a theory of sentence processing. *Journal of Psycholinguistic Research* 24(6): 437-468.
- Guo, Jingjing, Taomei Guo, Yan Yan, Nan Jiang, and Danling Peng. 2009. ERP evidence for different strategies employed by native speakers and L2 learners in sentence processing. *Journal of Neurolinguistics* 22(2). 123-134.
- Hwang, Hyekyung and Amy J. Schafer. 2009. Constituent length affects prosody and processing for a dative NP ambiguity in Korean. *Journal of Psycholinguistic Research* 38(2): 151.
- Inhoff, Albrecht Werner, Alexander Pollatsek, Michael I. Posner, and Keith Rayner. 1989. Covert attention and eye movements during reading. *The Quarterly Journal of Experimental Psychology Section A* 41(1): 63-89.
- Jacob, Gunnar and Claudia Felser. 2016. Reanalysis and semantic persistence in native and non-native garden-path recovery. *The Quarterly Journal of Experimental Psychology* 69(5): 907-925.
- Juffs, Alan and Michael Harrington. 1995. Parsing effects in second language sentence processing: Subject and object asymmetries in wh-extraction. *Studies in Second Language Acquisition* 17(4): 483-516.
- Juffs, Alan. 1998. Main verb versus reduced relative clause ambiguity resolution in L2 sentence processing. *Language Learning* 48(1): 107-147.
- Kirby, John R., Alain Desrochers, Leah Roth, and Sandy S. V. Lai. 2008. Longitudinal pre-

- dictors of word reading development. *Canadian Psychology/ Psychologie Canadienne* 49(2): 103-110.
- Kosslyn, Stephen M. and Ann M. Matt. 1977. If you speak slowly, do people read your prose slowly? Person-particular speech recoding during reading. *Bulletin of the Psychonomic Society* 9(4): 250-252
- Kurby, Christopher A., Joseph P. Magliano, and David N. Rapp. 2009. Those voices in your head: Activation of auditory images during reading. *Cognition* 112(3): 457-461.
- Lee, Jonghyeon and Jeong-Ah Shin. 2016. Syntactic reanalysis and lingering misinterpretations in L2 sentence processing. *Language Research* 33(S): 53-79.
- Lee, Jonghyeon, Mijeong Son, and Sung-eun Lee. 2019. The role of auditory perceptual simulation in L2 syntactic processing. *Language and Information* 23(1): 25-48.
- Lim, Jung Hyun and Hee Don Ahn. 2015. Task effects on reading implausible sentences in an L2: Evidence from self-paced reading. *Language and Linguistics* 66: 187-214.
- Lim, Jung Hyun and Kiel Christianson. 2013. Integrating meaning and structure in L1-L2 and L2-L1 translations. *Second Language Research* 29(3): 233-256.
- Lim, Jung Hyun and Kiel Christianson. 2013. Second language sentence processing in reading for comprehension and translation. *Bilingualism: Language and Cognition* 16(3): 518-537.
- Lim, Jung Hyun and Kiel Christianson. 2015. Second language sensitivity to agreement errors: Evidence from eye movements during comprehension and translation. *Applied Psycholinguistics* 36(6): 1283-1315.
- Pan, Hui-Yu and Claudia Felser. 2011. Referential context effects in L2 ambiguity resolution: Evidence from self-paced reading. *Lingua* 121(2): 221-236.
- Pan, Hui-Yu, Sarah Schimke, and Claudia Felser. 2015. Referential context effects in non-native relative clause ambiguity resolution. *International Journal of Bilingualism* 19(3): 298-313.
- Perception Research Systems. 2007. *Paradigm Stimulus Presentation*.
- Spivey-Knowlton, Michael J., John C. Trueswell, and Michael K. Tanenhaus. 1993. Context effects in syntactic ambiguity resolution: Discourse and semantic influences in parsing reduced relative clauses. *Canadian Journal of Experimental Psychology/ Revue Canadienne de Psychologie Experimentale* 47(2): 276.
- Steinhauer, Karsten. 2003. Electrophysiological correlates of prosody and punctuation. *Brain and Language* 86(1): 142-164.
- Wagner, Richard K., Joseph K. Torgesen, and Carol A. Rashotte. 1994. Development of reading-related phonological processing abilities: New evidence of bidirectional causality from a latent variable longitudinal study. *Developmental Psychology* 30(1): 73.
- Williams, John N. 2006. Incremental interpretation in second language sentence processing. *Bilingualism: Language and Cognition* 9(1): 71-88.
- Zhou, Peiyun and Kiel Christianson. 2016. I “hear” what you’re “saying”: Auditory percep-

tual simulation, reading speed, and reading comprehension. *The Quarterly Journal of Experimental Psychology* 69(5): 972-995.

YooLae Kim

Ph.D. Student

Dept. of English Language and Literature

Dongguk University

Seoul, 04620, Rep. of Korea

Email: yoolaekim@gmail.com

Jeong-Ah Shin

Associate Professor

Dept. of English Language and Literature

Dongguk University

Seoul, 04620, Rep. of Korea

Email: jashin@dongguk.edu

Received: 2019. 07. 10.

Revised: 2019. 09. 10.

Accepted: 2019. 09. 12.