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IN

LINGUISTICS

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ACQUISITION OF KOREAN DISJUNCTION UNDER NEGATION*

ON-SOON LEE

This study investigates Korean-speaking children's and Korean child heritage learners' comprehension of sentences containing a disjunction operator with a negated verb. Two experiments were conducted. The first shows that children robustly reject the disjunctive interpretation (81.6%) but accept the conjunctive interpretation (78.9%). Surprisingly, Korean adults marginally accept the disjunctive interpretation (34.2%). This raises the possibility that Korean *-(i)na* behaves differently from disjunction in languages like English or Japanese. Experiment 2 examines this possibility in four groups. The stories used as experimental materials were modified by reducing the number of characters so as to reduce demands on working memory. The structure of target sentences was also revised to avoid a highly biased interpretation (conjunctive interpretation). The results of Experiment 2 show that Korean-speaking adults and children and Korean child heritage learners accept target sentences around 33% of the time in the context favoring the disjunctive interpretation, whereas only Korean adult heritage learners reject target sentences 100% of the time. The findings indicate that the Korean disjunction *-(i)na* 'or' under negation behaves differently than English *or* or Japanese *ka*.

1. INTRODUCTION. In recent years, researchers have paid considerable attention to children's comprehension of sentences containing a disjunction operator in the direct object position with negated verbs (Chierchia et al. 2001, Crain et al. 2002, Goro and Akiba 2004, Gualmini and Crain 2002, Gualmini and Crain 2004, Szabolcsi 2002). In English, when a disjunction operator is in the scope of negation, it receives a conjunctive interpretation as in sentence (1). English disjunction *or* follows one of de Morgan's laws as in (2).

(1) John does not like ice cream or cake.
=John does not like ice cream and cake conjunctive interpretation (not>or)

(2) $\neg (P \vee Q) \Leftrightarrow \neg P \wedge \neg Q$

Studies on children's and adult's interpretation of negated disjunction have concluded that English-speaking children and adults correctly assigned the conjunctive interpretation to the disjunction in the scope of negation (Chierchia et al. 2001, Gualmini and Crain 2002, Gualmini and Crain 2004). For example, Chierchia et al. (2001) found that English-speaking children interpret sentences like (1) in conjunctive interpretation 91.6% of the time.

In contrast, Japanese disjunction *ka* in negation does not follow one of de Morgan's Laws as in (2). The Japanese disjunction *ka* in direct object position under negation takes a disjunctive interpretation. For example,

(3) John-wa aisu **ka** keki-wo tabe-**nakat**-ta.
John-TOP ice cream or cake-ACC eat-NEG-PST
=John didn't eat ice cream or didn't eat cake. disjunctive interpretation (or>not)

Goro and Akiba (2004) investigated how Japanese-speaking adults and children interpret sentences such as (3). They predicted that if Japanese-speaking children are like adults in their interpretation, the children will accept sentence (3) in a context favoring the disjunctive interpretation, while if Japanese-speaking children assign the conjunctive interpretation to negated *ka*, unlike adults, they will reject sentence (3). Their study (TVJT; 30 Japanese children, mean age 5;3; 10 Japanese adults) showed that adults correctly rejected the conjunctive interpretation 100% (20/20) of the time, and accepted the disjunctive interpretation 100% (20/20) of the time, as predicted. On the other hand, children accepted the conjunctive interpretation 78% (47/60) of the time, whereas they rejected the disjunctive interpretation

* My deepest thanks go to William O'Grady and Kamil Ud Deen for their valuable critical comments and suggestions in previous drafts of this paper. Any remaining errors are mine.

75% (45/60) of the time. This indicates that Japanese-speaking children assigned an English-type conjunctive interpretation to the negated disjunction.

Few studies have been conducted regarding the interpretation of the negated disjunction in Korean. There are two types of negation in Korean: the short form and the long form. In the short form, as in (4), negation *an* occurs immediately before the verb, while in the long form, negation *ahn-ta* occurs after the verb, as in (5). Szabolcsi (2002) stated that no matter what the form of negation, Korean *-(i)na* receives a conjunctive interpretation, as in (4) and (5).

(4) Mary-nun sakwa-**na** pay-lul **an** mek -nun -ta.
Mary-NOM apple -or pear-ACC NEG eat -PRES-DECL
'Mary did not eat apples or pears'

(5) Mary-nun sakwa-**na** pay-lul mekci -**ahn** -nun -ta.
Mary-NOM apple-or pear-ACC eat -NEG-PRES-DECL
'Mary did not eat apples or pears'
= Mary did not eat apples and pears

However, it is not clear whether this conclusion is justified, since the judgment for these sentences is based on the intuition of a few Korean students, not on experimental studies. This paper addresses this question by investigating the interpretation of Korean *-(i)na* in adult, child, and heritage Korean speakers.

This paper is organized as follows. Section 2 introduces the results of Experiment 1 on Korean adults and children, which uses Goro and Akiba's (2004) methodology. To test how often the target sentences occur in the input, the result of a corpus study on disjunction with negated verbs is presented, the discussion of which follows in section 3. Section 4 describes experiments 2, which involve a method that addresses methodological weaknesses in experiment 1. Section 5 discusses questions for further research.

2. EXPERIMENT 1. The first experiment of Korean disjunction was conducted using Goro and Akiba's (2004) design. Their experimental protocol is as follows:

> Children and adults were asked to listen to one illustrated story on the computer screen. There are two parts of a story. In the first part of the story, 12 animals appeared to join an eating contest involving cake, a carrot, and a green pepper. Participants were introduced to rules to win prizes like the following: If an animal eats all three foods, it receives a gold medal, if an animal eats cake and only one of the vegetables, it receives a blue medal, and if an animal eats only cake, it receives a black cross. Then, children were asked to present a prize to each animal (4 gold medals, 4 blue medals, and 4 black crosses). In the second part, the puppet started to guess how well each animal did in the eating contest, returning to each animal. On the basis of the color of the prizes, children were asked to judge test sentences presented by the puppet after listening to a lead-in, as in (6).
>
> (6) Lead-in : The pig had a blue medal, which means…
> Test sentence: "The pig ate the cake, but did not eat the carrot or the green pepper".[1]
>
> All participants were asked to judge whether test sentences are true or false on the basis of the color of the prizes and then justify their answers.

There were a total of twelve sentences including four target sentences (two conjunctive and two disjunctive interpretations) and eight filler sentences. Two filler sentences containing *-(i)na* 'or' in affirmative sentences, and six filler sentences containing *-wa* 'and' with negated verbs were used. Nineteen Korean adults and nineteen Korean-speaking children (mean age 5;8) participated in the experiment. Their accuracy for fillers containing *or* in affirmative sentences indicated that children knew the meaning of *or*. As seen in table 1, the results show that children accepted the conjunctive interpretation 78.9% of the time, and accepted the disjunctive interpretation 18.4% of the time. The difference of acceptance rate between two contexts is significant, $t(18)=4.867$, $p<.001$. In contrast, Korean adults accepted the conjunctive interpretation 65.8% of the time, whereas they accepted the

[1] To improve children's performance in making sentences felicitous, the negative statements in test sentences are preceded by affirmative sentences (Musolino and Lidz 2002).

disjunctive interpretation 34.2% of the time. However, the difference of acceptance rate between the two contexts is not significant, $t(18)=1.645$, $p=0.117$.

TABLE 1. Acceptance rate of Korean adults and children.

	Conjunctive Interpretation (K=2)	Disjunctive Interpretation (K=2)
Children (n=19)	78.9%	18.4%
Adults (n=19)	65.8%	34.2%

Note. K represents the number of items

There is some doubt as to whether the materials, as used in Goro and Akiba's experiment, are appropriate to test how the negated disjunction in Korean is interpreted. First, the methodology adopted is problematic because there were 12 animals in one story. This raises a memory issue, because participants were asked to guess whether the animals eat either of the vegetables on the basis of the color of the medals. When justifying their answers, the adults explained that the task of memorizing which foods 12 animals ate in a story is too difficult.

Another possible flaw is related to the number of target items. To simplify the task, Goro and Akiba included just two tokens for each type (conjunctive and disjunctive interpretation), which leads to the possibility of item effects. Lastly, in this study and in Goro and Akiba's (2004) study, the test sentences were composed of an affirmative sentence followed by *-man* 'but' in the first conjunct, and negation with the disjunction was in the second conjunct as in (7). I suggest that this structure of the target sentence is highly biased toward the conjunctive interpretation because the presence of *-man* 'but' creates two sets: One is the object mentioned in the first clause (Set 1), and a second contrast set (Set 2) contains the two objects referred to in the negative clause. For example,

Set 1 ↓ Set 2 ↓

(7) Mickey-nun kheyik-lul mek-ess-ci **man**, tangkun-ina kochwu-lul an mek-ess-eyo.
Mickey-TOP cake-ACC eat-PST-CI - but carrot -or pepper-ACC NEG eat-PST-REGISTER
'Mickey ate a cake, but didn't eat a carrot or a pepper'

In sentence (7), after listening to the affirmative clause in the first conjunct, the negative clause in the second conjunct is immediately generated in Korean native speakers' mind when encountered the presence of *-man* 'but'. This makes the contrast condition between the first and the second sets as in (7), where the opposite proposition, in contrary to the proposition in the first clause, naturally follows right after *-man* 'but'. This naturally leads to a conjunctive interpretation of the two objects in the second conjunct. A new round of experimentation is called for. I begin with a report on a corpus study that I conducted with a view to determining how frequently *-(i)na* occurs in the object position of a negated sentence and what interpretation it has in such sentences.

3. CORPUS-BASED STUDY OF DISJUNCTION. The corpus-based study explores the frequency of *-(i)na* in object position under negation. The data used for this study came from one general corpus, the *Sejong* Corpus (2,050,000 spoken and 47,290,000 written ecels).[2, 3] This corpus was used to investigate the overall frequency of sentences in Korean containing both *-(i)na* in the object position and a short form negation *an*, as in (8). In the corpus, all sentences containing *-(i)na* under negation were retrieved by

[2] Since 1998, a national project has aimed at building an information technology system for the Korean language. This has produced the *Sejong* Corpus, the largest corpus of Korean language data as of 2004 (Bley-Vroman and Ko 2005:258).

[3] An ecel is a unit of analysis frequently used in Korean, which consists of one or more than one word. Orthographically, it is distinguished by spaces. For example, sentence (7) is compromised of six ecels.

means of MonoConc Pro (Version 2.0).[4] After a manual procedure eliminating irrelevant sentences, both quantitative and qualitative analyses were conducted.

In order to examine the overall frequency of sentences containing *-(i)na* with negative *an* in Korean, all sentences containing -(*i*)*na* in the *Sejong* Corpus were analyzed. Table 2 summarizes the frequency of the disjunction in the object position across affirmative and negative sentences. It shows that sentences containing *-(i)na* in object position occur rarely across the written and spoken corpora (1,586 out of 49,340,000 ecels).

TABLE 2. Frequency of *–(i)na* in object position without/with negation.

Sejong Corpus	Frequency of −(*i*)*na* in object position without negation	Frequency of −(*i*)*na* in object position with negation		Total
Size (ecels)		Short Neg	Long Neg	
Spoken (2,050,000 ecels)	52 (2.5%)	0	3 (1.5%)	55 (2.6%)
Written (47,290,000 ecels)	1469 (3.1%)	0	62 (1.3%)	1531 (3.2%)

-(i)na in object position occurs very rarely in negated sentences—a mere 65 times (1.3%) out of 49,340,000 ecels. All occurrences involve long-form negation and the vast majority (62 out of 65) is found in written texts. Some examples are given in (8).

(8) Some examples of disjunctive operators under long form negation:

7 … silchenhalye-nun nolyek-**ina** sikan-ul helak -ha-ci **ahn**-un-chay…
behave RC effort –or time-ACC permit-do-CI NEG-PRES
'It does not permit an effort or time to behave'

184 sulphum-**ina** kippum-ul kethulo tulenay-ci -**ahn**-nun emeni-uy maum-un…
sadness –or happiness-ACC apparently reveal-CI-NEG-RC mother-GEN heart-TOP
'Nobody knows mother's heart which does not reveal sadness or happiness apparently'

195 yeseng-i susulo etten piphan **-ina** cehang -ul ha-ci- **ahn**-ko …
woman-NOM herself any criticism -or opposition-ACC do-CI-NEG-and
'A woman herself does not do any criticism or opposition, and …'

Furthermore, as the examples in (8) help illustrate, *-(i)na* received the conjunctive interpretation in all 65 sentences. We can thus draw two conclusions: *-(i)na* rarely appears in direct object position in negated sentences, but when it does (always with long-form negation and almost always in the written language), it has the conjunctive interpretation. We thus expect that, all other things being equal, Korean children and adults will interpret the disjunction under negation as a conjunctive interpretation. The next section investigates this prediction experimentally by using an improved methodology.

4. EXPERIMENT 2. The goal of Experiment 2 is to examine how Korean-speaking children and adults interpret sentences containing disjunction with negated verbs by employing revised materials. Korean heritage learners also are tested in order to examine any difference between Korean monolingual children and Korean child heritage learners.

Recall the third methodological flaw found in experiment 1. To prevent the bias toward the conjunctive interpretation, the structure of test sentences is manipulated from (9) to (10). Sentence (9) has a strong bias toward the conjunctive interpretation of the second conjunct.

[4] This is a kind of concordance program that shows how many examples of words or phrases are in the corpus. This program is commercially available. The readable file type is a text file (Bley-Vroman and Ko 2005:258).

(9) Mickey-nun kheyik-lul mek-ess-ci **man**, tangkun-ina kochwu-lul an mek-ess-eyo.
Mickey-TOP cake-ACC eat-PST-CI - but carrot -or pepper-ACC NEG eat-PST-REGISTER
'Mickey ate a cake, but didn't eat a carrot or a pepper'

In sentence (9), two propositions occur: The first clause is affirmative, and the following conjunct is expected as a negative clause due to the presence of *-man* 'but'. To avoid this contrast condition between two conjuncts, sentence (9) is split into two sentences, (10a) and (10b):

(10) a. Kay-nun kheyik-ul mek-ess-eyo.
dog-TOP cake-ACC eat -PST-REGISTER
'The dog ate a cake.'
b. Kulehciman, kay-nun tangkun-ina thomatho-ul an mek-ess-eyo.
However dog-TOP carrot -or tomato-ACC NEG eat -PST-REGISTER
'However, the dog did not eat a carrot or a tomato.'

In the experiment, participants were asked to judge whether the sentence (10a) was true or not, independent of sentence (10b). Then, the judgment of sentence (10b) was asked to participants, so sentence (10b) occurred in only one proposition, independent of sentence (10a). This made the contrast condition as seen in (9) disappear. Sentence (10b) led equally to either of two interpretations. All materials used in experiment 2 were modified in this way. The following section shows how Experiment 2 was conducted.

4.1 METHODOLOGY.

Participants. There were four groups of participants. The first group included eighteen Korean-speaking children aged 3 to 5 years (mean age 4;8) and the second group included twenty Korean-speaking adults aged 19 to 25 (mean age 20;5). In the third group, there were eleven child heritage learners aged 3;11 to 8;0 (mean age 5;5), whose length of exposure to English ranged from 1;9 to 8;0 years (mean length of exposure to English 3;6). They also were first exposed to English at mean age 2;5 (see more biographical information in the Appendix).[5] Eleven advanced adult heritage learners aged from 22 to 33 (mean age 25;9) whose length of exposure to English ranged from 15 to 31;8 years (mean length of exposure to English 21;5) participated in this experiment. All were Korean-American graduate students in the University of Hawai'i's M.A. in Korean Flagship program, designed for students who have learned Korean for a professional purpose (see biographical information in the Appendix).

Procedure. The TVJT was employed to test the children's and adults' interpretation of the target sentences. In the first session, each participant was asked to listen to five illustrated stories (including one practice story) that favored either the conjunctive or the disjunctive interpretation. One week later, they listened to another five illustrated stories that favored the other interpretation. The order of sessions was counterbalanced. In each session, participants were asked to answer "true" or "false" to fifteen sentences, including five target sentences and ten filler sentences, presented by a puppet while the participant was looking at a picture that summarized the outcome. "True" and "false" answers for filler sentences were counterbalanced. After each response, the experimenter asked participants to justify their answers. The entire experiment was recorded for later analysis. For each group of participants, test sentences were presented in a Latin square design so that none of the participants heard the same test items. The whole task took between 30 and 40 minutes for the children to complete, and less than 30 minutes for the adults.

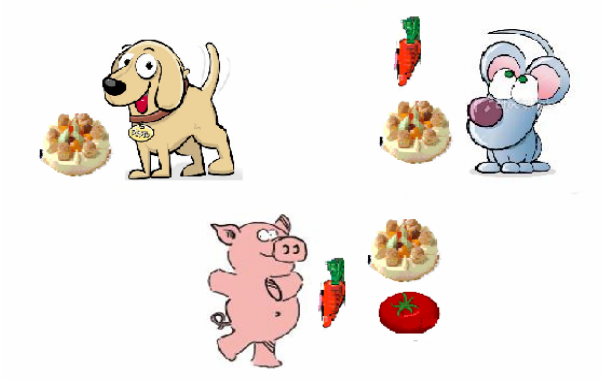
Materials. Test materials consisted of ten illustrated stories including one practice story. The practice story included three sentences that examined whether or not participants understood sentences containing the negation *an*. The ten illustrated stories consisted of two types of contexts. Five illustrated stories were designed to favor the conjunctive interpretation, while the other five illustrated stories were designed to favor the disjunctive interpretation. The English translation of a sample story follows:

[5] All participants attended English-language schools, and their dominant language is English rather than Korean, matching the profile of heritage language learners (Montrul 2008).

Sample story favoring a conjunctive interpretation

The teacher told a mouse, a pig, and a dog that they should eat all their food for good health. There was a cake, a carrot, and a tomato. The teacher will give ice cream to any animal who eats all the food. Let's see who got the ice cream. The mouse ate a cake and a carrot. The dog ate only a cake. However, the pig ate a cake, a carrot, and a tomato because he was so hungry. Who do you think received the ice cream? [Answer: the pig]

FIGURE 1. Sample picture in a story favoring the conjunctive interpretation.



After each story, participants were asked to judge whether the three sentences presented by the puppet were true or false while looking at the picture summarizing the final outcome of the story. English translations of three sample test sentences including fillers are given here:

a. Filler: The mouse ate a carrot [Answer: True].
b. Test sentence: The dog ate a cake [Answer: True].
However, the dog did not eat a carrot or a tomato [Answer: True].
c. Filler: The pig did not eat a tomato [Answer: False].

Sentences (a) and (c) are filler sentences to test whether children comprehend the stories well. The test sentence (b) consists of two split sentences. After hearing the first sentence, participants were asked to answer whether it was true or not. Then, after hearing the second sentence, they were asked to judge whether that sentence was true or not, as in example (11).

(11) Kay-nun kheyik-ul mek-ess-eyo. [Answer: True]
dog-TOP cake-ACC eat -PST-REGISTER
'The dog ate a cake'
Kulehciman, kay-nun tangkun-ina thomatho-ul an mek-ess-eyo.
However dog-TOP carrot -or tomato-ACC NEG eat -PST-REGISTER
'However, the dog did not eat a carrot or a tomato'
Conjunctive interpretation: 'The dog ate neither a carrot nor a tomato'
[Target Answer: True]

The possible readings to the target sentence are 'The dog did not eat a carrot and did not eat a tomato (conjunctive interpretation)' or 'the dog did not eat a carrot or did not eat a tomato (disjunctive interpretation)'. If 'the dog did not eat a carrot and did not eat a tomato' is true, 'the dog did not eat a carrot or did not eat a tomato' is also true because the conjunctive interpretation entails the disjunctive interpretation. Thus, if participants answer "True" to each target sentence, it does not really imply that participants prefer or accept only the conjunctive interpretation of the target sentence in this story (see more discussion in section 5). Sorry; the program is acting up here. I can't delete the single quotes above or make the corrections in the next paragraph..

In contrast, the context favoring a disjunctive interpretation included three characters with three items. One character performed an action on only two out of three objects. The English translation of a sample story is given below:

Sample story favoring a disjunctive interpretation

The teacher told a mouse, a pig, and a bear that they should eat all their food for good health. For lunch, there are noodles, a cucumber, and French fries. The teacher will give chocolate to any animal who eats all the food. Let's see who got the chocolate. The bear ate only noodles. The mouse ate a cucumber, French fries, and noodles. However, the pig ate only the cucumber and noodles. Who do you think received the chocolate? [Answer: the mouse]

FIGURE 2. Sample picture in a story favoring the disjunctive interpretation.

Then three sentences for this story follow, given here in English translation:

d. Filler: The bear ate noodles [Answer: True].
e. Test sentence: The pig ate noodles [Answer: True].
However, the pig did not eat French fries or a cucumber [Answer: True].
f. Filler: The mouse did not eat a cucumber [Answer: False].

The procedure is the same as described for the items favoring the conjunctive interpretation. Given the picture in Figure 2, participants were asked to evaluate the target sentence in (12).

(12) Tawyci-nun kwukswu-lul mek-ess-eyo. [Answer: True]
Pig -TOP noodle -ACC eat-PST-REGISTER
'The pig ate noodles'

Kulehciman, twayci-nun oi -(i)na phuleychi phulai-lul an mek-ess-eyo.
However pig -TOP cucumber –or French fries -ACC NEG eat-PST-REGISTER
'However, the pig did not eat French fries or a cucumber'

Disjunctive Interpretation: 'The pig did not eat French fries or did not eat a cucumber'
[Target Answer: True]

As seen here, a true response indicates that the participants assign the target sentence a disjunctive interpretation. If participants answer "False," they reject the disjunctive interpretation in this context in favor of a conjunctive interpretation. Table 3 indicates the summary of expected results.

TABLE 3. Summary of expected results.

	Conjunctive Interpretation	Disjunctive Interpretation
Conjunctive Context	True	True/False
Disjunctive Context	False	True

4.2 RESULTS. Table 4 illustrates the results for Korean native adults and child speakers.

TABLE 4. Responses of Korean native speakers.

	Children (n=18)	Adults (n=20)
Conjunctive Context (K=5)	100%	100%
Disjunctive Context (K=5)	40%	33%

All participants did well on the filler sentences (99%), which did not include 'or', indicating that they comprehended each story well. Korean speakers (adults and children) accepted the conjunctive interpretation 100% of the time for target sentences containing *-(i)na* 'or' with the negated verb in contexts supporting conjunctive interpretations. They accepted the disjunctive interpretation around 37% of the time in contexts supporting disjunctive interpretations. The difference of acceptance rate between two contexts is significant (in adult group, $t(19)=6.789$, $p<.0001$; in the children group, $t(17)=7.013$, $p<.0001$). It can be concluded that Korean native speakers allow a conjunctive interpretation with negated verbs in the conjunctive context, but that Korean native speakers accept disjunctive interpretations only a third of the time in the disjunctive context.

Table 5 shows the results from Korean heritage learners. All participants did well on the filler sentences (98%). Korean adult heritage learners generally accepted the conjunctive interpretation, but they never accepted the disjunctive interpretation. The children accepted the conjunctive interpretation 91% of the time, and the disjunctive interpretation 33% of the time. The difference of acceptance rate between the two contexts is significant, $t(10)=5.022$, $p<.001$.

TABLE 5. Responses of Korean heritage learners.

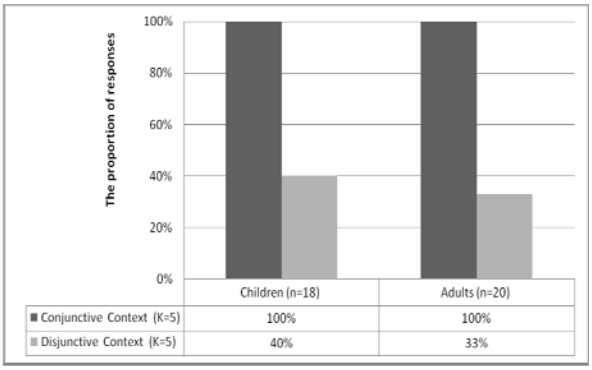
	Children (n=11)	Adults (n=11)
Conjunctive Context (K=5)	91%	100%
Disjunctive Context (K=5)	33%	0%

It is concluded that the conjunctive interpretation is dominant for *-(i)na* in the scope of negation in Korean, but the disjunctive interpretation is also marginally allowed by native speakers. This indicates that Korean disjunction under negation behaves differently than English *or* and Japanese *ka*. Korean heritage learners (adults and children) accepted the conjunctive interpretation. The heritage learner adults never accepted the disjunctive interpretation of negated disjunction in Korean. Only child heritage learners accepted the disjunctive interpretation 33% of the time, as native speakers did.

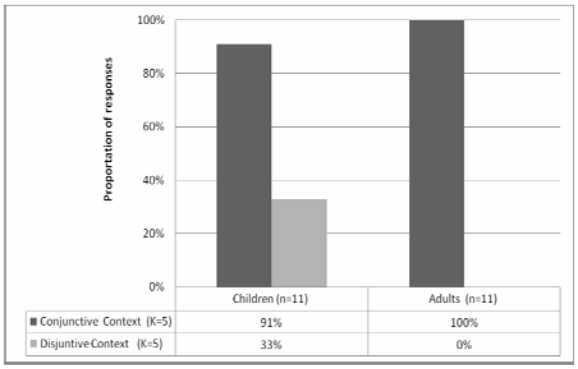
5. GENERAL DISCUSSION. This experiment supports the conclusion that Korean monolingual children and adults have a preference for a conjunctive interpretation of sentences containing disjunction in the direct object position with negated verbs, but that they sometimes accept the disjunctive interpretation, as shown in figure 3(a), which is not consistent with Szabolcsi's (2002) claim.

FIGURE 3. The proportion of responses in four groups.

a. Korean native speakers



b. Korean heritage learners



The corpus study shows that even in production Korean native speakers have a preference for the conjunctive interpretation, but it is still unclear why Korean native speakers marginally accepted the disjunctive interpretation. Korean *-(i)na* behaves differently than English *or* under negation, in that English-speaking children and adults accepted only the conjunctive interpretation. Korean *-(i)na* also differs from Japanese *ka* in that adults as well as children marginally accept the disjunctive interpretation.

Based on these results, let us now consider the semantic subset problem. Crain and Thornton (1998: 117–18) define the semantic subset problem as follows:

> Sometimes, more than one interpretation of a sentence is made available by Universal Grammar. To further complicate matters, these alternatives may form a subset/superset relation; that is, the circumstances that make the sentence true on one interpretation may be a proper subset of the circumstances that make it true on another interpretation. In such cases, a semantic subset problem arises if the target language includes the subset reading, but not the superset reading. To avoid semantic subset problems, the interpretive options for sentences must be ordered in the Language Acquisition Device by a principle instructing learners to initially choose the representation that is true in the smallest set of circumstances. This is called the *Semantic Subset Principle*.
>
> Suppose that the interpretive component of Universal Grammar makes two interpretations, A and B, available for a sentence, S. If so, then see if S is true in a narrower range of circumstances on the interpretation A than on interpretation B. If so, then A will be hypothesized before B in the course of language development.

Recall that sentences such as (13) are ambiguous. With one meaning, (13) can be interpreted as 'The pig did not eat French fries and a cucumber'. In this case, *-(i)na* is interpreted within the scope of negation. With the other meaning, (13) can be interpreted as 'The pig did not eat French fries or did not eat a cucumber', in which *-(i)na* is interpreted outside the scope of negation.

(13) twayci-nun oi -na phuleychi phulai-lul an mek-ess-eyo.
pig -TOP cucumber –or French fries -ACC NEG eat-PST-REGISTER
'The pig did not eat French fries or a cucumber'
a. The pig did not eat French fries and a cucumber (conjunctive interpretation)
b. The pig did not eat French fries or did not eat a cucumber (disjunctive interpretation)

Notice that the two readings of (13) are arranged in a subset/superset configuration because (13a) entails (13b). In other words, if (13a) is true, then (13b) must also be true, but not vice versa. Assuming, as Crain and Thornton suggest, that learners opt for the narrower "subset" interpretation, all other things being equal, it makes sense that the conjunctive interpretation will be the initial and preferred reading for sentences such as (13)—which is just what we found. The disjunctive interpretation, to the extent that it is allowed at all, will not be dominant.

In detail, the individual performance shows that 21 out of 38 Korean native speakers, including adults and children, accepted the disjunctive interpretation at least once. Among these 21, 9 participants (6

adults and 3 children) accepted both the conjunctive and disjunctive interpretations at least 4 out of 5 times. It indicates that more than half the population accepts only the conjunctive interpretation to negated disjunction, while a third of the population accepts both conjunctive and disjunction interpretations to negated disjunction. Results in the individual performance imply a strong preference for the conjunctive interpretation in Korean native speakers even though the disjunctive interpretation is marginally accepted.

Returning to the second research question, child heritage learners accepted the disjunctive interpretation just as Korean native speakers did, but adult heritage learners did not, as shown in Figure 3(b). One possible explanation is the length of exposure to English of adults and child heritage learners. Typically, heritage language learners receive a rich input of heritage language from their parents at home, but the amount of input of the heritage language becomes reduced when they begin to attend formal schools (Kondo-Brown 2006). The reduction in input of heritage language could result in *language attrition* or *language loss*. O'Grady et al. (2008) suggest that adult heritage learners lose the possibility of the disjunctive interpretation as the result of being dominantly exposed to the English negated *or* pattern. As seen in figure 3(b), the heritage children—but not the heritage adults—resembled Korean native speakers. This suggests that the length of exposure to English may explain why Korean adult heritage learners' interpretation is an English-type interpretation to negated disjunction unlike Korean child heritage learners' interpretation: The mean length of exposure to English in adults is longer than that in child heritage learners, $t(10)= -11.503$, $p<.0001$. This implies that English is a strongly dominant language of Korean adult heritage learners, whereas Korean child heritage learners' dominant language is Korean.

In bilingual situations, the maintenance of two languages is difficult, especially for heritage language learners. For example, Korean is a dominant language of Korean-American children living in the United States before their exposure to English in formal schools, whereas adult heritage learners' dominant language tends toward English due to the rich input of English—which implies that the dominant language is easier to access than the less-dominant language at the level of vocabulary or morphosyntax (O'Grady et al. 2009). De Bot (2004:234) pointed out that languages "need maintenance and advanced use ... learning another language does not remove older languages from memory, but does push them more to the background and makes it accordingly more difficult to access them." These two factors—the amount of the input and the maintenance of heritage language—could be possible explanations for why monolingual Korean children and Korean child heritage learners accepted the conjunctive and disjunctive interpretations at a similar rate, unlike adult heritage learners.

6. CONCLUDING REMARKS. The findings of the present study demonstrate that Korean native speakers have a preference for the conjunctive interpretation to negated disjunction, but they also marginally accepted the disjunctive interpretation. The findings reveal that the semantic property of Korean disjunction *-(i)na* 'or' cross-linguistically differs from Japanese *ka* or English *or*. This raises the question of what exactly makes it so infrequent for Korean native speakers and Korean child heritage learners to assign the disjunctive interpretation to negated disjunction. On the other hand, five adult native speakers and three child native speakers always accepted both interpretations, indicating that it is possible to assign two interpretations to the negated disjunction. It is necessary to explain how two interpretations are assigned, considering the interaction between disjunction and negation.

The modified materials overcame some methodological flaws found in previous experiments, but the contrast condition in the two split sentences containing *kulehciman* 'however' still exists (Deen, personal communication, November, 2008). To remove this bias in the test sentences, further research should be conducted with more fine-grained materials so as to provide evidence for how Korean disjunction is different than disjunction in other languages and how Korean native speakers acquire the interaction between disjunction and negation.

APPENDIX. BIOGRAPHICAL INFORMATION OF KOREAN HERITAGE LEARNERS.

1. Adult Heritage Learners

Student ID	Age	Gender	Birth place	Age of arrival	Age of Exposure to Korean	Age of Exposure to English	Parents' Language
1	30	f	Korea	9:0	0	9;11	Korean
2	23	f	Korea	4:0	0	4;10	Korean
3	24	m	Korea	9:0	0	6	Korean
4	33	f	Korea	1:3	0	1;03	Korean
5	26	f	Korea	12:0	0	11	Korean
6	31	f	Korea	3:0	0	5	Korean
7	24	f	USA	n/a	0	0	Korean
8	25	f	USA	n/a	0	4	Korean
9	22	f	USA	n/a	0	3	Korean
10	24	f	USA	n/a	0	4	Korean
11	23	f	USA	n/a	0	0	Korean

2. Child Heritage Learners

Student ID	Age	Gender	Birth place	Age of arrival	Age of Exposure to Korean	Age of Exposure to English	Parents' Language
1	6;6	F	USA	n/a	0	4	Korean
2	6;4	M	USA	n/a	0	2;6	Korean
3	8;0	M	USA	n/a	0	5;0	Korean
4	6;6	F	Korea	2;6	0	3;7	Korean
5	8;0	F	USA	n/a	0	4;0	Korean
6	5;0	M	USA	n/a	0	3;0	Korean
7	3;11	F	USA	n/a	0	0	Korean
8	8;0	M	USA	n/a	0	0	Korean
9	6;10	F	USA	n/a	0	2;8	Korean
10	5;10	F	USA	n/a	0	3;1	Korean
11	3;11	F	USA	n/a	0	2;0	Korean

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