Belief Reports Facilitate Long-Distance Binding in Child Japanese

Akari Ohba and Kamil Deen

1. Introduction

A well-known finding is that, in a variety of languages, long-distance binding of a reflexive is a challenge for young children (Chinese *ziji*, Chien, Wexler & Chang, 1993; Danish *sig*, Jakubowicz & Olsen, 1988; **Japanese *zibun***, Orita, Ono, Feldman & Lidz, 2021; Korean *caki*, Lee & Wexler, 1987), but the precise source(s) of this challenge is still under debate. In this study, we pursue a new view of the difficulty that Japanese children face in long-distance binding of Japanese *zibun* 'self.' First, we identify a confounding factor in the most recent research: children are tested on their ability to do long-distance binding of *zibun* in sentences where the matrix verb is a belief verb, *omou* 'think.' We note that children have independently been shown to have difficulty in interpreting *think* (de Villiers & de Villiers, 2000; Perner, Sprung, Zauner & Haider, 2003, amongst many others), though not as old as the children in question. We show that Japanese children exhibit difficulty with adult-like interpretations of *omou* 'think,' which in turn lead to the observed difficulties with *zibun.* We go on to show that when the difficulties with *omou* 'think' are addressed, the difficulty with long-distance binding is alleviated, and we conclude that the computations involved in long-distance binding itself are not a sole cause of the challenge, and the observed difficulties come from other related areas of language and cognition.

2. Background

2.1. Long-distance binding of *zibun* 'self'

Japanese has two reflexives: a mono-morphemic reflexive *zibun* 'self' and polymorphemic reflexive *zibunzisin* 'self-self.' The difference is that *zibunzisin* must refer to (be bound by) a local subject as its antecedent just like English *himself/herself*, while *zibun* can refer to either a local or a long-distance subject as its antecedent (1), like Korean *caki* or Mandarin *ziji.*

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(1) a. John$_1$-wa [$_{CP}$ Mary$_2$-ga zibun$_{1/2}$-o seme-ta to] omot-ta.
John-TOP Mary-NOM self-ACC blame-PST COMP think-PST
'John$_1$ thought that Mary$_2$ blamed herself$_2$ / him$_1$.'

b. John$_1$-wa [$_{CP}$ Mary$_2$-ga zibunzisin$_{*1/2}$-o seme-ta to] omot-ta.
John-TOP Mary-NOM self.self-ACC blame-PST COMP think-PST
'John$_1$ thought that Mary$_2$ blamed herself$_2$ / *him$_1$.'

The environments that **license** long-distance *zibun* are commonly described as being of two kinds. LOGOPHORICITY and EMPATHY (Kishida, 2011; Kuno & Kaburaki, 1977; Oshima, 2004, 2007), of which we focus on the former in this study. In logophoric binding, *zibun* is bound by a logophoric individual "whose speech, thoughts, feelings, or general state of consciousness are reported" (Clements, 1975). For example, a subject of a belief verb, *omou* 'think' is a logophoric individual whose thought is reported, thus it can be the antecedent for *zibun* in the embedded clause as shown in (2).

(2) **John$_1$**-wa [Mary$_2$-ga zibun$_{1/2}$-o seme-ta] to **omot**-ta.
John-TOP Mary-NOM self-ACC blame-PST COMP think-PST
'John$_1$ thought that Mary$_2$ blamed self$_{1/2}$.'

When we replace the matrix verb with something non-logophoric such as *kaeru* 'go.home' as in (3), Japanese adults strongly prefer the local interpretation of *zibun* (Ohba & Deen, 2021) or they do not show a significant preference for either interpretation (Umeda et al., 2017[1])[2]. This contrasts with previous psycholinguistic experiments using logophoric verbs which report that Japanese adults prefer the long-distance interpretation of *zibun* (e.g., Omaki et al., 2015[3]; Orita et al., 2021).

(3) **John$_1$**-wa [Mary$_2$-ga zibun$_{1<2}$-o seme-ta atoni/atode] **kaet**-ta.
John-TOP Mary-NOM self-ACC blame-PST after go.home-PST
'John$_1$ went home after Mary$_2$ blamed self$_{1<2}$.'

This indicates that having the logophoric verb, such as *omou* 'think,' significantly contributes to the long-distance interpretation of *zibun*. Our study is the first to investigate the potential link between long-distance binding of *zibun* and the meaning of the logophoric verb, *omou* 'think.'

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[1] In their study, Japanese adults accepted the local interpretation of *zibun* 68.1% of the time and the long-distance interpretation of *zibun* 58.3% of the time.

[2] Special thanks to Kook-Hee Gil and Victoria Mateu for suggesting that we compare the possibility of the long-distance interpretation of *zibun* in logophoric and non-logophoric contexts **keeping the clause type constant**. Although we used the adjunct *atoni/atode* 'after' clause for the comparison in this paper, we are preparing an experiment using sentences containing a non-logophoric verb which can take a *to* 'COMP'-clause like *omou*.

[3] Omaki et al. (2015) called this "the anti-locality bias" in Japanese reflexive binding.

2.2. Previous L1 acquisition studies on long-distance binding of *zibun* 'self'

Earlier acquisition studies report that Japanese children as young as age 3yrs are able to access the long-distance interpretation of *zibun* 'self' like adults (Otsu, 1997; Okabe, 2008). In contrast, a more recent study (Orita, Ono, Feldman & Lidz, 2021) address some methodological flaws in previous studies (e.g., the small number of participants and items, a lack of Plausible Deniability in the Truth Value Judgment Task, TVJT, Crain & Thornton, 1998), and find that 4- and 5-year-olds cannot access the long-distance interpretation of *zibun*. Orita et al. (2021) tested children's and adults' interpretations of *zibun* as in (4) and *kare* 'he' as in (5). Differently from *zibun*, *kare* can only refer to the matrix subject.

(4) Taroo$_1$-wa [Akira$_2$-ga zibun$_{1/2}$-ni penki-o nut-ta] to omot-ta.
Taroo-TOP Akira-NOM self-ACC paint-ACC paint-PST COMP think-PST
'Taroo$_1$ thought that Akira$_2$ painted self$_{1/2}$.'

(5) Taroo$_1$-wa [Akira$_2$-ga kare$_{1/*2}$-ni penki-o nut-ta] to omot-ta.
Taroo-TOP Akira-NOM he-ACC paint-ACC paint-PST COMP think-PST
'Taroo$_1$ thought that Akira$_2$ painted him$_{1/*2}$.'

Orita et al. (2021) show that children (4;5–6;2) accepted the long-distance interpretation with *zibun* only 20.8% of the time even though the adults accepted this interpretation 83.3% of the time. Meanwhile, age-matched children (4;1–5;8) accepted the long-distance antecedent for the pronoun *kare* 'he' 60.4% of the time similarly to adults (78.8%). This indicates that the long-distance antecedent itself is accessible for children when it is required by the pronoun, but they somehow cannot access this antecedent when the anaphor is *zibun*, even though adults prefer the long-distance antecedent for *zibun*.

Orita et al. (2021) suggested two possibilities for this difficulty. First, children might have incorrectly learned that *zibun* only permits a local antecedent, since *zibun* almost never appears in a long-distance-binding context in child directed speech, according to Orita et al.'s corpus analysis. Second, the ambiguity of *zibun* poses a processing challenge for children, and they default to the local antecedent, which is the most salient in working memory.

In this study, we argue for a third possibility. The core problem with long-distance binding has to do with **the licensing factor** for *zibun*, logophoricity. The logic is as follows. The long-distance interpretation of *zibun* in (4) is licensed by the belief verb, *omou* 'think,' in that the subject of *omou* is a logophoric individual whose thought is reported. *Zibun*, by its very nature, requires an antecedent of a certain kind (either a logophoric or empathic individual, *ibid*) in a long-distance context. Hence, it is crucial for children to be able to interpret *omou* as a belief-reporting verb in order to treat the subject of *omou* as a logophoric antecedent. However, in §2.3 below, we review well-established previous findings that preschoolers do not seem to interpret belief verbs like *think* as belief-reporting verbs. Given that, we argue that their non-adult-like interpretation with *omou* could be a cause for their difficulty with the long-distance interpretation of *zibun*.

2.3. Children's non-adult-like interpretations with belief verbs

It is well-known that children show non-adult-like interpretations with belief verbs like *think* until around age 4yrs. Specifically, children report a sentence with *think* as false when the complement clause is false but the whole sentence true (de Villiers & de Villiers, 2000; de Villiers & Pyers, 2002; Perner, Sprung, Zauner & Haider, 2003; a.o.). For example, children incorrectly judge a sentence like "John thinks that dogs quack" as false because it is false that dogs quack, even if John actually believes that dogs quack.

There have been various hypotheses on potential sources of children's non-adult-like interpretation with *think*, but we focus on the most recent proposal by Lewis, Hacquard & Lidz (2017), who propose that children's non-adult-like interpretation of *think* is not because of their lack of understanding of false beliefs or syntactic/semantic knowledge of the verb *think*, but due to misunderstanding of **pragmatics** associated with the context when *think* is used.[4] Consider what speaker B reports in the following conversations.

(6) A: Why didn't Mary invite John to the meeting?
B: She thinks he's working from home.
(7) A: Where is John? It's time to start the meeting.
B: Mary thinks he's working from home. (Lewis et al., 2017, p. 361)

Speaker B's utterance in (6) is a report of Mary's belief where Mary believes that John is working from home. In this case, speaker B does not have any commitment to the truth of Mary's belief – it could be either true or false (henceforth, **a literal meaning of *think***). On the other hand, speaker B's utterance in (7) is not a mere belief report – speaker B is giving speaker A as much information as possible about where John is. Here, Mary's belief is less relevant, and speaker B tries to convey "true" information which is consistent with reality as much as possible (henceforth, **a speaker meaning of *think***). Lewis et al. (2017) propose that children often access the speaker meaning of *think* where belief reports are less relevant rather than the literal meaning of *think* where belief reports are relevant. That is, "although children are capable of computing the literal meaning of belief reports, they often misjudge the discourse context and fail to recognize when beliefs are relevant to the conversation" (Lewis et al., 2017, p. 361; see Hacquard & Lidz, 2019, 2022 for review).

Lewis et al. (2017) empirically confirmed this hypothesis. One of their experiments tested whether English-speaking children (3;1–4;2; n = 66) can access the literal meaning of *think* when the speaker meaning is blocked in the following way. In a hide-and-seek context, a hider (Swiper) hides behind a box but a seeker (Dora) stops in front of a curtain, indicating that Dora thinks that Swiper is behind the curtain. In this context, a puppet says "Dora thinks that Swiper is behind the box." Here, the complement is true, while the entire sentence

[4] For a review of alternative hypotheses, see Lewis et al. (2017).

is false. The entirely-false sentences with *think* block the speaker meaning, since the speaker cannot use the subject of *think* (Dora) as the source of evidence for the truth of the embedded proposition (Swiper's actual hiding spot). When the speaker meaning is blocked in this way, 3- to 4-year-old children's performance with *think* significantly improved. A similar but weaker result was reported in Mandarin by Hacquard, Yang, and Lidz (2021).

We will utilize their experimental manipulation in a part of our experiment to investigate i) whether Japanese children are able to access the literal belief meaning of *omou* 'think' when the speaker meaning is blocked, and ii) whether this correlates with their ability to access the long-distance interpretation of *zibun*.

3. Our study

Given that logophoricity is one of the licensing factors for long-distance binding of *zibun*, the subject of *omou* 'think' has to be treated as the one whose thought is reported in order to consider it as an antecedent of *zibun* 'self.' However, if Japanese children tend to interpret *omou* with **the speaker meaning** in which the matrix subject's belief is less relevant, the matrix subject is not the logophoric individual, thus not an appropriate antecedent for *zibun*. This could be why children do not accept the long-distance interpretation of *zibun*.[5] We ask a research question in (8), which is answered through two sub-questions in (9).

(8) Can the observed difficulty with long-distance binding of *zibun* be attributed to the difficulty with *omou* 'think'?

(9) a. Sub-question 1: Do Japanese children age-matched for those in Orita et al.'s study make false belief errors?
    b. Sub-question 2: Does children's interpretation of *omou* 'think' affect their ability to access long-distance antecedents for *zibun*?

Importantly, we investigate the sub-question 2 by adding two manipulations in our experiment. First, we highlight the literal belief meaning of *omou* in a sentence with *zibun* (in a way that we will explain in §3.1.3). We predict that children should be able to treat the matrix subject as a logophoric individual when the literal meaning of *omou* is highlighted, and therefore be able to access the long-distance interpretation of *zibun*.

Second, we examine whether there is a correlation between children who can access the literal meaning of *omou* and children who can access the long-distance interpretation with *zibun*. Remember that entirely-false sentences only induce the literal belief meaning of *think*, since they block the speaker meaning. We predict that children who successfully reject entirely-false sentences with *omou* should be

[5] Orita et al. indeed consider this possibility, but dismiss it on the grounds that the Japanese children in question are past the age at which difficulties with *think* have been observed in languages like English. However, we have reason to believe that Japanese children's difficulties with *omou* 'think' may persist longer than in other languages (thanks to Jill De Villiers for discussion on this point).

able to access the long-distance interpretation with *zibun*, while children who incorrectly accept entirely-false sentences should not be able to access the long-distance interpretation with *zibun*.

3.1. Method of our experiment

3.1.1. Participants

Twenty-four Japanese-acquiring children (4;4–6;2, mean: 5;2) and forty-nine Japanese adults are included in our analysis.[6] The children were tested in-person individually in a kindergarten in Shizuoka, Japan. The adults recruited through a crowd-sourcing website (CrowdWorks: https://crowdworks.jp/) were tested online using Google Forms.

3.1.2. Procedure

We used the TVJT. For children, stories were shown as animated stories on a laptop computer with the narration by the experimenter, and pre-recorded test sentences were uttered by a puppet after each story. Children were asked to indicate when the puppet was right and when he was wrong. Experimental sessions were audio-recorded. For adults, each story was pre-recorded as a single video, including a pre-recorded test sentence. After each video, the participants were asked to press the appropriate button to indicate that the sentence was true or false.

3.1.3. Materials

The experiment included two practice items (1 true and 1 false[7]), and twelve critical items which are divided into two sentence types: those containing *omou* 'think' and those containing both *omou* and *zibun* 'self.' Table 1 summarizes the conditions of this experiment. The critical items were pseudo-randomized.

Table 1. List of sentence types and numbers of items in the experiment.

Conditions		**Number**
	Practice items	$k = 2$
Omou 'think'	Entirely-true / Complement-false	$k = 3$
	Entirely-false / Complement-true	$k = 3$
Zibun 'self'	Sentences with *zibun* and *omou* where the local reading is true	$k = 3$
	Sentences with *zibun* and *omou* where the long-distance reading is true	$k = 3$

[6] One child and four adults were excluded before the analysis because they answered at least one of the practice items incorrectly.

[7] The false item tested whether children know the meaning of *zibun* in a simple sentence.

Following Lewis et al. (2017) and Hacquard et al. (2021), we used hide-and-seek stories. First, let us introduce an example story and a corresponding test sentence of the entirely-true/complement-false condition. After the story in (10) and Figure 1 is shown, a puppet appears on the screen, and he utters the test sentence in (11).

(10) Story: The rabbit and the squirrel are playing hide-and-seek in a room (Scene 1). The rabbit wonders whether she should hide behind the curtain (moving in front of the curtain), but she decided to hide behind the treasure box (Scene 2). Then, the squirrel wonders where the rabbit is hiding. The squirrel says "hmm, is rabbit here (moving in front of the box)? No, maybe the rabbit is here" and moves to and stops in front of the curtain (Last scene).

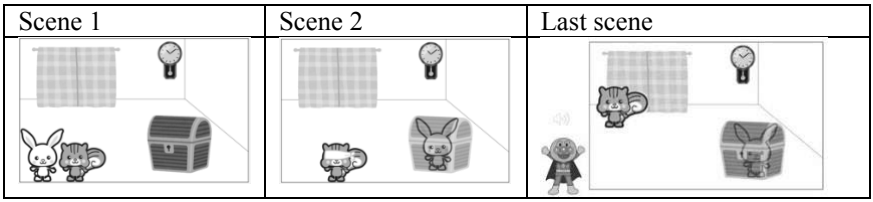

Figure 1. Pictures of the crucial scenes in the story
Note. The hiding spot was not transparent in the actual experiment.

(11) Risusan-wa [usagisan-ga kaaten-no usiro-ni kakure-teiru to]
squirrel-TOP rabbit-NOM curtain-GEN behind-DAT hide-PROG COMP
omot-teiru yo. Correct answer: true
think-PROG SFP
'The squirrel thinks that the rabbit is hiding behind the curtain.'

If Japanese children also over-assume the speaker meaning of *omou*, they are expected to answer "false" to the entirely-true/complement-false sentences like (11).

Next, the example item of the entirely-false/complement-true condition is shown in (12), Figure 2, and (13). This is the key condition where the speaker meaning of *omou* is blocked, since the puppet cannot use the dog's position as the evidence for the truth about the lion's hiding spot.

(12) Story: The lion and the dog are playing hide-and-seek in a room (Scene 1). The lion wonders whether she should hide behind the bookshelf (moving in front of the bookshelf), but she decided to hide behind the sofa (Scene 2). Then, the dog wonders where the lion is hiding. The dog says "hmm, is lion here (moving in front of the sofa)? No, maybe the lion is here" and moves to and stops in front of the bookshelf (Last scene).

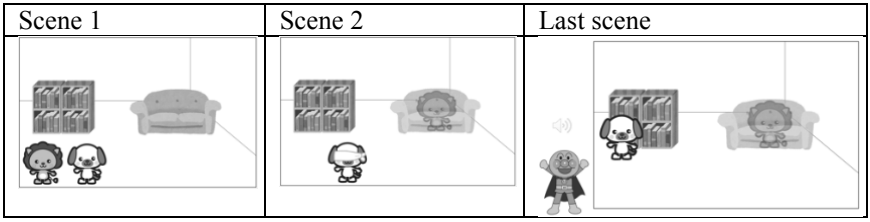

Figure 2. Pictures of the crucial scenes in the story

(13) Inusan-wa [lionsan-ga sofa-no usiro-ni kakure-teiru to]
dog-TOP lion-NOM sofa-GEN behind-DAT hide-PROG COMP
omot-teiru yo. Correct answer: false
think-PROG SFP
'The dog thinks that the lion is hiding behind the sofa.'

Finally, the sentences with *omou* 'think' and *zibun* 'self' test whether children can access the long-distance interpretation of *zibun* when the literal belief meaning of *omou* is highlighted in a way that we describe here. Consider an example item below where *zibun* is provided with a story in which the long-distance interpretation would be true. The most important point is the lead-in question in (15) – this question was given by the experimenter to the puppet.

(14) Story: The cow and the elephant are playing hide-and-seek in a house (Scene 1). The cow wonders whether she should hide in her own room[8] (moving in front of her own room), but she decided to hide in the elephant's room (Scene 2). Then, the elephant wonders where the cow is hiding. The elephant says "hmm, is cow here (moving in front of cow's room)? No, maybe the cow is here" and moves to and stops in front of the elephant's room (Last scene).

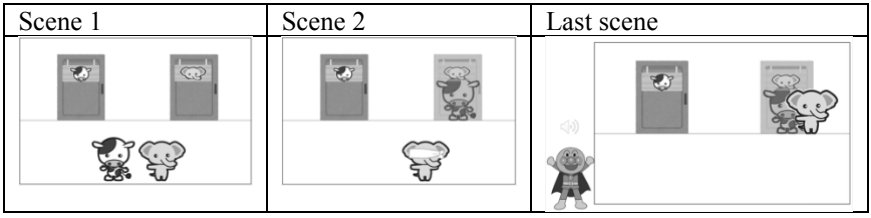

Figure 3. Pictures of the crucial scenes in the story

(15) Lead-in (experimenter):
Zousan-wa doosite kono heya-no mae-ni tat-teiru no?
elephant-TOP why this room-GEN front-DAT stand-PROG Q
'Why is the elephant standing in front of this room?'

[8] In the actual narration, we did not prime the word *zibun* 'self.'

(16) Test Sentence (puppet):
Zousan$_1$-wa [usisan$_2$-ga **zibun**$_{1/2}$-no heya-ni kakure-teiru to]
elephant-TOP cow-NOM self-GEN room-DAT hide-PROG COMP
omot-teiru kara da yo. Long-distance: true, Local: false
think-PROG because COP SFP
'It is because the elephant thinks that the cow is hiding in zibun's room.'

The lead-in question asks a reason for the elephant's behavior. Crucially, the elephant is standing in front of her own room because she **believes** that the cow is here, thus the question under discussion is about **the elephant's belief**. By adding this lead-in question highlighting the relevance of the elephant's belief, we examined whether children can consider the matrix subject (the elephant) as a logophoric individual (whose thought is reported) and accept the long-distance interpretation of *zibun*.

All items with *zibun* were preceded by the same kind of lead-in questions asking the reason for the seeker's final position. In order to make the test sentence sound natural as the response to *doosite* 'why' questions, all sentences with *zibun* were embedded under the *kara* 'because' clause. We also had the opposite condition where the local reading of *zibun* was true while the long-distance reading was false, not discussed here due to space limitations.

3.2. Results

3.2.1. Interpretation of *omou* 'think'

Figure 4 shows the percentages of "yes" responses to sentences with *omou* 'think' divided by *Group* (adults vs. children) and *Sentence truth* (true vs. false).

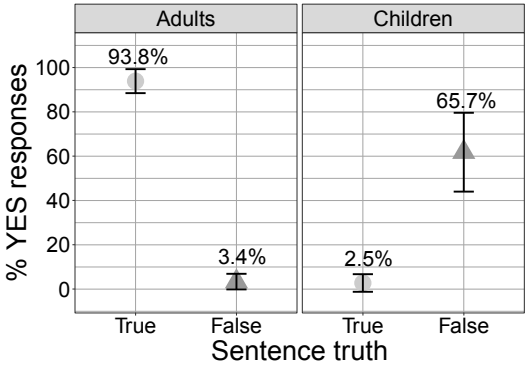

Figure 4. Mean percentages of YES responses to sentences with *omou* 'think.' Errors bars show 95% confidence intervals.

Adults correctly accepted the entirely-true/complement-false sentences (93.8%), while the children (4;4–6;2) incorrectly rejected these sentences

(acceptance rate: 2.5%). This confirms our first sub-question – Japanese children, age-matched to Orita et al.'s children, still tend to make false belief errors.

Turning to the key condition where the whole sentence is false, adults almost never accepted this condition (3.4%), while children incorrectly accepted this condition 65.7% of the time. However, as the large error bar shows, there were individual differences. Table 2 shows the number of children divided by how many times they incorrectly accepted the entirely-false sentences with *omou*.

Table 2. The number of children divided by the number of items that they incorrectly accepted the entirely-false/complement-true sentences.

Number of items	$k = 0$	$k = 1$	$k = 2$	$k = 3$
Number of children	$n = 4$	$n = 4$	$n = 5$	$n = 11$

A crucial question is whether this individual difference is actually correlated with an individual difference that we will present for long-distance binding. For later analysis, we group the children who accepted the entirely-false sentences with *omou* never or once as "consistent rejecters," and the children who accepted these sentences twice or third as "consistent acceptors."

3.2.2. Interpretation of *zibun* 'self'

Figure 5 shows the mean percentages of "yes" responses to sentences with *zibun* and *omou*, divided by *Group* (adults vs. children) and *Story type* (local true vs. long-distance (LD) true).

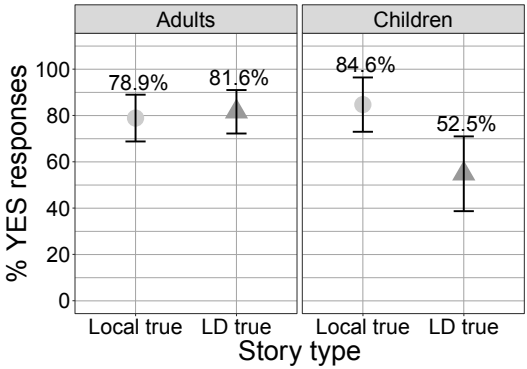

Figure 5. Mean percentages of YES responses to sentences with *zibun* 'self' and *omou* 'think.' Errors bars show 95% confidence intervals.

Adults accepted *zibun* in both local-true (78.9%) and long-distance-true conditions (81.6%). This means that, in the adult grammar, *zibun* is ambiguous – it can take either a local or long-distance antecedent.

Children also accepted *zibun* in the local-true condition frequently (84.6%). On the other hand, they accepted *zibun* only 52.5% of the time when the long-distance reading was true. However, the acceptance of the long-distance reading in our study was much higher than in Orita et al. (20%). Additionally, 52.5% here looks like all the children performed at chance, but there were individual differences: some children successfully accepted the long-distance reading of *zibun*, while others did not.

The crucial difference from Orita et al.'s experiment is that we added lead-in questions which highlighted the literal belief meaning of *omou* 'think.' Given the individual differences in the acceptance of the long-distance interpretation of *zibun*, our study shows that highlighting the belief meaning of *omou* was effective for **a subset of the children** that we tested. The most important question is whether this individual difference observed with *zibun* can be explained by the individual difference that we already observed with *omou* 'think.'

3.2.3. Correlation between *omou* 'think' and *zibun* 'self'

Figure 6 shows the percentages of "yes" responses with *zibun* 'self' divided into three groups: adults, children who consistently rejected entirely-false sentences with *omou* 'think' (consistent rejecters), and children who consistently accepted these sentences (consistent acceptors).

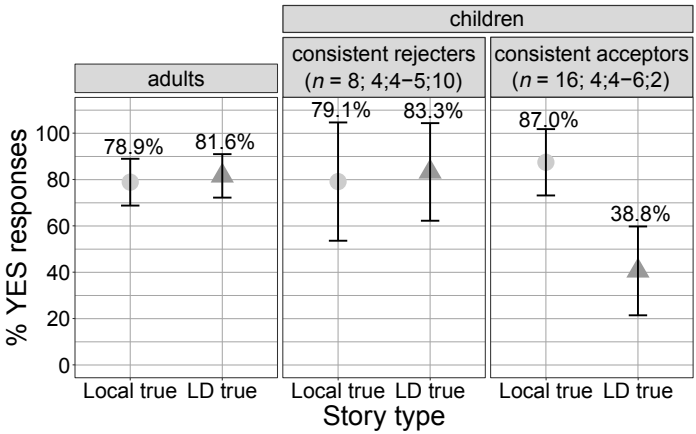

Figure 6. Mean percentages of YES responses to the sentences with *zibun* 'self' divided by children's performance on entirely-false/complement-true sentences with *omou* 'think.' Errors bars show 95% confidence intervals.

The consistent rejecter children accepted the long-distance interpretation of *zibun* (83.3%) as well as the local interpretation (79.1%) like adults. In contrast, the consistent acceptor children accepted the long-distance interpretation of *zibun* only 38.8% of the time, while accepting the local interpretation 87.0% of the time.

These results confirm our second sub-question: children's interpretation of *omou* 'think' affected their ability to access the long-distance interpretation of *zibun*.

The data were fit into a binomial mixed logistic regression model with a *Judgment* (true vs. false) as a response variable, and *Story type* (local true vs. long-distance true) and *Group* (adults vs. consistent rejecters vs. consistent acceptors) as predictor variables. *Story type* was sum-coded, and *Group* was treatment-coded ("adults" as a reference level). The random effect structure included participants as random intercepts. Table 3 shows the full output of the biggest model that succeeded in converging.

Table 3. Output of the binomial logistic mixed effects model

	Estimate	*SE*	*z* value	*p* value
Intercept	1.65	0.23	7.10	< .0001***
Story type	0.09	0.15	0.62	0.53
Group (consistent rejecters)	0.08	0.56	0.15	0.87
Group (consistent acceptors)	−0.79	0.41	−1.92	0.05
Story type * *Group* (consistent rejecters)	0.05	0.42	0.13	0.89
Story type * *Group* (consistent acceptors)	−1.44	0.31	−4.60	< .0001***

Model: glmer(Judgment ~ 1 + Story type * Group + (1 | ParticipantID), family = binomial)

Crucially, the interaction between *Story type* and *Group* (adults vs. **consistent rejecters**) was not significant ($p = .89$), while the interaction between *Story type* and *Group* (adults vs. **consistent acceptors**) was significant ($p < .0001$). This indicates that the judgment pattern on the sentences with *zibun* by the consistent rejecters was not significantly different from the adults, whereas that by the consistent acceptors was significantly different from the adults.

4. Discussion and conclusion

This study reports the following three main findings. First, Japanese 4- to 5-year-old children make false belief errors over 90% of the time. On Lewis et al.'s story, this means that these children accessed the speaker meaning of *omou* 'think.' Second, on the key sentences with *omou* in which **the speaker meaning is blocked,** eight out of twenty-four children correctly answered "false" consistently. On Lewis et al.'s story, this means that they accessed the literal belief meaning of *omou*. Hence, for these children, the subject of *omou* was treated as a logophoric individual. Third, most importantly, those eight children **who used the literal meaning of *omou* 'think'** successfully **accepted the long-distance interpretation of *zibun* 'self'** like adults.

Overall, our prediction was borne out: children need to treat the subject of *omou* as the one whose thought is reported in order to consider it an eligible antecedent for *zibun*. We believe that our results contribute both to the field of language acquisition and to the field of linguistic theory on two points.

First, our experiment found that Japanese children might need more time to be adult-like in interpreting *omou* 'think' compared to English-acquiring children. One potential reason for this difference is input frequency: belief verbs in Japanese are significantly rarer than in English. Suzuki & Nomura (2020) reported that, per 10,000 verbs, there were 5.43 instances of belief verbs in child-directed speech to Japanese children, while there were 64.90 instances to English-acquiring children. If children need observation to become familiar with discourse contexts corresponding to the literal meaning of *think* and the speaker meaning of *think*, this significant gap in input frequency between Japanese and English might explain why our 4- to 5-year-olds still made false belief errors.

Our second contribution is that we clarified one of the sources of children's difficulty with the long-distance interpretation of *zibun*. That is, the challenges with the meaning of *think* spillover into children's use of *zibun*, which might obscure what is actually adultlike knowledge of long-distance binding. Our result supports the theoretical proposal that logophoricity is a licensing factor for long-distance binding of *zibun*. Furthermore, our study might provide a trigger to clarify tasks for children to acquire long-distance binding which involves a potential learnability problem. For example, Orita et al.'s (2021) analysis of child-directed speech found zero instance of *zibun* in long-distance binding context. Given the link between the long-distance binding and logophoricity, children need to learn in what context long-distance binding is possible, not just to learn that mono-morphemic reflexives like *zibun* allow long-distance binding. We hope to contribute to solving this potential learnability problem in future study.

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