CHAPTER EIGHT

ELIDED CONJUNCTION IN CHILD JAPANESE AND ITS IMPLICATIONS*

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The goal of this study is to see which operation children apply to ellipsis phenomena such that they require a linguistic antecedent, phonological deletion or syntactic deletion. Following Merchant (2001), we argue that Japanese ellipsis of arguments is syntactic because it cancels the polarity sensitivities of polarity items and yield the different interpretation between overt and covert elements. This contrast in interpretation could not be expected if ellipsis were a pure phonological deletion. We experimentally tested whether children know that ellipsis cancels the polarity sensitivity of Japanese PPI conjunction *-mo-mo*. The result of our experiment shows that many of the child participants were not sensitive to the difference between the overt and covert conjunction, which suggests that Japanese children around age 5 apply a phonological deletion to null arguments as in English early subjectless utterances (Gerken 1991, 1994).

1. Introduction

This study investigates whether children's operation of ellipsis is the same as adults' by studying null arguments in Japanese. In this paper, we focus on ellipsis phenomena such that they require a linguistic antecedent (Hankamer and Sag 1976).

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Japanese is a so-called "radical *pro* drop" language and easily allows null arguments in a sentence. For example, the verb "made" can stand as a grammatical sentence by itself as shown in (1) and the null subject and object can be interpreted in any way based on discourse context such as "John made a cake", "Mary got a new boyfriend", "the birds nested", etc.

(1) Tsukut-ta.
make-PAST
"Someone made something."

The traditional approach to Japanese null arguments is that a phonologically null pronoun, *pro*, occupies the argument positions (Kuroda 1965). However, Otani and Whitman (1991) argue that there is another strategy to derive null arguments in Japanese instead of using phonologically empty items. That is ellipsis. They observe that a null object can exhibit an interpretation that cannot be obtained with a pronoun. For example, taking (2a) as an antecedent, the null object in (2b) can be interpreted as "the panda's tricycle (strict interpretation)" and "the pig's tricycle (sloppy interpretation)". However, as shown in (2c), the latter interpretation cannot be obtained with the overt pronoun *sore* "it".

(2) a. Panda-san-ga zibun-no sanrinsya-o aratte-ru yo.
panda-Mr.-NOM self-GEN tricycle-ACC wash-PRES PRT
"The panda is washing his own tricycle."

b. Buta-san-mo _____ aratte-ru yo.
pig-Mr.-also wash-PRES PRT
lit. "The pig is also washing __."
Strict: "The pig is also washing it (= the panda's tricycle)."
Sloppy: "The pig is also washing his own tricycle."

c. Buta-san-mo sore-o aratte-ru yo.
pig-Mr.-also it-ACC wash-PRES PRT
"The pig is also washing it/ *his own tricycle."(Sugisaki 2007:607)

This suggests that the *pro* analysis does not work for the sloppy reading in (2b) since the overt pronoun cannot derive it. According to Otani and Whitman, it is ellipsis that yields the sloppy interpretation in (2b).

Takahashi (2008) further observes that "sloppy" interpretations can be attested with quantifiers.

(3) a. Kuma-san-wa san-ko-no booru-o ket-ta yo.
bear-Mr.-TOP three-CL-GEN ball-ACC kick-PAST PRT
"The bear kicked three balls."

b. Kitune-san-mo _____ ket-ta yo.
fox-Mr.-also kick-PAST PRT
lit. "The fox also kicked __."
Strict: "The fox also kicked them (= the balls the bear kicked)."
Sloppy: "The fox also kicked a new set of three balls."
(Otaki 2014: 157)

c. Kitsune-san-mo sore-ra-o ket-ta yo.
fox-Mr.-also it-PL-ACC kick-PAST PRT
"The fox also kicked them/ *a new set of three balls."
(Otaki 2014, 154, slightly modified)

(3a) is an antecedent sentence containing the numeral expression "three". Following this sentence, (3b) is ambiguous between the strict and sloppy reading, while (3c) only has the strict interpretation. This indicates that the sloppy reading in (3b) is derived not by the empty pronoun *pro* but by ellipsis.

There are several studies that investigate whether children can use ellipsis in Japanese (Matsuo 2007; Sugisaki 2007, 2009; Otaki and Yusa 2009, 2012; Sugisaki 2013; Otaki 2014; Fujiwara 2017; Sugisaki 2018). Most of them argue that Japanese children can apply ellipsis to interpret a null position. For instance, Sugisaki (2007) observed in his experiment with a Truth Value Judgment Task (TVJT; Crain and McKee 1985) that 10 children (age 3;1-5;4, mean 4;5) accepted the sloppy interpretation in (2b) but not in (2c). Furthermore, Otaki (2014) reported that 19 children (age 4;3-6;2, mean 5;2) accessed the sloppy interpretation of the numeral quantifier "three" in (3b) in his TVJT experiment. Thus, these studies suggest that children around this age already have an operation that derives ellipsis phenomena like null arguments in Japanese.

This paper attempts to see what operation children apply to ellipsis phenomena. In particular, we investigate whether null arguments in child Japanese are derived by a phonological rule or a syntactic operation. In Universal Grammar, both phonological and syntactic deletion are allowed. Napoli (1982) claims that initial material can be omitted in English colloquial speech, as in (4).

(4) a. Seen Tom? (Have you seen …)
b. 'Fessor you expected is here. (The professor …) (Napoli 1982, 85)

According to her, these initial material deletions are derived by a phonological rule and not a syntactic deletion because syntactic operations in general cannot be applied to a non-constituent as in (4a) or a part of a word as in (4b).

On the other hand, ellipsis phenomena requiring a linguistic antecedent are not derived just by "surface omission" (Merchant 2001).[1] It has been observed that ellipsis rescues island-violations as in (5).

(5) Ben will be mad if Abby talks to one of the teachers, but …
a.*she couldn't remember which [$_{TP}$ Ben will be mad if she talks to].
b. she couldn't remember which ~~[$_{TP}$ Ben will be mad if she talks to]~~.
(Merchant 2001, 88)

(5a) illustrates the adjunct island violation, in which the *wh*-phrase moves out of the conditional clause. However, this island violation can be ameliorated by eliding the embedded TP (i.e. sluicing) as in (5b). The grammatical difference between the overt and covert TP indicates that ellipsis is not a mere phonological deletion. Moreover, it has been reported that ellipsis cancels the polarity sensitivities of polarity items (Sag 1976; Johnson 2001). In English, "anyone" must take scope under negation as shown in (6b), whereas "someone" cannot take scope under negation as can be seen in (7b). The former is called a Negative Polarity Item (NPI) and the latter a Positive Polarity Item (PPI). However, their polarity sensitivity disappears when they are elided. (6a), which contains the covert NPI "anyone" in the ellipsis site, is grammatical without negation. On the other hand, the covert PPI "someone" can be interpreted under negation in (7a).

(6) John didn't see anyone,
a. but Mary did.
b. *but Mary did see anyone.

[1] Here, what we mean by "phonological rule" or "surface omission" is different from PF-deletion and LF-copy analyses, which are the major approaches to ellipsis that requires a linguistic antecedent. We regard both PF-deletion and LF-copy as syntactic operations. The difference between PF-deletion and LF-copy is not discussed in this paper.

(7) John saw someone,
a. but Mary didn't. (not > some/ *some > not)
b. but Mary didn't see someone. (*not > some/ some > not)
(Merchant 2013, 446)

This contrast also suggests that ellipsis cannot be a purely phonological operation. Hence, given the differences between overt and covert elements in (5)-(7), ellipsis should be a syntactic operation so that it can affect grammaticality and interpretation.

Note that the previous studies on acquisition of Japanese ellipsis cannot tease apart the two operations discussed here since the sloppy readings in (2b) and (3b) can be obtained with the overt counterparts of the null elements as shown in (8).

(8) a. Buta-san-mo zibun-no sanrinsya-o aratte-ru yo.
pig-Mr.-also self-GEN tricycle-ACC wash-PRES PRT
"The pig is also washing his own tricycle."

b. Kitune-san-mo san-ko-no booru-o ket-ta yo.
fox-Mr.-also three-CL-GEN ball-ACC kick-PAST PRT
"The fox also kicked three balls."

Therefore, children's ellipsis observed in the previous literatures cannot tell whether it is derived by a mere phonological operation or syntactic operation. It can also be shown that Japanese-type ellipsis, which derives null arguments, is not surface omission by using PPI logical connectives. Goro (2007) observes that the Japanese logical connective *ka* "or" and *-mo-mo* "and" behave as PPIs, as in (9).

(9) a. John-wa supeingo ka furansugo-o hanasa-nai.
John-TOP Spanish or French-ACC speak-NEG
lit. "John doesn't speak Spanish or French." (or > not/ *not > or)

b. John-wa supeingo-mo furansugo-mo hanasa-nai.
John-TOP Spanish-also French-also speak-NEG
lit. "John doesn't speak Spanish and French."
(and > not/ *not > and) (Goro 2007, 188)

(9a) means that "John doesn't speak Spanish" or "John doesn't speak French", while (9b) means that "John speaks neither of them". Therefore,

Japanese logical connectives cannot take scope under negation. However, when they are elided they take scope under negation as illustrated in (10) (Funakoshi 2013).

(10) a. Mary-wa supeingo ka furansugo-o hanas-u ga,
Mary-TOP Spanish or French-ACC speak-PRES but
John-wa _____ hanasa-nai.
John-TOP speak-NEG
"Mary speaks Spanish or French, but John doesn't." (not > or)
(Funakoshi 2013: 13)

b. Mary-wa supeingo-mo furansugo-mo hanas-u ga,
Mary-TOP Spanish-also French-also speak-PRES but
John-wa _____ hanasa-nai.
John-TOP speak-NEG
"Mary speaks Spanish and French, but John doesn't." (not > and)
(Funakoshi 2013, 15)

The interpretation of (10a) is that "John speaks neither of the two languages", while (10b) means that "it is not the case that he speaks both". Thus, (10b) is true even when John speaks one of them. The contrast in interpretation between (9) and (10) suggests that Japanese ellipsis is also derived by a syntactic operation like English sluicing (cf. 5) and VP-ellipsis (cf. 6-7). According to Funakoshi (2013), this contrast occurs because the PPI feature of the logical connectives is deleted under ellipsis.[2] Therefore, this type of ellipsis can be derived only by a syntactic operation.

This study attempts to address the question whether children's ellipsis is a phonological rule or syntactic operation by testing children's interpretation of the elided connectives in sentences like (10). In the next section, we review Goro's (2007) experiment on the acquisition of Japanese connectives, which is the basis of our experiment.

2. Previous study

Goro (2007) examined sentences with the overt connectives such as (11a) and (11b) to see whether Japanese preschool children know that Japanese logical connectives must take scope over negation in simple

[2] See also Merchant (2013) for another account of why ellipsis can cancel polarity sensitivities.

negative sentences. In his test items, negative sentences follow affirmative sentences in order to make negation sound natural.

(11) Buta-san-wa keeki-o tabeta kedo …,
pig-Mr.-TOP cake-ACC eat-PAST but
"The pig ate the cake but…"

a. ninjin ka piman-o tabe-nakat-ta.
carrot or pepper-ACC eat-NEG-PAST
"he didn't eat the carrot or the pepper." (or > not)/*(not > or)

b. ninjin-mo piman-mo tabe-nakat-ta.
carrot-also pepper-also eat-NEG-PAST
"he didn't eat the carrot and the pepper." (and > not)/*(not > and)
(Goro 2007, 228, 230)

The method of his experiment was TVJT. In order to satisfy a pragmatic felicity condition for using the disjunction *ka*, he made participants unable to see what the animals ate when he gave them test sentences. Instead, he used medals to make participants guess what happened in the story; a gold medal is given to animals who ate both vegetables; a blue medal is given to animals who ate one of the vegetables but not both; and a black cross is given to animals who could not eat any of the vegetables. The target condition for (11) is that the pig has a blue medal. Under the reading where the logical connectives take scope over negation (i.e. or > not, and > not), (11a) is true and (11b) false. On the other hand, (11a) becomes false and (11b) true under the non-adult-like reading, where the logical connectives take scope under negation (i.e, not > or, not > and).

The result of his experiment shows that Japanese children aged from 3 to 6 already know that Japanese overt conjunction *-mo-mo* must take scope over negation in simple negative sentences, but not the disjunction *ka*. In other words, Japanese preschool children have adult-like knowledge on conjunction but not on disjunction. However, Goro (2007) did not test sentence with the elided conjunction.

In light of this background, we conducted an experiment to see whether children know that logical connectives can take scope under negation when they are elided as in (10). However, the disjunction *ka* is not used in our experiment since Japanese children have difficulty in comprehending it with negation as Goro's study has shown.

3. Experiment

Ten Japanese children at age 5;3-5;11 (mean 5;8) and 10 Japanese adults participated in this experiment. The method is TVJT. Our experiment consists of three sections. The first section tests eight practice items. The first four items are used as practice for TVJT. The next two items are to see whether participants can judge two conjoined sentences. One of them is tested in a matching story and the other is tested in a mismatching story. A sample item is given in (12).

(12) Usagi-wa jampu-si-ta kedo, kaeru-wa jampu-si-nakat-ta.
rabbit-TOP jump-do-PAST but frog-TOP jump-do-NEG-PAST
"The rabbit jumped but the frog didn't jump."

The last two items in the first session involve an ellipsis site in the second clause, as in (13). Both of them are given in a mismatching story. For example, (13) is given in a situation where Zibanyan and the pig ate the carrots, but they didn't eat the peppers.

(13) Zibanyan-wa ninjin-o tabe-re-ta kedo,
Zibanyan-TOP carrot-ACC eat-can-PAST but

buta-wa _____ tabe-re-nakat-ta.
pig-TOP eat-can-NEG-PAST
"Zibanyan was able to eat the carrot but the pig wasn't."

Every participant gave correct answers to all the practice items in the first section.

Following Goro's (2007) experiment, we used a gold medal, a blue medal and a black cross to indicate who ate how many vegetables in the third session. In the second session, we taught the participants which medal indicates what. A gold medal indicates that a character ate the carrot and the pepper. A blue medal indicates that one ate one of the vegetables but not both. A black cross means that one ate neither of them. In order to confirm their understanding of what these medals mean, we also asked them which medal is given to characters who ate or didn't eat vegetable(s). None of the participants had any problems in giving correct medals to the characters.

In the third section, we tested the sentences in (14). (14a) is the antecedent sentence for (14b) and (14c). Both (14b) and (14c) follow (14a).

(14b) is a target item which contains an elided conjunction and negation. (14c) is a control item which has an overt conjunction and negation.

(14) a. Zibanyan-wa [ninjin-mo piiman-mo] tabe-re-ta kedo
Zibanyan-TOP carrot-also pepper-also eat-can-PAST but
"Zibanyan managed to eat the carrot and the pepper, but…."

b. pengin-wa _____ tabe-re-nakat-ta.
penguin-TOP eat-can-NEG-PAST
lit. "the penguin couldn't eat ___." (not > and)

c. pengin-wa [ninjin-mo piiman-mo] tabe-re-nakat-ta.
penguin-TOP carrot-also pepper-also eat-can-NEG-PAST
lit. "the penguin couldn't eat the carrot and the pepper."
(and > not / *not > and)
(and > not): "the penguin ate neither the carrot nor the pepper."
(not > and): "it is not the case that the penguin ate both of the vegetables."

The target sentence in (14b) can yield the "not > and" reading, whereas the control sentence in (14c) cannot.

(14) was given to participants after a story like the following. A bear (playing the role of teacher) gives a pepper and a carrot to Zibanyan and a penguin, and he suggests eating the vegetables. He tells them that he will give them a medal based on what they eat (Figure 8-1). When they are about to eat the vegetables, a curtain shows up and participants cannot see what they eat. Then, they come out with a medal. Zibanyan has a gold medal and the penguin a blue medal (Figure 8-2). This indicates that the former managed to eat both the pepper and the carrot, but the latter ate only one of them.

Figure 8-1

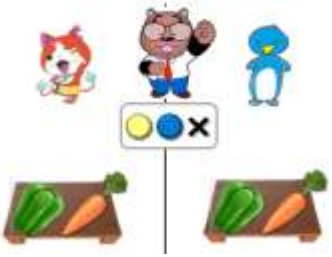
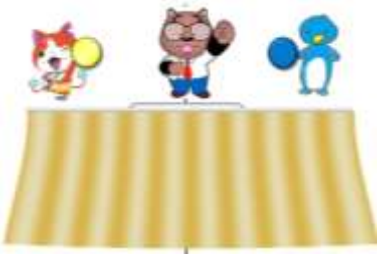


Figure 8-2



This story matches the target item in (14b) since it allows the "not > and" interpretation, that is, it is not the case that the penguin ate both of the vegetables. On the other hand, the control item in (14c) does not allow this interpretation and therefore it mismatches this sample story. Thus, if participants assign the "not > and" reading to the test items in (14b) and (14c), they should accept them under this "blue medal" condition. In contrast, if they assign the "and > not" reading, they should reject them since the blue medal that the penguin holds is indicating that he managed to eat one vegetable.

In addition to this "blue medal" condition, we tested the target item in the "gold medal" condition, where the penguin gets a gold medal. This condition mismatches the target sentence. Moreover, we examined the control item in the "black cross" condition, in which the penguin gets a black cross. This condition matches the control item. In every condition, Zibanyan gets a gold medal. Hence, there are matching and mismatching stories for both target items and control items. In total, we tested two target items and two control items in the "blue medal" condition, one target item in the "gold medal" condition, and one control item in the "black cross" condition.

The results are summarized in Table 8-1.

Table 8-1. Results

	Blue Medal		**Gold Medal**		**Black Cross**	
	Adult	**Child**	**Adult**	**Child**	**Adult**	**Child**
Target (14b) not > and	95% (19/20) Accept	35% (7/20) Accept	100% (10/10) Reject	100% (10/10) Reject		
Control (14c) and > not	100% (20/20) Reject	100% (20/20) Reject			100% (10/10) Accept	100% (10/10) Accept

As shown above, the adult participants accepted the target items like (14b) in the "blue medal" condition at the rate of 95%. This suggest that Japanese adults can assign a "not > and" reading to elided-conjunction sentences. In contrast to the adult participants, the children accepted the target items at the rate of only 35%. The individual results are as follows: three of the ten children accepted the target items at 100% (2/2), one of them did at 50 % (1/2), and six of them didn't accept at all (0/2). Given that even one adult participant accepted the target item only once out of two times, four children are adult-like and six children are non-adult-like.

Both the adult participants and the child participants correctly rejected the target items in the "gold medal" condition at the rate of 100%. Also, they correctly rejected the control items in the "blue medal" condition at 100%.

4. Discussion

The result of our experiment shows three important points. First, we experimentally observed what Funakoshi (2013) reports, that is, Japanese adults can assign the "not > and" reading to elided-conjunction sentences. Note that they do not assign it to overt conjunction sentences as can be seen in our experiment. Given that the contrast in interpretation between overt and covert conjunction is due to a syntactic operation of ellipsis as we discussed in the first section, our study has experimentally shown that ellipsis in adult Japanese is derived by a syntactic operation and not by a mere phonological deletion.

Second, our experiment succeeded in replicating Goro's (2007) finding. The child participants disallowed assignment of the "not > and" interpretation to overt conjunction under negation. This finding is consistent with the Semantic Subset Principle (Crain 1993; Crain, Ni, and Conway 1994; Crain 2012). Szabolcsi (2002) observes that there is cross-linguistic variation concerning interpretations of conjunctions under negation. Goro (2007) and Crain (2012) suggest that this cross-linguistic variation can be captured by the lexical parameter [±PPI]: Japanese conjunction is [+PPI], and thus it must take scope over negation. In contrast, English conjunction is [-PPI]. Hence, it can take scope under negation. (15) illustrates this point.

(15) a. Buta-wa ninjin-mo piiman-mo tabe-nakat-ta.
pig-TOP carrot-also pepper-also eat-NEG-PAST
lit. "The pig didn't eat the carrot and the pepper. " (and > not)

b. The pig didn't eat both the carrot and the pepper. (not > and)

According to Crain, the default value of this lexical parameter is [+PPI], which follows from the Semantic Subset Principle. Under the Semantic Subset Principle, children initially adopt a value that generates a subset truth condition. The default value here is [+PPI] since the truth condition of [+PPI] entails the one of [-PPI] as illustrated in Table 8-2.

Table 8-2. Truth value condition

	Language	**¬A&B**	**A&¬B**	**¬A&¬B**	**A&B**
[-PPI]: not > and	English	T	T	T	F
[+PPI]: and > not	Japanese	F	F	T	F

In fact, Crain et al. (2013) observe that 3- to 5- year-old English-speaking children cannot access the "not > and" interpretation in (15b), whereas adult participants accepted it at the rate of 88%. On the other hand, as Goro's (2007) and our experiment have shown, children have adult-like knowledge of the [+PPI] connective *-mo-mo* in Japanese. This contrast in acquisition of conjunction between English and Japanese is exactly what the Semantic Subset Principle predicts (cf. Crain et al. 2013).

Finally, the results of our experiment have shown that many children had difficulty with accessing the "not > and" reading in elided conjunction sentences. This suggests that their ellipsis is not the one that can cancel the PPI property. In other words, their ellipsis is derived by a phonological rule rather than a syntactic operation unlike adults. We might be able to capture this finding with Gerken's (1991, 1994) idea. She argues that children's early subjectless utterances are derived by a phonological process. Given this, children's null object sentences might be an object version of children's early subjectless utterances. However, if so, the question is how Japanese children shift the operation of ellipsis from a phonological one to a syntactic one. This seems to create a big learnability problem because the inputs which diagnose the syntactic ellipsis should be extremely rare. Instead of pushing the idea of phonological ellipsis here, we would rather point out a confounding factor in our experiment.

We speculate that the child participants in our experiment might have difficulty in using ellipsis itself in our target sentences. Although Sugisaki (2007) and Otaki (2014) show that Japanese children at around age 4-5 have acquired the knowledge of ellipsis as we have reviewed in the first section, there is a crucial difference between their target sentences and ours. Their target items are affirmative sentences (cf. 2b and 3b), whereas ours contain negation (cf. 14b). Since it has been reported in the literature that children have difficulty in giving truth-value judgments to negative statements, this might have caused children's non-adult-like behavior in our experiment. In fact, Otaki and Yusa (2009) observe that children at age 4-5 have problems in accessing the sloppy reading of the negative sentence in (16).

(16) Ushisan to tanukisan-wa zibun-no syashin-o tot-ta kedo,
cow and raccoon-TOP self-GEN picture-ACC take-PAST but
"The cow and raccoon took their own pictures, but…"

butasan to hitsujisan- wa _____ tora-na-kat-ta yo.
pig and sheep-TOP take-NEG-PAST PRT
lit."the pig and the sheep didn't take __." (Strict/ Sloppy)
(Otaki and Yusa 2009, 204)

According to them, children's acceptance rate of the sloppy reading is just around 40%. This suggests that it is difficult for four- to five-year-old children to apply ellipsis in negative sentences like (16). Hence, the reason why many of the children in our study could not access the "not > and" reading of the target items, which is derived by ellipsis, may come from the difficulty in negation.

In fact, if we used an empty pronoun *pro*, instead of ellipsis, to interpret the target sentence, we would get the "and > not"-like reading. In (17a), a null pronoun occupies the null object position, while an overt pronoun occurs in (17b).

(17) a. Pengin-wa pro_{them} tabe-re-nakat-ta.
penguin-TOP eat-can-NEG-PAST
"The penguin couldn't eat them."

b. Pengin-wa sore-ra-o tabe-re-nakat-ta.
penguin-TOP it-PL-ACC eat-can-NEG-PAST
"The penguin couldn't eat them."

Crucially, the overt pronoun *sore-ra* in (17b) can refer to the penguin's pepper and carrot in the story in our experiment, which brings the same truth condition to (17b) as the "and > not" interpretation. Given that the empty pronoun in (17a) is a covert counterpart of the pronoun *sore-ra*, (17a) should also have the same truth condition as (17b), which is truth-conditionally the same as the "and > not" reading. In our experiment, six out of the ten children assigned the "and > not" interpretation to the target sentences. However, given the discussion here, we cannot tell whether they applied a phonological deletion to the null object or they interpreted the target sentence with an empty pronoun like (17a). In addition, given Otaki and Yusa's observation, it seems plausible that the children in our experiment used the *pro* strategy in our negative target sentences. We would like to leave this issue for future research.

5. Conclusion

This study investigates whether children's operation of ellipsis is the same as adults'. We have seen that ellipsis such as VP-ellipsis, sluicing and Japanese null arguments is a syntactic phenomenon by looking at the differences between overt and elided elements. We have also shown that there are some types of deletion phenomena derived by a phonological deletion (Napoli 1982). Then, we attempt to see whether children's ellipsis is a syntactic operation or a phonological operation by testing the interpretation of elided conjunction with negation. Japanese overt conjunction *-mo-mo* must take scope over negation like PPI items, while it can take scope under negation when it is elided. The results of our experiment have shown that many of the child participants were not sensitive to the difference between the overt and covert conjunction. This suggests that Japanese children around age 5 apply a phonological deletion to Japanese null argument sentences as in English early subjectless utterances (Gerken 1991, 1994). Alternatively, the children in our experiment may have used an empty pronoun to interpret the null object position. On the other hand, we succeeded in experimentally showing that the adult participants were sensitive to the contrast between the overt and covert conjunction, which indicates that their ellipsis is derived by a syntactic operation.

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