A conservative interpretation of the reflexive *zibun* 
by Japanese children

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1 Introduction

The Japanese reflexive *zibun* can be bound across clause boundaries as in (1) (Inoue, 1976, inter alia).

(1) Taro$_i$-wa Akira$_j$-ga zibun$_i$-ni penki-wo nut-ta to
Taro-TOP Akira-NOM zibun-DAT paint(noun)-ACC paint(verb)-PAST COMP
omot-ta.
think-PAST

“Taro thinks that Akira painted self.”

However, we show that in speech to children long-distance reflexive *zibun* does not occur, leading us to ask about children’s knowledge. We show experimentally that children, unlike adults, incorrectly reject the long-distance antecedent for *zibun*, despite being able to access this antecedent for a pronoun, *kare*.

This paper is organized as follows. Section 2 describes a learning problem. Section 3 shows the distribution of *zibun* in child-directed speech. Section 4 reviews previous acquisition studies that examine children’s knowledge of long-distance *zibun*. Section 5 presents our experiments. Section 6 shows results of the experiments. Section 7 discusses implications and future directions.

2 Learning problem: The domain of reflexivization

The domain of reflexivization differs substantially across languages (Koster & Reuland, 1991, inter alia). For example, while English reflexive pronouns take their antecedents in the approximately minimal clause containing the reflexive, Icelandic monomorphemic reflexive *sig* can be bound across a subjunctive (2b) or infinitival (2c) clause boundary, but not a finite clause (2d) (Hyams & Sigurjónsdóttir, 1990).

(2) a. Jón$_i$, rakadi sig$_{i,j}$
   ‘John shaves himself.’
b. Jóni segir a Pétur raki sig_{i,j}  
   ‘John says that Peter shaves (SUBJ) himself.’

c. Jóni skipadi Pétur adraka sig_{i,j}  
   ‘John ordered Peter to shave (INF) himself.’

d. Jóni veit ad Pétur raka sig_{i,j}  
   ‘John knows that Peter shaves (IND) himself.’

Japanese reflexive *zibun* can be bound across any number of clause boundaries as in (3) (Inoue, 1976; Kuno, 1987, inter alia).

(3) Taro_{i}-wa Akira_{j}-ga zibun-{ni penki-wo} nut-ta to 
   Taro-TOP Akira-NOM zibun-DAT paint(noun)-ACC paint(verb)-PAST COMP 
   omot-ta. 
   think-PAST
   “Taro thinks that Akira painted self.”

This cross-linguistic variability suggests that learners need to determine the domain of reflexivation in a language they are exposed to. Determining the domain of anaphora can be complicated as it requires the following steps: (a) identifying that a given form is anaphoric, (b) getting an estimate of sentence meaning on the basis of the context, (c) building a representation of the sentence structure, and (d) using (a)-(c) as evidence for identifying the domain of anaphora.

Besides, distributional constraints on pronouns vary within a language. For example, in addition to the long-distance reflexive *zibun*, Japanese have non-reflexives *kare/kanojo* (he/she) and an only-local reflexive/intensifier suffix -*zishin*. These items have overlapping but non-identical local domains (Hoji, 1990; Noguchi, 1997; Hara, 2002, among many).

Despite these problems, people acquire the knowledge of locality of pronouns at some point. Here we examine Japanese children’s knowledge of the locality of *zibun*, as an initial step towards characterizing how learners acquire the locality of pronouns in a language they are exposed to. This study particularly asks whether children know the locality of *zibun*.

### 3 Sparse input problem

While *zibun* does occur in speech to children, here we show that learning that it can be bound across clauses requires projecting beyond the input. We examined child-directed speech in the MiiPro Corpus (Nisisawa & Miyata, 2010), Arika (2;11-5;0). In this corpus, there are 40,412 utterances in total from her mother. Of 40,412 utterances, there are 49 instances of *zibun*, which is only 0.12% of mother’s utterances.

The following table breaks up 49 instances of *zibun*. Each row indicates attached case marker and each column indicates person and its locality information. A number in each cell indicates frequency. The most frequent use of *zibun* is as a 2nd person

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2
Table 1: Instances of *zibun* in MiiPro, Arika corpora

<table>
<thead>
<tr>
<th></th>
<th>2nd person, local</th>
<th>3rd person, local</th>
<th>3rd person, non-local, intra-sentential</th>
<th>3rd person, extra-sentential</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>zibun-de</em></td>
<td>30</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td><em>(by zibun)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>zibun-no</em></td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td><em>(zibun's)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>zibun-wa/ga</em></td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td><em>(zibun-TOP/NOM)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>zibun-wo/ni</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>(zibun-ACC/DAT)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>8</td>
<td>0</td>
<td>4</td>
<td>49</td>
</tr>
</tbody>
</table>

 Pronoun with no anaphoric antecedent, i.e., indexical (75%). Of the anaphoric uses, all display local binding. In other words, there is no *zibun* that takes the antecedent across clause-boundary. Thus, direct evidence about the full set of binding possibilities of *zibun* is lacking from children’s input.

This distributional fact poses a sparse input problem. How can children find that *zibun* can be bound across the clause boundary despite a lack of evidence about this binding possibility? This study does not directly ask how they find the long-distance binding possibility, but examine when they know the locality of *zibun*, as an initial step to investigate how they acquire this knowledge, given the sparse input.

4 Past acquisition studies

Prior work has argued that children have knowledge of long-distance *zibun* (Otsu, 1992; Okabe, 2008). However, in those studies the potential long-distance antecedent was disproportionately salient and the Condition of Plausible Dissent was not sufficiently satisfied (Crain & Thornton, 1998). These factors could lead children to accept the long distance antecedent even if it weren’t licensed by their grammar.

4.1 Otsu (1997)

Otsu (1992) tested children’s interpretation of *zibun* in the sentence (4) with a modified version of Truth Value Judgment task. The sentence in (4) is potentially ambiguous between two interpretations: (i) ‘Taro thought that Akira showed Hanako Taro’s picture.’ (*zibun* is bound by the long-distance antecedent) and (ii) ‘Taro thought that Akira showed Hanako Akira’s picture.’ (*zibun* is bound by the local antecedent).
(4) Taro-wa Akira-ga Hanako-ni zibun-no e-o mise-ta to Taro-TOP Akira-NOM Hanako-ACC self-GEN picture-ACC show-PAST COMP omot-ta.
think-PAST
‘Taro thought that Akira showed Hanako self’s picture.’

Child participants in this experiment consisted of 12 three year olds, 14 four year olds, and 15 five year olds (41 in total). In this experiment, an experimenter manipulates dolls behind an occluder so that a child participant and a puppet sitting in front of the occluder cannot see what happens. After manipulating dolls behind the occluder, the experimenter whispers the test sentence in (4) to the child. Then the experimenter asks the puppet to guess what the dolls did behind the occluder. The question sentence to the puppet is in (5). The child’s task is to reward the puppet upon hearing the sentence whispered by the experimenter: If the child thinks that the puppet’s guess is correct, the child gives the puppet a sweet. If the child thinks that the puppet’s guess is wrong, the child gives the puppet a rag.

(5) Taro-wa Akira-ga Hanako-ni dare-no e-o mise-ta to Taro-TOP Akira-NOM Hanako-ACC who-GEN picture-ACC show-PAST COMP omot-ta no.
think-PAST Q
‘Whose picture did Taro think that Akira showed to Hanako?’

Otsu considers children’s responses as adult-like if they give a sweet to the puppet given his answer either ‘Taro’s picture’ or ‘Akira’s picture’, and non-adult-like if they give a rag to the puppet given his answer ‘Hanako’s picture’. Otsu reports the following result as in Table 2. Based on this result, Otsu concludes that children have adult-like knowledge of zibun in that zibun allows to be bound by the long-distance antecedent.

<table>
<thead>
<tr>
<th>age</th>
<th># of children</th>
<th># of children who had adult-like responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 2: Results in Otsu (1997)

However, it is not clear what exactly adult-like responses in this study. There is no information whether there were adult-controls. There is also no information on the experimental set-up (how many trials/test sentences etc.) and no information of how many local and long-distance responses. Thus, it is not clear whether children in this experiment have local-bias or long-distance bias.

Besides, there seems to be a confounding factor in the test sentence (4). The genitive-marked reflexive zibun as in zibun-no e (self’s picture), has at least three interpretations as in (6).
(6) a. zibun (self) as an owner of the picture  
b. zibun (self) as a painter of the picture  
c. the picture of zibun (self) 

If their interpretation of *self’s picture* is something like either (6a) or (6b), this could be problematic. In cases of (6a,b) without special contextual support, it is not likely that someone who does not own or has not painted the picture shows the picture to a person who owns or painted the picture. If they interpret *self’s picture* as either (6a) or (6b), pragmatic knowledge put a greater pressure towards the interpretation of zibun as a shower, the local antecedent Akira, because the most natural interpretation is that the owner/painter of the picture shows that picture to the other. Children might have used this kind of pragmatic knowledge instead of accessing their grammar. Since this paper does not provide the detailed information on the experiments and results, it is hard to infer whether this confound has produced children’s local bias.

In summary, Otsu claims that children age 3-5 know the long-distance zibun. However, the experimental setting and results are unclear, and there is a potential confound in the test sentence. Thus, it seems to be difficult to conclude that children have adult-like knowledge of zibun from this study.

4.2 Okabe (2008)


(7) Buta_i-wa kuma_j-ga zibuni,j-no keeki-o tabe-ta no-o mi-ta.  
pig-TOP bear-NOM self-GEN cake-ACC eat-PAST COMP-ACC see-PAST  
‘The pig saw that the bear ate self’s cake.’

The sentence in (7) is potentially ambiguous between two interpretations: (i) ‘The pig saw that the bear ate the pig’s cake.’ (zibun is bound by the long-distance antecedent), and (ii) ‘The pig saw that the bear ate the bear’s cake.’ (zibun is bound by the local antecedent). This study has two scenarios corresponding to these two readings as in (8) and (9).

(8) Scenario where the interpretation (i) is true (long-distance reading) (Okabe, 2008)

A pig and a bear bought cakes, one for each. This big one is for the pig, and this small one is for the bear. The bear came there. He was so hungry that he wanted to eat the pig’s big cake rather than his small cake. “Well... I know this big one is for Pig. But he is not here now. What do I do?” He thought about this a while, but he can’t help but eat the pig’s big cake. But while the bear was eating the pig’s big cake, the pig was standing right behind the door and watching what the bear was doing.
A pig and a bear bought cakes, one for each. They decided to eat them together later. The pig said, “Don’t eat the cakes, okay? Let’s eat them together later!” and left the room. But, when the bear was left in the room alone, he became so hungry and could not wait for the pig. “Umm... we promised to eat them together... I can’t eat this now. But I want to...” The bear tried not to eat the cake. But as the cakes look so yummy, he said, “Umm... this one is mine. So I can eat this” and ate his cake. But while the bear was eating his cake, the pig was standing outside of the room and looked what the bear did through the window.

Okabe reports that children in all ages (9 four year olds, 10 five year olds, and 9 six year olds) allowed both local and long-distance antecedents and showed preference to the local antecedent. The average percentage of the long-distance antecedent responses in a condition that the matrix subject interpretation is true (i.e., zibun refers to the pig) was 71% (N=28). The average percentage of the local antecedent responses in a condition that the embedded subject interpretation is true (i.e., zibun refers to the bear) was 93% (N=28).

However, this study seems to have a problem in satisfying the Condition of Plausible Dissent (Crain & Thornton, 1998; Conroy, Takahashi, Lidz, & Phillips, 2009). In Truth Value Judgment task, the test sentence is potentially ambiguous between two interpretations. We infer which interpretation of the sentence children would access by observing their responses. If children systematically fail to one interpretation, then we can infer that they do not allow that interpretation of the test sentence. In the typical Truth Value Judgment task, the test sentence is presented at the end of the scenario where only one reading of the sentence is true and the other is false. Crucially, two interpretations should be sufficiently available at some point in the scenario. If we do not satisfy this condition, children’s responses might not come from their grammar but from some factors in discourse. In other words, the false reading should be considered and made “disputable” in the context. If the false reading was never considered in the scenario, children may have a difficulty with rejecting that interpretation, even though their grammar disallows that interpretation.

Children whose grammar disallows the long-distance binding of zibun would have accepted the long-distance interpretation in scenario (8) because the local interpretation, “The pig saw that the bear ate the bear’s cake”, was never considered in the story. In order to satisfy the Condition of Plausible Dissent in (8), an event such that the bear ate his cake and the pig almost saw that needs to be almost made true but clearly made false in the story. There is also a possibility that children might not be able to represent both matrix and embedded clauses and interpret the sentence independent of the pig’s perception. Therefore, an event such that the bear almost ate his own cake also needs to be almost made true but made false in the story. Without having these events in the story, children might have a difficulty with rejecting the long-distance binding in-
terpretation even if their grammar disallows it, because this was the only interpretation made available in the context. In other words, children may have been forced to choose the long-distance antecedent because that is the only discourse-accessible antecedent, even if it were not grammatically licensed.

To conclude, though previous studies report that children have knowledge of long-distance *zibun*, we argue that these results could be derived from methodological problems. We control these issues and examine children’s knowledge of locality of *zibun*.

5 Experiment

The aim of our experiment is to get a better understanding of when children demonstrate their knowledge of locality of *zibun*, once the methodological problems in TVJT described above are controlled.

5.1 Subjects

Children (age range: 4;5-6;2, N=36) and adult controls (undergraduate students, N=51) participated in this study. Child participants were recruited in several preschools in Japan. Adult participants were recruited in several universities in Japan.

5.2 Design

We created two scenarios to examine the two possible meanings of (10), given in (11): In the **Matrix-true** scenario, (11a) is true but (11b) is false. In the **Embedded-true** scenario, (11a) is false but (11b) is true. Table 3 summarizes truth values for each scenario type. We tested *zibun* in both scenarios to see which interpretations participants associated with (10).

(10) Taro-wa Akira-ga zibun-ni penki-wo nut-ta to
    Taro-TOP Akira-NOM zibun-DAT paint(noun)-ACC paint(verb)-PAST COMP
    omot-ta.
    think-PAST
    “Taro thinks that Akira painted self.”

(11) a. Taro thinks that Akira painted Taro. (the long-distance antecedent for *zibun*)
    b. Taro thinks that Akira painted Akira. (the local antecedent for *zibun*)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>(11a)</th>
<th>(11b)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Matrix-true</strong></td>
<td>True</td>
<td>False</td>
</tr>
<tr>
<td><strong>Embedded-true</strong></td>
<td>False</td>
<td>True</td>
</tr>
</tbody>
</table>

Table 3: Truth values of the test sentence in each scenario
A 2x2 between-subjects design was used for zibun: 2 scenario types (MATRIX-TRUE and EMBEDDED-TRUE) and 2 age groups (children and adults). In addition, we compared children and adults’ interpretations, in the matrix-true context, of sentences with kare (12), a third person male pronoun that allows binding by the matrix subject and normally disallows binding by the local subject \(^1\). This condition will help determine whether the matrix subject was made available by the discourse context and whether children can access that NP as antecedent for a pronominal form that allows it.

(12) Taro\(_1\)-wa Akira\(_{1}\)-ga kare\(_{1}\)-ni penki-wo mut-ta to omot-ta.
   Taro-TOP Akira-NOM kare-DAT paint.N-ACC paint.V-PAST COMP think-PAST
   “Taro thinks that Akira painted him.”

The experiment used a Truth Value Judgment task, in which a child and a puppet companion, Shaun the Sheep, watched the experimenter acting out a story on a computer screen. When the story was over, Shaun made a statement about it, and the child’s task was to reward or correct Shaun based on the accuracy of his statement with respect to the scenario.

The experimental materials consisted of 4 target items where each of which was compatible with test sentences, 4 control items, and 2 practice items. After the 2 practice items, the 4 target items were combined with 4 control items that were intermixed with the target items to create a test consisting of 10 stories.

Control stories were included to provide an independent measure of the children’s understanding of the test sentences. In the control sentences, the embedded object NP, which is either zibun or kare in the test sentences, is replaced with a proper name. Control sentences were always false, to ensure that children could say ‘no’ to sentences that were unambiguously false and to ensure that they could answer questions of the same grammatical complexity in similarly complex scenarios. In test and control sentences, the matrix verb was always omo-u (think), and four different embedded verbs were used: nu-ru (paint), nose-ru (put), tsuke-ru (put) and kabuse-ru (cover).

In a representative story, there are three boys and two different colored paints as in Figure 1. The boys are playing a painting game. One boy wears a blindfold while the other two paint somebody. After the painting is finished, the boy with the blindfold takes it off and guesses which boy used which color. He first considers the wrong possibilities but then discovers evidence that leads him to the correct guess. The following (13) is a script of one story for the MATRIX-TRUE scenario.

(13) a. Taro (a boy in the middle) puts the blinder. While he cannot see and listen to anything, Akira (a boy with a hat in the left side) and Jiro (a boy with spiky hair in the right side) are going to paint somebody. Taro’s task is to find who painted which color.

b. It’s Akira’s painting turn. Akira is wondering “Well, I can paint yellow one on my kimono, but they don’t match. I’ll paint Taro yellow.” (After Akira’s

\(^1\)It is observed that kare is allowed to be bound by the local antecedent given some appropriate contexts (Hoji, 1995).
painting event, the experimenter points out that Akira inadvertently left a piece of his pink fan on the yellow paint.

(c) Now it’s Jiro’s turn. Jiro painted the red one on Akira’s head. (After Jiro’s painting event, the experimenter points out that Jiro inadvertently left a piece of his hair on the red paint.)

d. Taro takes the blinder off and guesses which boy used which color. He guesses that Akira painted the red one because the red paint matches Akira’s kimono. Subsequently, he found Jiro’s hair on the red paint and he noticed that Jiro painted the red one.

e. Then Taro guesses that Jiro painted the yellow one. Subsequently, he found Akira’s fan on the yellow paint and he noticed that Akira painted the yellow one.

This design satisfies the Condition of Plausible Dissent by ensuring that all possible readings are both disputable and available. The matrix antecedent reading is true at the end of the story (13e), and the embedded antecedent reading was almost made true but clearly made false in the story (13d). Since we were concerned that children might not be able to represent both clauses, and so interpret the puppet’s assertion not with respect to Taro’s beliefs, we also ensured that the interpretation “Akira painted Akira” (independent of Taro’s beliefs) was almost made true, but clearly made false in the scenario (13b).

5.3 Predictions

We consider three possibilities. First, children’s knowledge could be adult-like, in which case they would accept the sentences across all three conditions. Second, children could believe that zibun only allows local antecedents, in which case they would accept the
sentences in the Embedded-true condition, but reject in the Matrix-true condition. We call this hypothesis as **local-only hypothesis**. Finally, children could have acquired the right grammar for *zibun*, but for independent reasons be unable to access the matrix subject. We call this hypothesis as **inaccessible matrix subject hypothesis**. The latter possibility makes the same prediction as the local-only hypothesis for *zibun*, but the two hypotheses differ for *kare*. The local-only hypothesis predicts children to accept in the *kare* condition whereas the inaccessible matrix subject hypothesis predicts that they will reject in this condition.

## 6 Results

### 6.1 *zibun*

Results are based on the number of “yes” responses to the puppet’s statements. Adults and children correctly rejected nearly all control sentences as false. Figure 2 shows that children and adults are alike in the *zibun* Embedded-true condition but different in the *zibun* Matrix-true condition. Children accepted the local antecedent in 66.67% of trials and the matrix antecedent in 20.83% of trials. Adults accepted the local antecedent in 60.94% of trials and the matrix antecedent in 83.33% of trials. We entered the data into a 2x2 ANOVA with the factors condition (scenario type: Embedded-true and Matrix-true) and age group (children and adults). We found a significant main effect of condition (F(1,57) = 4.57, p = 0.037) and a significant interaction between age and condition (F(1,57) = 16.87, p < 0.01). This shows that children have a locality bias. Adults show a slightly depressed acceptance rate in the embedded-true condition, possibly reflecting an anti-locality bias in on-line processing (Omaki, Dillon, Kubo, Sato, & Sakai, 2014). Figure 4, 5, 6, and 7 show individual measure of performance in each condition and age group. These confirm the observed effects. These results are consistent with two possibilities: **local-only hypothesis** and **inaccessible matrix subject hypothesis**.

### 6.2 *kare*

In order to distinguish these hypotheses, we ran the *kare* condition. Figure 3 shows that children and adults are alike in the *kare* condition. Children accepted the matrix antecedent in 60.42% of trials, and adults did so in 73.33%. This difference was not significant (t(24.59) = 0.84, p = 0.40). Judgments in the *kare* condition are below ceiling in both children and adults, possibly because *kare* can felicitously refer to someone not mentioned in the test sentence. We also entered the data into a 2x2 ANOVA with the factors condition (scenario type: *Kare* and Matrix-true) and age group (children and adults). We found a significant main effect of age group (F(1,56) = 27.22, p < 0.01) and a significant interaction between age and condition (F(1,57) = 7.99, p < 0.01). These results show that performance in the *kare* condition and Matrix-
TRUE condition are different in children but not in adults. We will show individual performance in this condition in the following discussion section.

6.3 Summary

These results indicate that the differences they show in the zibun matrix-true condition cannot be attributed to children’s inability to access the matrix subject. Children incorrectly rejected the matrix antecedent for zibun, despite being able to access this antecedent for kare. The results are most consistent with the local-only hypothesis.

6.4 Discussion

6.4.1 zibun-de (by self)

We have 6 children uttered zibun-de (by self) after hearing the test sentence: 3 children (out of 12) in the MATRIX-TRUE condition and 3 children (out of 12) in the EMBEDDED TRUE condition. In fact, (?) found that children productively replace zibun in an argument position that is subject/object case-marked with zibun-de in their elicited production task.

The interpretation of our test sentence would be “Akira thought that Taro painted by himself” when zibun-ni (zibun-DAT) is replaced with zibun-de (by self), and crucially, only local reading is possible in adult grammar. This local-only interpretation would be false in the MATRIX-TRUE scenario and be true in the EMBEDDED-TRUE scenario for adult speakers. Indeed, children’s “yes” responses in each condition do not seem to contradict with this potential interpretation (20.83% “yes” responses in the MATRIX-TRUE condition and 66.67% in the EMBEDDED-TRUE condition). Our corpus study
Figure 4: Children’s individual responses in Matrix-true zibun

Figure 5: Children’s individual responses in Embedded-true zibun

Figure 6: Adults’ individual responses in Matrix-true zibun

Figure 7: Adults’ individual responses in Embedded-true zibun
also shows that instances of zibun-de accounts for about 61% of the total, which is the most frequent use of zibun.

These suggest that children might represent zibun-ni (zibun-DAT) in the test sentence as zibun-de (by self), despite that is not what the experimenter said, and interpret the sentence as it had zibun-de in it. They would have done it probably due to their grammatical conservatism (Snyder, 2007). Snyder argues that children productively use a particular structure in spontaneous speech only when they are sure that it is allowed in the adult grammar. If they are not certain, they would avoid to use it. Though children’s utterances in our experiment are not spontaneous speech in natural conversation, they might not be certain about zibun in object position, and consequently they might have avoided to represent that and used the more certain one instead.

6.4.2 kare

Children accepted the matrix antecedent in 60.42% of trials in the kare condition. This 60.42% acceptance does not mean that about 60% of children accepted 100% of the time. It is more noisy. Figure 8 shows an individual measure of performance. This shows that 4 children (33%) accepted all of four test sentences. Note that judgments in the kare condition are below ceiling even in adults because kare can felicitously refer to someone not mentioned in the test sentence. Figure 9 shows an individual measure of performance in the adult control. Adult participants who accepted all of the test sentences with kare account for 66%. If the majority of children in our experiment have some knowledge of kare (locality of kare), the distribution of the individual measure in Figure 8 should approximate to the one in the adult-control. Moreover, we had 5 children explicitly said that they do not know kare (e.g., ‘What’s kare?’). The number of “yes” responses of each of these 5 children is 3, 4, 3, 2, 0 (mean 2.4). Further, we have not observed any instance of kare in our corpus study. These suggest that children may not have knowledge of kare at all, and they just use their pragmatics to get the antecedent of this unknown word.

Alternatively, children might know kare, and the gap between children and adult-controls in the individual measure might reflect children’s difficulty to revise their initial consideration of the local antecedent. A number of research has shown that children have difficulty with sentence revision processes (Omaki & Lidz, 2014). Though we know little about children’s revision of the initial binding, their revision difficulty might have influenced on the performance in this task to some extent.

Although it is not clear whether children know kare at this point, we argue that the difference between the MATRIX-TRUE zibun condition and the kare condition supports our analysis. The reason of having this condition is to help determine whether the matrix subject was made available by the context and whether children can access that matrix subject as antecedent. Our results that children access the matrix subject for kare suggest that that interpretation was actually made available for other potentially unknown form by the context. However, children do not access the matrix subject for zibun even though it was available. This contrast suggests that their failure to access
the matrix subject for *zibun* was not caused by extralinguistic factors.

7 Discussion

7.1 Children’s knowledge of long-distance *zibun* binding

The corpus study shows that in speech to children long-distance reflexive *zibun* does not occur. The experiments show that children, unlike adults, incorrectly reject the long-distance antecedent for *zibun*, despite being able to access this antecedent for a pronoun, *kare*.

These results are compatible with two hypotheses. The first hypothesis is local-only hypothesis: Children might have wrongly learned that *zibun* only allows local antecedents. The second hypothesis is processing difficulty hypothesis: Their grammar might be adult-like (they know the long-distance binding of *zibun*), but the availability of the local antecedent for *zibun* inhibits access to the long-distance antecedent, probably due to features of on-line antecedent retrieval (Dillon et al., 2014).

These hypotheses are contingent on children’s knowledge of *kare*. If they do not know the locality of *kare* (normally disallows local binding), the local antecedent for *kare* should be available and could inhibit access to the matrix subject, but child participants in our experiments appear to be able to access the matrix subject for *kare*. This is probably because the matrix subject was highly made accessible by the context. However, they did not access the matrix subject with *zibun*, suggesting that their knowledge of *zibun* is local-only and they must not know that *zibun* can take the long-distance antecedent. This is consistent with local-only hypothesis.

On the other hand, if they know the locality of *kare*, they must have used different
information in accessing its antecedent than it does for accessing the antecedent of \textit{zibun}. In other words, they might have accessed the matrix subject using their grammatical knowledge of \textit{kare}, in addition to the contextual information. This suggests that the gap between long-distance \textit{zibun} and \textit{kare} in the children’s performance may be due to different antecedent retrieval processes. This scenario is compatible with both children who know the long-distance binding of \textit{zibun} and children who do not know it. If they know the long-distance binding of \textit{zibun}, their inability to access the matrix subject may be due to the memory retrieval problem. Dillon et al. (2014) shows that local binding of Chinese \textit{ziji} becomes accessible before non-local binding. Omaki and Lidz (2014) suggests a possibility that children may also consider local binding first and this makes the long-distance subject less accessible, probably due to their difficulty to revise the initial reflexive interpretation. Though the recent data in Japanese does not seem to parallel with Chinese in that Japanese adult speakers show an anti-locality preference in eye-tracking experiments (Omaki et al., 2014), this direction still appears to be reasonable to pursue in that Chinese children in Truth Value Judgment tasks also show the local preference (Chien & Lust, 2006). This scenario is consistent with \textbf{processing difficulty hypothesis}. Alternatively, children might have wrongly learned \textit{zibun} as local-only. In this scenario, the gap between the long-distance \textit{zibun} and \textit{kare} may reflect their grammatical knowledge of each item (i.e., they know the locality of \textit{kare}, but wrongly learned the locality of \textit{zibun}). This is consistent with \textbf{local-only hypothesis}.

There seem to be two directions to clarify children’s knowledge of the locality of \textit{zibun}: (i) examine whether making the local subject less accessible helps them access the matrix subject, and (ii) examine their knowledge of the locality of \textit{kare}. One way of examining the first question is to use an inanimate antecedent in the local clause. Without any contextual support, \textit{zibun} cannot take the inanimate antecedent (Kuno, 1978). This manipulation could alleviate children’s difficulty in processing the long-distance antecedent. If they know that \textit{zibun} cannot take the inanimate antecedent, they may not consider the local binding at the first place, and this could help them access the matrix subject in that it does not require the revision of the initial interpretation. Alternatively, we could look at individual differences in cognitive control mechanisms (Mazuka, Jincho, & Oishi, 2009) as a predictor of their long-distance interpretation. Children who have good cognitive-control might be able to perform better in the MATRIX-TRUE condition than children who do not. For the second question, no research has explored the acquisition of locality of \textit{kare} as far as we recognize. As a first step, we could run the EMBEDDED-TRUE condition with \textit{kare} to ensure whether they know that \textit{kare} disallows the local binding in this particular context and sentences.

\subsection{7.2 How do children learn long-distance binding?}

In either case, they must learn that \textit{zibun} allows long-distance binding at some point. Here we suggest two types of learning stories: \textbf{input driven hypothesis} and \textbf{prior knowledge driven hypothesis}.
The **input driven hypothesis** assumes that children would infer that *zibun* is a local anaphor by observing the instances of *zibun* potentially distributed as we found in the corpus study. This hypothesis predicts that the timing of the acquisition of the long-distance *zibun* depends on when they encounter the instance of the long-distance *zibun*. Though we have not found *zibun* bound by the long-distance antecedent in the child-directed speech, there are such instances in writing texts. Children may encounter long-distance bound *zibun* in texts such as picture books and textbooks. That is, they would encounter long-distance bound *zibun*, probably after they learned to read. Thus, the acquisitional timing would be sometime after they enter elementary school. Note that this learning story might require reasonable discourse knowledge. In order to learn that *zibun* allows long-distance binding, they must have a good estimate of the interpretation of the sentence because they need to override the more restrictive grammar based on the interpretation of the sentence. Recent studies on children’s discourse knowledge suggest that they might be able to utilize discourse information to learn words (Horowitz & Frank, 2015; Sullivan & Barner, 2015). Though these studies particularly examine the role of discourse continuity as a kind of discourse information (which would not directly provide the sentence interpretation), it is indicative that even young children could use discourse information to learn words (3-6 years old in Horowitz and Frank (2015) and 2-4 years old in Sullivan and Barner (2015)). Since we assume that the acquisitional timing of long-distance *zibun* would be relatively late, the requirement of discourse knowledge does not seem to be unrealistic, given these findings with young children.

The **prior knowledge driven hypothesis** assumes that children have some prior linguistic knowledge, know its relevance to this particular learning problem, and be able to use it. There is a typological correlation between intensifiers and reflexives; if an intensifier has a different form from a reflexive, that reflexive is likely to be a long-distance reflexive (Konig & Siemund, 2000; Bergeton, 2004). Japanese has an intensifier *-zishin*, which is different form from *zibun*. Suppose that children antecedently know this relation between intensifiers and reflexives, if they have a chance to observe some uses of intensifiers and reflexives and if they notice that the intensifier has a different form from the reflexive, they might be able to infer how the reflexive system in their language would be.

**References**


