日本語児の比較構文の解釈における語順の影響

The Impact of Word Order on Comparative Interpretation in Japanese-Speaking Children

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ABSTRACT

本論文では，日本語児による比較構文の理解に対する語順の影響を調べる二つの実験を紹介する。先行研究は主に英語発話データに偏り，また比較構文などの状態表現における語順の影響についての研究が不足していた。本研究は，このような点に焦点を置く。実験 1 では真偽値判断課題，実験 2 では絵画強制選択課題を用い，日本語児にとって「Y よりXが大きい」（S 比較）の方が「XがY より大きい」（A 比較）より理解しやすいことを示した。これを受け，S比較構文が基本語順であるという仮説と，談話語用論的観点から S 比較構文が話し手に好まれるという二つの仮説を提案する。さらに，これらの仮説を支持する証拠として，大人の日本語話者が子供に向けた発話を分析し，S 比較構文がより頻繁に使用されることを示した。本研究は，子供言語の研究が子供たちの認知過程だけでなく，言語構造や使用パターンの深い理解にも寄与し得る可能性を示した。

This paper presents the results of two experiments exploring the impact of word-order variation on Japanese-speaking children's comprehension of comparative constructions. Addressing two gaps in current linguistic research, our study focuses on understanding how different word orders affect children's interpretation of non-transitive sentences, such as comparatives, and increases the limited cross-linguistic data available, particularly beyond predominantly English production data. The two experimental tasks (Experiment 1: truth-value judgment task; Experiment 2: forced-choice picture selection task), consistently found that standard-first comparatives (e.g., X-*yori* *Y-ga ookii*, lit. 'than X, Y is bigger') are more easily understood by children than associate-first comparatives (e.g., *Y-ga* *X-yori* *ookii*, lit. 'Y is bigger than X'). These findings led us to propose two potential explanations: the Basic Order Significance and Pragmatic Processing Facilitation Hypotheses. Under the former, S-comparatives represent a basic, more natural word order, whereas the latter suggests a discourse-driven preference for S-comparatives among speakers. Our

corpus analysis of child-directed speech by adult Japanese speakers shows that S-comparatives are indeed more frequently used, indicating a possible preference for this structure. Our findings imply that the study of child language acquisition not only provides insights into children's cognitive processes, but also offers a deeper understanding of the underlying structure and usage patterns of linguistic constructions.

1. Introduction[(i)]

This study explored the impact of word order on children's sentence comprehension, which has been observed cross-linguistically. In Japanese, the canonical word order is subject–object–verb (SOV), as in (1a), where the object follows the subject agent.[(ii)] When Japanese-speaking children are presented with the scrambled OSV sentence in (1b), they often misinterpret the first NP as the agent and interpret the sentence as "John pushed Mary" (Hayashibe, 1975).

(1) a. Mary-ga John-o osita. (SOV)
Mary-NOM John-ACC pushed
'Mary pushed John.'
b. John-o_i Mary-ga t_i osita. (OSV)
John-ACC Mary-NOM pushed
'Mary pushed John.' (lit. 'John, Mary pushed.')

Similar word order effects have been reported cross-linguistically for other types of constructions such as passives and clefts (Baldie, 1976; Bever, 1970; Cho, 1982; Hakuta, 1982; Kim et al., 1995; Maratsos, 1974; Sudhalter & Braine, 1985; Turner & Rommetveit, 1967).

Children do not lack the linguistic knowledge required to interpret such sentences. In experiments designed to ensure that children pay attention to a scrambled object or the relation between case particles and thematic roles, OSV sentences are interpreted more correctly (Minai et al., 2015; Otsu, 1994). Thus, children's misinterpretations cannot be attributed to their linguistic knowledge of scrambling, but rather perhaps to their immature processing capacities. Sentences with scrambled word order are more difficult to process than their canonical counterparts, even for adults (Chujo, 1983; Tamaoka et al., 2005). Although adults can correctly interpret non-canonical sentences without support, their reaction times are slower when processing non-canonical than canonical sentences. Such difficulties can be attributed to *the filler-gap dependency*. For example, in sentence (1b) above, parsers must determine whether the accusative NP in sentence-initial position (i.e., *John-o*) is appropriate for the object, typically placed immediately preceding the verb in canonical word order, and then search for the original position (i.e., the gap) to form a filler-gap dependency. This extra parsing can cause slow parsing in adults when processing non-canonical sentences. Compared with adults, children have immature processing abilities. Therefore, the additional parsing required to form a filler-gap dependency may be difficult for children, resulting in misinterpretations.

Thus, cross-linguistic research has demonstrated that alternative word orders affect both children and adults. While these studies have primarily focused on constructions containing transitive verbs, there is a lack of research on the effects of word order on children's interpretations of non-transitive sentences like comparatives. Transitive sentences describe actions, while comparative sentences describe stative situations. Nevertheless, like transitive sentences, comparatives consist of two NPs and one predicate. In Japanese, these two NPs can have different word orders while maintaining the same interpretation:

(2) a. Associate-first comparative (A-comparative)
Haburasi-ga pen-yori nagai.

toothbrush-NOM pen-than long
'The toothbrush is longer than the pen.'

b. Standard-first comparative (S-comparative)
Pen-yori haburasi-ga nagai.
pen-than toothbrush-NOM long
'The toothbrush is longer than the pen.' (lit. 'Than the pen, the toothbrush is longer.')

Following Bhatt and Takahashi (2011), we term the *yori* 'than'-marked NP the *standard* and the NP compared with the standard the *associate*. In (2), the associate NP *haburasi* 'toothbrush' is compared with the standard NP *pen* 'pen' in terms of length, using the predicate *nagai* 'long.' In (2a), the associate NP, marked with *-ga*, is followed by the standard NP, marked with *-yori*; however, in (2b), the *yori*-marked standard NP appears before the *ga*-marked associate NP. To distinguish these word orders, the construction in (2a) is referred to as the *associate-first comparative* (*A-comparative*) and that in (2b) the *standard-first comparative* (*S-comparative*).

This study addresses how alternative word orders in comparatives affect children as they develop sentence comprehension abilities. To the best of our knowledge, no study has investigated the effects of word order on children's interpretations of comparatives or other stative constructions allowing alternative word orders. Accordingly, this study specifically examined the effects of word order on Japanese-speaking children's interpretations of comparatives.

Moreover, this study aims to fill a gap in the acquisition literature on comparatives. An overview of the acquisition literature on comparatives by Syrett (2016) reveals a gap in our understanding of the linguistic representations children assign to comparatives and how their interpretations align with those of adults over time. Syrett (2016) points out that data have predominantly focused on children's production and highlights the lack of cross-linguistic data, primarily concerning English. This study aims to address this gap by providing empirical evidence of how word order affects Japanese-speaking children's comprehension of comparatives, thus contributing to a broader understanding beyond English.

The remainder of this paper is organized as follows: Section 2 introduces the theoretical and developmental background of comparatives. Sections 3 and 4 report the findings of two experiments, which show that S-comparatives are easier for children to comprehend than A-comparatives. Finally, Section 5 presents two possible explanations for the findings along with supportive evidence from child-directed speech by adult Japanese speakers.

2. Theoretical and Developmental Background of Comparatives

English comparative morphology involves *er/more*; however, Japanese does not have such comparative morphemes. The adjective *nagai* 'long' in its unmarked positive form is identical to the comparative form 'longer,' as shown in (3).

(3) a. Haburasi-ga nagai.
toothbrush-NOM long
'The toothbrush is long.'

b. Haburasi-ga pen-yori nagai.
toothbrush-NOM pen-than long
'The toothbrush is longer than the pen.'

In (3b), the explicit standard is provided by the *yori*-phrase, which is comparable to the English *than*-phrase. Although (3b) lacks a comparative morpheme, it is interpreted comparatively, as indicated by its English translation.

This study adopts *the degree-based approach* (cf. Kennedy & McNally, 2005). Despite the differences between English and Japanese, Japanese

comparatives have been analyzed similarly to English ones by postulating a null comparative morpheme whose syntax and semantics are analogous to the English *-er* (Ishii, 1991; Kennedy, 2007). Moreover, the comparatives in (3b) are referred to as *phrasal comparatives*, where *yori* combines with an NP. Regarding their syntactic structure, we follow Bhatt and Takahashi (2011), who posit that the postposition *yori* is directly attached to the preceding NP.

As we have seen, the standard phrase can be placed in sentence-initial position in Japanese (S-comparatives). Bhatt and Takahashi (2011) suggested that this word order is derived by scrambling the *yori*-phrase from its original position, which is below the subject *haburasi* 'toothbrush,' though without providing evidence.

In the acquisition literature, it has long been known that children produce comparatives that markedly differ from those produced by adults up to age six (Brown, 1974; Hohaus et al., 2014; among others). For example, English-speaking children may express comparatives using multiple comparative morphemes (e.g., *more dirtier*; Brown, 1974).

Moreover, research on children's comprehension of comparatives showed that their understanding may differ from that of adults (Bishop & Bourne, 1985; Gor & Syrett, 2015; Kawahara, 2017; Arii et al., 2017; Syrett, 2016). For example, children might not interpret the entire construction; instead, they appear to assume that the subject of the comparative possesses some positive degree of the property expressed by the predicate (Bishop & Bourne, 1985). Thus, for children, the assertion *Tom is taller than Bill* seems to mean that Tom is tall. However, in adult grammar, this assertion does not necessarily imply that Tom is tall, especially in a context where both boys are much shorter than the average height for boys. More recent research on children's interpretations of differential comparatives (e.g., *X is 30cm higher than Y*) reveals that both English- and Japanese-speaking children assign a non-adult-like interpretation to these comparatives, often mistakenly interpreting the measure phrase *30cm* as the absolute height of X (Arii et al., 2017). The authors assume a function degree head *Meas* to explain a semantic selectional restriction on adjectives modified with a measure phrase (Sawada & Grano, 2011) and proposed that *Meas* in child and adult grammar differ with respect to selectional restriction. Researchers have thus concluded that the acquisition of comparatives takes a long time and occurs in stages (see Hohaus et al. (2004) for the time course of the acquisition of comparative constructions).

However, it is also well known that in the development of child language, the ability to produce language does not necessarily reflect the child's level of understanding. Thus, children's non-adult-like use of comparatives does not tell us whether they interpret them correctly (Syrett, 2016). In addition, recent studies using updated experimental designs have shown that children interpret comparatives more accurately than previously reported. Children can correctly interpret simple comparatives in child-friendly-design tasks such as judgment and act-out tasks. Gor and Syrett (2015) demonstrate that English-speaking children as young as four years can correctly interpret the comparatives shown in (4). Similarly, Kawahara (2017) reports that Japanese-speaking children at around five years can assign correct interpretations to adverbial comparatives, as in (5).

(4) Sheriff Woody fed more bear cubs than Jessie.

(5) Baikinman-wa Anpanman-yori hayaku
Baikinmna-TOP Anpanman-than fast
hasit-ta.
run-PAST
'Baikinman ran faster than Anpanman.'

Over the years, thus, researchers have shown considerable interest in children's production and interpretation of comparatives. However, Syrett (2016) pointed out that our understanding remains incomplete, with data predominantly focusing on children's production. She also highlighted the lack of cross-linguistic data, predominantly focusing on English. Our study seeks to address this gap by offering empirical evidence of the influence of word order on Japanese-speaking children's comprehension of comparatives, thereby extending our understanding beyond English.

To the best of our knowledge, children's comprehension of comparatives regarding word-order effects has never been explored. Thus, this study was not primarily driven by previous studies on the acquisition of comparatives but by earlier studies on children's interpretation of scrambled sentences, passives, and clefts, as reviewed in the previous chapter. Given that earlier studies on word-order effects have mainly focused on transitive sentences, this study is the first to explore the effects on children's comprehension of non-transitive sentences. The following sections report the findings of two experiments that investigated the effects of word order on children's interpretations of comparatives.

3. Experiment 1: Truth-Value Judgment Task

In the first experiment, participants completed a truth-value judgment task (Crain & McKee, 1985; Crain & Thornton, 1998) where they were asked to determine whether a sentence accurately compared the animal characters' size or length.

3.1 Participants

All the participants were native Japanese speakers recruited and tested in the Tokyo Metropolitan Area. The children's group comprised 16 participants aged 5;0–6;8 years (M = 5;10) who were tested in their preschool. The adult control group consisted of 8 college students aged 19–20 years (M = 18;9). The children participated with their parents' consent, and the adults based on their informed consent.

3.2 Stimuli

In Experiments 1 and 2, auditory and visual stimuli were presented to participants on a computer monitor using SuperLab, an experimental software developed by the Cedrus Corporation (2014).[iii] This setup was consistent across Experiments 1 and 2. Experiment 1 comprised two tasks administered on different days: size and length judgment tasks. In the size judgment task, participants were presented with stimuli containing the adjectives *ookii* 'big' or *tiisai* 'small,' as shown in (6), and asked to compare the size of animals. In the length judgment task, participants were presented with stimuli containing adjectives *nagai* 'long' or *mizikai* 'short,' as shown in (7), and asked to compare the length of the animals.

(6) a. Hituzi-ga inu-yori ookii.
sheep-NOM dog-than big
(A-comparative)
'The sheep is bigger than the dog.'
b. Nezumi-yori risu-ga tiisai.
rat-than squirrel-NOM small
(S-comparative)
'The squirrel is smaller than the rat.' (lit. 'Than the rat, the squirrel is smaller.')

(7) a. Kame-ga ebi-yori nagai.
turtle-NOM shrimp-than long
(A-comparative)
'The turtle is longer than the shrimp.'
b. Hugu-yori ebi-ga mizikai.
blowfish-than shrimp-NOM short
(S-comparative)
'The shrimp is shorter than the blowfish.' (lit.

'Than the blowfish, the shrimp is shorter.')

In the experiment, each participant completed 16 trials for each task, with half presenting A-comparatives and the other half S-comparatives. The order of presentation of the stimuli was counterbalanced across participants.

During each trial, the participants were asked to match the auditory stimuli, which were played twice, with the visual stimuli, and indicate their response by pressing either a red button with a circle (for a correct match) or a blue button with a cross (for an incorrect match) on the response pad. No feedback was provided regarding the interpretation of the stimulus sentences. The software automatically recorded participants' responses. In half the trials, the correct response was to push the red button, and in the other half, the blue one. Counterbalancing of correct responses was ensured.

3.3 Procedure

Participants were tested individually in a quiet room. The experiment began with a brief training session in which participants practiced pressing the correct button, and their comprehension of the adjectives used in the stimulus sentences was confirmed. None of the participants reported difficulties during the training sessions. Target task trials were conducted after the training sessions.

At the beginning of the target task, the researcher introduced a puppet to the participants. The puppet attempted to describe a picture (i.e., a visual stimulus) in each trial, and the participants judged whether the description matched the picture by pushing a button. For example, a participant was shown the picture illustrated in Figure 1, in which the sheep was larger than the dog but smaller than the pig. The puppet stated 'the sheep is bigger than the dog' using either an A- or S-comparative. In this case, the puppet's statement matched the picture, and the participant was expected to press the red-circle button.

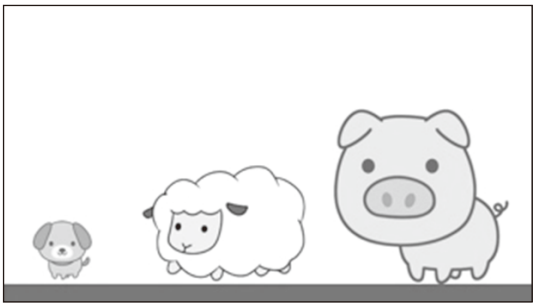
However, when the puppet mistakenly stated 'the sheep is smaller than the dog' using either an A- or S-comparative, the participant was expected to press the blue-cross button.

In each image, three animals of varying sizes and lengths were presented, following the experimental design of Arii et al. (2017). Animals in the middle of the size or length scale were always the associate in the comparative stimuli such as the sheep in Figure 1. This design aimed to counteract the children's tendency to not fully attend to the entire construction. Often, they interpret the subject of the comparative as having some positive degree of the property expressed by the adjective (e.g., interpreting "the sheep is bigger than the dog" as meaning that the sheep is big in the context) (Bishop & Bourne, 1985).

Consider a picture with only two animals (X and Y, with X larger). If children accept 'X is bigger than Y,' it could mean either they correctly assign a comparative interpretation, or they misinterpret it as 'X is BIG.' This ambiguity arises because the picture allows both assertions (i.e., 'X is bigger than Y' and 'X is big') to be true. However, in experiments with three animals, a positive interpretation is not available, as the medium-sized animal (e.g., the sheep in Figure 1) cannot be considered big when

Figure 1

Example Picture Stimulus in the Truth-Value Judgment Task in Experiment 1 Using the Adjective 'Big': 'The Sheep is Bigger than the Dog.' (True)



there is a larger one (e.g., the pig in Figure 1). By using the medium-sized animal as the associate, we aimed to prompt children to recognize the sentence as comparative, not positive. Correct responses required them to identify the standard animal. This experimental design is likely to elicit correct interpretations of the comparatives in children.

3.4 Results and Discussion

The combined results of the size and length judgment tasks are shown in Figure 2. As the figure indicates, the adults demonstrated a ceiling performance. In comparison, children performed worse than adults but still above chance level, with correct response rates of 75.8% and 86.3% for A- and S-comparative word orders.

We statistically examined whether there was a significant difference in accuracy between A-comparative and S-comparative word orders. We initially employed a full model using a generalized linear mixed model (GLMM) with 'glmer': 'response ~ condition + (1 | kinds of adjective) + (1 | participant) + (1 | item).' However, to ensure model convergence, we simplified the model to: 'response ~ condition + (1 | participant).' Participants' correct responses were coded as '1' and incorrect responses as '0,' representing binary outcomes in the logistic regression model. The fixed effect 'condition' was treated as a categorical factor: A-comparative or S-comparative. This approach of treating variables as factors was also applied to the random effects 'participant,' 'kinds of adjective,' and 'item.' A summary of these analyses is presented in Table 1.

Figure 2

Combined Rates of Correct Responses for the Size Judgment Task and the Length Judgment Task in Experiment 1

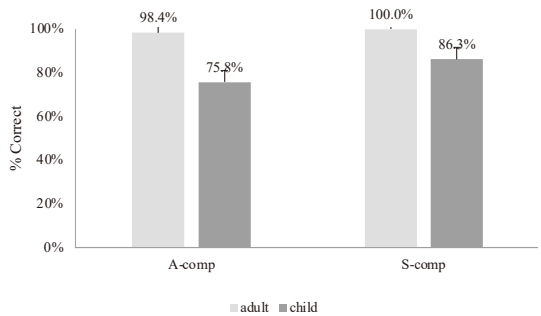


Table 1 shows significantly more correct responses in the S-comparative condition ($p < .001$) than in the A-comparative condition. In other words, the children had less difficulty with S-comparative sentences (*estimate* = 0.84, *SE* = 0.25).

To summarize, in Experiment 1, the children's performance on both the A- and S-comparative word orders was above chance, although their overall performance was significantly worse than that of the adults, suggesting that the children in our experiment did not neglect the standard phrase, unlike what has been reported for English-speaking children in previous studies (Bishop & Bourne, 1985). Moreover, we found word-order effects on children's interpretation of comparatives: S-comparatives were easier for Japanese-speaking children than were A-comparatives.

Before concluding that S-comparatives are inherently easier for Japanese-speaking children than A-comparatives, we must consider the

Table 1

Summary of GLMM Analysis for Response in Experiment 1: glmer: response ~ condition + (1 | participant)

Fixed effects:	Estimate	Std. Error	*z*-value	Pr(>|*z*|)
(Intercept)	1.50	0.29	5.18	< .001***
condition (S-comp)	0.84	0.25	3.35	< .001***

possibility that the lower correct response rates for A-comparatives may be due to unnaturalness of A-comparatives as stimulus sentences. In the stimuli, the subject is followed by the nominative case marker *ga*, as in (8).

(8) a. Hituzi-ga inu-yori ookii.
sheep-NOM dog-than big
(A-comparative)
'The sheep is bigger than the dog.'
b. Inu-yori hituzi-ga ookii.
dog-than sheep-NOM big
(S-comparative)
'The sheep is bigger than the dog.' (lit. 'Than the dog, the sheep is bigger.')

The case marker *ga* carries an exhaustive listing reading (Kuno 1973; Heycock 2008). Strictly speaking, therefore, (8a) implies that the sheep is the only animal bigger than the dog. However, there are three animals in Figure 1, among which both the sheep and pig are bigger than the dog. Thus, this illustration does not strictly correspond to the stimulus sentence in (8a), perhaps influencing the children's performance with A-comparatives.(iv)

In S-comparatives, as in (8b), the *yori*-phrase is placed at the beginning of the sentence and can be interpreted as the topic: 'As for the dog, the sheep is bigger than it.' If the topical interpretation overrides the exhaustive listing reading, then S-comparatives might be easier for children to process than A-comparatives despite both being marked with *-ga*. To determine how word order affects children's comprehension of comparatives, it is necessary to present both types of comparatives in a naturally comparable manner. The next chapter reports on Experiment 2, which investigated children's comprehension of both types of comparatives using naturally presented stimulus sentences.

4. Experiment 2: Forced-Choice Picture Selection Task

Experiment 2 employed a forced-choice picture selection task in which participants were asked to look at a pair of pictures with two items differing in length or size and choose the picture that matched a stimulus sentence. While Experiment 1 investigated whether the participants knew how to compare different sizes or lengths among three animals, Experiment 2 required them to directly compare two items, making the exhaustive listing reading of the *ga*-marked associate natural.

4.1 Participants

The participants were 18 Japanese-speaking children (5;5–6;8; *M* = 5;10) and 8 Japanese-speaking adults as controls. Sixteen children participated in Experiment 1 at least one week prior. Children participated with their parents' consent, and adults based on their informed consent.

4.2 Stimuli and Procedure

In the forced-choice picture selection task, participants were instructed to press either a red or blue button as quickly as possible to select the picture that matched the stimulus sentence.(v) Responses and reaction times were automatically recorded by the software.

All the participants were tested individually in a quiet room. The experiment began with a brief training session in which participants practiced pressing the correct button, and their comprehension of the objects and adjectives used in the stimulus sentences was confirmed. No participants reported difficulties during the training session. Target task trials were administered after the training session.

In the target trials, participants were shown a pair of pictures, each with two objects, as shown in Figure 3. To match the color of the buttons on the response pad, the left picture had a blue square

encircling the frame and the right picture a red square. In Figure 3, the blue-framed picture (left picture) shows a toothbrush and spoon, where the toothbrush is longer than the spoon. In the red-framed picture (right picture), the spoon was longer than the toothbrush. Each item was placed in the same position (left or right) in both pictures (toothbrush on the left, spoon on the right). Participants were then asked either an A-comparative (9a) or S-comparative (9b) question. If the participant selected the blue-framed picture by pressing the blue button, their response was recorded as "correct" by the software. However, if they selected the red-framed picture, their response was recorded as "incorrect." In this experiment, stimulus sentences contained two types of size-denoting adjectives (*ookii* 'big,' and *tiisai* 'small') or two types of length-denoting adjectives (*nagai* 'long,' and *mizikai* 'short'). The target trials comprised 16 items belonging to either the A- or S-comparative condition, with an equal number of correct responses (i.e., blue or red). The trials were presented in a random order to each participant.

(9) a. A-comparative condition
Haburasi-ga supun-yori nagai-no-wa
toothbrush-NOM spoon-than long-one-TOP
dotti.
which
'Which is the picture in which the toothbrush is longer than the spoon?'

b. S-comparative condition
Supun-yori haburasi-ga nagai-no-wa
spoon-than toothbrush-NOM long-one-TOP
dotti.
which
'Which is the picture in which the toothbrush is longer than the spoon?'
(lit. 'Which is the picture in which than the spoon, the toothbrush is longer?')

In Experiment 2, we used *ga*-marked comparatives as in Experiment 1. However, as discussed, the comparative sounds more natural in Experiment 2 because the comparative part in the stimulus only compares two objects (i.e., spoon vs. toothbrush), where an exhaustive listing reading (i.e., the toothbrush is the only object bigger than the spoon) is fitting.

The participants were divided into two groups. One group was shown a set of pictures in which the associate object (e.g., *haburasi* 'toothbrush' in (9)) was on the left side in each framed picture (Figure 3). The other group was shown a set of pictures with the same items, but with the associated object on the right side (Figure 4). This design was intended to prevent participants from confusing the associate and standard items.

Figure 3
Example Picture Stimulus in Experiment 2 (Associate on the Left)

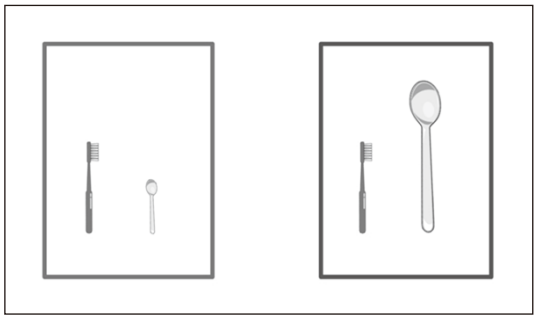
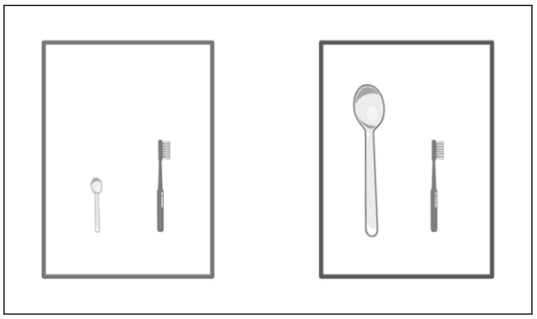


Figure 4
Example Picture Stimulus in Experiment 2 (Associate on the Right)



4.3 Results and Discussion

The results of Experiment 2 are shown in Figure 5. Adults demonstrate an almost complete ceiling performance, but the children performed significantly worse, with correct response rates of 43.8% and 63.2% for A-comparative and S-comparative word orders. While the average correct response rate for children was approximately 50%, a binomial test indicated that the children's performance was significantly different from chance (A-comparative: $p = .002$; S-comparative: $p < .001$), suggesting that children are more likely to correctly interpret S-comparatives, despite their overall lower response rates. Conversely, they tended not to interpret A-comparatives correctly, often confusing the associate and standard items, implying that children may misinterpret A-comparatives as S-comparatives.

To determine whether there was a significant difference in accuracy between A- and S-comparatives, we adopted the same GLMM approach as in Experiment 1, coding participants' responses as binary outcomes and treating 'condition' as a categorical fixed effect: A-comparative or S-comparative. The initial model also included 'kinds of adjective,' 'participant,' and 'item' as random effects. Due to convergence issues, we adjusted the model to 'response ~ condition + (1 | participant).' The summary table for the analysis is presented in Table 2.

The results show that children gave significantly more correct responses ($p < .001$) in the S-comparative than the A-comparative condition. In other words, the children had less difficulty with S-comparative sentences (*estimate* = 1.12, *SE* = 0.29).

We further investigated the potential impact of word order on the participants' reaction times (RT). Initially, we employed a full model using a linear mixed-effects model (LMM) with 'lmer': 'LogRT ~ condition*group + (1 | kinds of adjective) + (1 | participant) + (1 | item).' In this model, the logarithm of RT (LogRT) served as the dependent variable. We included 'condition' (A-comparative or S-comparative) as a categorical fixed effect. Additionally, 'group' was another fixed effect, categorizing participants as adults or children, and we assumed an interaction between these factors. Due to convergence issues, we adjusted the model to: 'LogRT ~ condition*group + (1 | item) + (1 | participant).' Table 3 summarizes this analysis.

Table 3 shows that 'condition' (i.e., word order) did not have a significant impact on RT ($p = .80$).

Figure 5

Rates of Correct Responses in Experiment 2

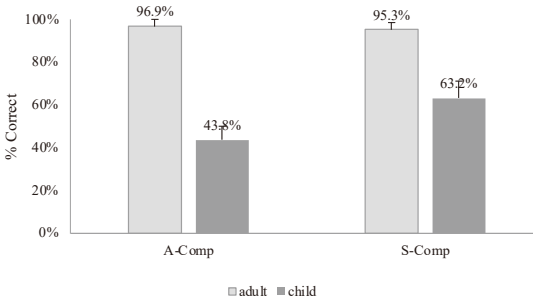


Table 2

Summary of GLMM Analysis for Response in Experiment 2: glmer: response ~ condition + (1 | participant)

Fixed effects:	Estimate	Std. Error	*z*-value	Pr(>|*z*|)
(Intercept)	−0.38	0.42	−0.90	.37
condition (S-comp)	1.12	0.29	3.84	< .001***

Table 3
Summary of GLMM Analysis for Reaction Times in Experiment 2:
*lmer: LogRT ~ condition*age + (1 | item) + (1 | participant)*

Fixed effects:	Estimate	Std. Error	*t*-value	Pr(>|*t*|)
(Intercept)	8.37	0.09	96.71	< .001***
condition (S-comp)	0.02	0.06	0.25	.80
group (child)	0.36	0.1	3.54	< .01**
condition (S-comp) : group (child)	0.07	0.08	0.94	.35

While the difference in RT between children and adults was statistically significant, with children displaying longer RTs ($p < .01$), the lack of a significant interaction between 'condition' and 'group' ($p = .35$) suggests a consistent absence of word order effect for both adults and children.

In summary, Experiment 2 investigated the effects of word order on children's interpretation of comparatives through a forced-choice picture selection task, presenting the *ga*-marked comparatives more naturally than in Experiment 1. We found results consistent with those of Experiment 1, such that S-comparatives were easier for children to comprehend than A-comparatives. Additionally, children seemed to misinterpret A-comparatives as S-comparatives. This indicates that the lower correct response rates for A-comparatives among children reported in Experiment 1 were not due to the unnaturalness of A-comparatives as stimulus sentences. Therefore, despite the small sample size in each experiment, the consistency in children's response patterns across different tasks suggests that word order effects on children's interpretations are robust.

Figure 5 indicates that the accuracy rates for the children in Experiment 2 were lower than those in Experiment 1, perhaps because in Experiment 2, the participants had to compare two sets of objects at the same time to respond to the stimulus sentence, unlike in Experiment 1, where they had to compare just one set of objects. For example, in Figure 3, the participants had to compare the lengths of two objects in both pictures, which could have created a processing burden, resulting in children's poorer performance than in Experiment 1. Despite the difference in correct response rates between the two experiments, the most significant finding is that S-comparatives were easier for children to comprehend than A-comparatives.

In Experiment 2, the children seemed to misinterpret A-comparatives as S-comparatives, which might have been influenced by the fact that S-comparatives are easier for them to comprehend. Having repeatedly heard comparatives as stimulus sentences, the children likely expected further S-comparatives even when A-comparatives actually occurred. Thus, this tendency toward misinterpretation can be seen as evidence supporting the effects of word order on children's understanding of comparatives.

5. General Discussion

Experiments 1 and 2 showed that Japanese-speaking children encounter greater difficulty interpreting A-comparatives than S-comparatives. Moreover, Experiment 2 revealed that they seemed to misinterpret A-comparatives as S-comparatives. Despite the limited number of participants in each experiment, the consistency in children's responses across various tasks indicates that the impact of word order on their comprehension is robust.

Why are S-comparatives easier for children than A-comparatives? One simple explanation would be that in S-comparatives, the sentence-beginning *yori* 'than' phrase allows children to recognize that the stimulus is a comparative. By contrast, when interpreting A-comparatives, the *yori*-phrase determining the representation of the stimulus comes later. This difference in timing might explain why S-comparatives are easier to comprehend than A-comparatives. However, this explanation is unlikely because the children, having repeatedly heard comparatives, likely anticipated further comparative stimuli and did not need to determine whether each stimulus was a comparative. However, participants tended to confuse the associate and standard animals, particularly when presented with A-comparatives. Therefore, this explanation is implausible. The following sections propose two alternative explanations for the great comprehensibility of S-comparatives.

5.1 Basic Order Significance Hypothesis

One possible explanation for their greater difficulty with A-comparatives is that A-comparatives are derived from S-comparatives through scrambling. As reviewed in Section 1, researchers have consistently demonstrated that word order affects parsing in both children and adults (for children, see Hayashibe, 1975; and for adults, see Chujo, 1983; Tamaoka et al., 2005). As sentences in their canonical order are inherently easier to process than in a derived order, it is plausible to hypothesize that canonical order corresponds to S-comparatives, from which A-comparatives are derived.

In previous studies, A-comparatives have commonly been assumed to be the basic word order without analyzing the underlying representation (e.g., Bhatt & Takahashi, 2011). Therefore, A-comparatives are often presented in the literature as examples of Japanese comparatives. However, our findings suggest that S-comparatives are the basic word order. To examine this possibility, we must analyze both types of comparatives syntactically and semantically. We leave this task for future research.

5.2 Pragmatic Processing Facilitation Hypothesis

An alternative explanation of why S-comparatives are easier for children stems from discourse-pragmatic factors. Previous studies have shown that adults tend to express known referents (i.e., topics) earlier than new information, which is referred to as *information structure* (Lambrecht, 1996). Additionally, adults find it easier to comprehend sentences with a given-new ordering than with a new-given ordering (Brown et al., 2012). Therefore, it can be argued that sentences with given-new ordering are generally easier for adults to process than those with the opposite ordering.

In comparatives, to understand an object's size or length, a known object is often used as the standard of comparison, typically introduced by *yori* 'than.' By comparing the object of interest with the standard of comparison, its size and length can be determined. Considering the preference for a given-new information structure, the known standard of comparison (i.e., the *yori*-phrase) might tend to be placed at the beginning of the sentence, which results in S-comparatives.

In both experiments, the participants were introduced to all the objects for comparison before being presented with a stimulus sentence. Consequently, the preference for a given-new information structure would not directly affect the children's performance. Moreover, it remains unclear whether children share adults' preferences regarding information structure. However, if adult Japanese speakers tend to use S-comparatives more than A-comparatives, following discourse preference, children would likely be exposed to more S-comparatives than A-comparatives in their linguistic input.

In summary, we propose two possible explanations as to why S-comparatives are easier for children to comprehend than A-comparatives: the Basic Order Significance and the Pragmatic Processing Facilitation Hypotheses.[vi] These explanations are not mutually exclusive but may be compatible. However, we cannot conclusively determine which explanation is plausible or whether both explanations are simultaneously valid. To reach a conclusion, we need to closely analyze the syntax and semantics of A- and S-comparatives and examine the discourse context in which these comparatives are used. We leave this task for future research. Before concluding, however, we present supportive evidence from a corpus analysis of child-directed speech in Japanese in the following section.

5.3 Corpus Analysis Support

If S-comparatives are the basic or preferred word order in Japanese, they should be produced more frequently than A-comparatives in daily life. Regarding SOV and the scrambled OSV word order, Kuno (1971) demonstrated that SOV and OSV occur in Japanese in a 17-to-1 ratio, suggesting that the canonical or preferred order is SOV. To determine the canonical or preferred order in comparatives, following Kuno's (1971) methodology, we investigated the frequency ratio between A- and S-comparatives.

We searched for comparatives in child-directed speech by adult Japanese speakers in 927 files from 13 Japanese corpora available in the CHILDES database (MacWhinney, 2000), yielding a total sample of approximately 500,000 lines of adult speech. The corpora included Hamasaki (2004), Ishii (2004), Kokuritsu Kokugo Kenkyujo (1981), Miyata (2004a, 2004b, 2004c), Miyata and Nisisawa (2009, 2010), Nisisawa and Miyata (2009, 2010), Noji et al. (2004), Okayama et al. (2013), and Yokoyama and Miyata (2017). As Japanese does not have comparative morphemes like *-er* in English, we identified sentences containing the standard marker *yori* 'than' using the CLAN program. Our search yielded only 308 sentences, 54 of which contained both an associate and standard NP.[vii] Among these target sentences, 15 were A-comparatives and 39 were S-comparatives, for a ratio of 1 to 2.6. This small ratio alone may not be sufficient to conclude definitively that S-comparatives are the basic word order, but it does suggest that S-comparatives could at least be considered the preferred word order.

In summary, our corpus analysis suggests that adult Japanese speakers may prefer S-comparatives over A-comparatives. These findings support both the Basic Order Significance and Pragmatic Processing Facilitation Hypotheses. According to the former, if S-comparatives are the basic word order and A-comparatives are derived, adult Japanese speakers would use S-comparatives more often than A-comparatives, similar to the SOV versus OSV distinction. Additionally, if S-comparatives are preferred based on discourse preferences, this would lead to their more frequent use by adult Japanese speakers. At present, we cannot conclusively determine which explanation is more plausible or whether both are valid simultaneously. Nevertheless, the findings of our corpus analysis are consistent with these explanations. Thus, our study suggests that child language research can shed light on the underlying structures and usage patterns of certain constructions. This goes beyond merely providing insights into children's cognitive processes.

6. Conclusion

This study addresses these two gaps in the literature. While cross-linguistic research has demonstrated that alternative word orders affect children's comprehension, particularly in transitive constructions, there has been little investigation of the impact of word order on children's

understanding of non-transitive sentences, such as comparatives. Furthermore, while acquisition research on comparatives has primarily focused on children's production, with a significant emphasis on English, there is a lack of cross-linguistic data. To bridge these gaps, this study provides empirical evidence of how word order influences the comprehension of comparatives by Japanese-speaking children, thereby contributing to a broader understanding beyond English.

Despite the different experimental tasks, our two experiments yielded consistent results: S-comparatives were more easily comprehended by children than A-comparatives. We propose two possible explanations for these findings: the Basic Order Significance Hypothesis, which posits that S-comparatives are the basic word order from which A-comparatives are derived, and the Pragmatic Processing Facilitation Hypothesis, which suggests a preference for S-comparatives over A-comparatives based on discourse preferences. Further supporting these hypotheses, our corpus analysis of child-directed speech in Japanese indicated that S-comparatives may be the preferred word order among adult Japanese speakers. These explanations are not mutually exclusive but may be compatible. To conclusively determine which explanation is more plausible, or whether both are simultaneously valid, a close analysis of the syntax and semantics of A- and S-comparatives and the discourse contexts in which they are used is necessary. This task should be addressed in future research. However, this study demonstrates that research on child languages can provide valuable insights into the underlying structure and usage patterns of linguistic constructions.

Notes

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(ii) The gloss abbreviations used in this paper are as follows: ACC = accusative, NOM = nominative, PART = particle, PAST = past and TOP = topic.

(iii) The audio stimuli were recorded using the Praat software to ensure controlled prosody across all items, considering that prosody can sometimes affect children's interpretations (cf., Hattori et al., 2006; Minai et al., 2015).

(iv) When the associate in (8a) is marked with the topic marker *wa*, the sentence naturally conveys the intended meaning: 'The sheep is bigger than the dog,' as shown below. However, we did not use the *wa*-marked comparative as our stimulus because the *wa*-marked associate is considered to be topicalized to a position higher than subject, yielding a more complex structure (Chomsky, 1977; Miyagawa, 2017).

Hituzi-wa inu-yori ookii.
sheep-TOP dog-than big
'The sheep is bigger than the dog.'

(v) In the acquisition literature, when reaction times are the focus of analysis, child participants are sometimes instructed to respond as quickly as possible (cf. Devescov et al., 1999). This instruction is particularly relevant when comparing the ease with which the stimuli can be processed.

(vi) An anonymous reviewer suggested that gestures could be a more universally applicable parsing strategy, citing the work of Goldin-Meadow (2011), which posited that gestures indirectly facilitate learning by influencing the learning environment. This insight led us to reflect on our own practice of pointing to the standard animal while presenting slides to the participants. Such gestures might have contributed to easier processing of S-comparatives. We plan to explore this issue in future studies.

(vii) In addition to the 54 target sentences, we identified 34 comparative sentences containing both an associate and standard NP. However, these sentences were right-dislocated comparatives, as illustrated below, and were excluded from the analysis.

< File 50027 in MiiPro corpora>
Koko-yori-wa chikai-yo, Akita-no
here-than-TOP near-PART Akita-GEN
Jiichan-to Baachan (u)chi.
Grampa-and Gramma house
'Grampa and Gramma's house in Akita is nearer (to some place) than here.' (lit. 'It's closer

from here to Grandpa and Grandma's house in Akita')

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