

Children's Interpretation of Japanese Disjunctive “*ka*”: Subject-Object Asymmetry

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1. Introduction

It has been observed that interpretations of disjunction in downward entailment contexts (e.g., in negative sentences) show cross-linguistic variations (Szabolcsi 2002, Notley et al. 2011). For example, in English, the disjunction operator “*or*” receives a conjunctive interpretation in a negative sentence when it is c-commanded by negation. In contrast, in Japanese, the disjunction operator “*ka*” does not receive a conjunctive interpretation but a disjunctive interpretation even when it is c-commanded by negation. In child languages, however, Goro and Akiba (2004) / Goro (2007) and Komine (2012) report that Japanese children, unlike adults, initially assign a conjunctive interpretation to the disjunction operator “*ka*” in one specific type of negative sentence and in one specific type of comparative sentence.

This study will provide a discussion of the findings of my experimental research which demonstrate that Japanese-speaking children correctly assign a disjunctive interpretation to the subject with the disjunction operator “*ka*” in one kind of negative sentence, while in the same kind of sentences they assign a conjunctive interpretation to the scrambled object with “*ka*”. This observation indicates that children’s interpretation of “*ka*” is determined by abstract hierarchical structure (i.e., c-command relation), and the scrambled object undergoes “reconstruction”, an abstract operation, even in a child language (Murasugi and Kawamura 2005, Goro 2007, Sano 2007; Leddon and Lidz 2006).

2. Disjunction in Downward Entailment Contexts

It is well-known that negation (“*not*”) and prepositions like “*before*” are downward entailment operators. As shown in (1), if the statement “John doesn’t speak a Romance language” is true, then the statement “John doesn’t speak French” is also necessarily true. In other words, the former statement entails the latter statement. Furthermore, as shown in (2), if the statement “John went to Europe before learning a Romance language” is true, then “John went to Europe before learning French” must also be true.

(1) John doesn’t speak a Romance language.

⇒ John doesn’t speak French

(2) John went to Europe before learning a Romance language.

⇒ John went to Europe before learning French

(Crain et al. 2002)

Let us now continue by reviewing the interpretations of disjunction in downward entailment contexts which display cross-linguistic variations. In English and other languages, including German, Greek, and Korean, the disjunction operators receive a conjunctive interpretation, as shown in (3). This relation follows one of de Morgan’s laws of propositional logic, as shown in (4).

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- (3) John didn't eat ice cream or cake.
 ⇒ John didn't eat ice cream AND John didn't eat cake

$$(4) \neg(P \vee Q) \Leftrightarrow \neg P \wedge \neg Q$$

(Goro and Akiba 2004)

In addition, the disjunction operator “*or*” receives a conjunctive interpretation in other downward entailment contexts. As shown in (5), the word “before” is one of the downward entailment operators and the disjunction in the “*before*”-clause yield a conjunctive interpretation. Thus, “John went to Europe before learning French or Spanish” means “John went to Europe before learning French AND John went to Europe before learning Spanish”. Therefore, as discussed in Crain et al. 2002, the relation between downward entailment operators and the disjunction can be restated as in (6).

- (5) John went to Europe before learning French or Spanish.
 ⇒ John went to Europe before learning French AND John went to Europe before learning Spanish

$$(6) OP_{DE}(A \vee B) \Leftrightarrow OP_{DE}(A) \wedge OP_{DE}(B)$$

In contrast, Japanese and other languages, including Hungarian, Italian, and Russian, exhibit different behavior. As shown in (7), the counterpart of “*or*” in Japanese, “*ka*”, does not receive a conjunctive interpretation even when it seems to be c-commanded by negation.

- (7) John-wa aisu ka keeki-wo tabe-nakat-ta.
 John-Top ice cream or cake-Acc eat-Neg-Past
 Lit. ‘John didn't eat ice cream or cake’
 ⇒ John didn't eat ice cream OR John didn't eat cake

To summarize the above discussion, interpretations of disjunction in downward entailment contexts display cross-linguistic variations. In English-type languages, the disjunction operator in downward entailment contexts receives a conjunctive interpretation. In contrast, in Japanese-type languages, it receives a disjunctive interpretation. In child languages, however, it has been observed that Japanese-speaking children initially assign a conjunctive interpretation to “*ka*” in a negative sentence and in a comparative sentence. In the next section, we will shift our focus to some of the preceding acquisition studies which have examined Japanese-speaking children's interpretation of “*ka*”.

3. Previous Studies in Language Acquisition

The first of these studies is that of Goro and Akiba (2004) / Goro (2007) which investigated Japanese-speaking children's interpretation of sentences, as in (8) below.

- (8) Buta-wa ninjin ka piiman-wo tabe-nakat-ta.
 pig-Top carrot or green pepper-Acc eat-Neg-Past
 Lit. ‘The pig didn't eat the carrot or the green pepper’
 ⇒ The pig didn't eat the carrot OR the pig didn't eat the green pepper

As noted above, the disjunction operator “*ka*” receives a disjunctive interpretation and consequently this sentence means “The pig didn't eat the carrot OR the pig didn't eat the green pepper”.

30 Japanese-speaking children aged 3;7-6;3 (mean age 5;3) participated in the experiment using the Truth Value Judgment Task (Crain and Mckee 1985, Crain and Thornton 1998). Within these conditions, in the situation where the pig ate only one of the vegetables, a puppet was used to provide the stimulus sentence (8). In this scenario, the target sentence is true and it follows that if children assign a disjunctive interpretation to “*ka*”, they should accept the target sentences. In contrast, if children assign a conjunctive interpretation to “*ka*”, they should reject the target sentences.

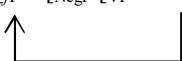
When the same experiment was conducted on 10 Japanese adults, they all accepted the target sentences 100% of the time. In other words, they never assigned a conjunctive interpretation to the disjunction operator “*ka*”. In contrast, children only accepted the target sentences 25% of the time, rejecting them in the other 75% of cases. Furthermore, when a sentence such as that in (8) was offered in reference to the animal that didn’t eat any vegetables, children accepted the target sentences 78% of the time. These results indicate that, unlike adults, Japanese-speaking children assigned a conjunctive interpretation to the disjunction operator “*ka*” when it appeared in a negative sentence.¹

We are now ready to proceed with a discussion of Goro’s analysis of the disjunction operator “*ka*” in adult Japanese and child Japanese. According to Goro and Akiba (2004), and Goro (2007), the cross-linguistic variations that we have seen so far are derived from the value of a parameter of disjunctions, as shown in (9).

(9) Boolean disjunctions in natural languages are associated with a lexical parameter, {+PPI, -PPI}.
(Goro 2007)

When a disjunction is -PPI, it is interpreted within the scope of negation, and therefore, it receives a conjunctive interpretation like “*or*” in English. In contrast, a +PPI disjunction has an uninterpretable feature that triggers covert raising and is unable to be interpreted within the scope of negation. According to Goro’s analysis, “*ka*” has a weak uninterpretable feature that must be checked in the spec of *fP*. Furthermore, *fP* is located between NegP and TP. To check the weak uninterpretable feature, “*ka*” moves to the spec of *fP* at LF, as shown in (10).

(10) [_{TP} Subject [_{fP} [_{NegP} [_{VP} NP *ka* NP V] Neg] *f*] T]



Hence, in adult Japanese, the disjunction operator is not interpreted within the scope of negation. In contrast, in child Japanese, “*ka*” is -PPI, and therefore, it remains within the scope of negation, which yields a conjunctive interpretation. Goro claims that the default value is -PPI and positive evidence (i.e., input data) to reset the value to +PPI is quite rare in Japanese. Consequently, Japanese-speaking children initially assign a conjunctive interpretation to “*ka*”.

To summarize, Japanese-speaking children, unlike adults, display a strong tendency to assign a conjunctive interpretation when the disjunction operator “*ka*” is in downward entailment contexts. According to Goro’s analysis, in adult Japanese, the disjunction operator “*ka*” has the value +PPI and undergoes covert movement to the spec of *fP*, which is located between NegP and TP. However, because the default value is -PPI and positive evidence (i.e., input data) to reset the value to +PPI is quite rare, Japanese-speaking children initially assign a conjunctive interpretation which is not accepted by adults.

4. Experiment

As discussed above, the preceding research reveals that Japanese children’s interpretation of “*ka*” in one kind of negative sentence and in one kind of comparative sentence is not adult-like; although

¹ Komine (2012) conducted experimental research which shows that Japanese-speaking children, in contrast to adults, assigned a conjunctive interpretation to the disjunction operator “*ka*” in not only a negative sentence such as (8), but also in a comparative sentence. An example sentence from Komine (2012) is given below in (i).

(i) Aoi hana-wa kiroi no ka akai no yori ookii.
blue flower-Top yellow one or red one than big

Lit. ‘The blue flower is bigger than the yellow one or the red one’

⇒ The blue flower is bigger than the yellow one OR the blue flower is bigger than the red one.

The results indicate that Japanese-speaking children initially assign a conjunctive interpretation to “*ka*” when it is within the scope of downward entailment operators.

Japanese adults didn't exhibit any difficulty in correctly assigning a disjunctive interpretation to "ka" even in cases where it appeared to be c-commanded by negation, children assigned a conjunctive interpretation to it. However, in the earlier studies, it is still unclear whether or not Japanese children's interpretation of "ka" is determined by abstract hierarchical structure, namely, c-command relation. In other words, it is still possible that the participants' interpretation of "ka" in these previous studies is determined by linear order. It is for this reason that in the study that follows, my experimental research will show that Japanese children's interpretation of "ka" is determined by c-command relation between negation and the disjunction, but not by linear order.

Goro's analysis makes the following prediction; if Goro's analysis is on the right track, it is predicted that Japanese-speaking children should correctly assign a disjunctive interpretation to the subject with "ka" in one kind of negative sentence, as the subject with "ka" is in the spec of TP which is higher than NegP.²

In order to empirically verify the prediction, I conducted an experiment with 10 adult Japanese native speakers and 10 monolingual Japanese-speaking children aged from 5;1-6;1(mean age: 5;4) as participants in the research. Employing the Truth Value Judgment Task in the experiment, I investigated children's interpretation of the subject with "ka" in a negative sentence like (11) below. However, even though "ka" is in the subject position in this experiment, it is still possible that Japanese children's interpretation of "ka" is determined by linear order; given the result of (11) shown in Table 3, it has already been established that Japanese children assign a disjunctive interpretation to "ka" when it appears in the first NP but they assign a conjunctive interpretation to it when it appears in the second NP. Consequently, in order to control this hypothetical linear order effect, I examined children's interpretation of the scrambled object with "ka" in a negative sentence where it appears in the scrambled object (12).

Each participant was given two practice items, two fillers, either two or three target sentences as in (11), and two or three target sentences found in (12).³ In general, in the conventional Truth Value Judgment Task, each participant is given the same number of stimulus sentences. In my experiment, each participant was tested with two sentences like (11) and two sentences like (12) with the story ending with "blue medal outcome", which makes the sentence true under the disjunctive interpretation of "ka". If a participant gave "true" judgments to the target sentences, then he/she interpreted the disjunction "ka" disjunctively. If a participant wrongly gave a "false" judgment to one of the target sentences (either (11) or (12)), then an extra target sentence was given with the black cross ending, which makes the target sentence true under the disjunctive interpretation, in order to make sure that the participant accessed the conjunctive interpretation of "ka". For this reason, each participant was given different number of the target sentences.

First, let us see the case of the subject with "ka". I investigated children's interpretation of sentences such as (11). This sentence means "The elephant or the pig didn't eat the apple".

- (11) Zou ka buta-ga ringo-wo tabe-nakat-ta.
 elephant or pig-Nom apple-Acc eat-Neg-Past
 Lit. 'The elephant or pig didn't eat the apple'
 ⇒ The elephant didn't eat the apple OR the pig didn't eat the apple

² In this study, following Goro (2007), I assume that the subject occupies the spec of TP.

³ Let me clarify the content of the filler sentences. Before conducting the experiment, it was unclear whether or not other scope-bearing elements (e.g. quantifiers) in the subject position could take scope over negation in child Japanese. For this reason, as filler tests, I gave the following sentences such as (ii) to show that such an element other than the disjunction in the subject position could take scope over negation in child Japanese.

- (ii) Zen'in-ga ringo-wo tabe-naka-ta.
 Everybody-Nom apple-Acc eat-Neg-Past
 'Everybody didn't eat an apple/apples.'

In the experiment, all the participants correctly assigned the surface scope interpretation (i.e., every > neg). Here, this item is now considered as a kind of fillers for the main experiment.

The procedure is as follows. In one scenario, there were two animals (e.g., an elephant and a pig). Each of the two animals tried to eat an item of food (e.g., an apple) and they received a medal as a reward, according to which of them ate. Medals and situations are summarized in Table 1. Based on the medal that they received, a puppet guessed what had happened and uttered the target sentences such as (11). Children’s task was to judge whether the puppet’s utterance was correct or not. In the blue medal situation, if children assigned a disjunctive interpretation, they were expected to accept the target sentences such as (11). In contrast, if they assigned a conjunctive interpretation, they were expected to reject them. The truth values of the target sentences for each medal condition are summarized in Table 2. Note that the most crucial situation is the blue medal situation.⁴

Table 1: Medals and situations for the subject with “*ka*”

Medal	Gold	Blue	Black Cross
Who ate the food?	Both the elephant and the pig	Either the elephant or the pig	Neither the elephant nor the pig

Table 2: Truth Values and medal-situations

Medals	Gold	Blue	Black Cross
Disjunctive interpretation of “ <i>ka</i> ” in (11)	F	T	T/F ⁵
Conjunctive interpretation of “ <i>ka</i> ” in (11)	F	F	T

Let us see a sample scenario. Pikachu, who is a famous character for Japanese children, acted as a teacher and there were two apples for the elephant and the pig. A puppet who produces the target sentence was watching the following story with a participant. Pikachu said, “Hi, everyone. Now, let’s try to practice eating. Both of you should eat the apple. When both of you eat the apple, I will give you a gold medal as a reward. When only one of you eats the apple, I will give you a blue medal. When neither of you eat the apple, I will give you a black cross.” Then, one experimenter hid the elephant and the pig with a curtain. The puppet who produces the target sentence such as (11) and the participant could not see what had happened behind the curtain. This situation makes the target sentence sound natural, especially as to the use of “*ka*” because the puppet did not know who actually ate the apple. After the curtain was removed, the elephant and the pig had a blue medal. The puppet saw the blue medal and uttered the target sentence given in (11). As discussed above, the disjunction operator “*ka*” receives a disjunctive interpretation. The children’s task was to judge whether the puppet’s utterance was correct or not. In this situation, the target sentence is true in adult Japanese. If children assign a disjunctive interpretation like adults, they should accept the target sentences.

Let us see Table 3 for the result.

Table 3: Acceptance rates for the subject with “*ka*” for the blue medal situation

	Children	Adults
Correct acceptance rates	85% (17/20)	100% (20/20)

As shown in Table 3, adults correctly accepted the target sentences 100% of the time. In other words, they never assigned a conjunctive interpretation to “*ka*”. In addition, Japanese-speaking children also accepted the target sentences 85% of the time. In other words, they assigned the disjunctive interpretation to the target sentences; they gave “true” judgments to the target sentences in the condition

⁴ The gold-medal situation is not important because the truth value of the target sentence in the gold medal situation is false whether or not they assigned a conjunctive interpretation. For this reason, I did not use the gold-medal situations in the experiment.

⁵ Assuming that “*ka*” is an inclusive disjunction, the target sentences such as (11) and (12) are truth-conditionally true in the black cross situation. However, it invokes scalar implicature and implies that, in (11), “it is not the case that neither the elephant nor the pig ate the apple.” Thus, I use T/F for the truth values of the target sentences such as (11) and (12). See Goro (2007).

where the target sentences were true under the disjunctive interpretation (i.e., the blue medal situation; see Table 2). Although the number of the participants in my experiment is less than that in the earlier studies, the acceptance rate is much higher. In addition, the difference of the acceptance rates is non-significant by a Mann-Whitney test ($Z = -1.451, ns$).

This result indicates that Japanese children assigned a disjunctive interpretation to the subject with “*ka*” in one kind of negative sentence like adults. However, it is still possible that children’s good performance with the subject with “*ka*” may be because “*ka*” is in the first NP, while “*ka*” is in the second NP in the stimulus sentences such as (8). To examine this hypothetical effect of linear order, I investigated the same children’s interpretation of (12), in which “*ka*” appears in the scrambled object. Note that (11) and (12) differ only in the case markers, that is, they have the same linear order (i.e., NP *ka* NP-Case NP-Case V-Neg-Past). If Japanese children’s interpretation of “*ka*” were determined by linear order, children would interpret it disjunctively.

- (12) Ringo ka ichigo-wo kaeru-ga tabe-nakat-ta.
 apple or strawberry-Acc frog-Nom eat-Neg-Past
 Lit. ‘The apple or the strawberry, the frog didn’t eat’
 ⇒ The frog eat didn’t eat the apple OR the frog didn’t eat the strawberry

In this sentence, the disjunction operator “*ka*” receives a disjunctive interpretation. In other words, this sentence means “The frog didn’t eat the apple OR the frog didn’t eat the strawberry”.

The procedure is basically the same; an animal (e.g., a frog) tried to eat two items of food (e.g., an apple and a strawberry) and it received a medal, according to what it ate. After that, based on the medal that it received, a puppet guessed what had happened. Medals and situations are summarized in Table 4. The truth values of the target sentences for each medal condition are summarized in Table 5.

Table 4: Medals and situations for the scrambled object with “*ka*”

Medal	Gold	Blue	Black Cross
What did the animal eat?	Both the apple and the strawberry	Either the apple or the strawberry	Neither the apple nor the strawberry

Table 5: Truth values and medal-situations

Medals	Gold	Blue	Black Cross
Disjunctive interpretation of “ <i>ka</i> ” in (12)	F	T	T/F
Conjunctive interpretation of “ <i>ka</i> ” in (12)	F	F	T

Let us see a sample scenario. Pikachu acted as a teacher and there was an apple and a strawberry for the frog. The puppet who produces the target sentences was watching the following story with a participant. Pikachu said, “Now, let’s try to practice eating. You shouldn’t be choosy. When you eat both the apple and the strawberry, I will give you a gold medal as a reward. When you eat only one of them, I will give you a blue medal. When you don’t eat any food, I will give you a black cross.” Then, one experimenter hid the frog with a curtain. The puppet who produces the target sentence such as (12) and the participant could not see what had happened behind the curtain. After the curtain was removed, the frog had a blue medal. The puppet saw the blue medal and uttered the target sentence given in (12). The children’s task was to judge whether the puppet’s utterance was correct or not. As we have already seen, the disjunction operator “*ka*” receives a disjunctive interpretation. Therefore, in this situation, the target sentence is true. If children assign a disjunctive interpretation like adults, they should accept the target sentences.

Let us see Table 6 for the result.

Table 6: Acceptance rates for the scrambled object with “*ka*” for the blue medal situation

	Children	Adults
Correct acceptance rates	45% (9/20)	100% (20/20)

Adults accepted the target sentences 100% of the time. In contrast, children accepted the target sentences only 45% of the time. In other words, children rejected them 55% of the time. 6 out of the same 10 children rejected the target sentences for the blue medal situation. In other words, the 6 children wrongly gave “false” judgments to the target sentences in the condition where the target sentences were true under the disjunctive interpretation (i.e., the blue medal situation). The difference of the acceptance rates is significant by a Mann-Whitney test ($Z = -2.828$, $p < .05$). Furthermore, 5 out of the same 6 children accepted the target sentence when an animal had a black cross; the 5 children gave “true” judgments to the target sentences in the condition where the target sentences were true under the conjunctive interpretation (i.e., the black cross situation; See Table 5). These results indicate that around half of the same 10 children assigned the conjunctive interpretation to the scrambled object with “*ka*”, in contrast to the subject with “*ka*”. Finally, the data comparison is given in Table 7.

Table 7: Comparison between correct acceptance rates of (11) and (12) for the blue medal situation

	Children
Correct acceptance rates of (11) (= subject with “ <i>ka</i> ”)	85%
Correct acceptance rates of (12) (= scrambled object with “ <i>ka</i> ”)	45%

The difference of the acceptance rates is nearly significant by a Wilcoxon Signed Rank test ($Z = -1.974$, $p = .052$).

To summarize, Japanese children assigned a conjunctive interpretation to the subject “*ka*” but they assigned a conjunctive interpretation to the scrambled object with “*ka*” although the two sentences have the same liner order (and differ only in the case markers).

5. Discussion

First, let us consider the case of the subject with “*ka*” given in (11). Roughly speaking, Japanese children correctly assigned a disjunctive interpretation to the subject with “*ka*”. The acceptance rate is much higher than that in the earlier studies which examined Japanese-speaking children’s interpretation of the sentences such as (8). Children’s good behavior with the subject with “*ka*” is not due to the linear order effect because around half of the same 10 children assigned a conjunctive interpretation to the scrambled object with “*ka*”. If their interpretation of “*ka*” was determined by linear order, the acceptance rate of (11) would be similar to that of (12). Rather, this result indicates that children’s interpretation of the disjunction operator “*ka*” is determined by c-command relation. In other words, the subject is not c-commanded by negation, and hence, it receives a disjunctive interpretation.

In contrast, when the disjunction operator “*ka*” appears in the scrambled object, 6 out of the same 10 children wrongly rejected the target sentences such as (12) for the blue medal situation. Furthermore, 5 out of the same 6 children accepted the target sentence for the black cross situation. As discussed in the previous section, the 5 children gave “true” judgments to the target sentences in the condition where the target sentences were true under the conjunctive interpretation (i.e., the black cross situation). These results indicate that the scrambled object undergoes reconstruction, as shown in (13).

(13) [[Ringo ka ichigo-wo] [TP kaeru-ga [VP tabe-nakat-ta]]]

The reconstructed object is c-commanded by negation, and hence, the disjunctive operator “*ka*” receives a conjunctive interpretation in child grammar. These findings provide a piece of evidence that children have “reconstruction” as a part of their grammar although it is unlikely that direct positive evidence for “reconstruction” is available to children (Murasugi and Kawamura 2005, Goro 2007, Sano 2007; Leddon and Lidz 2006).

It might be interesting to try to see why the acceptance rate for the scrambled object was higher, compared to the previous study (i.e., 25% in Goro 2007)? Although the reason is not clear, I would like

to make a speculation. It has been observed that children tend to interpret scope-bearing elements (e.g., quantifiers, negation, etc.) based on surface c-command relations. This is called the Observation of Isomorphism (Musolino 1998). In the case of the scrambled object with “*ka*”, as shown in (13), the disjunction is higher than negation (and the subject). In other words, in (12), the scrambled object with “*ka*” c-commands negation at the surface structure. Given the Observation of Isomorphism, in the case of the scrambled object with “*ka*”, some children may have interpreted the sentence (12) based on the surface c-command relation; the disjunction took scope over negation (i.e., or > neg), which yields the disjunctive interpretation. In contrast, in the test sentences such as (8) in the previous studies, the disjunction with the object is in the complement of V. In other words, negation is higher than the disjunction, that is, in (8), negation c-commands the disjunction at the surface structure. Thus, it might have been easier for the children to access the disjunctive interpretation in (12) than in (8) because the disjunction c-commands negation at the surface structure in (12). Of course, this is still speculative. I would like to leave this matter for future research.

6. Conclusion

It has been observed that Japanese-speaking children, unlike adults, assign a conjunctive interpretation to the disjunction operator “*ka*” in a negative sentence and in a comparative sentence. In this study, Japanese-speaking children assigned a disjunctive interpretation to “*ka*” in a negative sentence when it appears in the subject, which is not c-commanded by negation. In contrast, they assigned a conjunctive interpretation to “*ka*” when it appears in the scrambled object in a negative sentence. These results indicate that children’s interpretation of “*ka*” in a negative sentence is determined by c-command relation between negation and “*ka*”, and that the scrambled object undergoes reconstruction, an abstract operation, even in a child language.

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