An Experimental Investigation of Online and Offline Binding Properties of Korean Reflexives

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1. Introduction

Korean is a language that has a rich inventory of reflexives. The most representative and most frequently used reflexive is *caki*, a morphologically simple reflexive. The language also possesses several other reflexives, both morphologically simple and complex, such as *casin*, *caki-casin*, *pronoun-casin*, *tangsin* and *susulo*. Given this complex reflexive system of Korean, an important question that needs to be answered is what the functions of the different reflexives are. Why are there such many reflexives and how are they distinguished from each other?

The paper reports the results of an experimental study conducted to provide some insight on this issue. Crosslinguistically, we know that reflexives may be differentiated at multiple levels of linguistic categorization (lexical, syntactic and discourse-pragmatic). Among the dimensions along which the reflexives can potentially vary, we focused on the syntactic dimension−the binding distance of the reflexives, in our study. We investigated whether a

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reflexive can be bound by a local antecedent or by a long-distance antecedent, and if both types of binding are possible, which of the local and long-distance binding interpretation is preferred. We focused on three reflexives among those mentioned above—*caki*, *casin* and *caki-casin*.

Although the binding distance preference of these three reflexives has been addressed in previous literature (e.g. Kim, 2000; Moon, 1995; Yoon 1989), most studies have based their claims on informal intuitions. Kang (1998) is a notable exception. Kang conducted a corpus study to check whether the claims made in previous studies are confirmed in real life examples. Focusing the accusative marked forms of *caki*, *casin* and *caki-casin*, he examined how often these reflexives are used with local and long-distance antecedents in a Korean corpus of about 10 million words. He found that *caki* occurred about equally with long-distance and local antecedents (151 local vs. 165 long-distance antecedents, out of 316 total tokens). *Casin* preferred local antecedents to long-distance antecedents (311 local vs. 123 long-distance antecedents, out of 434 tokens), and *caki-casin* was locally bound most of the time (66 local vs. 5 long-distance antecedents, out of 71 tokens).

In addition to Kang's (1998) corpus study, a few experimental studies have been conducted recently to investigate the binding distance of reflexives. Kim and Yoon (2008) and Kim, Montrul and Yoon (2009) examined the binding distance of *caki*, *casin* and *caki-casin* using an offline truth value judgment task. Native Korean speakers were given sentences such as (1).

(1) Cheli-nun [Minswu-ka caki/casin/caki-casin-(l)ul
Cheli-top Minswu-nom self-acc

kuli-ess-ta-ko] malhay-ss-ta
draw-past-decl-comp say-past-decl

'Cheli said that Minswu drew himself.'

The sentences were presented together with pictures that represent either the local binding interpretation or the long-distance binding interpretation of the reflexive, and participants were asked to judge whether the sentences were true descriptions of the pictures. The results showed that participants strongly preferred long-distance binding for *caki*. For *casin*, there was either a slight preference of long-distance binding (Kim & Yoon, 2008) or no preference in binding distance (Kim, Montrul & Yoon, 2009), while for *caki-casin*, there was a strong preference for local binding. By and large, both corpus and experimental studies confirm the claims made in the previous

theoretical literature that there is a three-way distinction among these reflexives in terms of preferred binding distance.

Little is known, however, about how these reflexives are processed real time. In one of few studies on online processing of multiple reflexives, Choi and Kim (2007) conducted an eye-tracking study of *caki* and *casin*. Participants' eye-movements were recorded while they read bi-clausal sentences such as (2), where the embedded verbs disambiguated the interpretation of the reflexives.

(2) a. Halu-nun hoysawen-i [annaywen-i
one day-top company worker-nom receptionist-nom

caki/casin-ul pyelankan hoyphihay-ss-ta-ko] malhay-ss-ta
self-acc suddenly avoid-past-decl-comp say-past-decl

b. Halu-nun hoysawen-i [annaywen-i
one day-top company worker-nom receptionist-nom

caki/casin-ul pyelankan kwasihay-ss-ta-ko] malhay-ss-ta
self-acc suddenly show off-past-decl-comp say-past-decl

At the disambiguating embedded verb, the first pass reading times, which is usually considered to reflect early processes of sentence comprehension, were shorter in (2a) than in (2b) for *caki* sentences, but for *casin* sentences, no difference was found between the conditions. The same pattern of interaction between the reflexive and verb type was found in total reading times—an indicator of later processes—at the reflexive region and the embedded verb region. Based on these results, Choi and Kim (2007) concluded that *caki* is immediately assigned a long-distance interpretation (hence a longer first pass reading times of (2b), in which such initial interpretation should be revised), whereas *casin* does not have an immediate preference for either binding interpretation. Again, their results do not contradict the conclusions made in the previous literature, including those of corpus and experimental research.

Previous studies provide emerging experimental confirmation that binding distance is a factor discriminating among *caki*, *casin* and *caki*-*casin*, and more experiments are needed to obtain a complete picture of the preference in binding distance that different Korean reflexives have. Investigation of online interpretation of multiple reflexives is called for in particular, since online behavior of reflexives other than *caki* and *casin* has not been investigated so far. Also, while Choi and Kim (2007) came to their conclusion by introducing a bias on the embedded verb, we do not know how different

reflexives are processed in the absence of such biases. The present study conducted an experiment on the binding distance preference of all three reflexives—*caki*, *casin* and *caki-casin*—in both online and offline comprehension. The online task (visual world eye-tracking) examined the time course of antecedent search, and the offline task (antecedent identification) investigated the final interpretations possibly given to the reflexives. The online task results show evidence suggesting that *caki* and *casin* do not immediately select among the local and long-distance antecedent and maintain the ambiguity in interpretation if no disambiguating information follows. *Caki-casin*, however, is immediately bound by the local antecedent. The offline task results reveal a three-way distinction between the reflexives in final interpretation as in the previous studies.

The paper is organized as follows. Section 2 describes the study, in the order of the norming test (2.1.), the participants of the study (2.2.), the methods and results of the eye-tracking task (2.3.), and those of the antecedent identification task (2.4.). The results of the study are discussed in Section 3.

2. The Study

2.1. Norming test for the materials

Biclausal sentences such as (3) were used for the two main tasks of this study, where three reflexives (*caki*, *casin* and *caki-casin*) replaced the embedded object (marked *X*). The matrix subject (*Peterpan*) and the embedded subject (*Shrek*) served as long-distance and local antecedents, respectively. More detailed description of the experimental sentences will be given when we describe the eye-tracking task. Since we were interested in testing the long-distance or local interpretation of the reflexives, we made sure that the embedded verb or any other elements of the sentence do not introduce a bias in favor of local or long-distance interpretation. For this purpose, a norming test was conducted. Ten native speakers of Korean, who did not participate in the main task but had comparable linguistic and biographical profiles as the subjects for the main task, were given 73 sentences such as (3) and were asked to judge whether the embedded object (X) can refer to the matrix subject or the embedded subject. The two questions for each test item were spaced far apart, intermixed with questions of other items, to reduce the possibility of answer to one question affecting the response to the other. Participants were asked to choose a number on a 7-point Likert scale, where 1 indicated that X could never refer to the character mentioned in the question and 7 meant that X can refer to the character naturally.

(3) Peterpan-un [Shrek-i ppyocokhan panul-lo **X-lul** silswulo
P-top S-nom sharp needle-ins X-acc by mystake

ccille-ss-ta-ko] malhay-ss-sup-ni-ta.
prick-past-decl-comp say-past-hon-ind-decl

'Peterpan said Shrek pricked X with a sharp needle by mistake.'

Question 1: 'Can X be Peterpan in this sentence?'
Question 2: 'Can X be Shrek in this sentence?'

Among the 73 sentences we piloted, 21 sentences for which the matrix subject interpretation and the embedded subject interpretation received similar scores ($t1(9)=1.027$, $p>.05$, $t2(20)=1.623$, $p>.05$) were selected as target items for the main tasks. The selected sentences were not inherently biased for one of the two binding interpretations of objects. Therefore, if any bias in the interpretation emerges, we can conclude that they arise from the inherent lexical properties of the reflexives.

2.2. Participants

The participants of the main tasks were 16 native speakers of Korean who did not participate in the norming test. The participants were residing in the US at the time of testing (mean age=29.2, range=23-37). According to the language background questionnaire filled out by the participants, they were born in Korea and moved to the US as an adult (mean age of arrival=27.2, range=21-37). Three of them had lived in an English-speaking country before they moved to the US, but this was when they reached adulthood (one participant spent 10 months in the UK at age 22, one 13 months in Singapore at 35, and another 12 months in Singapore at 37). The total duration of stay in the US and in the other English-speaking countries ranged from 1 month to 59 months (mean=25.9 months).

2.3. Eye-tracking task

2.3.1. Design, materials and procedures

A visual world paradigm eye-tracking task was conducted in order to examine the process of moment-by-moment antecedent search of reflexives. The study adapted the design used in Clackson, Felser and Clahsen (2011), which investigated processing of the English reflexives and pronouns. Participants listened to Korean sentences while looking at a computer monitor that shows pictures. Example aural stimulus and the corresponding visual display are presented in (4) and Figure 1.

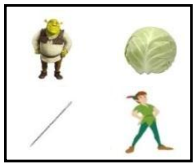
(4) a. Peterpan-un [Shrek-i ppyocokhan panul-lo **caki-lul** silswulo
P-top S-nom sharp needle-ins self-acc by mistake

ccille-ss-ta-ko] malhay-ss-sup-ni-ta.
prick-past-decl-comp say-past-hon-ind-decl

b. Peterpan-un [Shrek-i ppyocokhan panul-lo **casin-ul** silswulo ccille-ss-ta-ko] malhay-ss-sup-ni-ta.

c. Peterpan-un [Shrek-i ppyocokhan panul-lo **caki-casin-ul** silswulo ccille-ss-ta-ko] malhay-ss-sup-ni-ta.

'Peterpan said Shrek pricked **self** with a sharp needle by mistake.'



(Figure 1) The visual display corresponding to (4)

The experimental sentences were biclausal sentences where the embedded object was one of the three reflexives (*caki*/ *casin*/ *caki-casin*). Both the matrix subject and the embedded subject denoted 3rd person singular masculine animation characters, which matched the reflexives in phi-features. Six well-known animation characters were selected and used in equal amount of times, half of the times as the matrix subject and half of the times as the embedded subject. A postpositional phrase (such as *pyocokhan panul-lo* 'with a sharp needle') was inserted before the reflexive. This phrase was added to direct the participants' gaze to a single position in the display (the picture denoted by the NP within the PP) that is neither the picture of the matrix subject or that of the embedded subject, at the onset of the reflexive. After the reflexive, an adverb (such as *silswulo* 'by mistake') was inserted to create a 'spill-over' region, in order to secure some time to capture the effect of the reflexive before the participants hear the embedded verb. Twenty-one sets of experimental items were constructed and distributed among three lists in a Latin Square design. Each list also contained 59 filler sentences, intermixed with the experimental sentences in a pseudorandomized order. Participants were randomly assigned to one of the lists.

The visual display showed four pictures in the middle of the computer monitor—the picture of the matrix subject, the picture of the embedded subject, the picture depicting the object mentioned by the NP within the PP that occurred right before the reflexive (in the example display, *pyocokhan panul* 'a sharp needle'), and the picture of an object that was not mentioned in the aural stimuli. The four pictures were arranged to be displayed evenly in different positions (i.e., the subject picture was shown in the first quadrant in one fourth of the trials, and in the second quadrant in another one fourth of the trials, etc.).

The expected fixation patterns were as follows: It was expected that fixations would be directed to the matrix subject picture and the embedded subject picture respectively upon hearing the matrix subject and the embedded subject. On hearing the PP, fixations would move to the picture denoting the NP within the PP. As we discussed earlier, this step was created to direct fixations away from pictures of the potential antecedents of the reflexive (the matrix subject picture or the embedded subject picture) before participants heard the reflexive. The search for the antecedent would begin upon hearing the reflexive. The proportion of fixations on the matrix subject picture and on the embedded subject picture would change depending on which of the two subjects are considered as the antecedent. We thus compared the two fixation proportions from the onset of the reflexive.

From the reflexive onset, two possible time courses of antecedent search were predicted. First, it is possible that one of the two binding interpretations is assigned immediately when the reflexive is heard (or at the adverb, which is the spill-over word). The initially assigned interpretation will then be confirmed or revised as more information follows the reflexive. Note that in our stimuli, the information following the reflexive is not likely to cause a noticeable revision of the initial interpretation because we normed our stimuli so that they do not have a bias for local binding interpretation or for long-distance binding interpretation. Alternatively, it is possible that the antecedent selection is not immediately done at the reflexive (or at the spill-over word), but is delayed until potentially important information is given, for instance, at the embedded verb. In this case, due to the nature of our stimuli, the ambiguity of the reflexive will not be resolved even after additional words are given past the reflexive.

The proportions of fixations on the two potential antecedents were analyzed in two consecutive timing windows. The first window included the reflexive and the following adverb, and was expected to show the initial interpretation of the reflexives. In the next window, which included the embedded verb, was expected to show the influence of the embedded verb in determining the interpretation of reflexives. The next word (the matrix verb)

was excluded from the analysis because it could involve the sentence wrap-up effect, being the last word of the sentence.

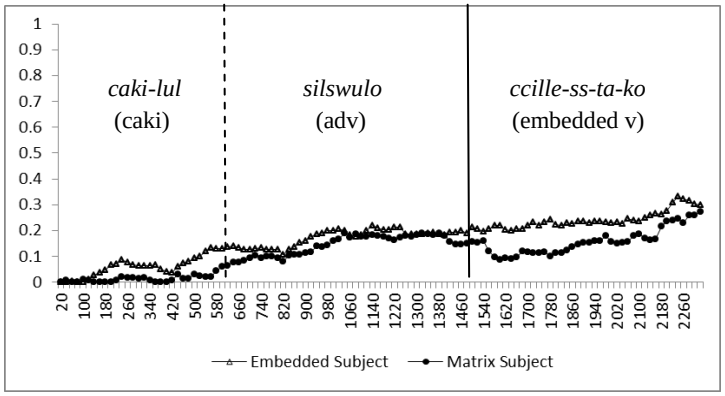
The experiment was conducted using a computer that is connected to Eye-link 1000. After the participants were familiarized with the experiment through a practice session, they proceeded to the main session. At the beginning of each trial the visual display to be used in the trial was shown briefly (for 2.5 seconds) on the screen. This was done so that the participants would become familiar with the picture arrays in the display. The next screen was a blank screen with a fixation cross in the middle (700msec). This screen was included to direct the participants' gaze to the center of the screen before they begin to hear the aural stimuli. On the next screen, the visual display shown earlier was presented again and the aural stimulus, recorded by a female native Korean speaker, was played at the same time. Participants were told that they could look anywhere they like to on the screen while trying to comprehend the meaning of the aural stimulus. 3.5 seconds after the stimulus ended, participants heard a comprehension question. It was a short description of the aural stimuli (e.g. *Shrek-i panul-lo ccillesssupnita.* 'Shrek pricked (someone) with a needle.' for (4)) and participants were asked to judge whether it was a true or a false description of the sentence they had heard by pressing one of two keys on the keyboard. With the keyboard press, the next trial began. The eye-tracker was calibrated at least four designated times (at the beginning of the practice session, at the beginning of the main session and twice in the middle of the eye-tracking experiment). Calibration was observed by one of the experimenters and the eye-tracker was additionally calibrated when necessary (e.g. in cases where the eye-tracker lost track of the eye or clear miscalibration was observed). Viewing was binocular, but only the movement of the right eye was recorded and analyzed.

2.3.2. Results

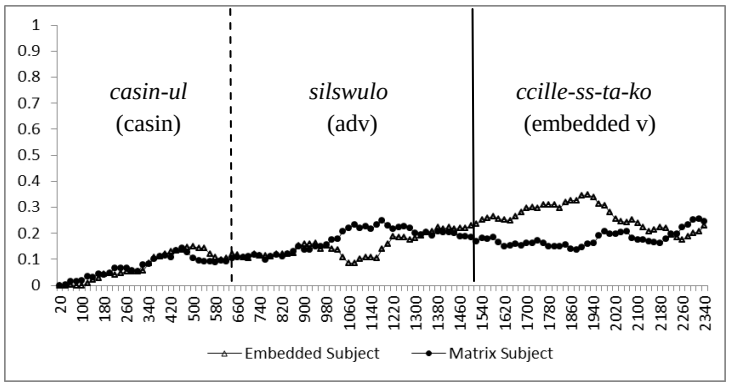
The mean accuracy of the comprehension questions was high (97.1%), suggesting that the participants were paying attention to the task. Questions for *caki* sentences and *casin* sentences had slightly lower accuracy than those for *caki-casin* sentences (*caki*−96%, *casin*−95.2%, *caki-casin*−100%), but a repeated-measures ANOVA performed on percent accuracy revealed that the accuracy was not significantly different across the three reflexives ($F1(2,30)=2.015$, $p>.05$, $F2(2,40)=1.727$, $p>.05$).

Turning to the fixation data, the proportion of fixations on the four pictures was first calculated. When the fixation patterns were visually examined from the onset of the stimulus sentence to the reflexive onset (i.e. end of the PP) (*Peterpan-un Shrek-i ppyocokhan panul-lo* 'Peterpan-top Shrek-nom sharp needle-ins' in (4)), the patterns generally confirmed our expectations:

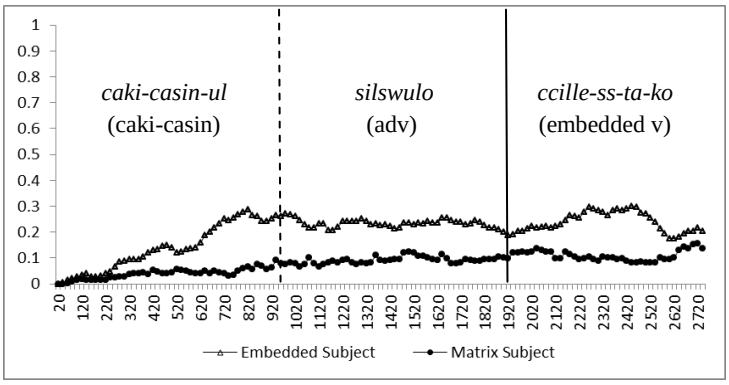
proportions of fixations increased in the order of the matrix subject picture, embedded subject picture and the picture depicting the NP in the PP. However, it turned out that the insertion of the PP before the reflexive was not entirely successful in directing fixations away from the pictures of the two potential antecedents of the reflexive. At reflexive onset, although the proportion of looks to the picture depicting the NP in the PP was the highest (0.45), proportion of looks to the embedded subject was not reduced enough to be comparable to the proportion of looks to the matrix subject (matrix subject−0.07 vs. embedded subject−0.22; cf, object not mentioned−0.04). Due to the difference between the proportions of looks to the two potential antecedents at reflexive onset, comparison of the two in the critical windows was not possible. Such baseline difference is sometimes found in visual world paradigm studies (Barr, 2011). As a way to deal with the baseline difference, we eliminated the trials where fixations were on the matrix subject picture or on the embedded subject picture at reflexive onset and analyzed the remaining trials (a suggestion made by Tanenhaus, Frank, Jaeger, Masharov and Salverda, 2008 (cited in Barr, 2011)). This made the proportion of fixations of the two subject pictures start from 0 at reflexive onset and allowed clearer interpretations of the trajectory of looks to the potential antecedents. The analyzed data constituted 69.9% of the total trials. Figures 2, 3 and 4 show the proportion of fixations on the matrix subject picture and the embedded subject picture in the critical timing windows for sentences including *caki*, *casin* and *caki-casin*, respectively. The x-axis represents time in msec. Note that the x-axis is longer for *caki-casin* sentences, due to the fact that *caki-casin* is longer than *caki* or *casin*.



(Figure 2) Proportion of fixations on the matrix subject picture and the embedded subject picture: *caki*



(Figure 3) Proportion of fixations on the matrix subject picture and the embedded subject picture: *casin*



(Figure 4) Proportion of fixations on the matrix subject picture and the embedded subject picture: *caki-casin*

Paired-samples t-tests were conducted for the three reflexives separately, to statistically compare the averaged fixation proportions of the matrix subject picture and the averaged fixation proportions of the embedded subject picture in each timing window. Considering that it takes about 300ms to program and launch eye-movement, the analyses were conducted from 300ms after the reflexive onset. The results revealed that in *caki* sentences, the proportion of fixations on the matrix subject picture was not significantly different from the proportion of fixations on the embedded subject picture in

the reflexive+adverb window ($t1(15)$=-.574, p>.05, $t2(20)$=-.812, p>.05). The two fixation proportions were not significantly different in the embedded verb window, either ($t1(15)$=-1.477, p>.05, $t2(20)$=-1.469, p>.05). The same statistical results were found in *casin* sentences, with fixation proportions on the two subjects not significantly different in the two timing windows (reflexive+adverb: $t1(15)$=.480, p>.05, $t2(20)$=.168, p>.05; embedded verb: $t1(15)$=-1.165, p>.05, $t2(20)$=-1.296, p>.05). A different pattern was found in *caki-casin* sentences. Fixation proportion on the embedded subject picture was significantly higher than that on the matrix subject picture in the reflexive+adverb window ($t1(15)$=-2.999, p<.01, $t2(20)$=-4.012, p<.01), and the difference was maintained in the embedded verb window ($t1(15)$=-2.844, p<.05, $t2(20)$=-3.092, p<.01).

2.4. Antecedent Identification task

2.4.1. Design, materials and procedures

After the eye-tracking task was conducted, participants were given a written antecedent identification task. The experimental items of the eye-tracking task were used for this task, distributed among the same three lists of the eye-tracking task. The filler items were not included for the antecedent identification task. Each sentence was accompanied by two questions explicitly asking whether the reflexive can refer to one of the two subjects. Since there were two questions for one sentence, each participant was given 42 sentence-question pairs in total (21 sentences x 2 questions). The within-list order was pseudorandomized so that the two questions for a sentence were placed far apart. Participants were assigned to a list that is different from the list they were given in the eye-tracking task. They gave 1 to the question if the answer is 'Yes' and 0 if it is 'No'.

2.4.2. Results

Table 1 shows the average response scores for the two binding interpretations for each reflexive.

(Table 1) Average response scores for local binding and long-distance binding interpretation for *caki*, *casin* and *caki-casin*

	caki	*casin*	*caki-casin*
Matrix subject-binding interpretation	0.74	0.58	0.24
Embedded subject-binding interpretation	0.74	0.82	0.96

Paired-samples t-tests comparing the scores for the two binding interpretation revealed that for *caki*, the two binding interpretations did not receive significantly different scores ($t1(15)$=.000, p>.05, $t2(20)$=.438, p>.05). For

casin, however, the matrix subject interpretation received significantly lower scores than the embedded subject interpretation ($t1(15)=-2.649$, $p<.05$, $t2(20)=-2.642$, $p<.05$). For *caki-casin*, the difference was even more highly significant ($t1(15)=-8.676$, $p<.001$, $t2(20)=-11.204$, $p<.001$).

3. Discussion

The present study investigated the binding distance preferences of the Korean reflexives *caki*, *casin* and *caki-casin* in online antecedent search process and in final interpretation. In the online eye-tracking task, we examined whether the three reflexives are incrementally interpreted, that is, whether they select their antecedents immediately after they are heard, and if so, which of the two antecedents they select. Our study did not find evidence that *caki* and *casin* immediately activate a preferred antecedent. Rather, the fixation patterns suggest that both local and long-distance antecedents are initially considered as potential antecedents for *caki* and *casin*. These reflexives continued to be ambiguous even after the embedded verb was heard, probably because the embedded verbs used in our study were not helpful in disambiguating them. By contrast, with *caki-casin*, participants' gaze was immediately directed to the embedded subject picture, suggesting that *caki-casin* is initially assigned the local binding interpretation. The initial interpretation was maintained after the (neutral) embedded verb was heard.

In the offline antecedent identification task, we examined the final interpretations given to the reflexives. The results showed that *caki* was judged to be ambiguous between the local and long-distance binding interpretations. *Casin* was also ambiguous but the local binding interpretation was preferred. *Caki-casin* strongly preferred the local binding interpretation.

Putting the results of the online and the offline tasks together, what is interesting is that *casin* showed a discrepancy between the initial and the final interpretation. In the online task, both the local and the long-distance antecedents were equally weighed as the potential antecedents of *casin*, but the offline judgment suggests that the local binding interpretation is slightly preferred. Relevant to this discrepancy might be the fact that *casin* is structurally ambiguous unlike *caki* or *caki-casin*. Although *casin* is morphologically simple, it can also be analyzed as a complex anaphor, containing a null pronoun as non-head—i.e., *pro-casin* (Kim, 2000; Kim & Yoon, 2008), since Korean is a pro-drop language. It is possible that the indeterminacy in the structural analysis of *casin* is what contributes to a delay in online antecedent resolution until after the entire sentence has been presented, at which point the possibility of the complex form analysis might increase the acceptability of the local binding interpretation.

The offline results of our study are not the same as the results of previous (offline) experimental studies. In Kim and Yoon (2008) and Kim,

Montrul and Yoon (2009), they found that *caki* has a strong long-distance binding preference, *casin* has a slight long-distance binding preference or no preference, and *caki-casin* has a strong local preference. However, this is not entirely incompatible with the results of our antecedent identification task in that all of the studies show a three-way distinction in binding distance among *caki*, *casin* and *caki-casin*. In our study, the preferences are pushed toward the side of local binding for reasons that are not currently clear. More difficult to piece together is our online results and Choi and Kim (2007), who found evidence of immediate long-distance binding preference with *caki*. There are several differences between the two studies such as the eye-tracking paradigm (visual world vs. sentence reading), mode of stimuli (aural vs. written), structure of stimuli (e.g. topic marking vs. case-marking of the matrix subject), etc, which may be worth considering in future studies.

Finally, it should be noted that the participants of our study were living in the US at the time of testing. Judging from their language background, it is clear that they had fully acquired and consolidated Korean before they left Korea. However, at the time of testing, they were probably using Korean less and were being exposed to English in daily life, a language that has a different, simpler reflexive system with a single local reflexive. We acknowledge that the possibility should be taken into account that the participants' experience of living in the US might have influenced our results to a certain degree.

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