The First Language Acquisition of Scalar Inferences
from -*Cocha* 'Even' by Korean-speaking Children

by
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Abstract

This thesis investigates the first language acquisition of scalar inferences from Korean particle *-cocha* 'even.' Based on the fact that *also* evokes the same existential inference with *even*, and that *also* and *even* have the same focus scope in Korean, this thesis compares the acquisition of Korean *-cocha* 'even' with *-to* 'also' to provide a more elaborated explanation of scalar inference acquisition.

Three experiments - one felicity judgement task, and two preference tasks - were conducted to answer the following research questions: i) when Korean-speaking children are able to make scalar inferences from *-cocha* 'even'; ii) whether Korean-speaking children are able to correctly assign the scope of *-to* 'also' and *-cocha* 'even' to the subject or the object; iii) which step of the *even* scalar inference process causes children's difficulty.

As a result, it was found that Korean-speaking children are able to draw existential inferences at the age of 9 to 10, but still have difficulty in making scalar inferences from *even*. Next, Korean-speaking children had difficulty in correctly assigning the scope of *also* and *even* to the subject or the object even though Korean focus particles are not governed by the c-command rule. Additionally, presenting an alternative phrase facilitated children's process of scalar inferences, as the reference-set hypothesis predicts. Finally, children even at the age of 3 and 4 had the cognitive ability to arrange the elements of a set according to probability.

In conclusion, children do not have the semantic ability to associate *even* with 'the lowest probability,' and syntactic ability to find what is focused by *even*. Consequently, children cannot create a set containing the focused phrase and alternative phrases although they already have the cognitive ability to compute probability and arrange the elements of the set in order of probability.

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1. Introduction

1.1. Overview

The thesis aims to investigate the first language (L1) acquisition of conventional scalar term *-cocha* 'even' by Korean-speaking children. To draw scalar inferences from *even* is a complex task that requires the semantic ability to associate 'even' with the meaning of 'the lowest probability,' the syntactic ability to find the focused phrase, the cognitive ability to create a set containing the focused phrase and alternative phrases, and the cognitive ability to compute probability and arrange the elements of the set in order of probability. However, it is still unclear when children are able to process scalar inferences from *even*, and which step of the process causes their difficulty.

The thesis aims to answer the three research questions: i) when Korean-speaking children are able to make scalar inferences as well as existential inferences from *-cocha* 'even'; ii) whether Korean-speaking children are able to correctly assign the scope of *-to* 'also' and *-cocha* 'even' to the subject or the object; iii) which step of the *even* scalar inference process causes children's difficulty. Korean would be an ideal language to study children's ability to draw scalar inferences from *even* in comparison with *also* because *also* and *even* have the same syntactic scope in Korean.

This study will have two major impacts. First, it will contribute to our knowledge of how children make scalar inferences by combining their cognitive ability and linguistic ability. Thus, this study will shed light on the intersections between children's cognitive development and language acquisition. Moreover, it will widen our understanding of focus adverbs and scalar terms. While the acquisition of focus adverb *only* and conversational scalar term *or* has been extensively studied, little is known about children's acquisition of conversational scalar term *even*. This study will extend the scope of the research on the acquisition of focus adverbs and scalar terms by testing whether the reference-set hypothesis and the syntactic hypothesis proposed for the acquisition of *only* and *or* can be also applied to the acquisition of *even*.

2. Literature Review

2.1. Scalar Inference

A scalar inference is a product of the cognitive processes by which communication participants figure out an intended set of elements arranged according to logical entailment or informative strength. Representative scalar terms are quantifier *some* and disjunction operator *or*. For example, *some* and *all* stand in a logical entailment relationship <*some*, *all*>, and *all* is a subset of *some*: *all* $\subseteq$ *some*. Therefore, *all* entails *some*, and *all* is stronger than *some* in terms of informativeness. Likewise, *or* and *and* stand in a logical entailment relationship <*and*, *or*>, and *and* is a subset of *or*: *and* $\subseteq$ *or*. Thus, *and* entails *or*, and *and* conveys more information than *or* as in Figure 1.

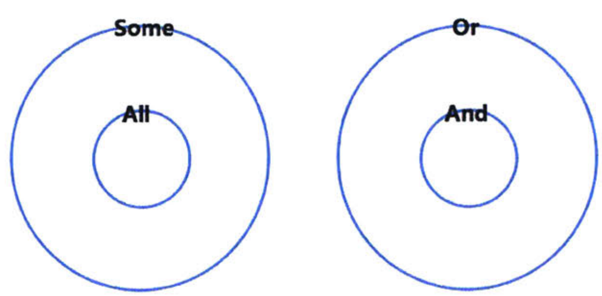


Figure 1. The logical entailment relationship between *some* and *all* (left), and the logical entailment relationship between *or* and *and* (right)

The computation of conversational scalar terms such as *some* and *or* is a very complicated task that requires a hearer to infer a speaker's intended meaning beyond what is literally said. For instance, in the dialogue (1), Bill is likely to infer that '*some* but not *all* students passed the exam' rather than '*some* and possibly *all* student passed the exam' from Jane's answer even though '*some* students' could literally mean '*all* students.'

(1) Bill: Did all students pass the exam?

Jane: **Some** students passed the exam.

Likewise, in the dialogue (2), John is likely to infer that 'Bill did not eat both pizza and pasta' from Mary's answer even though 'pizza *or* pasta' could literally mean 'pizza *and* pasta.'

(2) John: What did Bill eat?

Mary: He ate pizza **or** pasta.

In other words, a speaker's choice of the weaker (less informative) term suggests that the stronger term (more informative) does not hold as far as the speaker knows. The process of computing a conversational scalar inference involves four steps as follows: i) to compute literal meaning of a sentence S containing a scalar item; ii) to generate a set of alternatives to S, and call it S_{alt}; iii) to restrict S_{alt} by removing less informative alternatives and call it S'; iv) to strengthen the pragmatic meaning of S with the negation of S' (Barner et al., 2011). For example, in order to interpret *some*, a hearer first computes the literal meaning of *some* using his/her semantic information. Next, the hearer generates a set of *all* by lexically associating *all* with *some*. Then, the hearer restricts the set of *all* by removing all^c. Finally, the hearer strengthens the pragmatic meaning of *some* by negating the set of *all.* Indeed, the computation of conversational scalar inferences requires various linguistic and cognitive abilities together, and young children must have great difficulty in computing scalar inferences.

In recent years, conversational scalar terms such as *some* and *or* have been extensively studied to test children's grammatical, lexical, and pragmatic knowledge to draw conversational scalar inferences. As a result, the following accounts have been proposed to explain children's difficulty with conversational scalar inferences. First, according to the grammatical theory, a scalar inference can be drawn by a phonologically null grammatical operator, akin to *only* (Chierchia et al., 2012). For example, when encountering *some*, adults interpret it as *only some*, but children may not adopt *only* as adults do. Next, the lexical theory highlights the process of generating a lexically relevant set to scalar terms (Barner et al., 2011). This theory predicts that children may not be able to generate a set of *all* when encountering *some* because they fail to link *all* to *some*. In addition, the pragmatics theory assumes that a speaker gives the appropriate amount of information (maxim of quantity) and makes which he/she believes to be true (maxim of quality) in communication (Grice, 1975). Therefore, if a speaker utters *some* which is the weaker scalar term, the hearer assumes that *all*, the stronger scalar term, is inappropriate or unavailable. However, children cannot understand this cooperative principle, and thus fail to draw conversational scalar inferences. Finally, according to the game-theoretic pragmatic theory, a listener interprets an utterance by integrating his/her prior knowledge with the probability that the speaker would choose, given different states of the world (Frank and Goodman, 2012). Therefore, it is predicted that children cannot infer that the speaker would have been more likely to say *some* to communicate *not all* when hearing *some*.

2.2. *Even* Scalar Inference

Unlike a conversational scalar inference, a conventional scalar inference is drawn automatically from a word since it is always a part of the conventional meaning of a specific lexical element (Grice, 1975; Horn, 1969; Karttunen and Peters, 1979). For instance, *also* and *even* stand in a logical entailment relationship <*also*, *even*>, and *even* is a subset of *also*: *even* ⊆ *also*. Thus, *even* entails *also*, and *even* is stronger than *also* in terms of informativeness as in Figure 2. However, contrary to conversational scalar terms, the utterance of *also* which is the weaker term does not suggest that *even* which is the stronger term does not hold. Instead, the essential meaning of *even* automatically creates a scale including a set of elements arranged in order of probability.

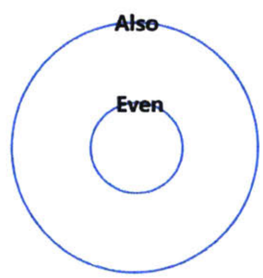


Figure 2. The logical entailment relationship between *also* and *even*

For instance, in the dialog (3) including *also*, John is likely to infer the existential inference 'there are other *x* under consideration besides Eric such that *x* likes the class' from Mary's answer. Here, the statement 'Eric *also* likes the class' does not suggest that '*Even* Eric likes the class' does not hold, and thus no scalar inference is drawn from *also* pragmatically or semantically.

(3) John: Who does like the class?

Bill: Lisa likes the class.

Mary: Eric **also** likes the class.

- Existential inference: There are other x under consideration besides Eric such that x likes the class.

The process of computing existential inferences from *also* requires the following steps of process. First, when a speaker says the word *also*, the hearer semantically associates *also* with 'addition.' Next, the hearer finds what is focused by *also* in the sentence. Finally, the hearer cognitively creates a set whose elements are the focused phrase and alternative phrases. For example, when John hears the word *also* in (3), he first thinks of 'addition' in his mind. Next, John finds that the Determiner Phrase (DP) 'Eric' is focused by *also*. Finally, John creates a set whose elements are the focused DP 'Eric' and the alternative DP 'Lisa.' In summary, John can derive an existential inference from *also* by including 'Eric' and 'Lisa' in the same set.

On the other hand, in the dialog (4) including *even*, John is likely to infer the scalar inference 'for all x under consideration besides Eric, the probability that x likes the class is greater than the probability that Eric likes the class' as well as the existential inference 'there are other x under consideration besides Eric such that x likes the class' from Mary's answer (Karttunen and Peters, 1979). Here, *even* creates a new scale whose elements are arranged according to the probability of liking the class.

(4) John: Who does likes the class?

Bill: Lisa likes the class.

Mary: **Even** Eric likes the class.

- Existential inference: There are other x under consideration besides Eric such that x

likes the class.

- Scalar inference: For all x under consideration besides Eric, the probability that x likes the class is greater than the probability that Eric likes the class.

The process of computing conventional scalar inferences from *even* goes further. First, when a speaker says the word *even*, the hearer semantically associates *even* with 'the lowest probability.' Next, the hearer finds what is focused by *even* in the sentence. Then, the hearer cognitively creates a set whose elements are the focused phrase and alternative phrases. Finally, the hearer arranges the elements of the set in order of probability, and checks if the focused element has the lowest probability. For example, when John hears the word *even* in (4), he first thinks of 'the lowest probability' in his mind. Next, John finds that the DP 'Eric' is focused by even. Then, John creates a set whose elements are the focused DP 'Eric' and the alternative DP 'Lisa.' Finally, John arranges 'Eric' and 'Lisa' according to the probability of 'liking the class,' and checks if 'Eric' has the lowest likelihood.

Since the acquisition of *even* has not been studied sufficiently, it is still unclear when children are able to fully acquire *even*, and which step of the process mainly causes their difficulty. Based on the fact that *also* evokes the same existential inference with *even*, this thesis compares the acquisition of *even* with *also* to provide a more elaborated explanation of when children are able to process scalar inferences.

2.3. Korean Particle -*Cocha* 'Even' and -*To* 'Also'

2.3.1. Focus Meaning of -*Cocha* 'Even' and -*To* 'Also'

Korean focus particle *-cocha* corresponds to English *even* (5), and focus particle *-to* corresponds to English *also* (6). In other words, the particle *-cocha* is a scalar particle that evokes a scalar inference as well as an existential inference, and the particle *-to* is an additive particle that evokes an existential inference.

(5) *Mary-cocha thongsalon-ul kongpwuha-n-ta.*

Mary-even syntax-ACC study-PRE-DECL

"**Even** Mary studies syntax."

- Existential inference: There are other x under consideration besides Mary such that x studies syntax.
- Scalar inference: For all x under consideration besides Bill, the probability that x studies syntax is greater than the probability that Mary studies syntax.

(6) *Mary-to thongsalon-ul kongpwuha-n-ta.*

Mary-also syntax-ACC study-PRE-DECL

"Mary **also** studies syntax."

- Existential inference: There are other x under consideration besides Mary such that x studies syntax.

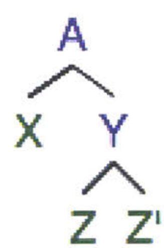
Even though the additive particle *-to* 'also' can evoke a scalar inference, it is rare and not necessary. Therefore, this thesis does not narrow down the meaning range of particle *-to* to scalar meaning and discusses its additive meaning.

2.3.2. Focus Scope of -*Cocha* 'Even' and -*To* 'Also'

In English, *even* and *also* have different focus scopes. First, the scope of *even* is determined by the c-command relationship (7). For example, *even* precedes the subject (8a) to focus the subject, or appears in the preverbal adverbial position between the subject and the predicate to focus the verb (8b) or the object (8c). *Even* can also immediately precede the object to focus it although it is very uncommon (8d).

(7) C-command (constituent-command)

A constituent X c-commands its sister constituent Y and any constituent Z which is contained within Y (Radford, 2004).



(8) a. **Even** PETER read the book.

b. Peter **even** READ the book.

c. Peter **even** read THE BOOK.

d. Peter read **even** THE BOOK.

On the other hand, *also* cannot immediately precede the subject to focus it (9a) although it can appear in the initial position of a sentence as a sentential adverb (9b). Instead, *also* usually occurs in preverbal position between the subject and the predicate when it focuses the subject (9c), the verb (9d), and the object (9e) (Lee, 2005). Therefore, *also* in preverbal position may cause a focus scope problem.

(9) a. ***Also** PETER read the book.

b. Also, peter read the book.

c. PETER **also** read the book.

d. Peter **also** READ the book.

e. Peter **also** read THE BOOK.

In contrast, Korean focus particle -*cocha* 'even' and -*to* 'also' have the same focus scope. Since Korean focus particle -*cocha* 'even' and -*to* 'also' are attached to the focused position, they immediately follow the focused subject (10), the verb (11), or the object (12).

(10) Focused subject in Korean

a. Even

Peter-cocha ku chayk-ul ilk-ess-ta.

Peter-even the book-ACC read-PST-DECL

"**Even** PETER read the book."

b. Also

Peter-to ku chayk-ul ilk-ess-ta.

Peter-also the book-ACC read-PST-DECL

"PETER **also** read the book."

(11) Focused verb in Korean

a. Even

Peter-ka ku chayk-ul ilk-ki-cocha-hayss-ta.

Peter-NOM the book-ACC read-ing-even-hayss-DECL

"Peter **even** READ the book."

b. Also

Peter-ka ku chayk-ul ilk-ki-to-hayss-ta.

Peter-NOM the book-ACC read-ing-also-hayss-DEC

"Peter **also** READ the book."

(12) Focused object in Korean

a. Even

Peter-ka ku chayk-cocha ilk-ess-ta.

Peter-NOM the book-even read-PST-DECL

"Peter **even** read THE BOOK."

b. Also

Peter-ka ku chayk-to ilk-ess-ta.

Peter-NOM the book-also read-PST-DECL

"Peter **also** read THE BOOK."

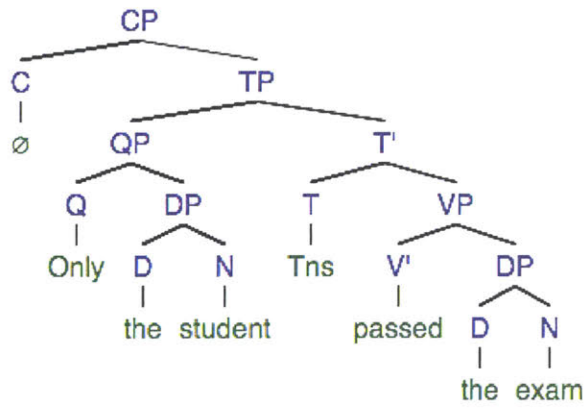
It is very difficult to grasp whether children's difficulty in acquiring *even* comes from the acquisition of existential inferences or scalar inferences. Therefore, it would be helpful to compare the acquisition of *even* with the acquisition of *also*. However, the acquisition of *-cocha* 'even' and *-to* 'also' cannot be directly compared in English because they have different focus scopes. In this sense, Korean is an ideal language to test whether children can draw scalar inferences since *also* and *even* have the same focus scope in Korean.

2.4. Theoretical Accounts on the Acquisition of O*nly* and *Even*

2.4.1. The Acquisition of *Only*: the C-command Hypothesis

In English, *only* is often compared to *even* because it has the same focus scope with *even*. While little is known about the acquisition of *even*, the acquisition of *only* in English has been extensively studied (Crain et al., 1994; Crain et al., 1992; Kim, 2011; Notley et al., 2009; Paterson et al., 2003; Paterson et al., 2006). As a result, it was found that English-speaking children have more difficulty in the acquisition of subject focused *only* than object focused *only*. This phenomenon can be syntactically explained by the C-command hypothesis. The scope of *only* is determined by the c-command relationship as the scope of *even*. When *only* precedes the subject, the focus can be only assigned to the subject which is c-commanded by *only*. For example, the suitable candidate for the focus of subject *only* in (13) is the subject 'the student' which is c-commanded by *even*.

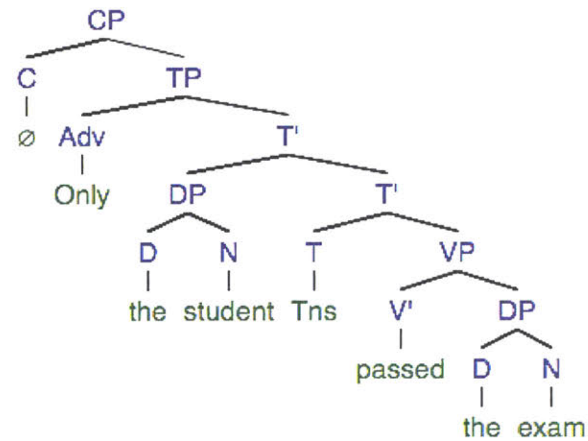
(13) Tree diagram of subject *only* in English



'Only the student passed the exam.'

However, young children often interpret subject *only* differently from adults because they even assign the focus of subject *only* to the object. Unlike adults, children may misinterpret subject *only* as a sentential adverb that c-commands both the subject and the verb phrase including the object. For instance, children may think that the potential candidate for the focus of subject *only* in (14) is the subject 'the student,' the verb 'passed,' and the object 'the exam.' Therefore, the C-command hypothesis suggests that children's non-adult-like responses to sentences with subject *only* is due to their lack of syntactic knowledge.

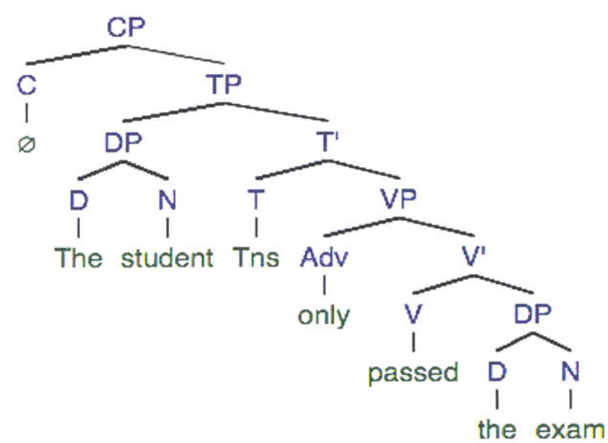
(14) Children's misinterpretation of subject *only*



‘Only the student passed the exam.’

In contrast, when *only* precedes the verb, it c-commands the verb phrase including the object. For example, when *only* precedes the verb as in (15), the potential candidates for the focus of object *only* are the verb ‘passed,’ and the object ‘the exam.’ Here, the subject ‘the student’ has no possibility of being c-commanded by the object *only*, and thus children may not experience any scope problem between the subject and the object.

(15) Tree diagram of object *only* in English



'The student only passed the exam.'

Even though a lot of previous studies have found that English-speaking children have more difficulty in the acquisition of subject *only* than object *only*, it has not been studied whether the same asymmetry exists in typologically different languages. In this sense, Korean is an ideal language to test the c-command hypothesis because Korean focus particles *-to* 'also' and *-cocha* 'even' are directly attached to the subject or the object, and thus are not governed by the c-command rule.

2.4.2. The Acquisition of *Even*: the Reference-set Hypothesis

To my knowledge, there are only a few studies on the acquisition of *even* scalar inferences. First, English-speaking children's ability to draw scalar inferences from *even* was examined (Kim, 2011). As a result, it was found that children had difficulty in making scalar inferences from *even*, and that the age between 4 and 5 was the transitional period of the acquisition of *even*. Additionally, the syntactic position of *even* did not affect children's performance against the c-command hypothesis. However, it is still unclear from when children are able to make a scalar inference from *even* because children aged over 5 were not included in this study. Moreover, previous studies on the acquisition of *also* found that Japanese-speaking children aged from 5 to 6 failed to give an adultlike response to *mo* 'also' (Matsuoka, 2004; Matsuoka et al., 2006), and that German-speaking children whose mean age was 5 failed to give an adultlike interpretation to *auch* 'also' (Hüttner et al., 2004). Considering that the acquisition of *even* must be more difficult than that of *also*, the argument that transitional period of *even* acquisition is between 4 and 5 is not very convincing.

Next, it was investigated whether Korean-speaking children are able to make scalar inferences from Korean particle *-to* 'even' (Kim, 2012). In the study, Korean-speaking children aged from 4 to 5 failed to compute scalar inferences, and the age of 6 seemed to be the starting point for children to converge on adultlike performance. However, the study could not provide conclusive evidence of children's knowledge of scalar inferences because Korean particle *-to* usually evokes only an existential inference without a scalar inference. In the experimental design, children were able to give correct responses even if they failed to make scalar inferences and made only existential inferences. For this reason, the validity of the argument that Korean children are able to compute scalar inferences from *even* at the age of 6 is questionable.

Finally, in Japanese it was investigated whether Japanese-speaking children can draw scalar inferences from Japanese particle *-datte* 'even' (Ito, 2012). The results showed that children's performance was better for object *-datte* than subject *-datte* against the C-command hypothesis. More importantly, the study found that children's performance was better when choosing a felicitous answer between two *even* sentences than when just judging the felicity of two *even* sentences. The results were explained by the reference-set hypothesis which suggests that constructing an alternative assertion imposes considerable demands on the memory (Reinhart, 2004). According to the hypothesis, to judge a felicity of an *even* sentence is beyond the young children's processing capacity because it requires them to maintain an assertion in memory to be compared with another assertion (Chierchia et. al, 2001). For instance, when judging the felicity of the *even* sentence in (16), the hearer must generate alternative elements that hate the movie.

(16) Even David hates the movie.

In contrast, comparing two *even* sentences does not require a hearer to make a set and generate the members. For instance, when choosing a more felicitous sentence between two *even* sentences in (17), the hearer does not have to generate alternative people who hate the movie besides David because another element 'Chloe' is already given. In summary, young children lack the cognitive ability to generate a set and maintain the elements in their mind. As a result, children's computation of *even* scalar inferences could be facilitated if a pair of *even* sentences is presented together.

(17) Even Chloe hates the movie.

Even David hates the movie.

However, the fact that Japanese-speaking children's ability to judge felicitous *even* sentences as felicitous worsened even though their ability to judge infelicitous *even* sentences as infelicitous improved significantly when choosing between two *even* sentences undermines the validity of the reference-set hypothesis. Therefore, it is inconclusive to argue that generating elements of a set is the real cause of children's difficulty with *even* scalar inferences even though children's overall performance was better when choosing between a pair of *even* sentences than when judging the felicity of *even* sentences.

From the previous studies on *even* acquisition in English, Korean, and Japanese, the following questions still remain unsolved. First, it is uncertain when children are able to draw scalar inferences from *even*. Moreover, even if children's difficulty with *even* was found, it was impossible to decide whether the difficulty comes from existential inferences or scalar inferences. In addition, it is unclear exactly which step of the process causes children's difficulty with *even* scalar inferences. Even though interpreting conventional scalar term *even* involves four steps, the process has not been fully studied. Finally, the validity of the C-command hypothesis and the reference-set hypothesis is questionable.

3. The Present Study

3.1. Research Questions

The present study aims to investigate the Korean-speaking children's acquisition of scalar inferences from *even*. In the course of examining the acquisition of *even* scalar inferences, the validity of the c-command hypothesis and the reference-set hypothesis will be also evaluated. The three main research questions are as follows:

1) When are Korean-speaking children able to compute scalar inferences from *even*?
2) Are Korean-speaking children able to correctly assign the focus scope of *even*? If not, do they show object-oriented responses or subject-oriented responses?
3) Which step of the process does cause children's difficulty in scalar inferences?

3.2. Predictions

Concerning the first research question, it is predicted that children are able to draw scalar inferences at a later age than existential inferences because arranging elements in order of probability is based on generating elements of a set. This prediction can be proved if the Korean-speaking children's acquisition of *even* is compared with that of *also*. As stated earlier, it is possible to compare the acquisition of *even* and *also* directly in Korean because they have the same syntactic distribution. According to previous studies on *also* acquisition, Japanese-speaking children aged from 4 to 6 failed to give an adult-like interpretation to *mo* corresponding to *also* (Matsuoka et al., 2006), and German-speaking children whose mean age was 5 failed to give an adult-like interpretation to *auch* corresponding to *also* (Hüttner et. al, 2003). In line with the previous studies, it is predicted that Korean-speaking children will also fail to show adultlike knowledge of *also* until 5-6 years old, and acquire *even* much later than *also*.

With respect to the second research question, if the c-command hypothesis proposed in the acquisition of *only* is valid, Korean-speaking children would not have the focus scope problem as English-speaking children. As previously stated, Korean focus particle *only*, *also*, and *even* are attached to the focused position, and thus directly follow the focused subject or the focused object. Therefore, subject *also* and subject *even* cannot be a sentential adverb that c-commands both the subject DP and the VP in Korean. For this reason, if the c-command hypothesis is valid, it is predicted that Korean-speaking children will not show a subject-oriented interpretation in the acquisition of *also* and *even*.

As to the third research question, four predictions can be made based on the four steps of process to compute *even* scalar inference. First, children may not have the semantic ability to associate *even* with the element that has 'the lowest probability.' If the first prediction is correct, children cannot process *even* scalar inferences even when an alternative phrase of a set is given. Secondly, children may not have the syntactic ability to find the phrase focused by *even*. If the prediction is correct, children will judge sentences in which the focus is wrongly assigned felicitous. Next, children may not have the cognitive ability to create a set whose elements are the focused phrase and alternative phrases, and maintain them in memory as the reference-set hypothesis suggests. If the prediction is correct, children will be able to compute *even* scalar inferences when an alternative phrase is given whereas they will not be able to compute *even* scalar inferences when an alternative phrase is not given. Finally, children may not have the cognitive ability to arrange the elements of a set according to probability. If the last prediction is correct, children will not be able to calculate probability of elements in a set and compare them.

3.3. Materials and Procedure

The design of the study is largely a replication of Kim's study (2012) on Korean-speaking children's acquisition of *-to* 'even' scalar. The similar scenarios were adopted, but the different scalar term *-cocha* 'even' was used in this study because Korean focus particle *-to* usually elicits only existential inferences. Additionally, an additional reference sentence from which participants can draw an existential inference were used in the study. This study is composed of three experiments: one felicity judgement task, and two preference tasks.

3.3.1. Experiment 1

Experiment 1 is a felicity judgment task that aims to answer the first, the second, and the third research questions. In other words, the experiment investigates i) when Korean-speaking children are able to compute scalar inferences from *-cocha* 'even;' ii) whether they are able to correctly assign the scope of *even*; and iii) which step of scalar inference process causes children's difficulty.

Experiment 1 requires the participant to go through all the four steps to process *even* scalar inferences. In addition, this experiment tests *also* as well as *even* to separate the ability to draw scalar inferences from the ability to draw existential inferences. Furthremore, the experiment includes both focused subjects and focused objects to test if Korean-speaking children are able to assign the scope of focus correctly.

The procedure of experiment 1 is as follows. There is a teacher, and two puppets operated by the experimenter changing the tone of voice. First, the experimenter told a story to the participant. Next, one puppet said a sentence about the story, which could be used as a reference to draw an existential inference. Then, the other puppet said a test sentence containing *also* or *even*. Finally, the teacher asked the participant to judge whether the test sentence was pragmatically felicitous or infelicitous by saying 'good' or 'bad.' During the experiment, the experimenter did not give any feedback informing whether his/her response is correct or wrong to the participant.

The experiment consists of three scenarios, and each scenario includes 16 main experimental trials. The experiment starts with 2 practice items that check whether participants understand the task and the story. All experimental trials of scenario 1 are given as examples in (18).

(18) Sample experimental trials of Scenario 1 in Experiment 1

[Instruction]

There are three animals: a frog, a monkey, and an elephant. The elephant is much stronger than the monkey, and the monkey is much stronger than the frog, and the frog is the weakest. There are three objects: a balloon, an apple, and an umbrella. An umbrella is much heavier than an apple, an apple is much heavier than a balloon, and a balloon is the lightest.

A teacher gives a balloon, an apple, and an umbrella to the frog. Let's see what happens. The frog can hold a balloon, but cannot hold an apple and an umbrella. Next, the teacher gives a balloon, an apple, and an umbrella to the monkey. Let's see what happens. The monkey can hold a balloon and an apple, but cannot hold an umbrella. Finally, the teacher gives a balloon, an apple, and an umbrella to the elephant. Let's see what happens. The elephant can hold a balloon, an apple, and an umbrella.

From now, you are going to listen to conversations between a cat and a dog. The cat and the dog always say a true statement. After hearing each conversation, please judge whether the dog's answer is good or bad.

1) Practice item

Cat: There are a frog, a monkey, and an elephant.

Dog: Yes, there are three animals.

Teacher: Are the dog's words good or bad? (Good)

Cat: The elephant can hold a balloon, an apple, and an umbrella.

Dog: Yes, the elephant can hold one of the three objects.

Teacher: Are the dog's words good or bad? (Bad)

2) Subject-Also condition

Cat: The monkey can hold a balloon.

Dog: Yes, *also*-the elephant can hold a balloon. - Highest probability

Teacher: Are the dog's words good or bad? (Good)

Cat: The monkey can hold a balloon.

Dog: Yes, *also*-the frog can hold a balloon. - Lowest probability

Teacher: Are the dog's words good or bad? (Good)

Cat: The monkey can hold a balloon.

Dog: Yes, *also*-the monkey can hold an apple. - Syntactic error

Teacher: Are the dog's words good or bad? (Bad)

Cat: The monkey can hold a balloon.

Dog: Yes, *also*-the elephant can hold an apple. - Semantic error

Teacher: Are the dog's words good or bad? (Bad)

3) Object-Also condition

Cat: The elephant can hold an apple.

Dog: Yes, the elephant can *also* hold a balloon. - Highest probability

Teacher: Are the dog's words good or bad? (Good)

Cat: The elephant can hold an apple.

Dog: Yes, the elephant can *also* hold an umbrella. - Lowest probability

Teacher: Are the dog's words good or bad? (Good)

Cat: The elephant can hold an apple.

Dog: Yes, the monkey can *also* hold an apple. - Syntactic error

Teacher: Are the dog's words good or bad? (Bad)

Cat: The elephant can hold an apple.

Dog: Yes, the frog can *also* hold a balloon. - Semantic error

Teacher: Are the dog's words good or bad? (Bad)

4) Subject-Even condition

Cat: The monkey can hold a balloon.

Dog: Yes, *even* the elephant can hold a balloon. - Highest probability

Teacher: Are the dog's words good or bad? (Bad)

Cat: The monkey can hold a balloon.

Dog: Yes, *even* the frog can hold a balloon. - Lowest probability

Teacher: Are the dog's words good or bad? (Good)

Cat: The monkey can hold a balloon.

Dog: Yes, *even* the monkey can hold an apple. - Syntactic error

Teacher: Are the dog's words good or bad? (Bad)

Cat: The monkey can hold a balloon.

Dog: Yes, *even* the elephant can hold an apple. - Semantic error

Teacher: Are the dog's words good or bad? (Bad)

5) Object-Even condition

Cat: The elephant can hold an apple.

Dog: Yes, the elephant can *even* hold a balloon. - Highest probability

Teacher: Are the dog's words good or bad? (Bad)

3.3.3. Experiment 2

Experiment 2 is a preference task, and employs a Felicity Judgment task that presents an alternative sentence as well as the target sentence for comparison (Chierchia et al. 2001). It aims to answer the third research question by studying which step of *even* scalar inferences process causes children's difficulty. More specifically, the experiment investigates whether Korean-speaking children are able to associate *-cocha* 'even' with 'the lowest probability,' and compare and compute probabilities. This experiment presents the participant with a reference sentence showing an alternative element in the set. Therefore, experiment 2 does not require the syntactic ability to find the phrase focused by *even*, and the cognitive ability to make a set using the focused phrase and alternative phrase whereas experiment 1 requires all the semantic, syntactic, and cognitive ability to compute *even* scalar inferences. It also includes both focused subjects and focused objects to test if Korean-speaking children show subject-oriented responses or object-oriented responses.

The procedure of experiment 2 is as follows. There is a teacher, and two puppets operated by the experimenter changing the tone of voice. First, the experimenter told a story to the participant. Next, the teacher said a sentence about the story, which could be used as a reference to draw an existential inference. Then, two puppets said a test sentence containing *even*. Finally, the teacher asked the participant to choose one puppet who gave a better answer. The choice was displayed by the action of pointing the puppet. In summary, the participants were asked to choose a more pragmatically felicitous sentence from a pair of sentences in Experiment 2 whereas the participants were asked to judge whether a test sentence is pragmatically felicitous or infelicitous in Experiment 1. During the experiment, the experimenter did not give any feedback informing whether his/her response is correct or wrong to the participant.

Experiment 2 consists of 6 scenarios, and each scenario includes 2 main experimental trials. The experiment starts with 2 practice items that check whether participants understand the task and the story. All experimental trials of scenario 1 are given in (19).

(19) Sample experimental trials of Scenario 1 in Experiment 2

[Instruction]

There are three animals: a frog, a monkey, and an elephant. The elephant is much stronger than the monkey, and the monkey is much stronger than the frog, and the frog is the weakest. There are three objects: a balloon, an apple, and an umbrella. An umbrella is much heavier than an apple, and an apple is much heavier than a balloon, and a balloon is the lightest.

A teacher gives a balloon, an apple, and an umbrella to the frog. Let's see what happens. The frog can hold a balloon, but cannot hold an apple and an umbrella. Next, the teacher gives a balloon, an apple, and an umbrella to the monkey. Let's see what happens. The monkey can hold a balloon and an apple, but cannot hold an umbrella. Finally, the teacher gives a balloon, an apple, and an umbrella to the elephant. Let's see what happens. The elephant can hold a balloon, an apple, and an umbrella.

From now, you are going to listen to conversations between a teacher, a cat, and a dog. After hearing each conversation, please choose one animal who gives a better answer.

1) Practice item

Teacher: There are a frog, a monkey, and an elephant.

Cat: Yes, there are three animals.

Dog: Yes, there is one animal.

Teacher: Whose answer is better? (answer: cat)

Teacher: The elephant can hold a balloon, an apple, and an umbrella.

Cat: Yes, the elephant can hold two objects.

Dog: Yes, the elephant can hold three objects.

Teacher: Whose answer is better? (answer: dog)

2) Subject-Even condition

Teacher: The monkey can hold a balloon.

Cat: Yes, *even* the frog can hold a balloon.

Dog: Yes, *even* the elephant can hold a balloon.

Teacher: Whose answer is better? (answer: cat)

3) Object-Even condition

Teacher: The elephant can hold an apple.

Cat: Yes, the elephant can *even* hold a balloon.

Dog: Yes, the elephant can *even* hold an umbrella.

Teacher: Whose answer is better? (answer: dog)

3.3.3. Experiment 3

Experiment 3 is a preference task. It aims to answer the third research question, and studies which step of *even* scalar inferences process causes children's difficulty. More specifically, the experiment studies whether Korean-speaking children have the cognitive ability to calculate and compare probability. The experiment asks the participant to compute probability without using the scalar term *-cocha* 'even.' Therefore, experiment 3 does not require the semantic ability to associate *even* with 'the lowest probability,' the syntactic ability to assign the focus scope, and the cognitive ability to create a set. The experiment covers both the subject and the object to study if Korean-speaking children are able to compute probability regardless of the grammatical function of the focused element.

The procedure of experiment 3 is as follows. There is a teacher, and two puppets operated by the experimenter changing the tone of voice. First, the experiment told a story to the participant. Next, the teacher asked one question, and two puppets answered. Then, the participant was asked to choose one puppet who gave a better answer. The choice was displayed by the action of pointing the puppet. During the experiment, the experimenter did not give any feedback informing whether his/her response is correct or wrong to the participant.

Experiment 3 consists of 12 scenarios, and each scenario includes 4 main experimental trials. The experiment starts with 2 practice items that check whether participants understand the task and the story. All experimental trials of Scenario 1 in experiment 3 is given in (20)

(20) Sample experimental trials of Scenario 1 in Experiment 3

[Instruction]

There are three animals: a frog, a monkey, and an elephant. The elephant is much stronger than the monkey, the monkey is much stronger than the frog, and the frog is the weakest. There are three objects: a balloon, an apple, and an umbrella. An umbrella is much heavier than an apple, an apple is much heavier than a balloon, and a balloon is the lightest.

A teacher gives a balloon, an apple, and an umbrella to the frog. Let's see what happens. The frog can hold a balloon, but cannot hold an apple, and an umbrella. Next, the teacher gives a balloon, an apple, and an umbrella to the monkey. Let's see what happens. The monkey can hold a balloon and an apple, but cannot hold an umbrella. Finally, the teacher gives a balloon, an apple, and an umbrella to the elephant. Let's see what happens. The elephant can hold a balloon, an apple, and an umbrella.

From now, you are going to listen to conversations between a teacher, a cat, and a dog. After hearing each conversation, please choose one animal who gives a better answer.

1) Practice item

Teacher: To whom did the teacher give the objects?

Cat: a monkey

Dog: a rabbit (answer: cat)

Teacher: What is the monkey given?

Cat: a flag

Dog: an apple (answer: dog)

2) High Probability

Teacher: For whom is it easier to hold a balloon? - Subject *also/even*

Cat: the monkey

Dog: the elephant (answer: dog)

Teacher: What is easier for the monkey to hold? - Object *also/even*

Cat: a balloon (answer: cat)

Dog: an apple

3) Low probability

Teacher: For whom is it more difficult to hold a balloon? - Subject *even*

Cat: the frog (answer: cat)

Dog: the monkey

Teacher: What is more difficult for the elephant to hold? - Object *even*

Cat: an apple (answer: dog)

Dog: an umbrella

3.4. Participants

First, a total of 34 native Korean children between the ages of 5 to 10 participated in experiment 1 and experiment 3. Among them, 4 children were excluded because they failed to give a correct answer to practice items, and 3 children were excluded for not paying attention. The subjects were classified into three experimental groups of two-year intervals. The first group included 17 children between the age of 5 and 6, the second group consisted of 5 children between the age of 7 and 8, and the third group consisted of 5 children between the age of 9 and 10.

Next, a total of 11 native Korean children between the ages of 3 to 6 participated in experiment 2. Among them, 1 child was excluded because he failed to give a correct answer to practice items, and 2 children were excluded for not paying attention. The subjects were classified into two experimental groups of two-year intervals. The first group included 4 children between the age of 3 and 4, and the second group consisted of 4 children between the age of 5 and 6. The data was collected from a kindergarten and an elementary school in Seoul, South Korea. A control group of 10 adult Korean speakers between the ages of 28 to 31 was also included in the study.

3.5. Results

3.5.1. Experiment 1

In experiment 1, it was investigated i) when Korean-speaking children are able to compute scalar inferences from *-cocha* 'even,' ii) whether children are able to correctly assign the focus scope to the subject or the object, and iii) which step of the process causes children's difficulty in *even* scalar inferences. As to the first research question, it was predicted that children would be able to draw scalar inferences from at a later age than existential inferences. The prediction can be proved if the Korean-speaking children's acquisition of *-cocha* 'even' is compared with that of *-to* 'also.' The results of experiment 1 sorted by the focus particle are summarized in Table 1. It shows the rate of correct responses to *-cocha* 'even' and *-to* 'also' across three different age groups along with the adult control group. The denominator of the fraction in the parentheses is the total number of test items, and the numerator is the number of test items judged correctly. The nearly 100% of correct responses from the adult group suggests that the task and the test sentences of this experiment were appropriate. The overall percentage of correct interpretations was 45.34% for children in the 5 to 6 age group, 63.75% for children in the 7 to 8 age group, and 81.25% for children in the 9 to 10 age group. Younger children had significantly more difficulty in processing the focus particles than older children ($p < .001$, Kruskal-Wallis test). More importantly, children acquired scalar inferences much later than existential inferences as predicted. The difficulty in processing *-cocha* 'even' was much greater than *-to* 'also' ($p < .001$, Wilcoxon-Mann-Whitney test). Children were able to make existential inferences from *-to* 'also' at the age of 9 and 10, but still had some difficulty in drawing scalar inferences from *-cocha* 'even.'

Table 1. The overall rate of correct responses to *-to* 'also' and *-cocha* 'even' in Experiment 1 (%)

Age	*-to* 'Also'	*-cocha* 'Even'	Total
5-6	62.01 (253/408)	28.68 (117/408)	45.34 (370/816)
7-8	76.67 (92/120)	50.83 (61/120)	63.75 (153/240)
9-10	90 (108/120)	72.50 (87/120)	81.25 (195/240)
Adults	99.58 (239/240)	98.75 (237/240)	99.17(476/480)

Next, with regard to the second research question, it was predicted that if the c-command hypothesis is valid, Korean-speaking children would not have the focus scope problem in the acquisition of *-to* 'also' and *-cocha* 'even.' The overall results sorted by the focused position are shown in Table 2. Table 2 presents the rate of correct responses when the subject was focused and when the object was focused. Children had difficulty in assigning the scope of Korean focus particles, and the c-command hypothesis was not supported. The syntactic position of *-cocha* 'even' and *-to* 'also' did not significantly affect children's performance ($p = .117$, Wilcoxon-Mann-Whitney test).

Table 2. The rate of correct responses to the subject and the object focused by *-to* 'also' or *-cocha* 'even' in Experiment 1 (%)

Age	Subject	Object
5-6	46.08 (188/408)	44.61 (182/408)
7-8	71.67 (86/120)	55.83 (67/120)
9-10	82.5 (99/120)	80 (96/120)
Adults	99.58 (239/240)	98.75 (237/240)

Furthermore, Korean-speaking children were not sensitive to focus scope problems. Table 3 presents the rate of correct responses when test items had a focus scope problem. The percentage of correct syntactic interpretations when target sentences had a focus scope problem was 8.82% for children in the 5 to 6 age group, 40% for children in the 7 to 8 age group, and 73.33% for children in the 9 to 10 age group. In other words, the sentences in which the focus scope was wrongly assigned were acceptable to children. There was no significant difference in syntactic acceptability between the wrongly assigned *-cocha* 'even' and *-to* 'also' (p = .616, Wilcoxon-Mann-Whitney test), and younger children had more difficulty in detecting focus scope problems than older children ($p < .001$, Kruskal-Wallis test).

Table 3. The rate of correct responses to *-to* 'also' and *-cocha* 'even' when test items had a focus scope problem in Experiment 1 (%)

Age	*-to* 'Also'	*-cocha* 'Even'	Total
5-6	9.80 (10/102)	7.84 (8/102)	8.82 (18/204)
7-8	36.67 (11/30)	43.33 (13/30)	40 (24/60)
9-10	80 (24/30)	66.67 (20/30)	73.33 (44/60)
Adults	100 (60/60)	95 (57/60)	97.5 (117/120)

Likewise, Korean-speaking children did not show object-oriented responses as English-speaking children did. Table 4 shows the rate of correct responses sorted by the syntactic position of focused DPs when test items had a scope problem. As seen in Table 4, there was no significant difference in acceptability between the subject and the object when the focus scope was wrongly assigned (p = .209, Wilcoxon-Mann-Whitney test). In other words, Korean-speaking children showed two-way responses, rejecting the c-command hypothesis. They sometimes misanalysed the focused subject as the focused object, and other times misanalysed the focused object as the focused subject.

Table 4. The rate of correct responses to the focused subject and the focused object when test items had a focus scope problem in Experiment 1 (%)

Age	Scope problem	
	Subject	Object
5-6	9.80 (10/102)	7.84 (8/102)
7-8	56.67 (17/30)	23.33 (7/30)
9-10	70 (21/30)	76.67 (23/30)
Adults	98.33 (59/60)	96.67 (58/60)

Finally, in regard to the third research question, it was predicted that children may not have the semantic ability to associate -*cocha* 'even' with 'the lowest likelihood,' or the syntactic ability to find the focused phrase correctly. The syntactic difficulty of assigning the focus scope of -*cocha* 'even' and -*to* 'also' was verified in table 2, 3, and 4. Table 5 shows the rate of correct responses to -*cocha* 'even' and -*to* 'also' when test items had a semantic problem. Children had significantly more difficulty in grasping the meaning of -*cocha* 'even' than the meaning of -*to* 'also' ($p < .001$, Wilcoxon-Mann-Whitney test), and younger children's difficulty in understanding the meaning of focus particles was greater than older children's difficulty ($p < .001$, Kruskal-Wallis test). The percentage of correct responses for target sentences that had a semantic problem with *-to* 'also' was already 90% at the age of 7 and 8. Therefore, children were already able to associate *-to* 'also' with the meaning of 'addition' at the age of 7 to 8. On the other hand, children had great difficulty in associating *-cocha* 'even' with 'the lowest likelihood' until 7-8 years old.

Table 5. The rate of correct responses to *-to* 'also' and *-cocha* 'even'

when test items have a semantic problem in Experiment 1 (%)

Age	*-to* 'Also'	*-cocha* 'Even'	Total
5-6	58.82 (60/102)	9.80 (10/102)	34.31 (70/204)
7-8	90 (27/30)	43.33 (13/30)	66.67 (40/60)
9-10	80 (24/30)	80 (24/30)	80 (48/60)
Adults	100 (60/60)	95 (57/60)	97.5 (117/120)

In order to study which step of the process causes children's difficulty in *even* scalar inferences, there is a need to put children's responses to syntactic problems and semantic problems together. Table 6 shows the rate of correct responses to *-cocha* 'even' and *-to* 'also' when test items had a syntactic problem or a semantic problem. Children's poor performance on *-to* 'also' mainly resulted from lack of syntactic knowledge. However, children's poor performance on *-cocha* 'even' resulted from lack of both semantic knowledge and syntactic knowledge.

Table 6. The rate of correct responses to *-to* 'also' and *-cocha* 'even'

when test items had a syntactic problem or a semantic problem in Experiment 1 (%)

Age	-*to* 'Also'		-*cocha* 'Even'	
	Syntactic Problem	Semantic Problem	Syntactic Problem	Semantic Problem
5-6	9.80 (10/102)	58.82 (60/102)	7.84 (8/102)	9.80 (10/102)
7-8	36.67 (11/30)	90 (27/30)	43.33 (13/30)	43.33 (13/30)
9-10	80 (24/30)	80 (24/30)	66.67 (20/30)	80 (24/30)
Adults	100 (60/60)	100 (60/60)	95 (57/60)	100 (60/60)

Children's lack of semantic knowledge of -*cocha* 'even' is confirmed by their high acceptability of -*cocha* 'even' when the focused DP had the highest probability. Table 7 shows the rate of correct responses to -*to* 'also' and -*cocha* 'even' when the focused DP had the highest probability and the lowest probability. To adults, -*to* 'also' was acceptable both when the focused DP had the highest probability and the lowest probability, but -*cocha* 'even' was acceptable only when the focused DP had the highest probability. As adults did, children accepted -*to* 'also' both when the focused DP had the highest probability and the lowest probability. However, children accepted -*cocha* 'even' even when the focused DP had the highest likelihood. In other words, children were able to successfully associate -*to* 'also' with the meaning of 'addition' from -*to* 'also,' but were not able to make a semantic association between -*cocha* 'even' and 'the lowest likelihood.'

Table 7. The rate of correct responses to -*to* 'also' and -*cocha* 'even'

when the focused DP had the lowest probability or the highest probability in Experiment 1 (%)

Age	-*to* 'also'	-*cocha* 'even'

	Highest Probability	Lowest Probability	Highest Probability	Lowest Probability
5-6	88.24 (90/102)	91.18 (93/102)	9.80 (10/102)	87.25 (89/102)
7-8	90 (27/30)	90 (27/30)	53.33 (16/30)	63.33 (19/30)
9-10	100 (30/30)	100 (30/30)	80 (24/30)	63.33 (19/30)
Adults	100 (60/60)	100 (60/60)	98.33 (59/60)	100 (60/60)

In conclusion, children did not show the semantic ability to associate *-cocha* 'even' with 'the lowest likelihood,' and the syntactic ability to find the focused phrase correctly. However, a further study is needed to fully answer the third research question because other steps of process to draw *even* scalar inferences such as creating a set and computing probability were not investigated in experiment 1.

3.5.2. Experiment 2

Next, in order to provide a more elaborated explanation of which step of *even* scalar inference process causes children's difficulty, it was investigated whether Korean-speaking children are able to compute scalar inferences from *-cocha* 'even' when a reference sentence showing an alternative element is given to the participant. The overall results of experiment 2 sorted by the focused position are summarized in Table 8. It shows the rate of correct responses to the focused subject and the focused object across two different age groups along with the adult control group.

Table 8. The rate of correct responses to the subject and the object focused by *-cocha* 'even' in Experiment 2 (%)

Age	Subject	Object	Total
3-4	83.33 (20/24)	100 (24/24)	91.67 (44/48)
5-6	50 (12/24)	83.33 (20/24)	66.67 (32/48)
Adults	100 (60/60)	100 (60/60)	100(120/120)

The 100% of correct responses from the adult group suggests that the task and the test sentences of this experiment were appropriate. The percentage of correct responses was 91.67 for the 3-4 years old group, and 66.67 for the 5-6 years old group. There was no significant difference in responses between the two age groups (p = .036, Wilcoxon-Mann-Whitney test), and between the two syntactic positions (p = .036, Wilcoxon-Mann-Whitney test). In comparison with experiment 1, there was a significant difference in responses between the two experiments (p = .094, Wilcoxon-Mann-Whitney test). Children's ability to draw scalar inferences from *-cocha* 'even' increased when a reference sentence was presented to the participants (experiment 2: 66.67%) than when a reference sentence was not presented to the participants (experiment 1: 48.53%) at the age of 5 to 6. Moreover, children's correct responses in experiment 2 already reached 91.7% at the age of 3 to 4. In other words, children's difficulty in making scalar inferences from *-cocha* 'even' decreased when they did not have to find the focused phrase, and create a set using the focused phrase and alternative phrases as the reference-set hypothesis predicts.

3.5.3. Experiment 3

Finally, in order to provide a more elaborated explanation of which step of *even* scalar inference process causes children's difficulty, it was investigated whether children have the cognitive ability to arrange the elements of a set according to probability. If the last prediction on the third research question is correct, children will not be able to calculate probability of elements in a set and compare them. Since test items in experiment 3 did not contain any focus particles, participants did not have to associate *-cocha* 'even' with 'the lowest likelihood.' Table 9 shows the rate of correct responses when children were asked to choose an element that has the lowest probability or the highest probability. The nearly 100% of correct responses from young children as well as adults suggests that the task and the test sentences of this experiment were appropriate, and that children were able to calculate the probability of elements in a set and compare them easily. In other words, children even at the age of 3 and 4 had the cognitive ability to arrange the elements of a set according to probability, which is needed to draw scalar inferences from *even*.

Table 9. The rate of correct responses when choosing the element that has the lowest probability or the highest probability in Experiment 3

Age	High probability		Low probability		Total
	Subject	Object	Subject	Object	
5-6	100 (51/51)	96.08 (49/51)	98.04 (50/51)	100 (51/51)	98.53 (201/204)
7-8	100 (15/15)	100 (15/15)	100 (15/15)	100 (15/15)	100 (60/60)
9-10	100 (15/15)	100 (15/15)	100 (15/15)	100 (15/15)	100 (60/60)
Adults	100 (30/30)	100 (30/30)	100 (30/30)	100 (30/30)	100 (120/120)

4. Discussion and Conclusion

The present study investigated Korean-speaking children's acquisition of *-to* 'even' scalar experiment. Three experiments - one felicity judgement task, and two preference tasks - were implemented in this study in order to investigate when Korean-speaking children are able to make scalar inferences from *-cocha* 'even' and which step of the process causes their difficulty.

To summarize the developmental stage in the acquisition of focus particles, Korean-children went through the existential inference stage and then the scalar inference stage. Initially, children were able to calculate probability of elements in a set and compare them. From the age of 3 and 4, children were able to correctly arrange the elements of a set according to probability. Thus, the cognitive ability to calculate probability did not hinder children from drawing scalar inferences from *even*. Next, around the age of 5 and 6, children started to associate focus particle *-to* 'also' with the meaning of 'addition.' However, children were not able to associate *-cocha* 'even' with the meaning of 'the lowest likelihood' at the age of 5 and 6. Then, at the age of 7 and 8, children started to correctly assign the focus scope *-to* 'also' and *-cocha* 'even.' However, children still had great difficulty in associating focus particle *-cocha* 'even' with the meaning of 'the lowest likelihood' at the age of 7 and 8. Finally, at the age of 9 and 10, children successfully drew existential inferences from *-to* 'also.' Children still had some difficulty in making association between *-cocha* 'even' and 'the lowest likelihood' until 9-10 years old. In conclusion, children were able to draw scalar inferences at a later age than existential inferences.

A closer look at the data reveals which step of the process causes children's difficulty with scalar inferences. In experiment 1, children accepted *-cocha* 'even' when the focused DP had the highest probability as well as the focused DP had the lowest probability. In addition, children had great difficulty in finding the phrase focused by *-cocha* 'even.' In experiment 2, children's difficulty in making scalar inferences from *-cocha* 'even' significantly decreased because they did not have to find the phrase focused by *even*, and create a set using the focused phrase and alternative phrases. In experiment 3, it was found that children even at the age of 3 and 4 had the cognitive ability to arrange the elements of a set according to probability. Putting together the overall results, it is concluded that children do not have the semantic ability to associate *even* with 'the lowest probability,' and syntactic ability to find what is focused by *even*. As a result, children cannot create a set containing the focused phrase and alternative phrases although they already have the cognitive ability to compute probability and arrange the elements of the set in order of probability.

In the course of examining the acquisition of *even* scalar inferences, the validity of the c-command hypothesis and the reference-set hypothesis were also evaluated. The fact that syntactic scope problems existed in the acquisition of *also* and *even* in Korean strongly rejects the c-command hypothesis proposed for the acquisition of English *only*. Considering that Japanese-speaking children produced more correct responses for object *even* than subject *even* sentences (Ito, 2012), more explanation is needed for this phenomenon. On the other hand, the reference-set hypothesis was supported in this study because children's ability to draw scalar inferences from *-cocha* 'even' increased when a reference sentence was presented to the participants than when a reference sentence was not presented to the participants.

Despite the relatively small number and narrow age range of participants in the experiments, this study is very meaningful for the following reasons. First, it is the first study that elaborately investigated which step of process hinders children from drawing *even* scalar inferences. Especially, it covered children's cognitive ability as well as linguistic ability that is required for the acquisition of *even* scalar inferences. Thus, the thesis widened our understanding of the intersections between cognitive development and language acquisition. In addition, this study extends the scope of research on the acquisition of focus adverbs and scalar terms beyond *only* and *or* to *even* about which only little is known so far. Perhaps, further study will shed light on the unresolved issue on children's knowledge of *even* scalar inferences with more participants from a variety of languages.

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