A Note on Japanese Children's Absolute Interpretation of Differential Verbal Expressions*

Tomoe Arii
University of Tokyo/JSPS Research Fellow

allie522@gmail.com

Keywords: children's non-adult-like interpretation, differential phrases, differential comparatives, differential verbal expressions

1. Introduction

It has been reported that English- and Japanese-speaking children assign an "absolute interpretation" to "differential comparatives" like (1) and (2) (Gibb (1956), Riley et al. (1983), Nunes and Bryant (1996), Arii (2012), etc.).[1]

(1) a. This building is 20 meters higher.
b. The boy has two more apples.

(2) a. Kono biru-wa 20-meetoru takai.
this building-TOP 20-meter higher
'This building is 20 meters higher'
b. Otokonoko-no ringo-wa ni-ko ooi.
boy-GEN apple-TOP two-CL more
Literal meaning: 'The boy's apples are two more.'
Intended meaning: 'The boy has two more apples.'

The numeral phrases in the above sentences denote a differential. However, children do not interpret them as a differential. Instead, they interpret them as the amount of degrees of a certain property which the subject has. For example, they interpret (1a) and (2a) as 'This building is 20 meters high' and interpret (1b) and (2b) as 'The boy has two apples.' We will call this type of children's interpretation as an absolute interpretation.[2]

Moreover, Arii (2012) reports that Japanese-speaking children also assign an absolute interpretation to another differential expression like (3).

(3) Otokonoko-no-ringo-wa ni-ko fue-ta.
boy-GEN-apple-TOP two-CL increase-PAST
'The number of apples the boy has has increased by two.'

This differential expression has a similar surface structure to differential comparatives in Japanese. We will call the expression in (3) as a "differential verbal expression." These previous studies suggest that children's absolute interpretation of a differential phrase is robust and that children cannot map a numeral phrase to a differential.

* I am grateful to Akira Watanabe, Takuya Goro, Kristen Syrett, Miwa Isobe, TPL members and two anonymous reviewers for insightful comments and suggestions. My gratitude also goes to peer reviewers. I am also grateful to teachers and children in the two nursery schools: Hagizono Aijien and Shonan Nadeshiko Hoikuen in Chigasaki. All remaining errors are, of course, my own.

[1] So far there are no studies which investigate and compare English- and Japanese-speaking children's interpretation of differential comparatives in the same experimental design.

[2] My ongoing research shows that many children who give an absolute interpretation to differential comparatives can appropriately interpret comparatives which do not include a differential phrase like *this building is higher*. It suggests that children's interpretative difficulty is limited to differential comparatives.

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Although these previous findings are clear, we have to examine each experimental design before accepting the picture of children's non-adult interpretation because previous findings can be sometimes artifacts.

This short paper examines the experiment of Arii (2012) on Japanese-speaking children's interpretation of differential verbal expressions and points out a possible deficit in the experiment. Then, a revised experiment shows that children still show absolute responses and their absolute interpretation is quite robust.

The organization of this paper is as follows. Section 2 reviews previous studies on children's absolute interpretation of differential comparatives and differential verbal expressions. After we see that the previous experiment in Arii (2012) has a deficit, Section 3 examines Japanese-speaking children's interpretation of differential verbal expressions with a revised experiment. Section 4 concludes.

2. Background

2.1. Two Hypotheses on Children's Absolute Interpretation of Differential Comparatives

Before moving on to children's acquisition of differential verbal expressions, we have to first review a controversy over the source of children's absolute interpretation of differential comparatives. In the field of mathematics education, comparison problems are notoriously difficult for children, which require them to determine a differential between two sets, e.g., "A boy has three apples and a girl has two apples. How many more apples does the boy have than the girl?" Even young school children wrongly answer the number of the boy's apples, three, instead of answering the differential between the two sets of apples, namely, one. Concerning it, two kinds of hypotheses have been proposed: a Linguistic Hypothesis (Hudson (1983)) and a Cognitive Hypothesis (Nunes and Bryant (1996)). The Linguistic Hypothesis holds that their absolute interpretation is due to their non-adult grammatical representation of comparatives (Hudson (1983)). On the other hand, the Cognitive Hypothesis holds that their absolute interpretation is due to their limited cognitive resources for doing subtraction (Nunes and Bryant (1996)).

Hudson (1983) shows when problems that involve comparing sets are expressed without using a differential comparative, children can solve them. In his experiment, a child participant was shown a picture where five children and three balloons were depicted. When he was asked "How many more children than balloons?" (*More* task), he wrongly answered the number of the children, five. In contrast, when he was asked "How many children won't get balloons?" (*Won't Get* task), the child correctly answered the differential, two. Based on these findings, Hudson (1983) argues that since children display an ability to establish correspondences between two sets in the *Won't Get* task, their failure in the *More* task involves their difficulty in understanding the meaning of comparatives.

On the other hand, Nunes and Bryant (1996) present a different explanation for children's difficulty in solving a comparison problem. First, they cast doubt on Hudson's (1983) linguistic hypothesis on the basis of the fact that 6- and 7-year-olds are successful in answering the question "Who has more/less?" Second, they argue that in order to quantify the difference between the sets it is necessary to connect an action on objects (the notions of addition and subtraction and a one-to-one correspondence strategy) with the situation where the question refers to a static relation. In Hudson (1983), in the *Won't Get* task there is a clear indication of what children need to do with the objects to answer the question, "How many children won't get balloons?" They need to make two matching sets and count out the remaining objects in the larger set. The one-to-one correspondence strategy is cued by the *Won't Get* task. In contrast, there are no such cues in the comparison problems. Moreover, the notions of addition and subtraction are not cued in the static comparison because children's initial conceptions of addition and subtraction are taken to be based on increasing or decreasing a quantity. So, neither the one-to-one correspondence strategy nor the notions of addition and subtraction is cued in the comparison problems. They argue that this is why children have difficulty in solving comparison problems and support the Cognitive Hypothesis.

2.2. Arii's (2012) Experiment on Children's Interpretation of Differential Verbal Expressions

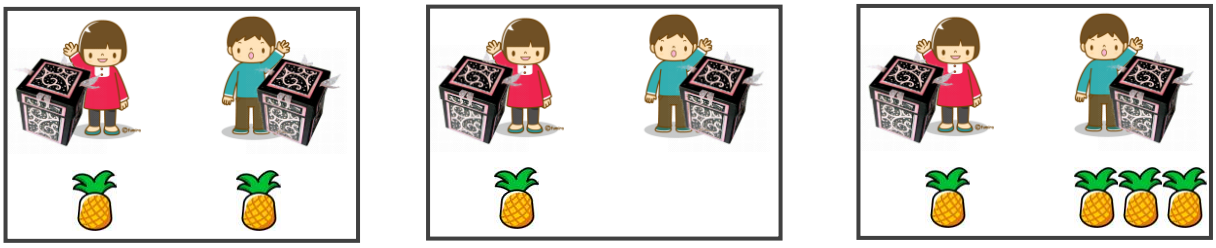
Responding to Nunes and Bryant's (1996) first argument that Hudson's (1983) linguistic hypothesis does not stand because 6- and 7-year-olds are successful in answering the question "Who has more/less?," Arii (2012) argues that differential comparatives like *this building is 20 meters higher* have a more complex underlying structure than simple comparatives like *this building is higher* and that it is possible that children's difficulty is specific to interpreting differential comparatives. Therefore, we should not abandon the Linguistic Hypothesis just because children can appropriately interpret such simple comparatives.

Moreover, showing that Japanese speaking children aged five to six years also assign an absolute interpretation to differential verbal expressions like (4), Arii (2012) argues that the second argument of Nunes and Bryant (1996) that children cannot solve comparison problems because they cannot connect an action on objects with static comparison does not stand.

(4) Otokonoko-no-painappuru-wa ni-ko fue-ta.
boy-GEN-pineapple-TOP *two-CL* *increase-PAST*
'The number of pineapples the boy has has increased by two.'

A situation expressed with differential verbal expressions like (4) involves comparing sets and it also involves a change unlike the one expressed with a differential comparative: it compares the number of objects before and after an increasing event. Nunes and Bryant (1996) argue that children cannot connect an action on objects with static comparison because nothing is added or taken away and the situation does not cue the notion of addition and subtraction. Unlike the *Won't Get* task in Hudson (1983), the one-to-one correspondence strategy is not cued, either. If the argument of Nunes and Bryant (1996) is right, children should be able to interpret (4) appropriately because the situation expressed with it is not static comparison. In the situation, objects (e.g. pineapples) are added and the notions of addition and subtraction are obviously cued. Given the argument of Nunes and Bryant (1996), children should be able to interpret (4) in an adult-like way.

However, the experiment in Arii (2012) shows the opposite. Children interpret (4) as 'the number of pineapples the boy has (after an increasing event) is two.' In the experiment, child participants (5;4-6;3, mean age: 6;0) were shown three slides, as shown in Figure 1.



Slide 1. Slide 2. Slide 3.

Figure 1. Pictures used in the experiment of Arii (2012)

First, a girl and a boy each have a pineapple. Then, they put it into their magic box [Slide 1]. An experimenter said "Let's see what has happened to the girl's pineapple" and confirmed that nothing had changed [Slide 2]. She asked a puppet to make a prediction about the boy's pineapple. The puppet said "I think the number of pineapples the boy has has increased by two (in Japanese (4))." Finally, the experimenter showed a child Slide 3 and asked him whether the puppet's prediction was right. On the basis of his judgment, we can know what interpretation he assigned to the differential verbal expression.

This experiment is seemingly designed well. However, using two characters (the girl and the boy) can be

problematic because the situation depicted in Slide 3 corresponds to static comparison; in Slide 3 children have to compare the number of pineapples the two characters have. Nunes and Bryant (1996) argue that problems involving static comparison are difficult for children because nothing is added or taken away and the connection between the situation and an operation on objects that would lead to problem solution is not clear. Although in the experiment above the number of pineapples increases and the experiment does involve a change, it is possible that the static comparison in Slide 3 makes it difficult for children to do subtraction. The next section introduces a revised experiment on children's interpretation of differential verbal expressions.

3. Experiment

3.1. Participants and Design

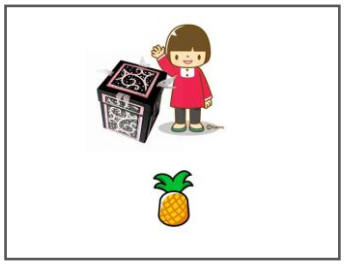
20 Japanese-speaking children (4;4-6;3, mean age: 5;6) who were able to do simple arithmetic participated in this experiment. Three additional children were excluded due to their continuous 'yes' responses to all items except filler items.[3] The 20 children were individually investigated on their interpretation of differential verbal expressions like (5).

(5) Otokonoko-no-ringo-wa ni-ko fue-ta.
boy-GEN-apple-TOP *two-CL* *increase-PAST*
'The number of apples the boy has has increased by two.'

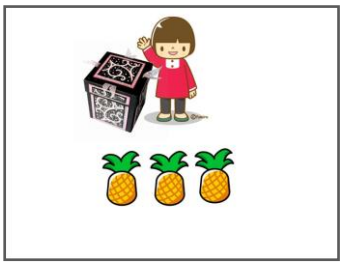
The same experimental design as Arii (2012) was adopted except the number of characters. The experiment employed Truth Value Judgment Tasks (TVJT) in 'prediction mode' (Chierchia et al. (1998)). First, an experimenter told a story by using a PowerPoint presentation on a lap-top computer. At that time, a puppet watched the slides alongside a child. Before shown the last slide, the puppet was asked to make a prediction about the number of objects a character had and he made a prediction (a stimulus sentence). Then, showing the last slide, the experimenter asked the child whether the puppet's prediction was right. Based on their judgment, we can know their interpretation of (5).

The experiment consists of three conditions: a comparative condition, an absolute condition and a neutral condition, illustrated below.

(6) Comparative Condition
a. Series of slides



Slide 1.



Slide 2.

[3] It is possible that these three children ignore the differential phrase in differential verbal expressions and interpret (5) as 'The number of apples the boy has has increased.' If they interpret them in this way, they should accept the stimulus sentence in all the conditions, which will be introduced shortly, because the number of objects a character has has always increased. Children's continuous 'yes' responses have been reported in experiments on children's interpretation of differential comparatives in Arii (2013). For more detail, see Arii (2013).

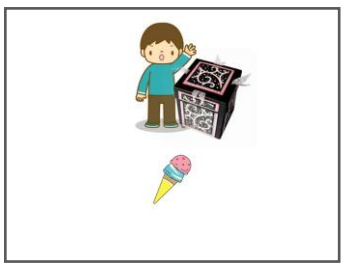
b. Puppet's prediction about the girl's pineapples

Onnanoko-no	painappuru-wa	ni-ko	fue-ta-to-omou-yo.
girl-GEN	*pineapples-TOP*	*two-CL*	*increase-PAST-COMP-think-EXCL*

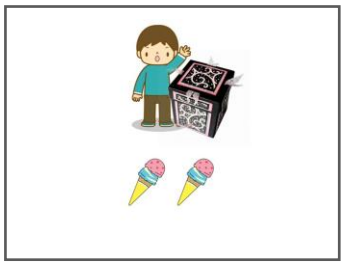
'I think the number of pineapples the girl has has increased by two.' [true]

(7) Absolute Condition

a. Series of slides



Slide 1.



Slide 2.

b. Puppet's prediction about the boy's ice creams

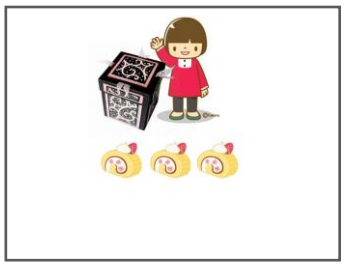
Otokonoko-no	aisucriimu-wa	ni-ko	fue-ta-to-omou-yo.
boy-GEN	*ice cream-TOP*	*two-CL*	*increase-PAST-COMP-think-EXCL*

'I think the number of ice creams the boy has has increased by two.' [false]

(8) Neutral Condition

a. Series of slides

Slide 1.



Slide 2.

b. Puppet's prediction about the girl's cakes

Onnanoko-no	keiki-wa	i-kko	fue-ta-to-omou-yo.
girl-GEN	*cake-TOP*	*one-CL*	*increase-PAST-COMP-think-EXCL*

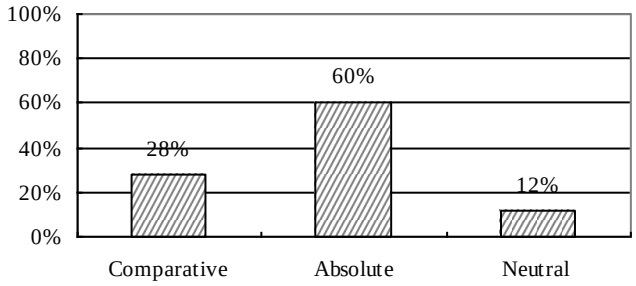
'I think the number of cakes the girl has has increased by one.' [false]

A crucial point is that the number of characters is only one, and we do not have to compare the number of objects two characters have. So, the situation in Slide 2 does not constitute static comparison and it is a true change problem. In the comparative condition, the comparative reading of the differential phrase makes the stimulus sentence true, and (6b) is acceptable to Japanese-speaking adults. On the other hand, if they assign an absolute interpretation to the differential phrase, children should reject (6b). In the absolute condition, the absolute reading of the differential phrase makes the stimulus sentence true, and (7b) is unacceptable to Japanese-speaking adults. On the other hand, if children assign an absolute interpretation to the differential phrase, children should accept (7b). Lastly, in the neutral condition, neither reading makes the stimulus sentence true. Japanese-speaking adults reject (8b). Regardless of whether children assign an absolute or comparative interpretation to the differential phrase, they should reject (8b). Whenever they reject the stimulus sentences, children are asked to justify their rejection. If they appropriately assign a comparative interpretation to the differential phrase in the neutral condition, children should reject (8b), saying the number of cakes the girl has has increased not by one but by two. In contrast, if they assign an absolute interpretation to the differential phrase in the neutral condition, children

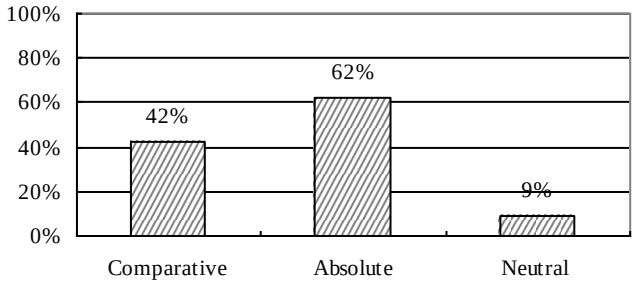
should reject (8b), saying that the number of cakes the girl has is not one but three. Based on their judgment and justification, we can tell what interpretation they assign to the differential phrase in differential verbal expressions. This experiment consists of 12 trials: 3 filler tasks, 3 tasks in the comparative condition, 3 tasks in the absolute condition and 3 tasks in the neutral condition. Sentence order was counterbalanced across children.

3.2. Results and Discussion

All of the children correctly responded to filler tasks 100% of the time. On the other hand, they responded correctly 52.0% (94/180) of the time in the target conditions. The rates of acceptance in each condition are presented in Figure 2, where we can compare the rates of the revised experiment and that of the previous experiment of Arii (2012).



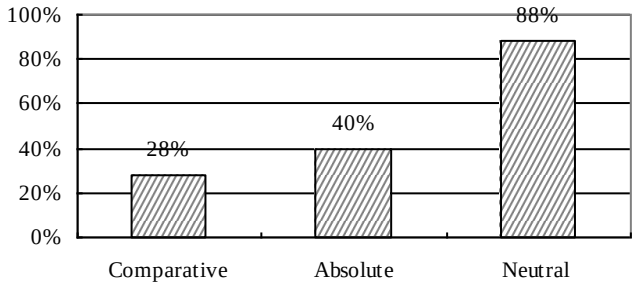
(i) Revised ver.



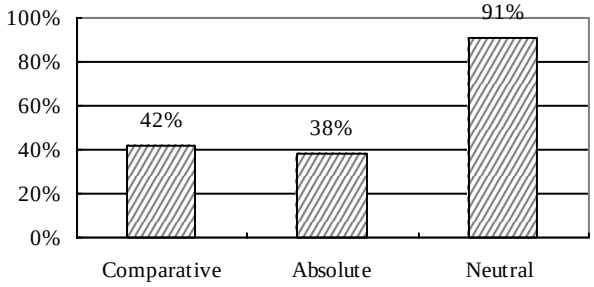
(ii) Previous ver.

Figure 2. The rates of acceptance in each condition

In the revised experiment, children correctly accepted the puppet's statement 28.3% (17/60) of the time in the comparative condition, wrongly accepted it 60.0% (36/60) of the time in the absolute condition, and wrongly accepted it 11.6% (7/60) of the time in the neutral condition. The rates of their correct responses in each condition are presented in Figure 3, where we can compare the rates of this revised experiment and that of the previous experiment of Arii (2012).



(i) Revised ver.

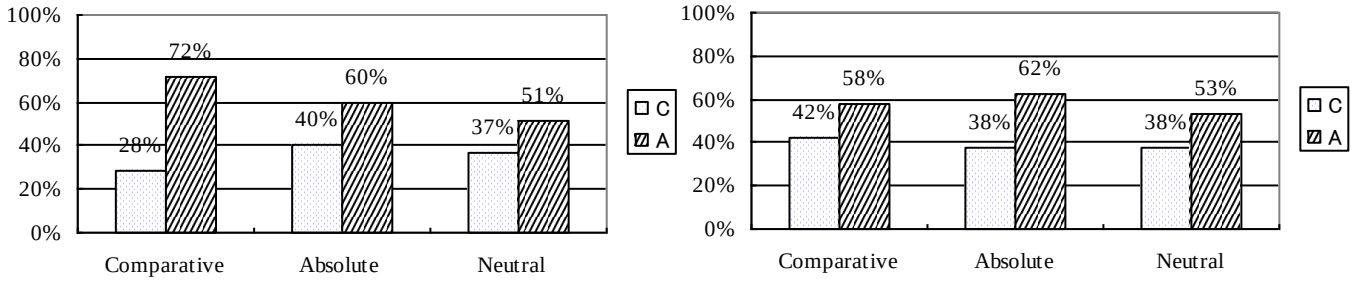


(ii) Previous ver.

Figure 3. The rates of correct answers in each condition

In the revised experiment, children correctly responded 28.3% (17/60) of the time in the comparative condition, 40.0% (24/60) of the time in the Absolute condition, 88.3% (53/60) of the time in the neutral condition. Similarly to the previous experiment, many children rejected the stimulus sentence in the comparative condition and accepted it in the absolute condition.

Based on their responses and justification, their interpretation of the differential phrase in differential verbal expressions is scored as comparative (C) or absolute (A). The rates of their absolute and the comparative readings in each condition are represented in Figure 4, where we can compare the rates of each reading of this revised experiment and that of the previous experiment of Arii (2012).

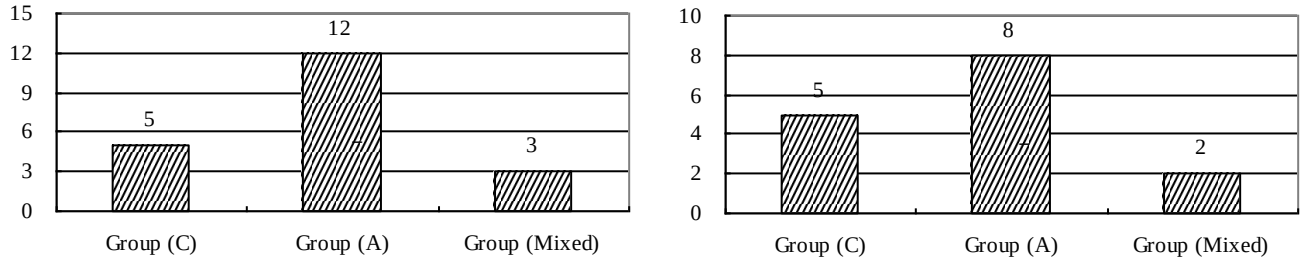


(i) Revised ver. (ii) Previous ver.

Figure 4. The rates of the absolute and the comparative readings in each condition

In the revised experiment, children interpreted the stimulus sentence as comparative 28% (17/60) of the time in the comparative condition, 40% (24/60) of the time in the absolute condition and 37% (22/60) of the time in the neutral condition.[4]

Moreover, children are classified into three groups based on their interpretation of the stimulus sentence. When their responses and justification in all conditions are scored as C, such children are classified into Group (C). On the other hand, when their responses and justification in all conditions are scored as A, such children are classified into Group (A). Lastly, when their scores include both C and A, such children are classified into Group (Mixed). As shown in Figure 5, in the revised experiment, 5 children are classified into Group (C), 12 children are classified into Group (A) and 3 children are classified into Group (Mixed). In the same way as the previous experiment, given that only a few children are classified into Croup (Mixed), most of children's interpretation of the stimulus sentences is consistent.



(i) Revised ver. (ii) Previous ver.

Figure 5. Classification of the children based on their interpretation of the stimulus sentence

As we have seen, even in the non-static comparison situation children assign an absolute interpretation to the differential phrase in differential verbal expressions. In contrast to Nunes and Bryant (1996), this shows that the reason why children cannot solve comparison problems is not because they cannot connect an action on objects with static comparison. This experiment suggests that children's difficulty in solving comparison problems is related to their interpretation of constructions which include a differential phrase like differential comparatives and differential verbal phrase. If the source of their difficulty is linguistic, it is possible that children have difficulty in mapping a numeral phrase to a differential. However, we cannot settle the controversy over the source of children's absolute interpretation only with this finding. In order to determine whether the source is linguistic or cognitive, we have to further examine children's cognitive abilities required in solving a comparison problem.

[4] Regarding children who wrongly accepted the puppet's statement in the neutral condition, we cannot tell what interpretation they assign to the differential phrase because in the neutral condition, neither the comparative nor the absolute makes the stimulus sentence true. In Figure 4, only responses of children who rejected the stimulus sentence are counted in the neutral condition. Therefore, the sum of the comparative and absolute responses in the condition does not constitute 100% of the time.

4. Conclusion

This short paper has reexamined Japanese-speaking children's interpretation of differential verbal expressions and has shown that their absolute interpretation of them is quite robust. This finding does not support Nunes and Bryant's (1996) argument that children cannot solve comparison problems because they cannot connect an action on objects with static comparison. In order to determine the source of children's absolute interpretation (a Linguistic or a Cognitive Hypothesis), further research is required.

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