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Structure Priming in the Interpretation of Korean Null Arguments*

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Abstract One of the well-observed phenomena in psycholinguistics is that comprehending or producing a sentence can be facilitated or guided by previous exposure to a sentence that shares the same syntactic structure. This phenomenon is called "structure priming". Although structure priming is well observed in many constructions in many languages, not many works have investigated whether unpronounced syntactic or semantic structures can be the subject of priming. This study investigates the priming effect in the processing of Korean null object constructions using a picture-matching task. In the experiment, participants were asked to choose a picture that matches a given sentence that includes a null object. The results show that participants were more likely to choose the picture that matches the sloppy interpretation for a target sentence when the previous prime sentence with a null object was biased to have the sloppy reading. Likewise, the picture that matches the strict reading was more likely to be chosen when the previous prime sentence was biased to have the strict reading. This indicates that the silent linguistic unit can be the subject of priming. Some implications of the observed priming effects on theoretical issues in Korean null arguments are discussed as well.

Keywords Priming in Comprehension, Null Objects, Picture-Matching Task, Argument Ellipsis

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1. Introduction

One of the fundamental strategies language users apply in language production is repetition. It is frequently observed that a speaker repeats the words he or she has just heard. Or, speakers may produce a word that shares the same consonant-vowel sequence with the previously processed word. Words and sound patterns are overtly realized units so language speakers can consciously repeat them using episodic memory. However, repetition in language use is not restricted to the domain of consciousness. One of the well-observed phenomena in Psycholinguistics is that comprehending or producing a sentence can be facilitated or guided by previous exposure to a sentence that shares the same syntactic structure. This phenomenon is called *structure priming*. Since Bock's (1986) initial finding of structural priming in a series of controlled experimental settings, a volume of studies has shown that structural priming is robust and persistent in many configurations and many languages (Potter and Lombardi, 1998; Hartsuiker and Kolk, 1998; Hartsuiker, Kolk, and Huiskamp 1999; Bock and Griffin, 2000; Branigan et al., 2000; Scheepers, 2003; Cleland and Pickering, 2003 among many others). For example, if a language user has just heard a passive-voice sentence (e.g. *A dog was bitten by a man*) before he is asked to produce a sentence that describes an event that can be structured in either the passive voice or the active voice, the speaker is more likely to spell the sentence in the passive-voice (*A ball was kicked by a boy*) than in the active voice (*A boy kicked a ball*), being presumably affected by the previous structure. Syntactic structures are abstract so it is less likely that native speakers process them consciously. Thus, identifying syntactic priming effect has led researchers to think that even abstract linguistic

representation can be repeated and a language production model must include a level for the abstract structure representation that can serve as the target of the priming effect (Pickering and Ferreira, 2009). Furthermore, as noted by Pickering and Ferreira, finding a priming effect of a certain structural representation may provide evidence for the certain structure representation. For example, Bock (1989) had participants hear and repeat prepositional object (S-V-NP-PP) prime sentences. The prepositions in the prime sentences were either *to* or *for*. After hearing and repeating the prime sentence, participants were asked to produce a ditransitive sentence that can be described with prepositional-object constructions or double-object constructions. In addition, participants were asked to use the preposition *to,* not *for*, if they would speak the prepositional-object constructions in the target sentences. The results show that when participants heard and repeated the prepositional-object prime sentences, regardless of the type of preposition used in the prime sentence, they are more likely to produce the target sentence in prepositional-object construction rather than double-object constructions. This is quite interesting that structure priming was observed even when the functional word, the preposition, is not repeated. In other words, the prepositional prime sentence with the preposition *for* can prime the prepositional target sentence with the preposition *to*. This study shows that the core mechanism underlying structural priming is the repetition of the structure *per se*, not the repetition of the use of the same functional word. The underlying syntactic structure that generates S-V-NP-PP word order was represented in language users' minds and primed. The current study is based on that premise and investigates which syntactic representation, among alternative syntactic mechanisms, is processed in Korean native

speakers' minds when they process sentences with a null object utilizing priming methods.

It has been attested that structure priming affects not only producing sentences but also comprehending sentences. Arai et al. (2007) report an eye-tracking experiment that shows a priming effect on comprehension. In their experiment, English native speakers listened to a sentence, *the pirate will send the princess the necklace* while looking at a picture that contains three entities, each of which represented the agent (*the pirate*), the recipient (*the princess*), and the theme (*the necklace*). In the condition in which the participants listened to the target sentence just after reading a priming sentence in a double object construction (*The schoolgirl will show the teacher the drawing*), they tended to look at the entity that corresponds to the recipient (*the princess*) more than the theme element after the onset of the verb (*send*), and vice versa in the prepositional dative priming condition in which participants read the priming sentence in the prepositional object construction (*The schoolgirl will show the drawing to the teacher*). Although it has been widely acknowledged that the priming effect in sentence comprehension is more lexically dependent and observed in more restricted conditions than that in sentence production (Branigan, Pickering, and McLean 2005; Tooley, Traxler, and Swaab 2009), investigating the priming effect in sentence comprehension can be an insightful tool to investigate the parsing strategy languages speakers use to process ambiguous sentences. The English sentence in (1) is an ambiguous sentence with two available readings. One reading is that the policeman used the gun in the prodding event (*high-attachment*) and the other reading is that the policeman is prodding the doctor and the doctor is holding the gun (*low-attachment*). In Branigan, Pickering, and McLean's (2005) study, participants

read a sentence and chose a picture that matches the sentence they read, among two pictures presented simultaneously. One picture includes a policeman with a gun and the policeman is prodding the doctor, which matches the high attachment interpretation. The other picture describes a situation in which a policeman is prodding a doctor and the doctor is holding a gun, which matches the low attachment interpretation. Using the picture matching task, Branigan, Pickering, and McLean show that when participants were forced to interpret the priming ambiguous sentence as involving high attachment, they tended to interpret the following target ambiguous sentence as involving high attachment as well if the prime and the target sentences share the same verb.[1] Likewise, the low attachment interpretation in the priming trial also primes the low attachment interpretation in the target trial.

(1) A policeman is prodding the doctor with the gun.

This kind of structural priming effect in ambiguous sentences is hardly observable in production studies since when participants were asked to

1 One noteworthy difference between production and comprehension regarding priming effect is that priming effect in production is observed even when the prime sentence and the target sentence have different verbs, while priming effect in comprehension is observed only when the target sentence has the same verb that is used in the prime sentence (Arai et al., 2007; Branigan et al., 2005; Ledoux et al., 2007; Traxler et al., 2014). It is under discussion what causes the discrepancy. One possible explanation is that in the production models (e.g. Garrett, 1975), abstract syntactic structures are constructed at the separate stage independent to the functional level where content words are planned. However, syntactic representations are very tightly associated with individual lexical items, expecially the verb in sentence processing [See Pickering and Ferreira (2008) for more discussion].

describe an event, the final output, the spelled-out sentence, gives us no clue whether participants structured the sentence involving high attachment or low attachment since the surface form is the same although the abstract syntactic structures are different. However, comprehension studies, like the picture-matching task employed in Branigan, Pickering, and McLean's study, allow us to detect which syntactic structure participants constructed by looking at the chosen interpretation. The current study aims to investigate syntactic representation underlying Korean null object constructions. As I will discuss in the next section, Korean null object constructions have ambiguous readings depending on syntactic representations. Thus, if a certain reading can be primed, it may provide supporting evidence for the particular syntactic representation that generates the reading. To see whether we can find priming in ambiguous sentences, the current study used a picture-matching task following Branigan, Pickering, and McLean (2005) in compliance with studies in structural priming in comprehension.

Although priming studies have been extensively discussed in psycholinguistics, it is left unanswered whether unpronounced syntactic or semantic structures can be the subject of priming. Recently, Xiang, Grove, and Merchant (2019) report four priming experiments on English VP ellipsis. In their first experiment, participants read a bi-clause ditransitive priming sentence in the three different clause-type conditions. In the VP ellipsis condition, the second sentence of the priming trial contains VP ellipsis (*First Ralph sang Sheila a song, and then Marcus did*). In the nonelliptical condition, the priming sentence does not contain an ellipsis, but a full-fledged overt form (*First Ralph sang Sheila a song, and then Marcus sang her one*). In the neutral control condition, the second sentence was presented in an

intransitive form (*First Ralph sang Sheila a song, and then Marcus groaned*). After silently and loudly reading the priming sentence, participants were asked to produce a sentence that describes a picture that represents an event including an agent, a recipient, and a theme. Interestingly, in both the ellipsis condition and the nonelliptical condition, participants were more likely to produce the event in the double object construction when the first sentence of the priming sentence was presented in the double object construction than when it was in the prepositional dative construction. However, in the neutral control condition, the proportion of the double object construction in participants' responses was not significantly different between the double object priming condition and the prepositional dative priming condition. Xiang, Grove, and Merchant interpret the results as that the priming effect occurs depending on the clause type of the second sentence and the elided VPs can generate a similar priming effect as the full-fledged VP structures do (unlike the intransitive VP even though the VP is not overtly realized). This finding is interesting, particularly in the sense that even an unpronounced structure could give rise to structure priming effects. However, as they state, their study calls for future studies leaving many questions open: What is the source of priming? Is it the syntactic structure or semantic representation in the ellipsis site? Can any kind of ellipsis be the subject of priming effect, including sluicing, argument ellipsis, or comparative ellipsis? How do the task demands affect the priming effect in ellipsis? In the current study, I investigate the priming effect in the processing of Korean null object constructions. If we could observe priming effects in null object constructions, the idea of priming effects from the silence part can be further supported. Furthermore, in the next section, I will discuss what priming effects in comprehending

null objects can talk about syntactic theories on null arguments. In section 3, I will report a picture-matching experiment and discuss the main implication of the study. In section 4, I will discuss the potential contribution of the current study to the priming literature.

2. Syntactic nature of Korean null objects

Korean allows null arguments when the silent argument can be recovered from the linguistic or situational context. For example, the sentence in (2b) contains a null object so that it is not overtly spelled out what *Jina* saw. Nevertheless, due to the corresponding object in the antecedent sentence (2a), the sentence with the null argument can be properly understood. Crucially, the sentence in (2b) is ambiguous. One reading is that Jina saw Minho's picture and the other reading is that Jina saw her own picture. The first reading is called the *strict reading* and the latter reading is called the *sloppy reading*. How and why both readings are available have been extensively discussed in the literature (Hoji, 1998; Oku, 1998; Kim, 1999; Saito, 2007; Takahashi, 2008a, b; Şener and Takahashi, 2010; Ahn and Cho, 2011, 2020; Han et al., 2020).

(2) a. Minho-ka caki-uy kurim-ul poassta.
Minho-Nom self-Gen picture-Acc saw
Lit. Minho saw self's picture.
b. Jina-to 〈e〉 poassta.
Jina-also saw
Lit. Jina saw 〈e〉, too.

Largely three explanations have been suggested to account for the ambiguity observed with Korean null objects. One account is called the argument ellipsis analysis. According to the argument ellipsis analysis, the null object in (2b) has a full-fledged syntactic and semantic representation that is not phonetically encoded (Oku 1998; Kim 1999; Saito 2007; Takahashi 2008a, b; Şener and Takahashi. 2010; Han et al. 2020). Thus, the semantic representation of (2b) corresponds to (3) and the silent reflexive anaphor can play a role as a bound variable. This is why the sloppy reading is available in (2b). In addition, having undergone a sort of semantic operation that shifts a referential value of an anaphor (e.g. Vehicle change by Fiengo and May (1994)), the reflexive anaphor *self* can behave as a pronominal anaphor, namely, *ku*, so it can refer to the antecedent in the previous sentence allowing the strict reading. Crucially, under the argument ellipsis approach, the strict reading and the sloppy reading are derived from different syntactic mechanisms. The sloppy reading arises due to the bound-variable interpretation between the reflexive anaphor and the subject in the same clause in (3) while the strict reading is derived from a semantic mechanism that allows the coreference between the silent object in (2b) and the overt object in (2a).

(3) Jina-to caki-uy kurim-ul poassta.
Jina-also self-Gen picture-Acc saw
Lit. Jina saw self's picture, too.

An alternative account is a bare noun approach (Hoji 1998). Under the bare noun approach, the null argument in (2b) corresponds to a bare noun in its syntactic and semantic representation as shown in (4). The

null object is a bare noun without an anaphoric expression syntactically associated with it. However, the nominal element can be interpreted in the possessive relation with a salient individual depending on contexts. Thus, the sloppy reading and the strict reading can be obtained depending on which referential value is salient, independent of the syntactic or semantic property of the anaphoric expression. For example, in (4), the strict reading (Jina saw a picture of Minho's picture) is obtained when the sentence is produced in the context where the conversation is about Jina or Jina's picture. On the other hand, the sloppy reading (Jina saw a picture of Jina's picture) is obtained, for example, when the sentence is spoken in the context where every person is supposed to take care of their own picture.

(4) Jina-to kurim-ul poassta.
Jina-also picture-Acc saw
Lit. Jina saw a picture, too.

Lastly, the pronoun approach was suggested (Ahn and Cho, 2011, 2020). This approach assumes that null objects in Korean are syntactically equivalent to overt pronouns but simply silent. Thus, as a pronoun *per se* does not have a referential value but refers to a contextually salient entity, this approach argues that null objects can have both strict and sloppy readings depending on the saliency of subject entities. Overall, unlike the argument ellipsis approach, both the bare noun approach and the pronoun approach do not assume that the strict reading and the sloppy reading arise from the different syntactic mechanisms. For either interpretation, the syntactic nature of the null object in (2b) is simply a bare noun or a pronoun (depending on approaches), but the semantic or discourse saliency

determines which entity the silent argument refers to.[2]

Returning to structure priming effects, if we could find priming effects in the interpretation of null objects, what may it tell us about the syntactic nature of null objects? Previous experimental works on Korean null arguments mainly have used a truth value judgment task (Han et al., 2020) or an off-line judgment task (Kang, 2022). Priming targets the syntactic or semantic representations. Thus, if the sloppy interpretation of a priming sentence primes the sloppy interpretation of the next coming target sentence and the strict interpretation of a priming sentence primes the strict interpretation of the next coming target sentence, it may provide evidence that the certain syntactic or semantic representation that generates the sloppy reading or the strict reading is processed in the mind of Korean speakers so that the particular structure can be the

2 Even though both the bare noun approach and the pronoun approach appeals the contextual saliency to account for the ambiguity, the two approaches have prediction. Ahn and Cho (2020) discuss the point. They show some cases where null objects can be interpreted as the overt pronoun can be interpreted but not as the overt bare noun can be interpreted. For example, the sentence with a null object in (iB) following the sentence in (iA) has the same interpretation as the one in (iD), but not as the one in (iC).

(i) A: John-un khi khun yeca-lul coahay. (Ahn and Cho, 2020; (53))
J.-Top height tall woman-Acc like
'John likes tall women.'
B: Bill-to pro coahay.
Bill-also like
'Bill also likes tall women.'
C: Bill-to yeca-lul coahay.
Bill-also women-Acc like
'Bill also likes women.'
D: Bill-to kutul-ul coahay.
Bill-also they-Acc like
'Bill also likes them.'

locus of the priming effect. This is compatible with the argument ellipsis approach since the approach assumes that the two types of readings are derived from different syntactic and semantic representations. If the semantic representation including bound-variable operation is primed, Korean speakers will be more likely to get the sloppy reading in the next sentence with a null argument. Likewise, if the semantic representation with coreference relation, they will be more likely to get the strict reading in the next sentence with a null argument. On the other hand, it is not clear whether the priming effect in null object interpretation can be compatible with the bare noun approach or the pronoun approach because the two approaches assume that the strict reading and the sloppy reading arise from the same syntactic and semantic representation. The bare noun approach and the pronoun approach both assume that the interpretation of the null object is pragmatically determined. Specifically, the bare noun approach may suggest that the potential possessive relation between the bare noun (*a picture* in (2b)) and the subject of the elliptical sentence (in the case of the sloppy reading) or that of the antecedent sentence (in the case of strict reading) can be the locus of priming effects giving rise to priming effects in null object constructions. However, as far as I acknowledge, there is no independent evidence for the priming effect on the possessive relation between a nominal element and a potential possessor. In addition, the relevant level of representation of the contextually supported possessive relation is hard to pin down concerning most production models (Garrett, 1975). The pronoun approach also relies on contextual prominence for the interpretation of null objects. The approach may suggest that the prominence of arguments can be primed. However, Bock (1986) shows that the grammatical role of a prominent argument does not give rise

to priming. In the experiment, participants read a passive sentence in which the patient argument appears at the beginning of the sentence, so it becomes the most prominent element. However, the prominent thematic role does not seem to be the locus of priming effects since the passive prime sentences do not increase the proportion of production of intransitives, the subject of which is a prominent patient (e.g. the church is burning). This indicates that the prominence of a certain thematic role does not necessarily affect the choice of syntactic structure in the next sentence production procedure. Thus, it seems to be less likely that the saliency or prominence of the argument is primed if we could find priming effects in Korean null object constructions. I do not argue that the bare noun approach or the pronoun approach cannot account for the priming effect in null object interpretation. Yet, given the lack of independent evidence, the potential priming effect is more compatible with the argument ellipsis approach.

In the next section, I will show a priming experiment where participants were asked to comprehend Korean sentences with null objects. The main goal of the experiment is to investigate whether silent syntactic structures can generate priming effects. In addition, I will further discuss what the results of the experiment tell us about the syntactic nature of Korean null objects if we could find a priming effect in the interpretation of the silent argument in section 4.

3. An experiment

The main purpose of the experiment is to investigate whether the strict

reading or the sloppy reading of Korean null objects can be the subject of the priming effect. To do this, I adopt the experiment methodology, a picture-matching task, used in Branigan, Pickering, and McLean's (2005) study since the methodology allows us to look into which syntactic and/or semantic representation language users construct for an ambiguous sentence by looking at the selected interpretation that is represented in a picture. However, there are some drawbacks of the methodology so I will discuss what we have to be cautious about in interpreting the results.

3.1. Method

Participants. I recruited 18 Korean native speakers who are undergraduate students at Seoul National University. No one reported that he or she is bilingual or has reading difficulties.

Design and materials. 16 experimental items were used. Each item comprised a prime trial and a target trial. In both a prime trial and a target trial, a sentence with a null object was presented with two pictures. In a prime trial, only one picture between the two pictures presented matched the priming sentence and the other picture did not match the sentence. In a target trial, each picture corresponded to either the strict interpretation or the sloppy interpretation. The intended sequence of the experiment was that participants were forced to choose the picture that match either the strict reading or the sloppy reading of a sentence with a null object in a prime trial and in the very next target trial, they were asked to choose one interpretation, between the strict reading and the sloppy reading, of the target sentence with a null object by choosing one

among pictures corresponding to both interpretations.

The experiment had two conditions depending on the type of pictures presented in the prime trials: The strict reading priming condition and the sloppy reading priming condition. In the strict reading priming condition, participants read an elliptical sentence and were forced to choose a picture that matches the strict reading of the sentence. For example, a participant read a priming sentence in (5) and was asked to choose a picture that matches the sentence among the two pictures in Figure 1 below.[3] Each of the two pictures included the subject of the first sentence (here, *Wonsek*, the boy wearing a hat) and that of the second sentence (*Siwu*, the boy wearing glasses). For participants to know who each human image represents, the name of the image was tagged under the image in Korean, as shown in Figure 1. Participants were instructed to interpret the "arrows" in pictures as the person at the starting point of the arrow did something to the object at the end point of the arrow. The two pictures were the same except that one picture included a "NOT" marking on an arrow, but the other did not. Thus, the left picture in Figure 1 can be read as follows: *Wonsek did something to the airplane, but Siwu did not do that to the same airplane.* On the other hand, the right picture can be read as follows: *Wonsek did something to the airplane and Siwu did something to the same airplane as well*. Participants were supposed to choose the right picture when the pictures were presented with the sentence in (5). Crucially, the selected picture describes the strict reading of the priming sentence in (5) since Wonsek and Siwu did something to the same airplane

3 The images were adopted from a free image distributing web-page: https://www.vecteezy.com/free-vector/kids-character

and the airplane must belong to Wonsek due to the first sentence that includes an overt reflexive anaphor.

(5) Wonsek-ika caki pihayngki-lul nalyepoassta. Siwu-to nalyepoassta.
Wonsek-Nom self plane-Acc fly Siwu-also fly
Lit. Wonsek flies self's (paper) airplane. Siwu flies 〈e〉, too.

The example of pictures presented in the sloppy reading priming condition is shown in Figure 2. The sentence presented to the participants in the sloppy reading priming condition is the same sentence presented in the strict reading priming condition. Thus, the priming sentence in (5) was presented in the sloppy reading priming condition as well. However, unlike in the strict reading priming condition, in the sloppy reading priming condition, participants were given a pair of pictures each of which includes two object images. The left picture in Figure 2 means that *Wonsek did something to an airplane, but Siwu did not do something to another airplane*. Similarly, the right picture in Figure 2 indicates the situation in which *Wonsek did something to an airplane and Siwu also did something to another airplane.* Participants were supposed to choose the right picture among the

[Figure 1] Picture Stimuli in the Strict Reading Priming Condition

[Figure 2] Picture Stimuli in the Sloppy Reading Priming condition

two pictures since the left picture does not match the priming sentence in (5). Thus, participants were forced to connect the right picture and the priming sentence, which would lead participants to interpret the priming sentence in the sloppy interpretation.

One example of the target sentences is shown in (6) and the corresponding picture stimuli are in Figure 3. The same pairs of sentence stimuli and picture stimuli were used in both the strict reading priming condition and the sloppy reading priming condition. To minimize the role of prominence in interpreting null object constructions, all the sentence stimuli were presented without a context. Thus, all the arguments were 'new information'.

(6) Hyencwu-ka caki pwungsen-ul nalyepoassta. Eunwu-to nalyepoassta.
Hyencwu-Nom self balloon-Acc fly Eunwu-also fly
Lit. Hyencwu flies self's balloon. Eunwu flies 〈e〉, too.

[Figure 3] Picture Stimuli in a Target

Each of the 16 experimental items included different verbs. However, within an experimental item, the verbs used in the priming sentences and the target sentences were the same. Thus, as shown in the example in (5) and (6), the main predicate of the priming sentences and the target sentences matched. This is because many previous priming studies on sentence comprehension show that the priming effect in sentence comprehension arises only when the verb in the priming item was repeated in the target item as well (Branigan et al., 2005; Tooley et al., 2009). The main purpose of the experiment is to see whether the priming effect found in comprehending other types of ambiguous sentences (e.g. the high attachment or the low attachment of prepositional phrases) in English can be also found in Korean elliptical sentences. Thus, to be maximally equivalent to the experimental conditions where the priming effect was observed in the previous studies, in the current experiment, the same verb was repeated between the prime trial and the target trial in a single experimental item. Care was given to constructing pictures. In the prime trials, the arrows in the picture stimuli were horizontal. By contrast, in the target trials, the arrows go vertical. The discrepancy in the direction of arrows between

primes and targets was designed to avoid any priming effect from the similarity in pictures *per se*, instead of processing sentences. The subjects of the prime and the target sentences were all human names. Four boy names and four girl names were used in random order, but crucially, the names used in the prime trial were not used in the target trial within a single experimental item. Likewise, the object was not repeated between the prime trial and the target trial within a single experimental item. Thus, only the verb was repeated between the prime and the target within a single experimental item. Crucially, to make sure whether the target sentences can have both strict reading and sloppy reading in the absence of the priming effect, three Korean native speakers who did not participate in the main experiment were asked whether they could get both strict reading and sloppy reading from all the 16 target sentences when the sentences were presented without the priming sentences. All 16 target sentences were accepted with strict reading and sloppy reading by the native speakers.

In addition to the experimental items, 32 filler items were included. Filler items as well consisted of a pair of two sentences and a set of two pictures per trial. Pictures in the filler items contained arrows as experimental items did so, which made the appearance of the experimental items and the filler items look alike and allowed experimental items not to be distinguished. Participants were asked to choose a picture that matches the given sentence in the filler items as well. However, none of the filler items included null objects. Filler sentences included verbs that were not used in the experimental items so that the processing of the verbs in the filler item would not affect the processing of the verbs in the experimental items.

Two lists were randomly assigned to participants. Each list contained 16 experimental items, half the trials (8 trials) were in the strict reading priming condition and the other half the trials (8 trials) were in the sloppy reading priming condition. The two priming conditions were counterbalanced across the lists. The total 64 items (16 prime items, 16 target items, and 32 filler items) were pseudo-randomized with the constraint that at least four filler trials intervene between an experimental item and the next experimental item. Within each list, the matching picture for the priming sentence appeared on the right for half the trials and the left for the other half. Similarly, the strict reading picture for the target appeared on the right for half the trials and the left for the other half. All counterbalancing manipulations were independent.

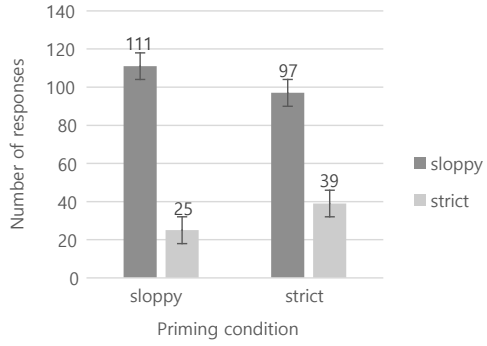
Procedure. The experiment was programmed using the web-based survey platform PCIbex Farm (Zehr and Schwarz, 2018) and took place online. Participants were asked to find a quiet place before they started the experiment to focus on the task. Before they started the main experiment, they conducted a practice session that consisted of 4 trials. Each trial in the practice session contained a pair of two sentences and a set of two pictures as the trials in the main experiment. Participants were asked to choose a picture that matches the given sentence by mouse-clicking the correct picture and their responses were recorded through the program. Crucially, the sentence stimuli and the pictures within a single trial were not presented simultaneously. If they were to be presented at the same time, participants could not try to process the syntactic or semantic structures of the sentences but simply make their decision in a word-by-word detection between the sentence and the pictures. Thus, to ensure that

the participants' decision is based on the sentence processing, sentence stimuli were presented for 3000msec and disappeared, and then two picture stimuli were presented immediately. There is no time limit for participants to make a decision, so participants could take time as much as they want and once they clicked one picture, the next trial started. Each trial started by clicking the "next" button in the middle of the display. By clicking the button, the mouse cursor was dragged to the middle of the monitor so that the previous click position would not affect the next decision.

Predictions. If there is a priming effect in comprehending Korean sentences with a null object, participants would be more likely to choose the picture that matches the strict reading than the other picture in the strict reading priming condition and vice versa in the sloppy reading priming condition. If there is no priming effect, participants' choices would not be significantly different between the priming conditions.

3.2. Results

There was a participant who chose the wrong picture for the prime sentence in more than 4 trials. I excluded the participant's responses from the analysis since the participant's responses did not show that the participant properly focused on the tasks. Thus, 17 participants' responses were coded for further analysis. Participants' responses were coded according to whether the participant chose the strict reading picture or the sloppy reading picture for the target sentence. Figure 4 visualizes the results. Overall, participants chose the pictures that match the sloppy reading more than the pictures that match the strict reading across the conditions.



[Figure 4] Overall Results

Branigan et al. (2005) and Ivanova et al. (2012) used a way of calculating priming effects such that the proportion of a certain type of response in one priming condition minus the proportion of the same type of response in the other priming condition. Adopting the idea, I calculated priming effects as the proportion of strict reading selection in the strict reading priming condition (28%) minus the proportion of strict reading selection in the sloppy reading priming condition (10%). The results showed an overall priming effect of 10%, which means that participants selected 10% more strict reading indicating picture than the sloppy reading indicating picture in the strict reading priming condition and vice versa in the sloppy reading priming condition.

To investigate whether this overall impression is statistically significant, a generalized logistic mixed effect model was constructed in R (R Core TeAM, 2020, version 4.0.2) using the lme4 package (Bates et al., 2015) and lmerTest (Kuznetsova et al, 2017). The condition factor (strict reading priming condition vs. sloppy reading priming condition) was entered into the model as fixed effects. The fixed effect was sum-coded and centered for further analysis. I included random intercepts over subjects and items. The model

was constructed with the maximal random effects structure permitted by the design (Barr et al., 2013), but according to the maximum likelihood, it was simplified by removing the random slope for the condition factor. The model shows that the fixed effect, condition, significantly affects participants' response ($\beta = 0.75$, se = 0.36, $p < 0.05$). The statistical analysis also confirms that the proportions of the sloppy reading selected or strict reading selected were significantly affected by the type of the priming sentence.

4. General Discussion

4.1. Priming effects in silence

The results of the experiment show that priming effects arise in processing Korean sentences with a null object. Participants were more likely to interpret a null object as involving the strict reading when they just processed a null object as involving the strict reading. Likewise, the proportion of the sloppy interpretation increased if participants just processed a null object in the sloppy reading. This finding is noteworthy in the sense that priming effects in sentence comprehension are not restricted to certain sentence types but are more widely observable in various sentence types. Furthermore, the priming effect arises not only in processing overt linguistic elements but also in processing silent syntactic elements. On par with the priming effect in VP ellipsis (Xiang et al. 2019), the current experiment provides supporting evidence for priming effects in silence. This poses an interesting implication that structure priming is independent of phonetic forms but targets more abstract representations.

In the current study, the phonetic form has nothing to do with the results due to its non-exist. Even without a phonetic form, structural priming can arise once there is a syntactic or semantic representation priming effects can be applied to.

However, I admit that several things need to be clarified to ensure that the current finding is the consequence of structural priming. First, even though the picture stimuli in the prime trial and the target trial were designed to have some differences (e.g. the direction of arrows), there were some inherent similarities between the two sets of trials since they share the same sentence types. Thus, to ensure that the priming effects observed are the consequence of priming effects applying the syntactic or semantic representation but not the pictures, a priming experiment that does not use picture stimuli seems to be required. However, Branigan et al. (2005) state that picture similarity does not play a role in priming effects in their similar experimental setting. Thus, given the absence of evidence, we could assume that observed priming effects are the results of sentence processing instead of mere picture matching.

Another thing that needs to be considered is to clarify whether the observed priming effects tap into the structure differences or whether they were induced at the interpretation level. In the current experiment, the target trial and the prime trial share the same type of interpretations. Fortunately, there is a way to design an experiment such that the prime trial and the target trial have distinguished interpretations but share a similar syntactic structure. When the corresponding object in the antecedent clause is a quantificational nominal, the null argument can have either the strict reading or the sloppy reading as shown in (7). In the strict reading, the null object refers to the same entities that are referred to by

the corresponding object in the antecedent sentence. On the other hand, in the sloppy reading (or quantificational reading, according to Takahashi (2008a) who first observe this phenomenon), the null object refers to another set of three students who are different from the three students Hyemin hugged.

(7) Hyemini-ka haksayng sey myeng-ul kkyeanassta.
Hyemin-Nom students three CL-Acc hugged
'Lit. Hyemin hugged three students.'
Salangi-to 〈e〉 kkyeanassta.
Salang-also hugged
'Lit. Salang hugged 〈e〉 too.'
Strict reading: Salang hugged the same three students Hyemin hugged.
Sloppy reading: Salang hugged another three students (who Hyemin did not hug).

Takahashi (2008a) argues that the reason why there is an ambiguity in (7) is actually the same reason we obtain an ambiguity in the possessive type sentences that were used in the current experiment (like (6) I repeated below in (8)). Strict readings in both types require a coreferential operation between the null object and the corresponding object in the antecedent clause. Thus, the null argument refers to the same three students Hyemin hugged in (7) and the null argument in (8) refers to the same balloon referred to in the antecedent clause (namely, Hyencwu's balloon). On the other hand, when the sloppy reading is obtained, the null object must have a full-fledged form in its semantic representation, but their phonetic forms are simply elided in both cases. Since the full-fledged linguistic form, *three students* occupy the null object position at semantic representation,

the quantificational reading is available in (7). Likewise, since the full-fledged form, *self's balloon*, is in the semantic representation of the null object in (8), the sloppy reading is available. To summarize, the quantificational interpretation and the sloppy reading on the one hand, and the strict reading on the other hand share the same syntactic properties in both cases even though the interpretation is not alike (one includes a quantificational interpretation and the other includes a possessive interpretation).

(8) Hyencwu-ka caki pwungsen-ul nalypoassta. Eunwu-to nalypoassta.
Hyencwu-Nom self balloon-Acc fly Eunwu-also fly
Lit. Hyencwu flies self's balloon. Eunwu flies 〈e〉, too.

If we can find a priming effect between a quantificational priming sentence and a possessive target sentence, we could safely conclude that priming effects in null object processing target syntactic operations, not just the interpretation level. The null argument in the priming sentences is a numeral quantifier so it includes the information of the number of entities denoted by the object while the one in the target sentences does not express a quantificational aspect of the object. Likewise, the possession relation that must be interpreted in the target sentences is not necessarily required in the interpretation of the priming sentences. Thus, the priming effect that would be observed in this experiment can be subsumed under the syntactic priming effect independent of semantic similarities. I will leave this issue open for future work.

One noteworthy observation from the experiment is that the sloppy

reading is more likely to be chosen over the strict reading as the interpretation of the null arguments in both priming conditions. This is contrary to the previous experimental studies that observe the strict-reading preference with null objects using a truth value judgment task (Han et al., 2020; cf. Kang, 2022). One potential reason for the discrepancy comes from the difference in the target sentences. One example of the elliptical sentences used in Han et al. (2020) is presented in (9). Here, the overt object in the antecedent clause is *ku-uy* 'he-GEN'. In Korean, both 'he-GEN' and 'self-GEN' form that was used in the current experiment can be used to indicate the possessive relation. Thus, in (9), *caki-uy* 'self-GEN' can replace ku-uy 'he-GEN' in the situation where Minswu moved his stuff.

(9) Minswu-ka ku-uy cim-ul nalu-ess-ko, Kiswu-to [e] nalu-ess-ta.
Minswu-NOM he-GEN stuff-ACC move-PAST-CONJ Kiswu-also move-PAST-DECL
'Minswu moved his stuff, and Kiswu moved, too.' (Han et al., 2020, (13))

The discrepancy in the preference of a certain reading between the current work and Han et al's experiment could arise due to the difference in the corresponding object in the antecedent clause.

Another possibility is that the difference in the way of presenting targets leads the difference in the preference. In the previous studies, participants were given elliptical sentences with a possible reading and they were supposed to judge how acceptable the sentence is in the given context. Thus, there was no single trial when the participants were forced to accept the sloppy reading or the strict reading with an elliptical sentence. However, in the current experiment, participants were forced to accept

either the strict reading or the sloppy reading in the prime trials. This would make both representations activated during the experimental trials, and if the priming effect does not work equivalently for the two readings, but the sloppy reading can be more likely to be affected by the priming effect, the sloppy reading preference can be obtained. This implies that the preference for sloppy reading over the strict reading observed in the current experiment may not reflect the preference in a neutral context. Rather, the preference for sloppy reading is a consequence of the priming task. By contrast, the reading preference observed in the previous studies that do not apply a priming technique, (so participants were never forced to choose a reading) may reflect the reading preference in a neutral context. This throws an interesting question. Can the degree of priming effect vary by structure or by representation? It is not hard to find a study that shows an unbalanced priming effect. Bock (1986) shows that the percentage of active utterances and that of passive utterances in the active-form priming condition are significantly different (51% vs. 24%), while the percentage of active utterances and that of passive utterances in the passive-form priming condition show a minimal difference (36% vs. 39%). The priming effects of the active form and that of the passive form do not seem to be equal. I suspect that the priming effect of the sloppy reading representation is much stronger than that of the strict reading representation, which gives rise to the sloppy reading preference. This definitely calls for future work that investigates the degree of the priming effect of each representation using different types of priming methods.

4.2. Implications on the syntactic nature of null objects

Even though null arguments do not have a phonetic form, they must have a proper semantic representation to get interpreted. As I discussed in section 2, there are roughly three approaches to account for the syntactic nature of Korean null objects, namely, argument ellipsis analysis, *pro*-analysis, and bare noun analysis. In this section, I will discuss the implication of the current priming experiment on theoretical debates regarding the syntax of Korean null arguments. I hope to clarify that this discussion is by no means a conclusive remark but an open question that must be discussed in future works. What does it mean that the strict reading or the sloppy reading is primed? When Korean native speakers are forced to interpret a sentence with a null object in the strict reading (or the sloppy reading), they are more likely to interpret the next sentence with a null object in the strict reading (or the sloppy reading) even though the way of interpreting the null argument is not restricted in one way. The question is what can be the target of repetition. If we adopt the idea that observing the syntactic priming effect can serve as supporting evidence for the existence of a certain representation, as suggested by Pickering and Ferreira (2008), the observed priming effects in the current experiment show that the representation for the sloppy reading and that for the strict reading does exist in the Korean native speakers' mind and they are processed. Thus, a theory that distinguishes the sloppy reading and the strict reading in terms of distinctive representation can be supported by the results.

According to the argument ellipsis analysis, the semantic representation for the strict reading involves a coreferential operation while the semantic

representation for the sloppy reading involves a bound variable operation. Thus, the discrepancy in interpretation comes from the difference in syntactic operations and semantic representations. On the other hand, under the bare noun or pronoun approach, the two readings share the same syntactic and semantic representations, namely a silent bare noun or a silent pronoun, respectively. Each reading is "available" due to the inference based on discourse prominence. Thus, without independent evidence that shows that pragmatic inferences can be primed, the bare noun approach and the pronoun approach can hardly explain the level of repeating representation. Therefore, as I discussed in section 2, if we could find any priming effect in the interpretation of null objects, the results could serve as supporting evidence for the argument ellipsis analysis over the other approaches by the assumption that priming of a certain reading appeals to a distinctive representation for that reading to which priming applies. This observation provides a new type of data in the discussion of null arguments. As far as I acknowledge, theoretical discussions regarding Korean null arguments have relied on the results of some off-line judgment tasks. However, the current work taps on the processing of null objects using the priming task. Even though the experiments' dependent measure was the participants' choice of a picture that is the final outcome of the processing, the priming *per se* is what happens in the process of syntactic and/or semantic structure of target sentences. Therefore, this work expands the empirical scope of the studies on null arguments and provides a new perspective to evaluate different models.

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초록

한국어의 목적어 영논항 해석에 작용하는 점화효과

강초롱*

문장을 발화하거나 듣고 처리할 때, 이전에 듣거나 발화한 문장의 통사구조에 영향을 받아서 이후 문장을 처리하는 현상을 구조점화현상이라 일컫는다. 구조점화 현상은 여러 언어의 여러 문장구조에서 다양하게 발견되어 왔으나, 명시적 표현이 없는 생략구문들에서도 점화효과가 있는가에 대한 연구는 많이 수행되어 오지 않았다. 본 연구는 한국어의 영논항 구문을 처리할 때 점화효과가 나타나는가를 실험적으로 살펴본 연구다. 문장처리 영역에서 구조점화 현상을 살펴볼 때 활용되는 실험방식인 '그림-맞추기' 실험방식을 채택하여 실험 참가자들이 한국어의 영논항이 포함된 문장의 중의적인 의미 중 어떤 의미로 해석하는가를 바탕으로 점화효과를 살펴보았다. 실험 결과 실험 참가자들은 점화시험에서 완화해석으로 영논항 구문을 해석한 경우 그다음에 제시된 영논항을 포함한 표적문장도 완화해석으로 해석하는 비율이 높아지고, 엄격해석으로 영논항 구문을 해석하도록 하는 점화시험 이후에 제시된 표적시험에서는 엄격해석의 의미를 선택하는 비율이 늘어나는 것을 확인할 수 있었다. 위 실험결과를 바탕으로 생략구문에서 나타나는 점화효과에 대한 논의와 나아가 이러한 실험 연구가 영논항에 대한 통사 이론에 어떠한 함의를 주는가를 논의하였다.

주제어 문장처리상의 점화효과, 목적어 영논항, 그림-맞추기 실험, 논항생략

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