A Linguistic Approach to Children's Absolute Interpretation of Differential Comparatives*

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Comparison problems are notoriously difficult for kids, 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. Children seem to interpret the differential phrase, how many *not as comparative but as absolute. This paper introduces a pilot experiment to settle a controversy over the source of children's absolute interpretation: linguistic or cognitive, and shows their absolute interpretation is not caused by their limited cognitive resources for quantifying a differential between two sets. Another pilot experiment scrutinizes their absolute interpretation and reveals what underlying representation it has. Finally, reviewing previous semantic analyses of differential comparatives, we argue that child grammar lacks a functional head which introduces a degree argument and that this lack causes their absolute interpretation of differential comparatives.*

Keywords: children's non-adult interpretation, differential comparatives, differential verbal expressions, differential phrase, subtraction operation, semantics of differential expressions

1. Introduction

Japanese does not have a comparative morpheme like *-er* in English and the adjectives in (1) are ambiguous: they have both comparative and non-comparative interpretations.[1]

(1) a. Kono biru-wa takai.
this building-TOP high/higher
'This building is high/higher.'
b. Otokonoko-no ringo-wa ooi.
boy-GEN apple-TOP many/more
Literal meaning: 'The boy's apples are many/more.'
Intended meaning: 'The boy has many/ more apples.'

When a standard phrase headed by *yori* 'than' is overtly expressed, the adjectives have only a comparative meaning, as shown in (2).[2]

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[1] This paper uses the following abbreviations in the glosses: CL: classifier, COMP: complementizer, COP: copula, GEN: genitive, LOC: location, PAST: past, PRES: present, STATE: state and TOP: topic.

[2] Sawada (2013) points out that *yori* is also used as a comparative morpheme as in (i).

(i) **Yori** ooku-no nihon-jin-ga Denver-yori New York-ni sun-deiru.
more many-GEN Japanese-people-NOM Denver-than New York-LOC live-STATE
'More Japanese people are living in New York than in Denver.'

Originally, Japanese did not have a comparative morpheme, but Modern Japanese has developed the new comparative morpheme usage of *yori* 'more' under the influence of translation from European languages, especially from Dutch.

(2) a. Kono biru-wa ano biru-yori takai.
this building-TOP that building-than higher
'This building is higher than that building.'
b. Otokonoko-no ringo-wa onnanoko-no-yori ooi.
boy-GEN apple-TOP girl-GEN-than more
Literal meaning: 'The boy's apples are more than the girl's.'
Intended meaning: 'The boy has more apples than the girl.'

Another way to make the adjectives unambiguous is adding a differential phrase like *20 meters* in front of the adjectives. The adjectives in (3) have only a comparative interpretation (Kikuchi (2002), Nakanishi (2004) and Kubota (2011)).

(3) 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.'

Following von Stechow (1984), we will call this type of comparative "differential comparatives" because a differential is overtly expressed in the comparatives.[3]

Previous studies have reported that children aged five-to-six years have difficulty in interpreting differential comparatives. Studies in the field of mathematics education have reported that "comparison problems" are notoriously difficult for English-speaking children. The comparison problems require them to determine a differential between two sets, i.e., "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 (Gibb (1956), Riley et al. (1983), and Nunes and Bryant (1996)). A similar difficulty for children has also been reported in the field of psychology (Duthie (1963) and Hudson (1983)). In the field of psycholinguistics, it has been reported that Japanese-speaking children also respond in a similar way (Arii (2010), (2011), (2012a), (2012b), (2012c) and (2013a)). For instance, they interpret *20 meetoru* '20 meters' in (3a) not as the differential between the heights of the two objects but as the height of this building, i.e., 'This building is 20 meters high.' In the same way, they misinterpret (3b) as 'The boy has two apples.' We will call this non-adult interpretation the "absolute interpretation" (and we will refer to children's non-adult response in their solving a comparison problem as an "absolute response") because they interpret the differential phrase not as comparative but as absolute.[4]

Concerning children's absolute interpretation of differential comparatives, two kinds of hypotheses have been proposed: a Linguistic Hypothesis and a Cognitive Hypothesis. The Linguistic Hypothesis holds that their absolute interpretation is due to their non-adult grammatical representation of comparatives (Hudson (1983)). On the other

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Sawada (2013) argues that the two kinds of *yori* are lexically different. This comparative morpheme is used in formal conversation and we cannot find the usage in children's daily speech. So, this paper does not take account of this usage of *yori*.

[3] The differential in comparatives is expressed not only with a numeral phrase like the measure phrase (MP) in (3a) and the numeral classifier phrase in (3b) but also with a quantifier phrase like *much* and *a little*. This paper mainly discusses differential comparatives whose differential is expressed with a numeral phrase. Section 6 discusses differential comparatives whose differential is expressed with a quantifier phrase.

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

hand, the Cognitive Hypothesis holds that their absolute interpretation is due to their limited cognitive resources for quantifying a differential between two sets (Nunes and Bryant (1996)).

This paper introduces two pilot studies. In the first pilot experiment, we will present experimental evidence for the Linguistic Hypothesis, showing that Japanese-speaking children aged five-to-six can do subtraction in order to determine a differential between two sets. The scale of the experiment is small so far, but given previous findings that children can resort to another strategy to determine the differential, it is enough for informing us that children have the ability to quantify the differential between two sets, which is necessary to solve a comparison problem. The second pilot study scrutinizes what underlying representation an absolute interpretation has. It reveals that children do not all share a single underlying representation. Instead, they assign various non-adult interpretations to differential comparatives. It suggests that once a differential phrase is added to the comparative, children come to be unable to compositionally interpret them as adults do. Then, children would have to resort to some other, non-compositional strategy to deal with the uninterpretable differential phrase, which would lead to various non-adult interpretations of differential comparatives. In order to understand children's non-adult interpretations and their acquisition of differential comparatives, we will review two kinds of semantic analyses of differential comparatives: the analysis of Schwarzchild (2005) and that of Kennedy and McNally (2005), Svenonius and Kennedy (2006), Kennedy and Levin (2008) and Grano and Kennedy (2012). After showing that the former analysis makes a wrong prediction about acquisition of comparatives, we will show that the latter analysis is compatible with our findings. On the basis of these latter studies, we will argue that child grammar lacks a functional head which introduces a degree argument and that this causes children's non-adult interpretations of differential comparatives.

The contribution of this paper is as follows:

- In the 1960s to the 1970s, children's acquisition of comparatives was enthusiastically studied in the field of psychology. Many studies reported that children had great difficulties in acquiring comparatives but they didn't make productive discussion about what the source of their difficulty was. Moreover, degree expressions have not received much attention in the field of psycholinguistics. This paper sheds new light on children's difficulty in acquiring comparatives by analyzing the source of their difficulty via linguistic theory.
- Concerning the source of children's difficulty in solving a comparison problem, this paper provides a piece of experimental evidence for the Linguistic Hypothesis.
- Another experimental finding reveals what underling representation children's absolute interpretation has.
- An analysis of differential comparatives in adult grammar has to be one which can explain children's acquisition process of differential comparatives. In this sense, our findings contribute to narrowing down possible analyses of differential comparatives in adult grammar.

The organization of this paper is as follows. Section 2 reviews previous studies on children's acquisition of comparatives. After that, it reviews previous studies especially on their acquisition of differential comparatives and two competing hypotheses on it. Section 3 introduces two pilot experiments. We will examine whether children's absolute interpretation of differential comparatives is due to their limited cognitive resources for quantifying a differential between two sets and seek what underlying representation their absolute interpretation has. In section 4, we will have an interim discussion. Section 5 reviews the analysis of Schwarzchild (2005) and that of Kennedy and McNally, Svenonius and Kennedy (2006), Kennedy and Levin (2008) and Grano and Kennedy (2012), and shows the latter is compatible with our experimental findings. Section 6 notes remaining issues. Section 7 concludes.

2. Previous Studies on Children's Interpretation of Comparatives

First, we will review previous studies on children's acquisition of comparatives in general. Then, we will review previous studies on children's interpretation of differential comparatives and two competing hypotheses on

it.

2.1. Acquisition of Comparatives

Many researchers have converged on the conclusion that children undergo stage-like development in acquiring adult-like usage and interpretation of comparatives (cf. Piaget (1928), Sinclair de Zwart (1967), Donaldson and Balfour (1968), Donaldson and Wales (1970), Clark (1970), Townsend (1974), Ehri (1976), Carey (1978), Syrett (to appear), etc.). Compared with other grammatical constructions, it takes a long time to acquire comparatives. For instance, there is a stage where children seem to interpret *less* as *more*, which lasts about five years (cf. Donaldson and Balfour (1968), Clark (1970), Donaldson and Wales (1970), Clark (1973), Ehri (1976) and Carey (1978)).[5] In addition, the presence of an explicit standard phrase (e.g. *than*) does not improve children's performance when they poorly perform on truncated comparatives (Sinclair de Zwart (1967), Townsend (1974), Ehri (1976), Arii (2010), etc.).[6,7]

2.2. Acquisition of Differential Comparatives

Children's difficulty in interpreting differential comparatives has been reported in many fields: mathematics education (Gibb (1956), Riley et al. (1983), and Nunes and Bryant (1996)), psychology (Duthie (1963) and Hudson (1983)) and psycholinguistics (Arii (2010), (2011), (2012a), (2012b), (2012c), (2013a) and (2013b)). Arii (2010, 2011, 2012a, 2012b and 2013a) reports that Japanese-speaking children aged five-to-six years wrongly assign an absolute interpretation to differential comparatives like (4).[8]

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[5] Donaldson and Balfour (1968), Clark (1970) and Donaldson and Wales (1970) argue that children acquire the positive polar adjective earlier than the negative one and that they misinterpret *less* as *more*. On the other hand, Carey (1978) argues that there is no such "*less* is *more* stage" by showing that children showed a similar response pattern to *less* and a novel word *tiv*. Children just exhibit a response bias towards increasing a quantity in response to a request like "Give me more/less X."

[6] Komine (2012) investigates Japanese-speaking children's interpretation of disjunction in a standard phrase of comparatives like (i).

(i) Aoi hana-wa [kiiroi-no-ka akai-no-yori] ookii.
blue flower-TOP yellow-GEN-or red-GEN-than bigger
Literally: 'The blue flower is bigger than the yellow one or the red one.'

In Japanese adult speech, the disjunction receives a disjunctive interpretation, and (i) means 'the blue flower is bigger than the yellow one OR the blue flower is bigger than the red one.' On the other hand, Komine (2012) reports that children aged five-to-six years assign a conjunctive interpretation to the disjunction, namely, 'the blue flower is bigger than the yellow one AND the blue flower is bigger than the red one.' She argues that this non-adult interpretation is due to a default state of the scope relation between the disjunction and the standard phrase. However, given the previous studies on acquisition of comparatives, it is quite possible that children's apparent conjunctive interpretation is caused by their ignoring the standard phrase. In her experimental design, there are three flowers. A red one is the biggest and a yellow one is the smallest. A blue flower is smaller than the red one but is bigger than the yellow one. While adults accepted the description in (i), most children rejected it. Ignoring the standard phrase, children might have taken (i) as 'The blue flower is big/bigger' and judged (i) false because the red flower is the biggest. This point has to be further investigated.

[7] Constructions including a bare adjective like *this building is high* are often referred to as "covert comparatives" because we judge this description true if this building is higher than a standard of comparison, namely, the average height of buildings. So, the standard of comparison for bare adjectives can be taken in the same way as the standard headed by *than* for comparative adjectives. Barner and Snedeker (2008) and Syrett et al. (2009) report that young children can appropriately shift the standard of comparison for bare adjectives in accordance with context. It is intriguing whether acquisition of the standard for bare adjectives and that for comparative adjectives is correlated. This topic is left for future research.

[8] In the experiments of Arii, a novel unit of measurement, *kirari*, was used in a stimulus sentence. Using the novel unit of measurement makes it possible to present children with a stimulus sentence which does not require them to have prior knowledge about the specific words for the units of measurements such as *meter*, *kilogram*, etc.

(4) a. Kono biru-wa 20-meetoru takai/hikui.
this building-TOP 20-meter higher/lower
'This building is 20 meters higher/lower.'

b. Otokonoko-no ringo-wa ni-ko ooi/sukunai.
boy-GEN apple-TOP two-CL more/fewer
Literal meaning: 'The boy's apples are two more/fewer.'
Intended meaning: 'The boy has two more/fewer apples.'

As shown above, the differential phrase can combine with both positive adjectives (e.g. *higher*) and negative adjectives (e.g. *lower*). Regardless of the polarity of adjectives, children interpret (4a) as 'this building is 20 meters high' and interpret (4b) as 'The boy has two apples.' Given that English-speaking children also interpret differential comparatives absolutely, their absolute interpretation is not due to lack of a comparative morpheme like *-er* in Japanese. Moreover, they also assign an absolute interpretation to differential comparatives whose standard phrase marked with *yori* 'than' is overtly expressed as in (5). When they interpret differential comparatives, they seem to neglect the standard phrase.[9]

(5) a. Kono biru-wa ano biru-yori 20-meetru takai.
this building-TOP that building-than 20-meter higher
'This building is 20 meters higher than that building.'

b. Otokonoko-no ringo-wa onnanoko-no-yori ni-ko ooi.
boy-GEN apple-TOP girl-GEN-than two-CL more
'The boy has two more apples than the girl.'

On the other hand, they appropriately assign an absolute interpretation to the "measure phrase (MP) absolute construction" in (6) where the numeral phrase refers not to a differential but to the degree of height the subject has.[10,11,12]

(6) Kono biru-wa taka-sa 20-meetoru-da.
this building-TOP high-sa 20-meter-COP
'This building is 20 meters high.'

In addition to differential comparatives, Arii (2012c and 2013b) investigates Japanese-speaking children's interpretation of "differential verbal expressions" like (7), which have a surface structure similar to differential comparatives.

[9] My ongoing research shows that many children who give an absolute interpretation to differential comparatives can appropriately interpret simple comparatives which do not include a differential phrase like *this building is higher*. This suggests that children understand the meaning of the standard phrase itself and their non-adult interpretation is specific to differential comparatives.

[10] Following Kennedy (1999), we will refer to constructions including a bare adjective as "absolute constructions." In particular, we will refer to constructions like (6) as "MP absolute constructions."

[11] Contrary to Snyder et al. (1995), Watanabe (2013) argues that Japanese has MP absolute constructions, as shown in (6). He argues that *takasa* in (6), which appears to be the nominalized form of the adjective *takai* 'high,' functions as an adjective because if *takasa* is a nominal, it would be ungrammatical without a case marker. The morphological shape *taka-sa* is taken to reflect agreement with a functional head.

[12] Section 5.2 shows a possibility that children have a non-adult underlying representation of (6) and their apparently appropriate interpretation of it might be caused by their bias toward taking MPs as a cardinality value.

(7) 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.'

Children also assign an absolute interpretation to (7), and interpret (7) as 'The boy has two apples (after an increasing event).' These previous studies suggest that children have difficulties in mapping a numeral phrase to a differential.

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

Concerning children's absolute interpretation of differential comparatives, two kinds of hypotheses have been proposed: a Linguistic Hypothesis (Hudson (1983)) and a Cognitive Hypothesis (Nunes and Bryant (1996)). Hudson (1983) shows that when problems that involve comparing sets are expressed without using a differential comparative, children can solve them. He presented English-speaking children aged six-to-seven years with a picture where two sets of items were depicted (e.g., children and balloons), as shown in Figure 1.

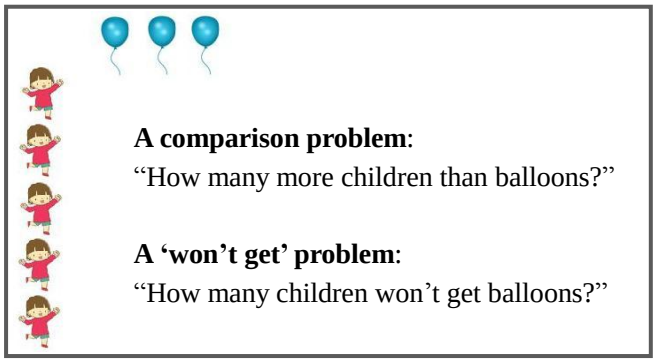


Figure 1. Simplified depiction of a picture used in Hudson (1983)

The items were positioned in order not to form an obvious visual pairing of the items in the two sets. Each picture showed two sets of items whose numerical difference was either one, two, or three. Half of the problems were presented as a comparison problem (e.g., *How many more children than balloons?*) and the other half were presented through a question that suggested to the children the idea of using a one-to-one correspondence strategy (e.g., *If all the children race and try to get a balloon, how many children won't get balloons?*).[13] Hudson (1983) observed that while 100% of the children responded correctly in the *Won't Get* task, only 64% of the children responded correctly to the *More* task. Many children gave an absolute response to the *More* question: they said five, the number of the children in Figure 1. Hudson (1983) conducted another experiment where items of two sets in a picture were aligned in order to visually highlight one-to-one correspondences between the sets. Even in this experiment, many children showed absolute responses to the *More* task. 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 *more*.[14] This argument is consistent with previous findings that the range of cognitive abilities elicited by cognitive-assessment tasks can be significantly affected by the language employed in those tasks (cf. Donaldson (1979), Gelman and Gallistel (1978), and Siegel (1978)).

On the other hand, Nenus and Bryant (1996) present a different explanation for children's difficulty in

[13] To put the comparison problem in a more formal way, we would say *how many more children than balloons are there?* I do not know why, but Hudson (1983) used the colloquial expression *how many more children than balloons?*, instead.

[14] Besides *more*, Hudson (1983) investigated children's reactions to other comparative adjectives: *less*, *taller*, *longer*, and *older*. Children showed absolute responses to these comparative adjectives, too.

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 a difference between two sets it is necessary to connect an action on objects (e.g. 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 the *Won't Get* task of Hudson (1983), 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 not such cues in the comparison problems. Moreover, the notions of addition and subtraction are also 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. Nunes and Bryant (1996) argue that this is why children have difficulty in solving comparison problems and support the Cognitive Hypothesis. 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 (2012c) 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 simple comparatives. Moreover, showing that Japanese-speaking children aged five to six years also assign an absolute interpretation to differential verbal expressions like (8), Arii (2012c and 2013b) argues against 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.

(8) 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.'

A situation expressed with differential verbal expressions like (8) 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 strategies are not cued there, either. If the argument of Nunes and Bryant (1996) is right, children should be able to interpret (8) appropriately because the situation expressed with it is not a static comparison. In the situation, objects (e.g. apple) 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 (8) in an adult-like way. However, children actually assign an absolute interpretation to (8), too. Contra Nunes and Bryant (1996), this finding shows that the reason why children cannot solve comparison problems is not because they cannot connect an action on objects with a static comparison.[15]

Even though we have found that Nunes and Bryant's (1996) cognitive hypothesis does not stand, it still remains possible that the source of children's difficulty in solving comparison problems is cognitive. In order to determine whether the source is linguistic or cognitive, we have to examine children's cognitive abilities required in solving comparison problems. The next section introduces a pilot experiment on children's abilities to determine a differential between two sets.

3. New Experimental Findings

[15] Arii (2013b) examines Nunes and Bryant's (1996) argument and experiment in detail. See Arii (2013b).

This section reports two pilot experiments. First, we will investigate whether Japanese children aged five-to-six years have cognitive abilities to quantify a differential between two sets, which are necessary to solve a comparison problem, and will give experimental support for the Linguistic Hypothesis. Next, in order to pin down a linguistic source of children's absolute interpretation, we will investigate what underlying representation it has.

3.1. Children's Ability to Quantify the Differential between Two Sets

3.1.1. Background

The controversy over the source of children's absolute interpretation of differential comparatives has not been settled for a long time because we are not sure whether children have the ability to quantify a differential between two sets. In order to quantify the difference, we have two strategies. First, we can use the one-to-one correspondence strategy. For that we need to make two matching sets and count out the remaining objects in the larger set. Previous studies have shown that children as young as four years old can use this strategy (Hudson (1983) and Arii (2012c)). The other strategy we use to quantify the differential is subtraction. After confirming the cardinality of each set, we subtract the smaller number from the larger number. Previous studies have shown that preschoolers are successful in addition and subtraction problems with small numbers (Zur and Gelman (2004) and Baroody et al. (2009)).[16] However, these previous studies only investigate children's ability to do subtraction, which determine whether the cardinality of a set increases or decreases ("within-set subtraction"). An example of such a subtraction problem is as follows. There are 10 donuts in the bakery shop. John got two donuts and walked away. Children are asked the question, *How many donuts are left?* On the other hand, the kind of subtraction which children are required to do in solving a comparison problem is to subtract the cardinality of the smaller set from the cardinality of the larger set and get the differential ("between-set subtraction"). These two kinds of subtraction can be qualitatively different.

According to Bloom et al. (1975) and Gitterman and Johnson (1983), children use a comparative expression to describe within-object changes before they use it to talk about between-object comparisons. According to Bloom et al. (1975), children are more likely to tune into events involving changes of states than pay attention to and comment on states of unchanging objects. For example, regarding comparative adjectives, a young child watches a balloon being blown up and says bigger, before he comments that one already inflated balloon is bigger than another. So, children are more sensitive to within-object changes than between-object comparison. Given this finding, it is quite possible that it is more difficult for children to do the between-set subtraction than the within-set subtraction.

In order to determine whether children have the ability to quantify the differential between two sets, we have to examine whether children can do between-set subtraction. In this case, we have to use an experimental design where children cannot use the one-to-one correspondence strategy to quantify the differential. The next section introduces such a pilot experiment.

3.1.2. Participants and Design

Nine Japanese-speaking children (5;2-6;3, mean age: 5;6) participated in this pilot experiment. They were individually investigated.

In the experiment, an experimenter introduces two characters to a child: a girl and a boy.[17] The girl and the boy each have a box. The boxes have a slit on them. These boxed are opaque and we cannot see the inside of them.

[16] Wynn (1992) reports that 5-month-old infants can calculate the results of simple arithmetical operations on small numbers of items. Infants determine that adding a single object to a second occluded object results in two objects rather than one or three, and that removing a single object from two occluded objects results in one object rather than two. For more detail, see Wynn (1992).

[17] In this experiment, actually, the famous Japanese cartoon characters, Anpanman and Pikachu were used. However, in order to avoid copyright infringement, here we illustrate the experiment with a girl and a boy instead.

The experimenter puts cards into the box one by one as depicted in Figure 2. On each card, a picture of a fruit is printed.

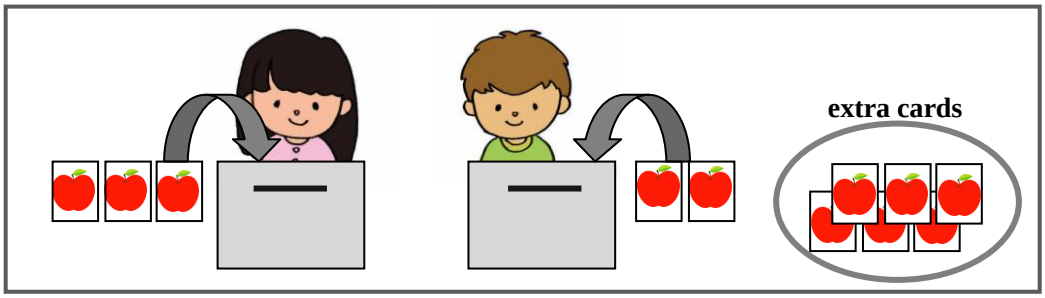


Figure 2. Design of the subtraction experiment (i): the experimenter puts cards into the boxes

While she puts the cards into the boxes, the experimenter does not count aloud. However, she urges the child to remember how many fruits the girl and the boy each have in their box. After she puts the cards into the boxes as depicted in Figure 2, the experimenter asks the child whether the boy and the girl have the same number of apples and if not, which one has more apples. After confirming that the girl has more apples than the boy, she asks the child to arrange for the girl and the boy to have the identical number of their apples. In front of the child, there are extra cards. If the child can remember the cardinality values of the two sets of apples and determine the right differential between them, namely one, he should put another card into the boy's box, as depicted in Figure 3.

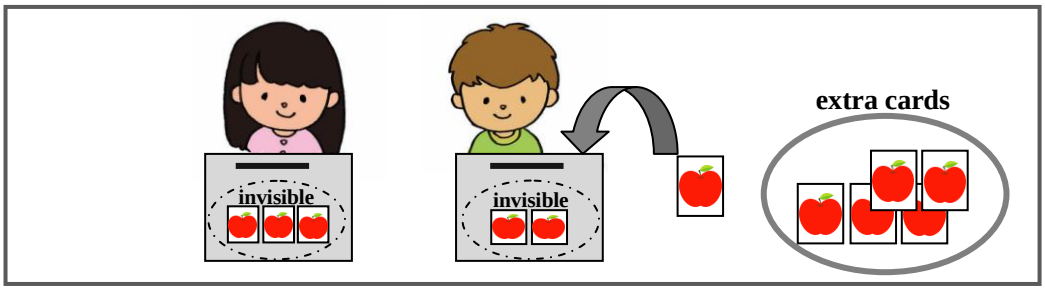


Figure 3. Design of the subtraction experiment (ii): the child's correct response

If he responds in a correct way in this experiment, this shows that the child can do between-set subtraction in order to quantify the differential between two sets without depending on the one-to-one strategy because the cards inside the boxes are invisible.

The child participant has 10 tasks altogether. In two practice tasks, the experimenter does not use the boxes and just puts the cards separately in front of the girl and the boy. In this case, the cards are always visible. The child practices giving extra cards to either the girl or the boy in order to make the two characters have the identical number of fruits. In four target tasks, the experimenter puts cards into the boxes in the following combinations: (3, 1) and (3, 2). In these cases, the child has to subtract the larger number from the smaller number. In four control tasks, the experimenter puts cards into the boxes as the following combinations: (2, 0), (3, 0), (3, 3) and (2, 2). With these control tasks, we can confirm whether the child can remember the number of each set of cards.

3.1.3. Results and Discussion

All of the 20 children correctly responded to the practice tasks. In the target and control tasks, children correctly responded 76.4% (55/72) of the time. In the four control tasks, they correctly responded 83.3% (30/36) of the time. Lastly, in the four target tasks, they correctly responded 69.4% (25/36) of the time.

These tasks require a clear memory of two numbers, and this is a big burden children have to take. The experimenter had difficulties to make the child maintain his concentration through the whole tasks. However, when they kept their concentration, they appropriately responded in the target tasks. The percentages of their

correct reaction in the target tasks cannot be explained by their random behavior. The scale of the experiment is small, but it is enough to conclude that children aged five-to-six years can do between-set subtraction with small numbers without depending on the one-to-one correspondence strategy. This shows that children have enough cognitive abilities to quantify the differential between two sets. This gives a piece of evidence against the Cognitive Hypothesis. In future research, we aim to investigate more children to confirm this experimental finding. On the basis of this finding, we will assume the Linguistic Hypothesis in the following sections.

3.2. More about Children's Absolute Interpretation of Differential Comparatives

3.2.1. Background

As we have seen in Section 2.2, previous studies have found that both English- and Japanese-speaking children assign an absolute interpretation to differential comparatives. However, we do not yet know what underlying representation children assign to them. Arii (2010 and 2011) argues that children mistakenly interpret them as MP absolute constructions like *this building is 20 meters high*, but her argument lacks motivation. In this section, we will investigate more about children's absolute interpretation.

Before that, we will review how previous studies have investigated children's interpretation of differential comparatives. In order to examine Japanese-speaking children's interpretation, Arii (2010 and 2011) uses Truth Value Judgment Tasks (TVJT) (Crain and Thornton (1998)) and investigates children's interpretation under three kinds of conditions, illustrated below.[18]

(9) Comparative Condition

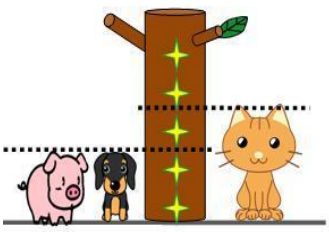
a. Panda-wa ichi-*kirari* takai.
panda-TOP *one-kirari* *taller*
'The panda is one *kirari* taller.'

b

(10) Absolute Condition

a. Neko-wa san-*kirari* takai.
cat-TOP *three-kirari* *taller*
'The cat is three *kiraris* taller.

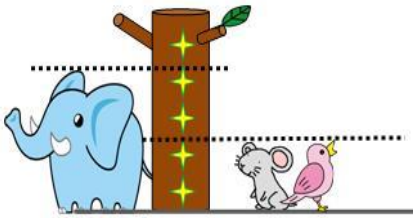
b.



(11) Neutral Condition

a. Zou-wa ichi-*kirari* takai.
elephant-TOP one-*kirari* taller
'The elephant is one *kirari* taller.'

[18] As we have seen in footnote 8, the novel unit of height *kirari* is used in the stimulus sentences.

b. 

In the comparative condition, the comparative reading makes the stimulus sentence true, and (9a) is acceptable to Japanese-speaking adults because the panda is one *kirari* taller than the other animals. In the absolute condition, the absolute reading makes the stimulus sentence true, and (10a) is unacceptable to Japanese-speaking adults because the cat is not three *kiraris* but one *kirari* taller than the other animals. Lastly, in the neutral condition, neither reading makes the stimulus sentence true. Japanese-speaking adults reject (11a) because the elephant is not one *kirari* but two *kiraris* taller than the other animals. Unlike adults, many Japanese-speaking children rejected (9a) and accepted (10a). Moreover, they rejected (11a), saying 'because the elephant is not one *kirari* but four *kiraris* tall (in Japanese).'[19] Namely, they interpreted the differential as absolute. Besides children who made an absolute interpretation, there were many children who consistently accepted all the stimulus sentences, although they correctly responded to filler items.

These previous findings show that children's absolute interpretation is quite robust. However, we are not sure what underlying representation makes them respond in such a way. We consider three possible underlying representations for differential comparatives in child grammar: (i) "adjective interpretation", (ii) "conjunctive interpretation" and (iii) "cardinality interpretation."[20] First, if children ignore the MP in *this building is 20 meters higher*, its representation in child grammar would be 'this building is higher.' In Japanese, the adjective *takai* is ambiguous between 'high' and 'higher.' So, strictly speaking, if they ignore the MP, the representation in child Japanese would be either 'this building is high' or 'this building is higher.' Second, if they interpret it conjunctively, its representation would be 'this building is 20 meters (high) and higher.' In the same way as the adjective interpretation, the representation in child Japanese would be either 'this building is 20 meters (high) and (it is) high' or 'this building is 20 meters (high) and (it is) higher.' Lastly, if they ignore the adjective, its representation would be 'this building is 20 meters (high).' If they interpret differential comparatives either as (ii) or (iii), they should reject the stimulus sentence in the comparative and neutral conditions and accept that in the absolute condition. These interpretations, (ii) and (iii), could cause children's absolute responses in the previous experiments. On the other hand, if they interpret them as (i), they should accept the stimulus sentence in all the three conditions because the target animals in the subject position are always high compared with the other two animals. Thus, the interpretation (i) could cause children's consistent acceptance of the stimulus sentence in all three conditions. In the next section, we will examine what underlying representation children assign to differential comparatives.

3.2.2. Participants and Design

Eight Japanese-speaking children (4;10-6;5, mean age: 5;9) participated in this pilot experiment. They were individually investigated. Before this, they had participated in another experiment where their interpretation of differential comparatives like (12) was investigated. In (12), the standard phrase marked with *yori* 'than' is explicitly expressed.

[19] There were actually only a few children who justified their rejection in the neutral condition in this explicit way. Most of the kids rejected the puppet's statement in (11b), just referring to the height of the elephant like "No. It's not one *kirari*. It's four *kiraris* (in Japanese)."

[20] Of course, it is possible that children make other non-adult interpretations of differential comparatives. However, this paper only deals with these three possible interpretations.

(12) Inu-wa neko-yori ichi-*kirari* takai.
dog-TOP *cat-than* *one-kirari* *taller*
'The dog is one *kirari* taller than the cat.'

The experimental design of Arii (2010 and 2011) was used. In the experiment, these eight children made non-adult interpretations of (12): five of them made absolute responses, one of them made both absolute and comparative responses ("mixed responses") and two of them made continuous 'yes' responses under the three conditions: the comparative, absolute, and neutral conditions.

In the pilot experiment, comparatives like (12) are used as a stimulus sentence. TVJTs in "prediction mode" are adopted (cf. Chierchia et al. (1998)). TVJTs in prediction mode differs from standard TVJTs in that a stimulus sentence (a puppet's statement) is presented to a child before the completion of a story as a prediction about what will happen in the remainder of the story. This ensures that child participants listen to the whole stimulus sentence and that they make their judgment based on it. First, an experimenter tells a story by using a power-point presentation on a lap-top computer. At that time, a puppet watches the slides alongside the children. Next, in the middle of the story, the puppet is asked to make a prediction (a stimulus sentence) about the following story and he makes a prediction. After finishing listening to the whole story, then, children are asked to judge whether the puppet's prediction is right or wrong.

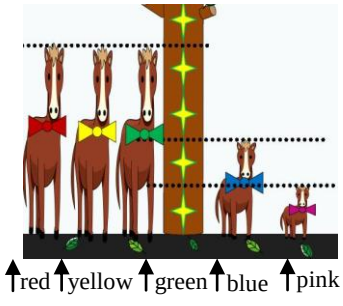
Child participants see three slides. In the first slide, four animals show up. The experimenter confirms each animal's height. In the next slide, an animal with a pink tie (the target animal) shows up. This slide does not include other animals or the tree as a measure, and children can neither compare the height of the target animal with that of other animals nor measure the height of the target animal. Watching the second slide, the puppet makes a prediction about the height of the target animal. This prediction corresponds to a stimulus sentence. After being shown the third slide where all animals are standing beside the tree, the children are asked to judge whether the puppet's prediction was correct.

Children's interpretation of differential comparatives is investigated with the three tasks illustrated below. The slides in (13-15) correspond to the third slide, on the basis of which children judge whether the puppet's prediction is correct. Children's expected response in each interpretation is given in square brackets.

(13) Task 1

a. Pinku-no-wa aoi-no-yori ichi-*kirari* takai-to omou.
pink-GEN-TOP *blue-GEN-than* *one-kirari* *taller-COMP* *think*
'I think the horse with a pink tie is one *kirari* taller than the one with a blue tie.'

b.

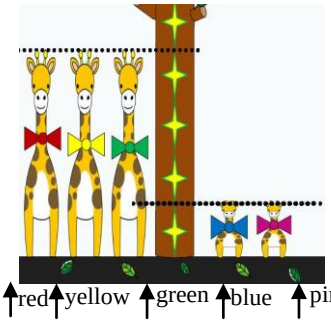


c. Possible non-adult interpretations
(i) adjective interpretation:
-'The horse with a pink tie is taller than the one with a blue tie.' **[*no*]**
-'The horse with a pink tie is tall.' **[*no*]**
(ii) conjunctive interpretation:
-'The horse with a pink tie is one *kirari* (tall) and taller than the one with a blue tie.' **[*no*]**
-'The horse with a pink tie is on *kirari* (tall) and tall.' **[*no*]**
(iii) cardinality interpretation:
'The horse with a pink tie is one kirari (tall) **[*yes*]**.'

(14) Task 2

a. Pinku-no-wa aoi-no-yori ichi-*kirari* takai-to omou.
pink-GEN-TOP *blue-GEN-than* *one-kirari* *taller-COMP* *think*
'I think the giraffe with a pink tie is one *kirari* taller than the one with a blue tie.'

b.



c. Possible non-adult interpretations

(i) adjective interpretation:

-'The giraffe with a pink tie is taller than the one with a blue tie.' **[*no*]**

-'The giraffe with a pink tie is tall.' **[*no*]**

(ii) conjunctive interpretation:

-'The giraffe with a pink tie is one *kirari* (tall) and taller than the one with a blue tie.' **[*no*]**

-'The giraffe with a pink tie is one kirari (tall) and tall.' **[*no*]**

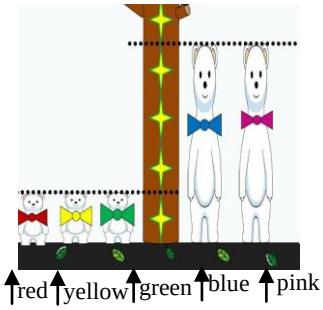
(iii) cardinality interpretation:

'The giraffe with a pink tie is one kirari (tall) **[*yes*]**.'

(15) Task 3

a. Pinku-no-wa aoi-no-yori yon-*kirari* takai-to omou.
pink-GEN-TOP *blue*-GEN-*than* *four*-*kirari* *taller*-COMP *think*
'I think the bear with a pink tie is four *kiraris* taller than the one with a blue tie.'

b.



c. Possible non-adult interpretations

(i) adjective interpretation:

-'The bear with a pink tie is taller than the one with a blue tie.' **[*no*]**

-'The bear with a pink tie is tall.' **[*yes*]**

(ii) conjunctive interpretation:

-'The bear with a pink tie is four *kiraris* (tall) and taller than the one with a blue tie.' **[*no*]**

-'The bear with a pink tie is four *kiraris* (tall) and tall.' **[*yes*]**.'

(iii) cardinality interpretation:

'The bear with a pink tie is four kiraris (tall) **[*yes*]**.'

Children's expected responses in each task are also represented in (16).

(16)

	(i) adjective		**(ii) conjunctive**		**(iii) cardinality**
adjective *takai*	'taller'	'tall'	'taller'	'tall'	
Task 1	*no*	*no*	*no*	*no*	*yes*
Task 2	*no*	*no*	*no*	*no*	*yes*
Task 3	*no*	*yes*	*no*	*yes*	*yes*

Table 1. Children's possible responses in each task

As shown in Table 1, there are two possible interpretations of the adjective *takai* regarding the adjective reading (i) and the conjunctive reading (ii) because *takai* is ambiguous between 'high' and 'higher.' In task 1, if they assign the cardinality interpretation (iii) to the stimulus sentence, they should accept it. On the other hand, if children assign either the adjective (i) or the conjunctive interpretation (ii) to it, they should reject it regardless of the meaning of the adjective: 'taller' or 'tall.' Similarly, in task 2, if children assign the cardinality interpretation (iii) to it, they should accept it. On the other hand, if children assign the other interpretations to it, they should reject it. Thus, we can know whether children assign the cardinality interpretation to differential comparatives or not with these two tasks. Specification of children's interpretation in task 3 is more complicated. Unfortunately, we cannot tell whether children make the adjective (i) or the conjunctive interpretation (ii) only on the basis of task 3. All we can know is whether children interpret the adjective *takai* as comparative or not. Thus, we cannot know exactly which interpretation children assign to differential comparatives but these three tasks can reveal whether children

assign the cardinality interpretation (iii) to differential comparatives and whether all children have the same representation for differential comparatives.

3.2.3. Results and Discussion

The results are represented in Table 2.

participant #	age	gender		responses in the previous experiment	tasks			interpretation of differential comparatives
		M	F		1	2	3	
Child #1	4;10	x		absolute	N	N	N	non-cardinality, taller
Child #2	4;11		x	absolute	N	N	N	non-cardinality, taller
Child #3	5;5		x	mixed	N	N	**Y**	non-cardinality, tall
Child #4	5;7		x	continuous 'yes' response	N	N	N	non-cardinality, taller
Child #5	6;3	x		absolute	N	N	N	non-cardinality, taller
Child #6	6;4		x	absolute	N	N	**Y**	non-cardinality, tall
Child #7	6;5		x	absolute	**Y**	**Y**	**Y**	cardinality
Child #8	6;5		x	continuous 'yes' response	N	N	N	non-cardinality, taller

Table 2. Children's responses in each task

Child #7 accepted the stimulus sentence in the three tasks, and so seems to give the target sentence the cardinality interpretation. Other children rejected the stimulus sentence both in tasks 1 and 2. Child #3 and Child #6 only accepted the stimulus sentence in task 3. Asked for their justification, they said that the puppet's prediction is right because the bear with a pink tie is four *kiraris* tall. Although we cannot tell whether they assigned the adjective or the conjunctive interpretation to differential comparatives, they did interpret the adjective *takai* and interpreted it as non-comparative 'tall'. On the other hand, children who rejected the stimulus sentence in all the three tasks seem to have interpreted the adjective as comparative 'taller'. Asked for their justification in task 3, they said that the puppet's prediction is wrong because the bear with a pink tie and that with a blue tie have the same height.

This pilot experiment reveals that children make various non-adult interpretations of differential comparatives. Some children ignore the adjective and make the cardinality interpretation. Other children interpret the adjective with some interpreting it as comparative and others as non-comparative. As we noted in footnote 9, children can appropriately interpret simple comparatives like *this horse is taller than that horse*. Once a differential phrase is added to the comparatives, however, children come to be unable to interpret them as adults do. Children seem to resort to some other, non-compositional strategy to deal with the uninterpretable differential phrase, which would lead to various non-adult interpretations of differential comparatives. In the next section, we will seek a theoretical explanation for the finding that children cannot interpret differential comparatives.[21]

4. Interim Discussion

In the previous section, we have found that children's absolute response to comparison problems is not caused by their immature cognitive resources to quantify the differential between two sets. Moreover, we have found that children do not all have the same underlying structure of differential comparatives. Once a differential phrase is added to comparatives, children become unable to interpret them and seem to resort to some other, non-compositional strategy to deal with the uninterpretable differential phrase. We need a theoretical explanation for children's difficulty in interpreting differential comparatives.

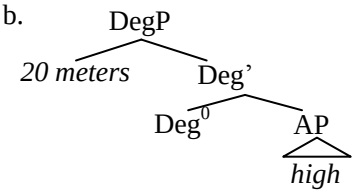
First, let us review Snyder et al. (1995), who argue that child English has an impoverished underlying

[21] We continue referring to these non-adult interpretations altogether as absolute interpretations because these interpretations cause children's absolute reaction in solving comparison problems.

structure for degree expressions in the same way as adult Japanese. They assume that English has DegP, whose head takes an AP as its complement (Abney (1987)) and that English has a "modifying MP" in the specifier of DegP.[22] The MP absolute construction in (17a) is taken to have the underlying structure in (17b).

(17) a. This building is 20 meters high.

b.

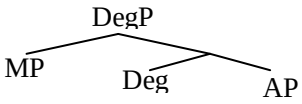


Concerning differential comparatives, they assume that a "differential MP" occupies a different slot from a modifying MP. So, the specifier of DegP is a slot only for modifying MPs like *20 meters* in (17a). In contrast to English, they argue that the specifier of DegP is not available in Japanese on the basis of their observation that the Japanese construction in (18) (a differential comparative) lacks the absolute reading 'this building is 20 meters high' even though the surface structure is similar to the English construction in (17a).[23]

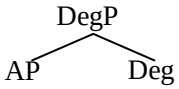
(18) Kono biru-wa 20-meetoru takai.
this building-TOP 20-meter higher
'This building is 20 meters higher'

In order to give an account of the interpretive difference between English and Japanese, Snyder et al. (1995) propose the syntactic structures in (19). While the DegP in English has a specifier, which is a slot for modifying MPs, the DegP in Japanese lacks a specifier.

(19) a. <u>English</u>



b. <u>Japanese</u>



Moreover, observing the late appearance of MP absolute constructions in child spontaneous speech, they argue that the default state of the DegP in child grammar is also impoverished like Japanese. Examining the CHILDES transcripts of spontaneous speech of English-speaking children, a majority of the children failed to produce expressions like *John is 4 years older than Bill* even at ages from 4 to 6. Summarizing Snyder et al.'s (1995) argument in a nutshell, while adult English is taken to have the underlying structure of degree constructions in (19a), adult Japanese and child English are taken to have the impoverished structure in (19b).

In contrast to Snyder et al. (1995), as we saw footnote 11, Watanabe (2013) argues that Japanese does have MP absolute constructions like (20).

(20) Kono biru-wa taka-sa 20-meetoru-da.
this building-TOP high-sa 20-meter-COP
'This building is 20 meters high.'

Moreover, Arii (2010 and 2011) argues that direct instruction about words for the units of measurement (e.g. *centimeter*, *kilogram*, etc.) is not formally introduced to children until entering school, and the late appearance of

[22] While we refer to the MPs in differential comparatives as differential MPs, we will refer to the MPs in the absolute constructions as modifying MPs, which express the degree of a certain property that a subject has.

[23] Snyder et al. (1995) assume that MPs in Japanese can combine with gradable adjectives only through the mediation of covert morphology that gives rise to a differential interpretation.

MP absolute constructions in child spontaneous speech is not so surprising.[24] So, we cannot apply the analysis of Snyder et al. (1995) to the late acquisition of differential comparatives.

However, their analysis that the underlying structure of degree constructions in child grammar is impoverished is compatible with our findings. We need to specify what child grammar lacks and need to explain how children acquire an adult-like interpretation of differential comparatives. When they interpret differential comparatives, children first assign various non-adult interpretations to them. Once they acquire adult grammar of differential comparatives, however, they cease assigning the non-adult interpretations to them. Therefore, learning the adult representation has a consequence of purging the non-adult interpretations from child grammar. In order to ensure that children achieve an adult interpretation, we need some abstract theoretical construct that can bridge the two events. Our findings present a significant problem that any explanatory theory of differential comparatives must solve.

5. Semantic Explanations of Children's Absolute Interpretation of Differential Comparatives

This section reviews two semantic analyses of differential comparatives which can give us an insight into the acquisition of differential comparatives: the analysis of Schwarzchild (2005) and that of Kennedy and McNally (2005), Svenonius and Kennedy (2006), Kennedy and Levin (2008) and Grano and Kennedy (2012). We will show that while the former makes a wrong prediction about children's acquisition of differential comparatives, the latter is quite compatible with what happens in the acquisition process of differential comparatives.

5.1. Schwarzchild (2005)

As Schwarzchild (2005) shows, the ability of adjectives to combine directly with MPs is lexically idiosyncratic. As shown in (21), *expensive* and *heavy* cannot combine with appropriate MPs unlike *tall*. In contrast, when combined with a comparative morpheme, every adjective can combine with an MP as in (22).

(21) a. five feet tall
b. *five dollars expensive
c. *five pounds heavy

(22) a. five feet taller
b. five dollars more expensive
c. five pounds heavier

Following Schwarzchild (2005), we will call an MP that combines with a bare adjective a "direct MP" (e.g. *two feet tall*) and we will call an MP that combines with a comparative or *too* phrase an "indirect MP" (e.g. *two feet taller*). Schwarzchild (2005) argues that direct MPs are marked on the basis of his observation in (21) and (22).[25]

In order to give an account for the contrast between direct and indirect MPs, Schwarzchild (2005) proposes that MPs are gap-predicates. For example, if John's height exceeds Mary's, there is a gap that spans from Mary's height up to John's. An MP can be used to tell us what the size of that gap is. If John is 2 inches taller than Mary,

[24] Concerning Japanese-speaking children's absolute interpretation of differential comparatives, Arii (2010 and 2011) argues that they interpret differential comparatives like *this building is 20 meters higher* as MP absolute constructions like *this building is 20 meters high*. Then, in contrast with Snyder et al. (1995), Arii argues that children do have a slot for an MP in MP absolute constructions because they interpret the differential MP as a modifying MP, mistakenly. However, as the pilot experiment has shown, children do not all share a single underlying representation for differential comparatives, and the argument of Arii that the underlying representation for differential comparatives in child Japanese is an MP absolute construction does not stand.

[25] According to Schwarzchild (2005), some languages never allow direct MPs, even though they do allow MPs in comparatives including Japanese (Snyder et al. (1995)), Russian (Matushansky (2002)) and Spanish (Bosque (1999)). In contrast, as we have seen in footnote 11, Watanabe (2013) argues that Japanese allows MP absolute constructions.

then it is a two-inch gap. So, MPs are taken not as predicates of a single degree but as predicates of a set of degrees.

If MPs describe a gap, and comparatives necessarily entail the presence of a gap, it is no surprise that comparative adjectives can always combine with MPs. Moreover, degree achievement verbs (DAs) such as *lengthen* in (23) entail a gap between values taken at two different times, and so it is natural that DAs and MPs fit together.

(23) John lengthened the rope five inches.

The same is true of the Japanese differential verbal expressions in (24) because *fueru* 'increase' can be taken as a DA.

(24) 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 analysis of MPs leads to the right prediction for direct MPs like (21b) and (21c), which are ill formed, because the MPs in (21b) and (21c) are supplied a single degree, not a gap. On the other hand, *tall* in (21a) is exceptionally allowed to directly combine with MPs. For such exceptional adjectives, Schwarzchild (1995) proposes a lexical rule, the Homonym Rule, which produces homonyms that have to have interval arguments (sets of degrees) in place of degree arguments, as shown in (25). Because of this rule, adjectives like *tall* exceptionally allow direct MP modification.

(25) Homonym Rule: from degrees to intervals
If A has meaning A' that relates individuals to degrees, then A has a secondary meaning relating individuals to sets of degrees (intervals).
Homonym Rule applies to *tall, wide, deep, thick, old, long,* and *high* (Schwarzchild (2005): (31))

To sum up, observing idiosyncratic behavior of direct MPs, Schwarzchild (2005) argues that direct MPs are marked and indirect MPs are unmarked. Moreover, he analyzes MPs as gap-predicates in order to capture the contrast between direct and indirect MPs.

Concerning acquisition of comparatives, this analysis makes a prediction that children should acquire differential comparatives like *this building is 20 meters higher* earlier than MP absolute constructions like *this building is 20 meters high*. Moreover, it makes a prediction that children should easily acquire the differential verbal expressions in (24). While they can naturally combine with comparative adjectives and DAs, MPs cannot combine with bare adjectives. In order to acquire MP absolute constructions, children have to learn which adjectives undergo the Homonym Rule on the basis of linguistic input.

However, the acquisition of gradable expressions occurs in the complete opposite order. As we have seen in Section 2.2, children have great difficulties in acquiring differential comparatives and differential verbal expressions. Moreover, Japanese-speaking children seem to appropriately interpret (26).[26]

(26) Kono biru-wa taka-sa 20-meetoru-da.
this *building-TOP* *high-sa* *20-meter-COP*
'This building is 20 meters high.'

[26] The next section considers the possibility that children also have non-adult representation for MP absolute constructions.

If Watanabe's (2013) argument that (26) corresponds to an MP absolute construction is right, it follows that Japanese-speaking children can interpret absolute MP constructions. This is not compatible with the prediction that children acquire differential comparatives earlier than MP absolute constructions. Thus, Schwarzchild's (2005) analysis is not compatible with the findings on language acquisition.

5.2. Kennedy and McNally (2005), Svenonius and Kennedy (2006), Kennedy and Levin (2008) and Grano and Kennedy (2012)

Kennedy and McNally (2005) (K&M), Svenonius and Kennedy (2006) (S&K), Kennedy and Levin (2008) (K&L) and Grano and Kennedy (2012) (G&K) give a different semantic analysis of differential comparatives.[27] They provide a unified analysis of differential comparatives and degree achievement verbs (DAs) like (27).

(27) a. The soup cooled 17 degrees.
b. The gap widened 6 inches.

Kennedy (1999) argues that a gradable adjective denote measure functions: functions from individuals to degrees (type $\langle e,d\rangle$). For example, the adjective *wide* denotes the function in (28). It takes an object and returns its (positive) degree of width.

(28) $\|wide\| = \lambda x.$ the degree to which x is wide

A consequence of this analysis is that a gradable adjective must combine with some other expression in order to be converted into something denoting a property of individuals (type $\langle e,t\rangle$); this is the function of degree morphology. In the case of bare adjectives, a null Deg head *pos* combines with them, which has the semantics in (29).[28]

(29) $\|pos\| = \lambda g \in D_{\langle e,d\rangle}\, \lambda x.\ g(x) \geq \text{stnd}(g)$

Here *stnd* is a function from gradable adjective meanings to degrees that returns a standard of comparison for the adjective in the context of utterance: the minimum degree required to "stand out" in the context relative to the kind of measurement expressed by the adjective. The positive form of *wide*, for example, denotes the property in (30), which is true of an object just in case its width exceeds the standard for width in the context of utterance.

(30) $\|pos(wide)\| = \lambda x.\ wide(x) \geq \text{stnd}(wide)$

Following Hay et al. (1999), K&M, S&K, K&L and G&K further assume that measure functions like gradable adjectives can be relativized to times because an object can have different degrees of height, weight, temperature, etc, at different times. For example, the adjective *wide* denotes a function from objects x and times s that returns the width of x at s. When it combines with *pos*, it denotes the property in (31).

(31) $\|pos(wide)\| = \lambda x \lambda s.\ wide(x)(s) \geq \text{stnd}(wide)$

K&M, S&K, K&L and G&K analyze comparative adjectives as special kinds of measure functions, called "difference functions", which measure the degree to which two objects diverge relative to a scalar dimension. For instance, if *wide* is a function from individuals to values on the width scale, as in (32a), then *wider than the carpet* is a function from individuals to the subpart of the width scale that begins with the width of the carpet like (32b)

[27] This paper uses the following abbreviation in references: K&M: Kennedy and McNally (2005), S&K: Svenonius and Kennedy (2006), K&L: Kennedy and Levin (2008) and G&K: Grano and Kennedy (2012)
[28] This paper uses the following types: e for individuals, d for degrees, s for time, u for events and t for truth values.

and measures the extent to which an object diverges from the carpet in width. In (32b), the width of the carpet is a "derived zero point."

(32) a. WIDTH: 0 ⟶ ∞

b. WIDTH: 0 ----- WIDTH (carpet) -----● ⟶ ∞

The comparative morphology, which consists of a comparative morpheme like *-er* and a standard phrase marked with *than* in English, thus turns a basic measure function into a difference function with a scale whose minimal element corresponds to the degree introduced by the standard phrase.

To represent the differential function based on a measure function **m** and a standard *y*, the notation $\mathbf{m}^{\uparrow}{}_{y}$ is used. It maps individuals in its domain onto the part of the **m** scale that uses the position of *y* as a zero point. For instance, if *wide* denotes the measure function **wide**, *wider than the carpet* denotes the difference function $\mathbf{wide}^{\uparrow}{}_{\mathbf{wide(c)}}$, which returns values that represent the degree to which an object's width exceeds that of the carpet (represented here as **wide(c)**, which suppresses the temporal argument for convenience). Like morphologically bare adjectives, comparative adjectives are of type ⟨*e*,*d*⟩ and need to combine with *pos* to derive a property of individuals, as shown in (33).

(33) a. The table is [wider than the carpet].

b. $\|pos(wide^{\uparrow}{}_{wide(c)})\| = \lambda x \lambda s.\ \text{wide}^{\uparrow}{}_{\text{wide(c)}}\,(x)(s) \geq \text{stnd}(\text{wide}^{\uparrow}{}_{\text{wide(c)}})$

(33b) is true of an individual if its property stands out relative to the kind of measurement expressed by the difference function $wide^{\uparrow}{}_{wide(c)}$.[29]

On the basis of S&K's analysis of the distribution of MPs, it is assumed that MPs saturate degree arguments that are introduced by a null degree head μ, which combines with a measure function to produce a relation between degrees and individuals, as shown in (31).[30]

(34) $\|\mu\| = \lambda g \in D_{\langle e,sd\rangle} \lambda d \lambda x \lambda s.\ g(x)(s) \geq d$ (K&L (2008): (30), slightly modified)

For example, (35a) has the semantics in (35b) and the structure in (35c).

(35) a. The table is 30 cm wide.

---

[29] For any measure function **m**, a difference function $\mathbf{m}^{\uparrow}{}_{d}$ based on **m** always uses a lower closed scale, whose minimal element is *d*. Generally, when an adjective uses a closed scale, the standard of comparison invariably corresponds to an endpoint of the scale, the minimum. So, (33b) denotes a property that is true of an object *x* if the degree we get by applying the difference function to *x* is greater than *wide (c)*.

[30] S&K and G&K argue that the degree morpheme μ is an actual syntactic object. They show that we can understand a puzzling set of facts involving degree questions in Northern Norwegian and "transitive comparatives" in Mandarin Chinese with this analysis of the distribution of MPs. Moreover, G&K argue that there is an overt affix in Mandarin Chinese which corresponds to μ. The canonical comparative construction in Mandarin Chinese ("bi-comparative") optionally allows a differential phrase as shown in (i).

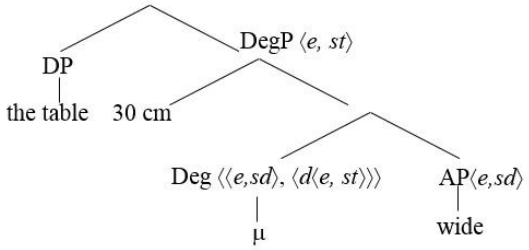
(i) Zhangsan bi Lisi gao (yi dian).
Zhangsan than Lisi tall (one dot)
'Zhangsan is (a little) taller than Lisi,'

(ii) Zhangsan bi Lisi gao **chu** *****(yi dian).
Zhangsan than Lisi tall CHU (one dot)
'Zhangsan is a little taller than Lisi.'

However, when an overt affix *chu*, whose lexical meaning is 'exist' or 'go beyond' combines with the adjective, that construction is ungrammatical without the differential phrase. S&K and G&K also argue that this analysis provides a means of accounting for cross-linguistic and language internal restrictions on the combinations of adjectives and MPs, which Schwarzchild (2005) has observed. For more detail, see S&K and G&K.

b. $[\![\mu]\!]([\![wide]\!])\ ([\![30cm]\!])([\![table]\!]) = \lambda s.\ \text{tall(table)}(s) \geq 30\text{cm}$
'It is true of a time *s* if the table's width is at least as great as 30cm.'

c.

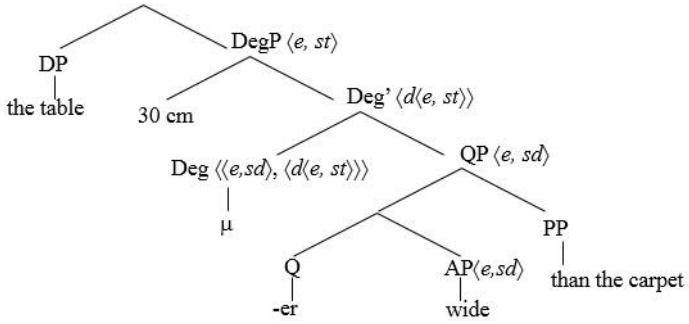


In the same way, the differential comparative in (36a) has the semantics in (36b) and the structure in (36c).

(36) a. The table is 30cm wider than the carpet.

b. $[\![\mu]\!]([\![wide^{\uparrow}_{wide\ (carpet)}]\!])\ ([\![30cm]\!])([\![table]\!]) = \lambda s.\ \text{wide}^{\uparrow}_{\text{wide (carpet)}}\ \text{(table)}(s) \geq 30\text{cm}$
'It is true of a time *s* if the degree returned by the difference function $\text{wide}^{\uparrow}_{\text{wide (c)}}$ to *the table* and *s* is at least as great as 30cm.'

c.



In the case of DAs, K&L propose that the adjectival core of a DA is a special kind of a difference function and define it as (37), which measures the amount that an object changes along a scalar dimension as a result of participating in an event.

(37) *Measure of change*
For any measure function **m**, $\mathbf{m}_{\Delta} = \lambda x \lambda u.\ \mathbf{m}^{\uparrow}_{\mathbf{m}(x)(init(u))}(x)(fin(u))$ (K&L (2008): (25))

(37) defines a new "measure of change function" $\mathbf{m}_{\Delta}$ for any measure function **m** from objects and times to degrees on scale *S*. Here, *init* and *fin* return the initial and final temporal intervals of an event. Like other measure functions, a measure of change must combine with μ in order to saturate a degree argument. (38) is a verbal version of μ.

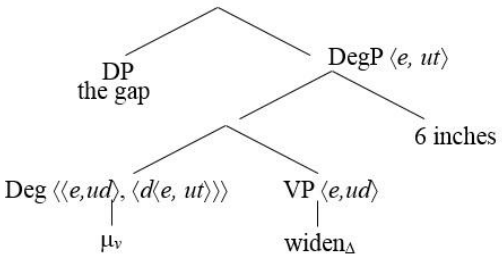
(38) A verbal version of μ
$[\![\mu_v]\!] = \lambda\ g \in D_{m\Delta} \lambda d \lambda x \lambda u.\ g(x)(u) \geq d$ (K&L (2008): (32))

For example, the DA in (39a) has the semantics in (39b) and (39c).

(39) a. The gap widened 6 inches.

b. $[\![\mu_v]\!]([\![wide_{\Delta}]\!])\ ([\![6\ inches]\!])([\![gap]\!]) = \lambda u.\text{wide}_{\Delta}(\text{gap})(u) \geq 6$ inches
'It is true of an event *u* if the degree returned by applying the measure of change function widen_{Δ} to *the gap* and *u* is at least as great as 6 inches.

c.



We can apply this analysis of DAs to the Japanese differential verbal expression in (40a). Leaving the compositional semantics for future research, we can define its semantics in (40b).

(40) a. Ringo-wa ni-ko fue-ta.
apple-TOP *two-CL* *increase-PAST*
'The number of apples has increased by two.'

b. $[\![\mu_v]\!]([\![MANY_{\Delta}]\!])([\![2]\!])([\![apple]\!]) = \lambda u.\text{MANY}_{\Delta}(\text{apple})(u) \geq 2$ &
$\text{MANY}(\text{apple})(init(u)) < \text{MANY}(\text{apple})(fin(u))$
'It is true of an event u if the degree returned by applying the measure of change function MANY_{Δ} to *apple* and u is at least as great as 2 and the number of apples at u_{fin} is greater than that at u_{init}.

Returning to children's absolute interpretation of differential comparatives and differential verbal expressions, we can attribute their absolute interpretation to the null heads μ and μ_v. If the null heads did not work in their grammar, there would be no slot for a differential phrase and the derivation of these differential constructions would clash. If so, children would have to resort to some other non-compositional strategy to deal with the uninterpretable differential phrase, which would lead to various non-adult interpretations of differential comparatives like those we saw in Section 3.2: some might neglect the adjective, some might neglect the differential phrase and others might interpret differential comparatives in a conjunctive way. Once they acquire the null heads, they stop assigning the non-adult interpretations to the differential constructions because the differential phrase becomes interpretable compositionally. It is thus possible that it takes a long time for children to acquire the null heads μ and μ_v and that the late acquisition causes the non-adult interpretations. In the analysis of K&M, S&K, K&L and G&K, they do not discuss Japanese, but if we assume that Japanese comparatives have a Q head which hosts a null comparative morpheme, the same analysis applies to Japanese (Bhatt and Takahashi (2011) and Shimoyama (2011)).[31]

As we reviewed in Section 2.2, it has been found that Japanese-speaking children seem to appropriately interpret MP absolute constructions like (41) (Arii (2010)).

(41) Kono biru-wa taka-sa 20-meetoru-da.
this *building-TOP* *high-sa* *20-meter-COP*
'This building is 20 meters high.'

Given the analysis above, however, it is possible that children also have a non-adult grammar of such sentences. In order to investigate children's interpretation of (41), Arii (2010) uses the three conditions we have seen in Section 3.2.1: the comparative, absolute and neutral conditions. In the comparative condition, almost all children correctly rejected a stimulus sentence (an MP absolute construction). In the absolute condition, they correctly accepted it. Lastly, in the neutral condition, they correctly rejected it, referring to the height of the compared animal in the

[31] The next section discusses a possible problem with Japanese-speaking children's acquisition of differential comparatives.

subject position. It seems that they appropriately assigned an absolute interpretation to the MP absolute constructions. Considering their strong tendency to assign an absolute interpretation to differential comparatives, nevertheless, their apparently appropriate interpretation of MP absolute construction can be due to their bias toward taking MPs as denoting a cardinality value. Unlike with the intricate conditions we have used in Section 3.2.2 in order to elicit children's various non-adult interpretations, children who cannot assign a correct interpretation to an MP have no choice but to take the MP as the height of the compared animal in the three conditions of Arii (2010).

Thus, if we adopt this analysis of acquisition of differential comparatives based on K&M, S&K, K&L and G&K, there would not be a problem about how children expunge the non-adult interpretations. Once they acquire the null heads μ and μ_v, the underlying representations of differential expressions have a slot for a differential phrase and the non-adult interpretations disappear. Therefore, comparing the analysis of Schwarzschild (2005), that of K&M, S&K, K&L and G&K is more compatible with what happens in language acquisition.

This analysis makes a prediction about children's interpretation of another construction. Given that the null heads μ and μ_v do not work in child grammar, children should also assign non-adult interpretations to another differential construction which expresses excessiveness like (42).

(42) Kono biru-wa 20-meetoru taka-sugi-ru.
this *building-TOP* *20-meter* *high-too much-PRES*
'This building is 20 meters too high.'

In the same way as differential comparatives and differential verbal expressions, the "excessiveness construction" is also analyzed to include the null head μ in the underlying representation. If children make non-adult interpretations of this construction, this would be further support for the analysis presented here.

6. Remaining Issues

In the previous section, following the analysis of K&M, S&K, K&L and G&K, we have argued that child grammar lacks the null heads μ and μ_v and that the lack causes children's non-adult interpretation of differential comparatives and differential verbal expressions. However, there still remain some questions. In this section, we will see three remaining questions.

6.1. Acquisition of the Null Heads μ and μ_v

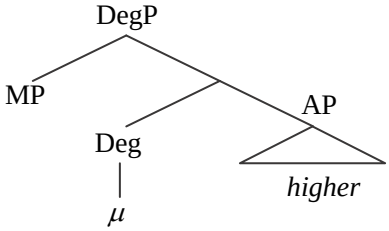
The first question is how children acquire the null heads μ and μ_v. They are null, and children cannot acquire them directly from their overt linguistic input. As we have seen in footnote 30, nevertheless, G&K propose that there is an overt affix in Mandarin Chinese which corresponds to μ. Considering the case in Mandarin Chinese, it is possible that there are formal syntactic or morphological features in English and Japanese, too, and that such features can trigger children's acquisition of the null heads. As G&K claim, since the presence of an MP entails the presence of μ, it follows that all and only those predicates that combine with MPs should manifest the formal morphosyntactic features associated with μ. In order to find possible triggers of acquisition of μ and μ_v, we should investigate other differential constructions and absolute constructions which are modified with an MP.[32]

6.2. Acquisition of the Unique Interpretation of Japanese Differential Comparatives

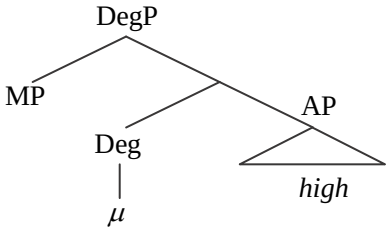
[32] In Japanese, bare adjectives are ambiguous between comparative and non-comparative meanings. However, when the adjectives are proceeded by an MP, they only have a comparative meaning. This is another piece of evidence for the degree morpheme μ.

The second question is how Japanese-speaking children learn that the adjective in differential comparative constructions has only a comparative interpretation, even though there is no morphological distinction between comparative and non-comparative adjectives in Japanese. Before considering the acquisition of Japanese differential comparatives, let us consider the acquisition of English differential comparatives. Once they acquire the null head μ, they acquire the adult-like underlying structures of differential comparative and the MP absolute constructions in (43).

(43) a. English differential comparative construction



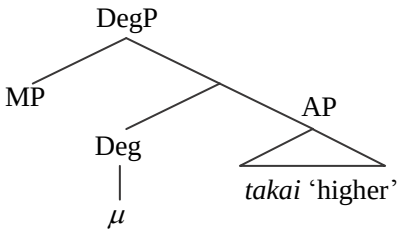
b. English MP absolute construction



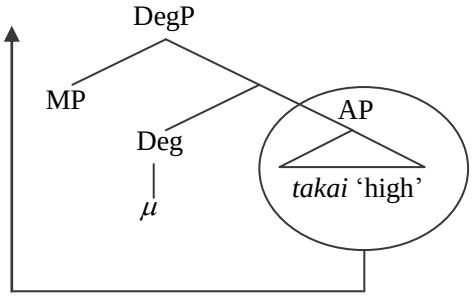
Owing to the morphological distinction between comparative and non-comparative adjectives in English, children should be able to distinguish the differential comparative construction in (43a) from the MP absolute construction in (43b) without any trouble.

On the other hand, the acquisition process of Japanese differential comparatives can be more complicated. In the same way as English-speaking children, once they acquire the null head μ, Japanese-speaking children acquire the adult-like underlying structures of differential comparative and MP absolute constructions in (44).

(44) a. Japanese differential comparative construction



b. Japanese MP absolute construction



(45) a. Kono biru-wa 20-meetoru takai.
this building-TOP 20-meter higher
‘This building is 20 meters higher’

b. Kono biru-wa taka-sa 20-meetoru-da.
this building-TOP high-sa 20-meter-COP
‘This building is 20 meters high.’

(44a) is the underlying structure of the differential comparative in (45a), while (44b) is the underlying structure of the MP absolute construction in (45b). Given Watanabe’s (2013) analysis of word order in MP absolute constructions, the AP undergoes movement over the MP and it gets the suffix *–sa* because of agreement with a functional head above. In (45b), thus, the adjective precedes the MP.

As we have seen in Section 1, Japanese does not have a comparative morpheme like *-er* in English and the adjective in (46) is ambiguous: it has both comparative and non-comparative interpretations.

(46) Kono biru-wa takai.
this building-TOP high/higher
‘This building is high/higher.’

Then, how do children learn that the adjective *takai* in (45a) has only a comparative interpretation? In Mandarin Chinese, there is no morphological distinction between comparative and non-comparative adjectives like Japanese. In this language, sentences that have a post-adjectival MP in combination with an adjective give rise to a comparative/non-comparative ambiguity, as in (47).[33]

(47) Zhangsan gao liang mi.
Zhangsan tall two meter
'Zhangsan is two meters tall.' OR 'Zhangsan is two meters taller (than some salient individual).'
(G&K (2012): (78))

Unlike (47), the Japanese differential comparative in (45a) has only a comparative interpretation. It follows that after they have acquired the null head μ, Japanese-speaking children also have to learn that the adjective in (45a) is unambiguously comparative. That is, acquisition of Japanese differential comparatives undergoes at least one more process than acquisition of English differential comparatives.

Given that children do not have access to negative evidence (Brown and Hanlon (1970) and Marcus (1993)), Japanese-speaking children face a learnability problem: they have to expunge the non-comparative interpretation of the AP in differential comparatives from their grammar with no evidence against it. Gualmini and Schwarz (2009) suggest a solution to such an "expunction problem." They claim that children could infer the unavailability of a specific reading on the basis of a dialogue between competent adult speakers. For example, suppose that an English-speaking child has incorrectly posited a non-local reading of embedded reflexives in addition to the local interpretation. The child would incorrectly allow for two interpretations of sentences like (48), licensing the unavailable non-local reading (49b) in addition to the available local reading (49a).

(48) John told Bill to shave himself.
(49) a. John told Bill to shave Bill. (local) (available in English)
b. John told Bill to shave John. (non-local) (unavailable in English)

If he knows the principle of charity that listeners interpret speakers' utterances charitably in the sense that they refrain from rejecting an utterance as false as long as an interpretation is available that they do not consider false, the child could infer that the non-local reading is not actually available in the adult grammar on the basis of a conversation like (50).

(50) Speaker A: John wanted Bill to shave himself.
Speaker B: No, actually, John had no problem with Bill's beard, but John wanted to get a shave from Bill.

The child could reason that, if such a non-local reading were available, Speaker B would have been able to access it and would accordingly not have objected to Speaker A's utterance on the ground of it being false. By drawing this inference, the child could expunge the unavailable non-local reading from his grammar.

We can apply the same solution to Japanese-speaking children's expunction of the non-comparative interpretation of the adjective in differential comparatives. If they know the principle of charity, children could

[33] In Mandarin Chinese, it is also possible for the MP to precede the adjective, as shown below. This construction is unambiguous: (i) has only a non-comparative interpretation.

(i) Zhangsan liang mi gao.
Zhangsan two meter tall
'Zhangsan is two meters tall.' NOT '*Zhangsan is two meters taller.' (Grano and Kennedy (2012): (79))

In order to capture this asymmetry between (47) and (i), G&K assume that the MP can merge with the AP either as its complement or as its specifier. This option is not available for comparative adjectives, however, because the specifier of the AP is filled with the standard argument in Mandarin Chinese.

infer that the non-comparative interpretation is not actually available in the adult grammar on the basis of a conversation like (51).

(51) Speaker A: Okaasan-no ame-wa san-ko ooi-to omou.
mother-GEN candy-TOP three-CL more-COMP think
'Mother has three more candies.'
Speaker B: Iie, okaasan-no ame-wa otosan-no-yori ni-ko ooi.
no mother-GEN candy-TOP father-GEN-than two-CL more
'No. Mother has two more candies than Father.

Suppose that the mother has three candies and the father has one candy. Children could reason that, if the non-comparative interpretation of *ooi* is available, Speaker B would have been able to access it and would accordingly not have objected to Speaker A's utterance on the grounds of it being false. At present, we have no idea about whether Japanese-speaking children actually use this solution in order to expunge the non-comparative interpretation. However, we argue that the expunction problem which Japanese-speaking children would face is not logically unsolvable.

Moreover, a Japanese contrastive morpheme *hoo* can also help children to acquire the comparative interpretation of the adjective in differential comparatives. According to Matsui and Kubota (2012), *hoo* is a morphology which invokes a presupposition that two entities are being contrasted with one another in terms of some contextually relevant property. Due to such property, *hoo* is often used in comparative constructions. As we have seen that the adjective in Japanese absolute constructions like (52a) is ambiguous between comparative and non-comparative interpretations. However, when the subject is followed by *hoo*, the adjective has only a comparative interpretation as shown in (52b) because *hoo* invokes a presupposition that the number of apples John has is contrasted with the number of apples another person, say, Mary has.

(52) a. John-no-ringo-wa ooi.
John-GEN-apple-TOP many/more
'John has many/more apples.'
b. John-no-ringo-no-hoo-ga ooi.
John-GEN-apple-GEN-hoo-NOM more
'(Not Mary but) John has more apples.'

Likewise, *hoo* can be used in differential comparatives, too, as shown below.

(53) John-no-ringo-no-hoo-ga ni-ko ooi.
John-GEN-apple-GEN-hoo-NOM two-CL more
'(Not Mary but) John has two more apples.'

Because of the contrastive morphology *hoo*, the comparative meaning of the adjective is salient in (53). It invokes the presupposition that the number of apples John has is compared with the number of apples Mary has, and it is natural to interpret the adjective as comparative. Under such presupposition, just referring to the number of apples John has sounds strange. This can help children learn the comparative interpretation of the adjective in differential comparatives. Give that children acquire their language conservatively, if children had not heard that the adjective in differential comparatives is unambiguously assigned a non-comparative interpretation in adults' conversation, only a possible interpretation of differential comparatives would be the comparative interpretation of the adjective in child grammar (Snyder (2007)). Therefore, regardless of whether children expunge the non-comparative interpretation or they conservatively learn the comparative interpretation, they can acquire the adult-like interpretation of differential comparatives. In relation to the acquisition of unambiguous interpretation of Japanese

differential comparatives, we also have to understand why the non-comparative interpretation of the adjective is blocked in the adult grammar.[34] We will leave this for future research.

6.3. Acquisition of Differential Comparatives whose Differential is Expressed with a Quantifier Phrase

Lastly, it is an intriguing question whether children also assign non-adult interpretations to differential comparatives where the differential phrase is expressed with a quantifier phrase like *much* and *a little*. If they do so in the same way as with differential comparatives, they might interpret *this building is a little higher* as follows: 'this building is higher' (the adjective interpretation), 'this building is a little (high) and it is higher' (the conjunctive interpretation) or 'this building is a little (high)' (the "quantifier reading").[35] However, the status of such quantifier phrases is more complicated than it looks. According to G&K, the quantifier phrases are ambiguous: they can function either as true MPs or as degree modifiers, which have different syntactic and semantic properties. As shown below, *a bit* can appear both with predicates which allow degree modifier *very* but disallow an MP as in (54) and with predicates which allow MPs but disallow *very* as in (55).

(54) a. a bit/*40°/very warm
b. a bit/*35 kg/very heavy
c. a bit/*20 kph/very slow (G&K (2012): (11))

(55) a. deepen the hole a bit/2 feet/*very
b. raise the curtain a bit/1 inch/*very
c. cool the soup a bit/3 degrees/*very (G&K (2012): (12))

Therefore, before investigating children's interpretation of such differential comparatives, we have to first clarify the status of the quantifier phrase in differential comparatives.

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[34] Based on K&M, S&K, K&L and G&K, Sawada and Grano (2011) offer an analysis on the obligatory comparative interpretation for the adjective in differential comparatives. They propose that the semantics of comparison is in the standard *yori* 'than' in Japanese (as opposed to in a null comparative morpheme, here we assume). Thus, differential comparatives with and without an overt *yori* phrase have a different way to get their comparative reading. Adding a semantic restriction on μ which ensures that it can only combine with adjectives that have a minimum element, they argue that comparative adjectives with an overt *yori* phrase can combine with the null head μ because the standard of comparison provides a minimal element. On the other hand, in differential comparatives without an overt *yori* phrase, a coercion operator coerces the meaning of an adjective to have a contextually determined implicit standard from which a measurement is computable, and the adjective is interpreted as comparative. Namely, the coercion operator intervenes in order to resolve the clash between adjectives without a minimum element and μ. As we have seen, children assign non-adult interpretations to both differential comparatives with and without a *yori* phrase. Regardless of how the adjectives get the comparative meaning, children have difficulty in combining a numeral phrase with the adjectives. Therefore, we can attribute English- and Japanese-speaking children's non-adult interpretation of differential comparatives to the null head μ in the same way. Regarding Sawada and Grano's (2011) analysis that the semantics of comparison is in the standard *yori* in Japanese, I have to note one question. As a basis for the analysis, they refer to the Japanese construction in (i).

(i) Kono tana-wa takai.
this *shelf-TOP* *tall*
'This shelf is tall.' (*Not*: This shelf is taller.') (Sawada and Grano (2011): (75a))

As opposed the observation presented here, they claim that (i) cannot be interpreted as 'This shelf is taller than a contextually determined object.' However, as shown in (ii), if the contrastive morphology *hoo* is attached to the subject, the sentence can be obviously interpreted as comparative even though there is no overt *yori* phrase. If we adopt the analysis that the semantics of comparison is in the standard *yori* in Japanese, we have to show why the sentence without a *yori* phrase in (ii) can have a comparative reading.

(ii) Kono tana-no-hoo-ga takai.
this *shelf-GEN-hoo-NOM* *tall*
'(Not that shelf but) this shelf is taller.'

[35] The quantifier reading corresponds to the cardinality reading for differential comparatives where the differential phrase is expressed with a numeral phrase, as we have seen in Section 3.2.

7. Conclusion

In this paper, we have seen two pilot studies. The scale of these studies is small, but we can learn a lot from them. The first pilot experiment shows that young children can quantify a differential between two sets and supports the Linguistic Hypothesis. The second pilot experiment reveals that children assign various non-adult interpretations to differential comparatives. It suggests that the underlying structure of differential comparatives in child Japanese lacks a slot for a differential phrase. It leads to children's resorting to some non-compositional solution to deal with the uninterpretable differential phrase. After that, reviewing the analysis of Schwarzchild's (2005) and that of K&M, S&K, K&L and G&K, we have shown that the latter is more compatible with what happens in acquisition of differential comparatives. As we pointed out in Section 6, there are remaining problems. Among them, the most significant problem is how children acquire the null heads μ and μ_v based on positive evidence in linguistic input. Further study is strongly required.

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