博士論文

論文題目　The Acquisition of English and Japanese Measure Phrase Comparatives
(英語と日本語の度量句を含む比較構文の獲得)

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The Acquisition of English and Japanese Measure Phrase Comparatives

by

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Abstract

This thesis investigates the acquisition of the interpretation of Measure Phrase (MP) modification in order to explore the learning mechanism for acquiring the form-meaning mapping. I especially focus on English and Japanese, because these two languages exhibit variation in the range of possible measurements when an MP modifies a gradable adjective (GA). As shown in (1) and (2), when modifying a GA, an MP can express both absolute and differential measurements in English, while it only expresses the differential one in Japanese (Hayashishita, 2009; Kennedy, 2007a; Kikuchi, 2002; Kubota, 2011; Nakanishi, 2007; Schwarzschild, 2005; Snyder *et al.*, 1995).

(1) a. X is 10 meters taller (than Y). (differential)

b. X is 10 meters tall. (absolute)

(2) a. X-wa Y-yori 10-meetoru takai. (differential)
X-TOP Y-than 10-meter tall
'X is 10 meters taller than Y.'

b. X-wa 10-meetoru takai. (differential)
X-TOP 10-meter tall
'X is 10 meters taller.'

Children learning these languages then have to learn which interpretations are possible and which are impossible for the combination of a GA and an MP. This thesis proposes an account of how English and Japanese children acquire such language-specific knowledge. I investigated their interpretation of *MP comparatives* as in (1a) and (2) through a series of experiments. Previewing the results, the experiments showed that children learning these languages consistently assign a non-adult, absolute interpretation to the construction. For example, they interpret (1a) as 'X is 10 meters tall.' Therefore, we have to explain how children acquire the correct, differential interpretation and

unlearn the absolute interpretation.

Chapter 1 specifies the scope of this thesis. We first examine the cross-linguistic variation between English and Japanese in the range of possible interpretations of the MP+GA constructions and then briefly preview that both English and Japanese children cannot correctly interpret MP comparatives. We then confirm that the theory of language acquisition has to explain the acquisition of the construction. Next, arguing that children cannot access the negative evidence that the absolute interpretation is not possible for MP comparatives, I conclude that we cannot explain the acquisition with a conservative learning model. In order to explore the possible explanations, we then review how previous studies of language acquisition dealt with children's non-adult behavior. One strategy that studies of language acquisition first adopt is to examine the design of the experiments in which children performed in a non-adult-like way. By doing so, we sometimes find a flaw of the design or find that the previous findings have been misinterpreted. In these cases, it is possible that a modified experiment can extract children's adult-like performance. When the children's non-adult behavior proves to be robust, two types of approaches have been generally taken in order to explain how children finally acquire the target grammar: *the maturational approach* and *the grammatical approach*. The maturational approach attributes the non-adult performance either to children's developing processing or to grammatical knowledge. In order to achieve adult-like performance, then, children do not have to learn anything, and need only wait for a responsible component to mature. On the other hand, the grammatical approach is built on a grammatical model in which the target grammar is a consequence of another grammatical property observable in the input, and explains the acquisition of the target grammar on the basis of positive evidence alone. This thesis proposes a grammatical account of the acquisition of MP comparatives and a maturational account of the delay in acquisition.

Chapter 2 reviews previous theoretical studies of comparatives. We first review analyses of comparative constructions in general. Next, we review analyses of MP

comparatives. Here, we review three kinds of analyses: the lexical analysis (Beck, 2011; Beck *et al*., 2004; Kikuchi, 2002; Oda, 2008) and the analyses of Schwarzschild (2005) and of Sawada and Grano (2011). Chapter 3 reviews the previous literature on the developing comprehension and production of each part of MP comparatives: GAs, comparatives without an MP, and MPs. Here, we confirm that English and Japanese children may possess a command of the components of MP comparatives at least by five years of age.

Chapter 4 presents seven experiments investigating English and Japanese children's interpretations of MP comparatives. These experiments show that children consistently and robustly interpret MP comparatives absolutely in both English and Japanese regardless of the presence or absence of the standard phrase, and they do so regardless of the kind of GAs or the polarity. This non-adult-like pattern of response appears to persist well into five to six years of age. On the other hand, they are able to correctly interpret comparatives without an MP (e.g., X is taller than Y). This suggests that it is the presence of the MP that hinders their performance. Moreover, their non-adult interpretation of MP comparatives cannot be attributed to extra-grammatical factors (i.e., incremental processing; arithmetical ability), nor to a non-compositional interpretation.

Chapter 5 proposes a grammatical account whereby children learn the differential interpretation, and as a consequence, unlearn the absolute interpretation, based on positive evidence alone. In this account, children's absolute interpretation is attributed to their wrong setting of the standard of comparison. When interpreting the MP comparative *X is MP taller (than Y)*, they set the standard as the absolute zero by default, and interpret the comparative as 'X is MP taller than the absolute zero.' This is the underlying representation of their absolute interpretation. In this case, when they come to be able to correctly set the standard, they can correctly take the MP as a differential measurement rather than an absolute one. This account is possible when there is a grammatical model that regulates the setting of the standard. For such a model, this

thesis adopts the theoretical device proposed by Sawada and Grano (2011), who proposed that MPs are introduced by null Deg head *Meas*. *Meas* imposes a selectional restriction on the GA with which it is combined. Assuming that children and adults share the same Degree Phrase structure, I propose that children's absolute interpretation is attributed to the lexical entry of *Meas* in child grammar, which is slightly different from that in adult grammar. In order to acquire the correct, differential interpretation, then, children have to revise the lexical entry of *Meas*. I argue that children can achieve this on the basis of positive evidence alone. Moreover, I propose a maturational account of the fact that it takes a long time to acquire MP comparatives, a delay that I argue is due to their immature processing capacity.

Chapter 6 summarizes the findings of the series of experiments reported in this thesis and the proposals concerning the acquisition on MP comparatives. Based on these, I suggest that when acquiring form-meaning correspondence in general, children assign meaning to subparts, which are then composed to yield a whole construction in the syntax and semantics.

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Abbreviations

CHILDES	the Child Language Data Exchange System
CL	classifier
CLF	cleft
COND	conditional
COP	copula
DAT	dative case
Deg	degree
GA	gradable adjective
GEN	genitive case
HONORIFICS	honorific suffix
IMP	imperative marker
MODAL	modal auxiliary
MP	measure phrase
NEG	negative morpheme
NOM	nominative case
PART	particle
PASS	passive form
PAST	past tense
PRED	predicate
Q	question marker
TOP	topic marker
TVJT	truth value judgment task
unacc.	unaccusative case

Chapter 1: Introduction

Acquisition of syntax-semantics mapping is a central problem for a theory of language acquisition. Children have to learn which interpretations are possible and impossible for a certain form based on what they hear. This is a non-trivial task because the relation of surface form and meaning is often complex and languages vary in how they are mapped to each other. This thesis investigates the acquisition of the interpretation of Measure Phrase (MP) modification in order to explore the learning mechanism of form-meaning mapping.

This thesis focuses on English and Japanese. These two languages exhibit variation as to the range of possible measurements when an MP modifies a gradable adjective (GA). English allows two kinds of measurements while Japanese only allows one of them. This thesis aims to determine how English and Japanese children acquire such language-specific knowledge. In this introduction, we begin by observing cross-linguistic variations in the possible measurements, and then we preview children's non-adult interpretation of MPs when they modify a GA. I then argue that the acquisition of the correct interpretation cannot be explained by conservative learning. Lastly, we review how previous studies have dealt with children's non-adult behavior.

1.1 Cross-linguistic variation in the interpretation of MP modification

Let us first consider the English sentences in (1).

1. a. This building is taller than that building.
   b. This building is tall.

These sentences include the GA *tall*. In (1a), the GA is in the comparative form (*taller*) and the sentence expresses an *explicit comparison* between the maximal height of the two buildings. In (1b), the GA is in the positive, bare form (*tall*), and the sentence

expresses an *implicit comparison* between *this building* and some contextually-determined standard (cf. Bartsch & Vennemann, 1972; Bierwisch, 1967; Cresswell, 1976; Kamp, 1975; Klein, 1980; Ludlow, 1989; von Stechow, 1984a; Wallace, 1972, among others). As can be seen, English has comparative morphology: the bound comparative morpheme *-er* in (1a) and the periphrastic *more* (e.g., *more beautiful*). When the standard is explicitly expressed with a *than*-phrase (e.g., *than that building*), it must always be accompanied by a comparative morpheme.

On the other hand, Japanese does not have comparative morphology. Nevertheless, this language can also express a comparison both explicitly and implicitly (cf. Beck *et al*., 2004; Kennedy, 2007a; Sawada, 2009). In (2a), a *yori* 'than'-phrase occurs with the GA in the bare form, *takai* 'tall,' and the sentence expresses an explicit comparison like that of the English sentence in (1a).[1]

2. a. Kono biru-wa ano biru-yori takai.
   this building-TOP that building-than tall
   'This building is taller than that building.'
   b. Kono biru-wa takai.
   this building-TOP tall
   'This building is tall.'

Without the *yori*-phrase, as in (2b), the sentence expresses an implicit comparison like the English counterpart in (1b), and the standard degree varies depending on context.[2]

When the English sentences in (1) are modified with a measure phrase (MP) *10 meters*, as shown in (3), they have different interpretations.

[1] In Japanese, the standard marker *yori* 'than' also corresponds to the English *from*.
[2] The interpretation of (2b) is actually controversial because several previous studies assumed that this sentence is comparative just like the English sentence *this building is taller* (Beck, 2011; Beck *et al*., 2004; Kikuchi, 2002; Oda, 2008). This dissertation nevertheless assumes that (2b) is a positive construction, following Sawada and Grano (2011). I will discuss its interpretation in Section 2.3.1.

3. a. This building is 10 meters taller (than that building). (differential)

b. This building is 10 meters tall. (absolute)

The MP in (3a) expresses a *differential* measurement, and the sentence indicates that the height of *this building* exceeds that of *that building* by 10 meters (von Stechow, 1984a). It does not say anything about the height of *this building* itself. On the other hand, the MP in (3b) expresses an *absolute* measurement of *this building*'s height.

Similarly, the Japanese sentences in (2) can be also modified with an MP as illustrated in (4).

4. a. Kono biru-wa ano biru-yori 10-meetoru takai.
this building-TOP that building-than 10-meter tall
'This building is 10 meters taller than that building.' (differential)

b. Kono biru-wa 10-meetoru takai.
this building-TOP 10-meter tall
#'This building is 10 meters tall.' (#absolute)
'This building is 10 meters taller.' (differential)

Unlike English, however, the MP in these sentences only expresses a differential measurement. In other words, the MP in (4b) does not license an absolute measurement even in the absence of the *yori*-phrase (Hayashishita, 2009; Kennedy, 2007a; Kikuchi, 2002; Kubota, 2011; Nakanishi, 2007; Schwarzschild, 2005; Snyder *et al.*, 1995). In order to express an absolute measurement, speakers of Japanese must resort to an explicitly non-comparative construction: a copular sentence with a nominalized GA as in (5) (e.g., Watanabe, 2013).[3]

[3] Watanabe (2013) actually argued that Japanese expresses an absolute measurement in the same way as English. In his analysis, Japanese has a positive construction corresponding to the English one in (3b), which is that in (5) without the nominative case marker *-ga*. Without the nominative case marker, he argued, *takasa* in (5) functions as a GA, even though it appears to be the

5. Kono biru-wa takasa(-ga) 10 meetoru da.
   This building-TOP height(-NOM) 10 meters COP
   'The height of this building is 10 meters.'

The sentence in (4b) does not include any comparative markers (i.e., comparative morphemes; overt standard phrases marked with the *yori* phrase), and nothing appears to force the MP to express the differential measurement. Thus, the apparently similar surface structures in English and Japanese, shown in (3b) and (4b), have different interpretations. In other words, when modifying a GA, an MP can express both absolute and differential measurements in English while it only expresses a differential one in Japanese. In what follows, I will respectively refer to these types of interpretation as the *absolute interpretation* and the *differential comparative interpretation* (or *differential interpretation* for short) (see Beck (2011), Schwarzschild (2005), and von Stechow (1984b) for further discussion). Moreover, I will use the term *MP comparative* to refer to surface forms like those in (3a) and (4) that yield a differential interpretation.

1.2 Children's non-adult interpretation

In this thesis, I focus on MP comparatives in English and Japanese in order to explore how children learning these languages acquire the differential interpretation. In order to acquire it, they need to determine the range of possible interpretations associated with the various forms (MP+GA constructions) in (3) and (4). Given such variation, children must somehow learn these language-specific features based on the linguistic input available to them.

I investigated English and Japanese children's interpretations of MP comparatives

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nominalized form of the GA *takai* 'high.' His analysis is based on the observation that if *takasa* is a nominal, it would be ungrammatical without a case marker. This thesis does not make any serious theoretical commitment about the non-comparative construction, because even if Japanese has a positive construction like (3b), this does not seem to make any significant difference with respect to my acquisition data and its analysis.

through a series of experiments. To preview the results, I found that children acquiring these languages showed the same non-adult-like pattern of behavior. They wrongly interpreted MP comparatives as expressing an absolute interpretation, rather than assigning a differential one. For example, to the constructions in (3a) and (4), they assign the absolute interpretation 'this building is 10 meters tall.' All of the children who participated in the experiments were able to correctly interpret simple comparatives (e.g., *this building is taller than that building*). They wrongly assigned the absolute interpretation regardless of explicit comparative morphology (English) and regardless of the fact that their target language does not allow an absolute interpretation when an MP occurs with a GA (Japanese). Furthermore, their performance did not improve even when the *than/yori*-phrase was present. Even five- and six-year-olds consistently assigned the absolute interpretation. The theory of language acquisition thus has to explain how children acquire the correct interpretation.

There are previous studies that also explored the acquisition of possible interpretations: Goro (2007) and Zhou and Crain (2009).[4] These studies respectively found that Japanese and Chinese children mistakenly allow a non-adult, inverse scope interpretation *in addition to* an adult-like, surface scope interpretation. These studies give an account of how Japanese and Chinese children expunge the inverse scope interpretation on the basis of positive evidence alone. In the current case, on the other hand, my experimental studies found that English and Japanese children consistently assign a non-adult, absolute interpretation to MP comparatives, *not allowing* the licit, differential interpretation. Thus, they have to not only learn the differential interpretation but also unlearn the absolute interpretation. In other words, in order to acquire the correct interpretation of MP comparatives, both learning and unlearning tasks are required. In this respect, this thesis deals with a different learning process from the previous studies.

[4] We will review Goro (2007) and Zhou and Crain (2009) in detail in Section 1.4.2.2.

1.3 Conservative learning

One possible learning scenario is that child grammar initially only allows an absolute measurement. Children then conservatively learn that a differential measurement is possible when they encounter linguistic input in which MPs are explicitly used with the differential interpretation. Let us consider this scenario under the Principles and Parameters approach (Chomsky, 1981, 1995). Suppose that there is a parameter distinguishing grammars that only allows an absolute measurement from grammars that allow both absolute and differential measurements. Given that English and Japanese children consistently assign an absolute interpretation to MP comparatives, the default setting of the parameter seems to be the value that only yields an absolute measurement. English and Japanese children can set the parameter to the other value by conservatively learning that their target grammar allows a differential measurement based on the linguistic input. However, MP comparatives in English and Japanese do not allow an absolute interpretation. How do children learning these languages unlearn it?

In this case, we have to deal with *the Subset Problem* (Angluin, 1980; Baker, 1979; Berwick, 1985; Wexler, 1993). For example, consider the schematic illustration in Figure 1.

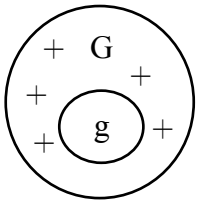

Figure 1. Situation that gives rise to the Subset Problem

Suppose that the target grammar *g* is a proper subset of the grammar *G* that the child has. The child will never be contradicted by the linguistic input because every instance of *g* is compatible with *G*. Thus, in order to acquire *g*, the child needs negative evidence that + forms are not allowed in the target grammar. In the case of MP comparatives, thus,

the Subset Problem would arise: after learning that their target grammar allows a differential interpretation, English and Japanese children have to move from a grammar in which both absolute and differential interpretations are possible to a grammar in which only the differential interpretation is possible. In this case, these two types of grammar (i.e., child and adult grammars) constitute a subset/superset relation: the adult grammar is the subset of the child one. Children would then need negative evidence that the absolute interpretation is not possible in their target grammar.

Goro (2007, 2015) discusses in detail whether negative evidence is available for children to unlearn a non-adult interpretation. Following his discussion, let us examine the availability of negative evidence for unlearning the absolute interpretation of MP comparatives. One type of negative evidence is *direct negative evidence* (DNE). This is given to children as parental feedback to their utterance in the form of correction and disapproval. However, previous research has shown that DNE is not equally provided to all children on all occasions, is generally noisy, and is not sufficient (Bowerman, 1988; Brown & Hanlon, 1970; Marcus, 1993; Morgan & Travis, 1989). Thus, Pinker (1989) concluded that children cannot count on DNE to learn whether an utterance is well-formed or not. In the current case, likewise, it seems unlikely that children receive DNE against an absolute interpretation. Such DNE could be available only when: (i) the child uses MP comparatives with an absolute interpretation; (ii) the caretaker identifies the child's intended interpretation; and (iii) the caretaker clearly tells the child that the interpretation is not possible with the construction. Given that children cannot count on DNE even in the cases where their errors are much more obvious (i.e., errors in forms, rather than interpretations), it is highly unlikely that children encounter such a situation.

Another type of negative evidence is *indirect negative evidence* (INE), which was first discussed by Chomsky (1981). INE is the absence of input evidence that certain forms are possible, which itself serves as a kind of evidence that such forms are ungrammatical. This idea has recently gained prominence in research on probabilistic learning models, and some learning models have formalized the idea of learning from

the absence of expected evidence (Elman, 1993; Pearl & Lidz, 2009; Pearl & Mis, 2011; Perfors *et al.*, 2011; Regier& Gahl, 2004; Tenenbaum & Griffiths, 2001). Importantly, some learning models have been shown to be able to discriminate subset-superset hypotheses, extracting INE from the linguistic input (e.g., Regier & Gahl, 2004). In the current case, English and Japanese adults never use MP comparatives with an absolute interpretation. This fact could then serve as INE against the absolute interpretation.

However, it seems unlikely that a probabilistic learning model can account for unlearning the absolute interpretation. In a probabilistic learning model, the absence of input evidence is crucial, and children must correctly detect in the input the absence of an absolute interpretation for MP comparatives. They gain information about an interpretation from their internally generated hypotheses about the meaning of the provided sentence. Thus, the discovery of the evidence against the absolute interpretation depends on the children's internal state. Given that both English and Japanese children consistently assign an absolute interpretation to the target construction, it is quite likely that they wrongly assign an absolute interpretation to the construction that they hear in the input. Even if the input lacks evidence for the absolute interpretation, children thus might wrongly generate false evidence for the illicit interpretation. This possibility can seriously interfere with a probabilistic learning model. Therefore, it seems unlikely that children unlearn the absolute interpretation through a probabilistic learning model.

Given that there is no concrete model that would explain the unlearning of the absolute interpretation, this thesis assumes that English and Japanese children do not rely on either DNE or INE to expunge the interpretation. Thus, we cannot account for the acquisition of MP comparatives with the conservative learning model, because children would need negative evidence that the absolute interpretation is not possible. Nevertheless, such negative evidence is not available. We thus need a different account of the acquisition of the correct interpretation.

1.4 Previous approaches to children's non-adult behavior

A central goal of any theory of language acquisition is to explain how children acquire the grammar of their language, and theories need to clarify how children overcome their non-adult performance, if they show any. In this section, I review how previous studies on language acquisition have dealt with children's non-adult behavior.

1.4.1 Examining previous experimental design

One strategy that previous studies first adopted is to examine the design of experiments in which children performed in a non-adult-like way in order to discover possible flaws of the design or possible misinterpretations of previous findings. When we find a flaw in the design, we then conduct a modified experiment to see whether or not children can improve their performance. When we find a misinterpretation of previous experimental results that suggests children's non-adult grammar, on the other hand, we attempt to reveal the children's actual grammatical knowledge using a different experimental design. Let us review these two types of previous studies one by one.

Examples of the former type of studies pointing out a possible flaw of previous experimental designs are Crain *et al*. (1996) and Sugisaki and Isobe (2001), who investigated children's understanding of universal quantification. It had been reported that children sometimes make non-adult responses to sentences containing *every* (Philip, 1995). For example, four- to six-year-olds sometimes say 'no' to the question in (6) about the situation illustrated in Figure 2, while adults answer 'yes.'

6. Is every boy riding an elephant?

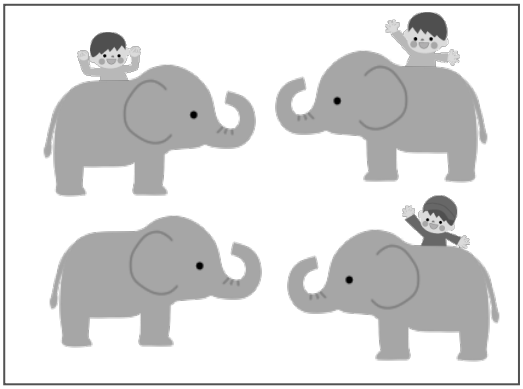

Figure 2. Sample picture used in Philip (1995)

In this situation, there are three boys riding an elephant and an "extra" elephant that is not being ridden by anybody. The children who say 'no' justify their response by pointing to the "extra" elephant. This negative response shows that in such a situation children seem to require a symmetrical relation between boys and elephants, and this response is called *symmetrical response*. Philip (1995) attributed this to children's non-adult linguistic knowledge. He argued that children mistakenly treat *every* as an adverb of quantification like *always* that ranges over events and interpret (6) as meaning that for any event that has a boy or an elephant (or both), it must be an event of a boy riding an elephant. However, Figure 2 does not illustrate such an event because of the extra elephant. Philip argued that this is the reason why children answer (6) negatively.

On the other hand, Crain *et al.* (1996) attributed the symmetrical response to the inappropriateness of the discourse context of the previous experiment. They argued that when we ask someone to judge whether a sentence is true or false, we have to satisfy *the felicity condition*: the discourse context must provide both a possible outcome and an actual outcome that respectively lead to different yes/no responses. However, the situation represented in Figure 2 does not satisfy this condition. In order to felicitously ask the yes/no question in (6), the context has to provide the possible and actual outcomes that correspond to the propositions in (7).

7. a. Yes, every boy is riding an elephant.

b. No, not every boy is riding an elephant.

Crain *et al.* demonstrated that children can correctly respond to sentences including *every* when the felicity condition is satisfied. They used the Truth Value Judgment Task (TVJT). In this task, one experimenter tells the child a story using toys, while a puppet (played by a second experimenter) watches the story alongside the child. At the end of the story, the puppet makes a statement about what he thinks happened in the story, which is either true or false depending on a certain condition, and asks the child whether he is correct or not. This task makes it possible to examine whether children allow the target interpretation for a construction. In one story that Crain *et al*. used, two children and their mother went skiing. They wanted to drink something and found five cups of hot apple cider and five bottles of soda. The mother drank cider, but the children wanted to drink the soda. However, the mother persuaded them to drink a cup of cider. In the end, the children decided to drink cider. The puppet then said (8).

8. Every skier drank a cup of hot apple cider.

This story satisfies the felicity condition. In the first part of the story, the mother drank cider, while the children considered drinking soda. This provides a possible outcome, where (8) is false. In the second part of the story, the children decided to drink cider. This is the actual outcome, where (8) is true. Crain *et al.* found that children aged three-to-five years judged (8) true in this context 88% of the time. They then concluded that children have full grammatical knowledge of universal quantification.

Sugisaki and Isobe (2001) provided support for Crain *et al.*'s conclusion cross-linguistically, demonstrating that Japanese children also have full knowledge of universal quantification. However, they argued that children correctly performed in Crain *et al.*'s experiment despite the context satisfying the felicity condition. In the story that Crain *et al.* used, each skier took one cup of apple cider, and the total number

of remaining objects were seven (two cups of apple cider and five bottles of soda). On the other hand, in Phillip's experiment as illustrated in Figure 2, the number of extra objects was only one. Sugisaki and Isobe argued that this difference in the number of remaining/extra objects elicited the adult-like response in Crain *et al.*'s experiment. Sugisaki and Isobe ran an experiment on Japanese children using a similar task as in Phillip's experiment, but with a context that did not satisfy the felicity condition. The child participants were divided into two groups. One group of children (the *control group*) was shown a picture like Figure 3, the other group (the *experimental group*) a picture like Figure 4.

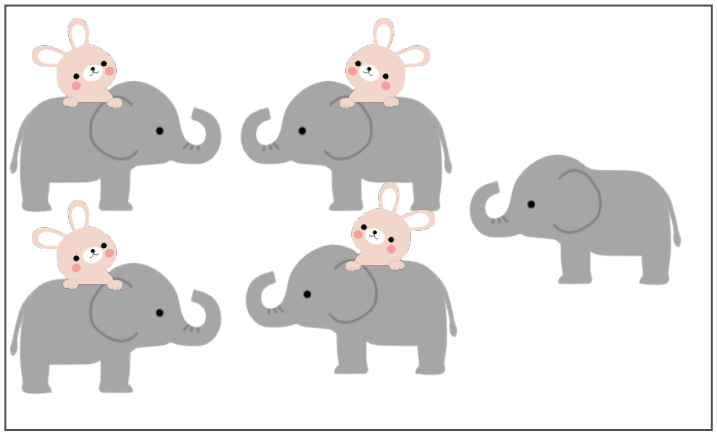

Figure 3. Sample picture for the control group in Sugisaki and Isobe (2001)

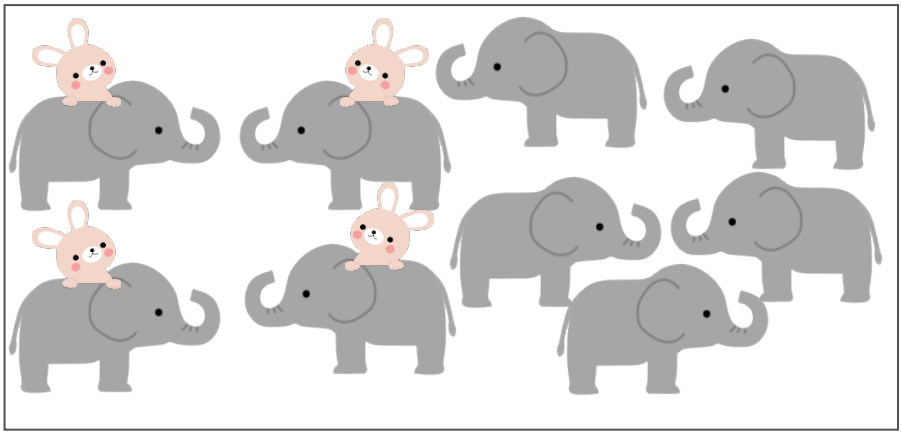

Figure 4. Sample picture for the experimental group in Sugisaki and Isobe (2001)

In Figure 3, there is only one extra object. On the other hand, in Figure 4, the number of extra objects is greater than four. Given the test sentence in (9), the children in the control group correctly accepted it 37.5% of the time, while the children in the experimental group correctly accepted it 87.5% of the time.

9. Dono usagi-mo zou-ni notteiruyo.
   every rabbit-also elephant-DAT ride
   'Every rabbit is riding an elephant.'

Thus, Sugisaki and Isobe elicited adult-like response even in a situation where the felicity condition is not satisfied. They then concluded that the adult-like performance in Crain *et al.*'s experiment is due to the large number of extra objects.[5] Thus, as these examples show, children's non-adult performance reported in previous studies might be due to some experimental flaw, and when this is the case, an appropriately modified experiment can elicit adult-like performance.

Next, let us review the other type of previous studies. These studies pointed out misinterpretations of previously reported experimental results that suggest children's non-adult grammar, and then attempted to reveal children's actual grammatical knowledge using a different experimental design. An example of this is Crain and McKee (1985), who investigated children's interpretation of *backward anaphora*. In (10a), the pronoun *he* and the referring expression *the Ninja Turtle* can refer to the same person. This is the backward anaphora interpretation. On the other hand, in (10b) such co-reference is not allowed.

10. a. While he_1 ate pizza, the Ninja $Turtle_{1/2}$ danced.

[5] Despite the findings of Crain *et al.* (1996) and Sugisaki and Isobe (2001), there are studies that attribute the symmetrical response to children's non-adult grammar: Drozd and van Loosbroek (1999) and Geurts (2003). These studies claimed that children misinterpret the strong quantifier *every* as if it were a weak quantifier like *many* and make a non-adult response (Milsark, 1974, 1977). For further detail, refer to these papers.

b. He_1 danced while the Ninja $Turtle_2$ ate pizza.

This prohibition cannot be accounted for by the linear order of the pronoun and the NP since the pronoun precedes the NP both in (10a) and in (10b). Instead, the contrast between these two sentences can be accounted for by a structure-dependent constraint, *Principle C* as in (11) (Chomsky, 1981, 1986; Lasnik, 1976).

11. An r-expression R (i.e., a referring expression) must be free everywhere.

This principle does not rule out the co-reference in (10a) because the pronoun does not c-command the referring expression. On the other hand, in (10b) the pronoun does c-command it and the co-reference is prohibited.

For the backward anaphora interpretation, it was reported that children do not have access to the interpretation (Chomsky, 1969; Lust, 1986). Their interpretation of backward anaphora was investigated with act-out tasks, in which children were asked to act out sentences by using toys. It was found that they did not assign the licit, anaphoric reading to sentences like (10a) and instead interpreted the pronoun either exophorically or as an extrasentential character. Based on this finding, Solan (1983) and Tavakolian (1978) argued that child grammar does not include Principle C and instead has a linear constraint that prohibits a pronoun from being anaphorically linked to its antecedent when the pronoun precedes the antecedent.

However, Crain and McKee (1985) pointed out that the act-out tasks can only highlight children's preference for a particular interpretation and cannot show whether or not children have grammatical knowledge that excludes the illicit reading of (10b). In order to investigate whether child grammar has Principle C, they examined children's interpretation with TVJT. As we have seen above, this task makes it possible to examine whether children allow the target interpretation for a construction. For sentences in (10), for example, the target sentences were presented in a context where the Ninja Turtle

was dancing and eating pizza at the same time. The results were that preschool three- to five-year-olds accepted sentences like (10a) 73% of the time, while they rejected sentences like (10b) 88% of the time. In other words, children allowed the anaphoric reading in (10a) but did not allow it in (10b). Crain and McKee then concluded that children have knowledge of Principle C. Thus, their findings show that the previous findings that children assigned the exophoric interpretation to sentences like (10a) does not reflect their grammatical knowledge but their preference. When we find non-adult behavior, thus, we first need to examine the experimental design, because the design could be flawed or the experimental finding that suggests the presence of children's non-adult grammar could be misinterpreted.

1.4.2 Explaining the acquisition of the target grammar

When their non-adult behavior is robust, we need to explain how children finally acquire the target grammar. In this case, two types of approaches have been generally taken. Let us call them *the maturational approach* and *the grammatical approach*.

1.4.2.1 The maturational approach

First, let us review the maturational approach. In this approach, children's non-adult performance is attributed to their developing mechanism responsible for computing the underlying representation of a target construction. This needs time to develop like any other instances of biological maturation (e.g., the maturation of secondary sexual characteristics). In order to achieve adult-like performance, thus, children do not have to learn anything but need only wait for the responsible component to mature. Roughly speaking, there are two types of maturational approaches: one attributes their non-adult behavior to their processing capacity (*the non-linguistic maturation hypothesis*) while the other attributes it to their grammatical knowledge (*the linguistic maturation hypothesis*).

Examples of the former type are Grodzinsky and Reinhart (1993) and Reinhart

(2006), who studied the acquisition of *Principle B*. For example, in (12) the NP *Mama Bear* and the pronoun *her* cannot refer to the same person in adult grammar.

12. Mama Bear touches her.

This can be accounted for by Principle B: a (nonreflexive) pronoun must be free in its local domain (Chomsky, 1981). In (12), the pronoun *her* is c-commanded by *Mama Bear*, and it cannot be anaphorically dependent on the NP. However, children interpret (12) about 50% of the time as meaning that Mama Bear touches herself (Chein & Wexler, 1990; McKee, 1992). This finding suggests that children interpret the pronoun both anaphorically and as an extrasentential character. Thus, their grammar seems to lack knowledge of Principle B.

Grodzinsky and Reinhart (1993) and Reinhart (2006) explained the acquisition by focusing on the fact that while children cannot correctly interpret sentences like (12), they can interpret sentences including quantifiers and *wh*-operators as in (13) (Chein & Wexler, 1990; Crain & Thornton, 1998; Thornton, 1990; Thornton & Wexler, 1990), in an adult-like way.

13. a. Every bear touches him.
    b. I know who scratches them.

Based on the findings, they claim that children's processing limitations are responsible for their non-adult interpretation of (12).

Let us first review Reinhart's (1983) analysis of sentences like (12), which Grodzinsky and Reinhart (1993) and Reinhart (2006) assumed. Here, Principle B prohibits the pronoun from being locally bound, and the pronoun takes its referent from the context. Suppose that we pick out *Mama Bear* as the referent of the pronoun. This case is called *coreference*. While syntactic binding affects bound variable anaphors, it

has nothing to say about such coreference anaphoras. However, adults do not usually license the coreference reading for sentences like (12). Reinhart accounted for this with *Rule I* in (14).

14. NP A cannot corefer with NP B if replacing A with C, C a variable A-bound by B, yields an indistinguishable interpretation. (Grodzinsky & Reinhart, 1993: (20))

In other words, when a reading similar to the coreference reading can be obtained through the mechanism of variable binding (e.g., the coreferential reading 'Mama Bear touches Mama Bear'; the anaphoric reading: 'Mama Bear touches herself'), the coreference reading is blocked.

Based on this analysis, Grodzinsky and Reinhart (1993) and Reinhart (2006) proposed that children know both Principle B and Rule I as parts of Universal Grammar. If so, in order to apply Rule I to sentences like (12), they have to keep in memory two LF representations and then compare the interpretations. However, as the processing load is too much for young children, they give up and guess the answer, thereby performing at chance level. For a pronoun that has a quantificational or a *wh* antecedent as in (13), on the other hand, a coreferential reading is impossible and children do not have to apply Rule I. This accounts for the contrast between their performances on (12) and (13). Thus, Grodzinsky and Reinhart (1993) and Reinhart (2006) attributed children's non-adult interpretation of sentences like (12) to their immature processing capacity. In order to acquire the correct interpretation, they do not have to learn anything, and all they have to do is wait for their processing resources to mature.[6]

In the other type of maturational approach, alternatively, children's non-adult behavior is attributed to their grammatical knowledge. An example of this is Borer and

[6] Contrary to the previous studies, Conroy *et al*. (2009) demonstrated that four-year-old children respect Principle B when interpreting sentences with a referential antecedent like (12) and sentences with a quantificational antecedent (13) in the same way. They argued that the previous findings of children's non-adult interpretation of sentences like (12) is caused by an experimental design factor. For further detail, see Conroy *et al*. (2009).

Wexler (1987, 1992), who studied the acquisition of passives. Previous studies have repeatedly found that children produce and comprehend actional verb passives like (15a) better than non-actional verb passives like (15b) and that they cannot reliably comprehend the latter until beyond the age of five years (Borer & Wexler, 1987, 1992; Fox & Grodzinsky, 1998; Gordon & Chafetz, 1990; Hirsch & Wexler, 2006; Hogan, 1978; Maratsos *et al*., 1985; Marchman *et al*., 1991; Sudhalter & Braine, 1985).

15. a. The boy was hit by the girl.
    b. The boy was loved by the girl.

In non-actional verb passives, they often confuse the experiencer with the theme (e.g., in (15b) the experiencer is *the girl* and the theme is *the boy*). Moreover, *short passives* (passives lacking the *by*-phrase) are produced and comprehended earlier than *long passives* (passives including the *by*-phrase).

As an account of the non-adult performance, Borer and Wexler (1987, 1992) argued that children cannot form *A-chains*. In their analysis, the machinery that allows the formation of A-chains is subject to maturation (*maturation of A-chains*). Thus, it takes time for children to come to be able to form A-chains. The formation of A-chains is necessary to generate verbal passives. In this type of passive, the NP occupying subject position is moved there from the underlying object position. Because of their inability to form A-chains, then, children cannot produce verbal passives.

Borer and Wexler further argued that children analyze verbal passive sentences as adjectival passives. Unlike verbal passives, children do not have any problems with adjectival passives, since the NP occupying subject position is directly generated there. Moreover, these two types of passives are homophonous. For example, the sentence *the door was closed* is ambiguous between two readings. One is a verbal, eventive reading, namely, someone closed the door. The other one is an adjectival, stative reading, namely, the door was in the state of being closed. The idea that children analyze verbal

passive sentences as adjectival passives can account for the observation that they produce and comprehend short passives earlier than long passives. In English, most adjectives are incompatible with *by*-phrases (e.g., **the door was open by the man*, on a non-locative reading (Hirsch & Wexler, 2006, p.2)), and children who mistakenly interpret verbal passives as adjectival ones cannot produce long passives. Moreover, compared to non-actional verbs, actional verbs tend to become better adjectives (e.g., $^{???}$*the seen doll*; ^{OK}*the combed doll*). Thus, this analysis also accounts for children's better comprehension of actional passives than non-actional passives. When the machinery that allows the formation of A-chains matures, child grammar can generate verbal passives, and children no longer analyze verbal passives as adjectival passives.[7]

To sum up, under the maturational approach, children's non-adult behavior is attributed either to their developing processing resources or grammatical knowledge. In order to achieve adult-like performance, children do not have to learn anything. Instead, they only have to wait for the responsible part to mature.

1.4.2.2 The grammatical approach

Let us now turn to the grammatical approach. This approach does not conflict with the maturational approach. The maturational account is opposed to accounts that

[7] The account of Borer and Wexler (1987, 1992) is in fact controversial. Fox and Grodzinsky (1998) argued against it based on their finding that young children can produce *get*-passives (e.g., *John got pushed by Mary*), which, they argued, do have A-chains. Moreover, they showed that children can comprehend actional verb passives regardless of the presence or absence of the *by*-phrase. These findings suggest that children can form A-chains and that the *by*-phrase does not impede their comprehension. Okabe and Sano (2002), Sano (2000), and Sano *et al*. (2001) also argued against the A-chain deficit hypothesis on the basis of the evidence from Japanese: Japanese children can comprehend *full unaccusatives* as in (i) early while there is a noticeable delay in the comprehension of *full passives* as in (ii). They claimed that this difference poses a problem for the account of Borer and Wexler because an A-chain is taken to be involved in both constructions.

(i) Butasan-ga zousan-ni tsukamat-ta. (full unaccusative)
pig-NOM elephant-by catch (unacc.)-PAST
'The pig was caught by the elephant.'

(ii) Butasan-ga zousan-ni tsukamae-rare-ta. (full passive)
pig-NOM elephant-by catch-PASS-PAST
'The pig was caught by the elephant.'

explain the acquisition of target grammar with learning models. On the other hand, the grammatical account is opposed to accounts that attribute non-adult behavior to an extra-grammatical factor. These kinds of opposition are orthogonal. In this section, however, let us for convenience suppose a situation where the maturational account cannot explain the acquisition of target grammar in order to learn what the grammatical approach is.

When child grammar generates an expression X that is not allowed in the target grammar, children have to learn that X is not possible. In this case, there are two possible unlearning scenarios (Goro, 2007; Pinker, 1989). A first is that children rely on negative evidence that X is not possible in their target grammar. A second is that the grammatical constraint that blocks X is not arbitrary in the sense that the constraint is a consequence of some general property of the target grammar. In this case, children can expunge X as a result of learning the general property in question. Suppose that the negative evidence is not available. In this case, if the constraint is arbitrary, we cannot explain the acquisition of X in any way. That is, when the negative evidence is not available, the constraint should not be arbitrary. The grammatical approach is taken in such a situation. This is built on a grammatical model in which the target grammar is a consequence of another grammatical property observable in the input. Such a grammatical model allows us to explain how children unlearn X on the basis of positive evidence alone.

This idea has its origin in the Principles and Parameters approach, which attempts to derive multiple consequences by setting the value of one parameter (Chomsky, 1981, 1986). An example is Hyams' (1986) analysis of early null subjects. It has been widely observed that children between two and three years old optionally omit the subject of sentences even though their target languages require it to be lexically expressed (e.g., Danish, Dutch, English, French, German, etc.) (Haegeman, 1995; Hamann & Plunkett, 1998; Hamann *et al*., 1996; Hyams, 1986; Weissenborn, 1992). For example, the following English sentences in (16) were spoken by children aged from 1;8 to 2;5

(Hyams, 1986).

16. a. Read bear book.
    b. Ride truck.
    c. Want look a man.

Note that these sentences are not imperative. Considering that there are languages that allow null subjects (e.g., Italian, Spanish) and assuming that these languages have a positive setting for the *pro*-drop parameter (Chomsky, 1981; Rizzi, 1986), Hyams argued that the child's early grammar has the *pro*-drop parameter positively set. Assuming that negative evidence is not available, she argued that children learn that the setting of the parameter is incorrect on the basis of positive evidence. She proposed that such evidence would be provided by the existence of expletive subjects. In a language in which subjects are optional, the use of expletives is not allowed. Thus, for children acquiring a non-*pro*-drop language like English, the presence of expletives in the input tells them that overt subjects are obligatory in the target language. Although Hyams later abandoned this analysis, pointing out the different properties and distribution of early null subjects and null subjects in adult grammar (Hyams, 1992), her contributions are nonetheless invaluable. She showed a way for children to learn that a certain grammatical property is not allowed in their target language without relying on negative evidence.

Other examples of the grammatical approach are Goro (2007) and Zhou and Crain (2009), who investigated the acquisition of a language-specific scope constraint. In Japanese and Mandarin Chinese, there is a constraint on scope interpretation. For example, in Japanese, a sentence involving existential and universal quantification, as in (17a), does not allow an inverse scope interpretation (i.e., for every food, there is some individual who ate it), while its English counterpart in (17b) allows it.

17. a. Dareka-ga dono tabemono-mo tabe-ta.
someone-NOM every food eat-PAST
Literally: ‘Someone ate every food.’
∃ >> ∀ / *∀ >>∃

b. Someone ate every food.
∃ >> ∀ / ^{OK}∀ >>∃

Similarly, the Chinese sentence in (18a) does not allow an inverse scope interpretation (i.e., not every horse jumped over the fence), while its English counterpart in (18b) allows it.

18. a. Mei-pi ma dou meiyou tiaoguo liba.
every-CL horse all not-have jump-over fence
Literary: ‘Every horse didn’t jump over the fence.’
∀ >> ¬ / *¬ >> ∀

b. Every horse didn’t jump over the fence.
∀ >> ¬ / ^{OK}¬ >> ∀

Goro (2007) and Zhou and Crain (2009), respectively, found that Japanese and Chinese children mistakenly allow an inverse scope interpretation for sentences like (17a) and (18a) in addition to the licit interpretation (Japanese: Goro, 2007; Chinese: Zhou & Crain, 2009). Accordingly, children from these languages have to expunge the non-adult interpretation. In both constructions in (17) and (18), the inverse scope interpretation entails the surface scope interpretation. In other words, under the condition that the surface scope interpretation is true, the inverse scope interpretation is also true. In the case of (18), for example, the inverse reading (i.e., ‘not every horse jumped over the fence’) is true under the circumstances in which none of the horses jumped over the fence. In this sense, the two interpretations constitute a superset/subset relation: the surface scope interpretation is the subset of the inverse scope interpretation. This gives

rise to the Subset Problem.

Assuming that the negative evidence showing that the inverse scope interpretation is impossible in (17a) and (18a) is not available, Goro (2007) and Zhou and Crain (2009) proposed that children learn the language-specific constraint from another grammatical property that is observable in the input. Goro argued that Japanese children can learn such a constraint from a semantic property of nominative subjects. In Japanese, nominative *ga*-marked subjects show a peculiar semantic characteristic, *exhaustive implicature* (Kuno, 1973; Kuroda, 1965); sentences with a *ga*-marked subject have the implicature that the subject represents an exhaustive list of entities that satisfy the predicate in the relevant context. Goro proposed that this semantic property bans the inverse scope interpretation in Japanese canonical sentences. In (17a), for example, the *ga*-marked subject *dareka-ga* 'someone-*ga*' carries an exhaustive listing implicature, and the sentence implies that 'someone' represents an exhaustive list of individuals who satisfy the predicate of the sentence, namely, eating every food. Therefore, this sentence has the implicature that only one individual ate every food. This implicature is not compatible with the inverse scope interpretation, since this interpretation entails that there are multiple individuals (i.e., one eater per food).

Similarly, Zhou and Crain argued that Chinese children can learn the constraint shown in (18) from another grammatical property: a focus operator. They argue that the sentence in (18a) includes a focus-sensitive operator, *dou*, that induces a cleft-like semantic structure. Thus, the sentence has a logical form corresponding to that of the English cleft construction in (19).

19. It was every horse that did not jump over the fence.

The sentence in (18a) thus says that the focus element *every horse* has the property of not having jumped over the fence. Therefore, the inverse scope interpretation is impossible in this sentence. Thus, Goro (2007) and Zhou and Crain (2009) proposed an

account such that children learn a language-specific scope constraint from another grammatical property that is observable in the input. The grammatical approach thus explains the acquisition of target grammatical knowledge on the basis of positive evidence alone, assuming a grammatical model in which a target grammar is a consequence of another grammatical property.

To sum up, in this section we reviewed how previous studies dealt with children's non-adult behavior. A first strategy is to examine the design of previous experiments in which children performed in a non-adult-like way in order to find a possible flaw of the design or a possible misinterpretation of the findings. If we find such a flaw or misinterpretation, we then attempt to reveal children's actual grammatical knowledge by conducting a modified experiment. Sometimes it turns out that children have full knowledge of target grammar. When their non-adult behavior is robust, on the other hand, two types of approaches generally have been taken. The maturational approach attributes the non-adult performance either to children's developing processing resources or to their immature grammatical knowledge. On the other hand, the grammatical approach is built on a grammatical model in which a target grammar is a consequence of another grammatical property observable in the input and explains the acquisition of the target grammar on the basis of positive evidence alone.

In this thesis, I investigate English and Japanese children's interpretation of MP comparatives through a series of experiments and confirm that they robustly assign them a non-adult interpretation. I then explain the acquisition of the correct interpretation using both maturational and grammatical approaches.

1.5 Organization

The rest of this thesis is organized as follows. Chapter 2 reviews previous theoretical studies of comparatives. We first review analyses of comparative constructions in general. Next, we review analyses of MP comparatives. Here, we review three kinds of analyses: *the lexical analysis* (Beck, 2011; Beck *et al.*, 2004;

Kikuchi, 2002; Oda, 2008) and the analyses of Schwarzschild (2005) and of Sawada and Grano (2011). Chapter 3 reviews earlier literature on the development of the comprehension and production of each part of MP comparatives: GAs, comparatives without an MP, and MPs.

Chapter 4 presents seven experiments investigating English and Japanese children's interpretations of MP comparatives. These experiments show that children's absolute interpretations of MP comparatives are consistent and robust both in English and in Japanese. They consistently interpret them absolutely regardless of the presence or absence of the standard phrase, and regardless of the kind of GAs or the polarity. This non-adult like pattern of response appears to persist well into five to six years of age. On the other hand, they are able to correctly interpret comparatives without an MP (e.g., X is taller than Y). This suggests that it is the presence of the MP that hinders their performance. Moreover, their non-adult interpretation of MP comparatives cannot be attributed to extra-grammatical factors (i.e., incremental processing, arithmetical ability) nor to a non-compositional interpretation. We then have to explain the acquisition of the correct interpretation.

Chapter 5 proposes a grammatical account such that children learn the differential interpretation, and as a consequence unlearn the absolute interpretation, based on positive evidence alone. Moreover, I propose a maturational account of the fact that it takes so long to acquire MP comparatives. I argue that this delay is caused by their immature processing capacity. Chapter 6 concludes this thesis.

Chapter 2: Theoretical background

2.1 Introduction

In this chapter, we review previous theoretical studies of comparatives. Comparatives in general can be roughly divided into two parts: in (20), for example, the main clause (the part to the left of *than*: *Tom is taller*) and the subordinate clause (or standard phrase) (the standard marker *than* and its right-hand complement: *than Bill (is*)).

20. Tom is taller than Bill (is).

The comparison takes place between two values—one supplied by the main clause (i.e., Tom's height) and one supplied by the subordinate clause (i.e., Bill's height).

We can further analyze these parts. The main clause consists of three subparts: the individual being compared to the standard (*Tom* in (20)), the GA (*tall* in (20)), and the comparative morpheme (*-er* in (20)). The comparative morphemes *-er/more* and *less* define an ordering relation between two values. *-er* and *more* define the ordering relation such that the value supplied by the main clause is larger than that supplied by the standard phrase. On the other hand, *less* defines the ordering relation in the opposite direction. The GAs are adjectives that can appear felicitously in comparative constructions and with degree adverbs. For example, *tall* can appear felicitously in comparatives, as in (21a), and can be modified with a degree adverb *very*, as in (21b). On the other hand, the corresponding sentences with *dead* in (22) are not felicitous.

21. a. Giraffes are taller than mice.
    b. The giraffe is very tall.
22. a. #Henry VIII is deader than Elizabeth I.
    b. #The queen is very dead.

This is because *tall* is a GA and we can measure degrees of height, while *dead* is not.

On the other hand, the subordinate clause is headed by the standard marker *than*, which introduces as its complement *the standard of comparison*. This supplies a value against which the value supplied by the main clause is compared. In (20), the standard of comparison is Bill's height. Putting these pieces together, the sentence in (20) has the interpretation that Tom's height exceeds Bill's height.

Such comparatives optionally appear with an MP (or a numeral) as in (23).

23. a. Tom is 10 cm taller than Bill.
    b. Mary has two more apples than Susan.

These are my target constructions, MP comparatives. Here, the MP and the numeral specify the difference between the two values. For example, in (23a) the MP *10 cm* specifies the difference between the heights of Tom and Bill. In (23b), the numeral *two* specifies the difference between the amounts of apples that Mary and Susan have. The MP and the numeral thus express a differential measurement, occurring in the same surface position. In this thesis, I accordingly assume that these elements occur in the same syntactic position and have the same semantics, as least in MP comparatives. I then refer to the numeral in (23b) as an MP for convenience.

MP comparatives in Japanese, as in (24), can be also be decomposed in the same manner.

24. a. Tom-wa Bill-yori 10cm takai.
       Tom-TOP Bill-than 10cm tall
       'Tom is 10 cm taller than Bill.'
    b. Mary-no-ringo-wa Susan-no-yori 2-ko ooi.
       Mary-GEN-apple-TOP Susan-GEN-than 2-CL many

'Mary has two more apples than Susan.'

In (24a), the main clause consists of *Tom-wa* and *10cm takai*, and the standard phrase is *Bill-yori* headed by the postposition *yori* 'than.'[8] In (24b), the standard phrase is *Susan-no-yori* and the main clause is the rest of the sentence. In Japanese, numeral classifiers such as *-ko* usually occur adjacent to a quantity expression including numbers, as shown in (24b). They constitute a grammatical system found in at least 37 East and Southeast Asian languages that reflects how speakers categorize objects that they count or quantify (Adams & Conklin, 1973). The selection of numeral classifiers is determined by the inherent semantic features of the noun being counted. In Japanese, for example, *-ko* is used for three-dimensional objects, *-nin* for humans, and *-hiki* for animals. Just like their English counterparts in (23), the MP and the numeral+classifier combination in (24) express a differential measurement, occurring in the same surface position. Therefore, I assume that these two kinds of elements occur in the same syntactic position and have the same semantics, at least in MP comparatives, and I refer to the numeral+classifier combination as an MP for convenience.[9] In this chapter, we

[8] In Japanese, comparatives regarding people's height optionally appear with *se-ga* as shown in (i), which makes it clear that the speaker is talking about people's height.

(i) Tom-wa Bill-yori (se-ga) takai.
Tom-TOP Bill-than height-NOM tall
'Tom is taller than Bill.'

[9] The GA *many* (*ooi* in Japanese) actually has a special status among GAs because it behaves differently from other GAs in a positive construction (Akira Watanabe (p.c.)). As shown in (i), in response to the question about tallness, length, width, and depth, we use a sentence where an MP is followed by a GA. On the other hand, in response to the corresponding question about quantity, *many* cannot follow the numeral as in (ii).

(i) "How tall/long/wide/deep is X?" "X is 10 meters tall/long/wide/deep."
(ii) "How many apples does X have?" "X has 2 (*many) apples."

When it comes to Japanese, if we adopt the analysis proposed in Watanabe (2013), as discussed in Footnote 3, that *takasa* in (iii) is a GA, we can find a similar phenomenon regarding to the use of the Japanese GA *ooi* 'many.' As shown in (iv), its (apparently) nominalized form *oosa* cannot precede the MP, unlike *takasa*.

(iii) Kono biru-wa takasa 10-meetoru da.
this building-TOP height 10-meters COP

first review previous analyses of comparative constructions in general. Next, we review proposed analyses of MP comparatives.

2.2 Comparative constructions

Let us first review the most widely accepted approach to comparatives, which is called either *the degree-based approach* or *the scalar analysis* (cf. Bartsch & Vennemann, 1972; Bierwisch, 1989; Cresswell, 1976; Gawron, 1995; Heim, 1985, 2000; Hellan, 1981; Hoeksema, 1983; Kennedy, 1999, 2001; Kennedy & McNally, 2005; Lerner & Pinkal, 1992, 1995; Moltmann, 1992; Rullmann, 1995; Schwarzschild, 2005; Seuren, 1973; von Stechow, 1984a, b, etc.).[10] This approach assumes that GAs map individuals onto *degrees*, which are represented as points or intervals partially ordered along some *dimension* (e.g., height, weight, etc.). The set of ordered degrees is

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'The height of this building is 10 meters.'

(iv) X-no-ringo-wa (*oosa) 2-ko da.
X-GEN-apple-TOP manyness 2-CL COP
'The number of apples that X has is two.'

Moreover, unlike other GAs, *many* can occur in the MP position, as shown in (v).

(v) Many more than 100 students attended the lecture. (Solt, 2015: (1d))

Nevertheless, *many* and other GAs have many features in common: having comparative and superlative forms and being able to be combined with the same degree modifiers, as shown in (vi).

(vi) a. many/more/most; tall/taller/tallest
b. very/too/so/as/that many; very/too/so/as/that tall

Because of these features, *many* can be analyzed as a GA (Solt, 2015). Moreover, at least in MP comparatives, the GA behaves in the same way as other GAs, occurring in the same surface position and allowing the MP to have a differential interpretation. This thesis, therefore, does not take account of the special feature of *many* (and *ooi*).

[10] The chief alternative to the scalar analysis is *the vague predicate analysis* (or called *the A-not-A analysis*) (cf. Kamp, 1975; Klein, 1980, 1982; Larson, 1988; McConnell-Ginet, 1973; Sánchez-Valencia, 1994; Schwarzschild, 2008; van Benthem, 1983). Unlike the scalar analysis, this analysis does not assume either degrees or scales. Instead, it treats the comparative as inducing a partitioning of the domain of GAs such that the property in question is true of one set but not of the other. For example, the comparative *Tom is taller than Bill* is true if there is a partitioning of the domain of *tall* such that *Tom* comes out tall but *Bill* does not. As far as I know, there is only one study that attempted to analyze MP comparatives based on the vague predicate analysis: Schwarzschild (2008), who only presented a rough idea without showing the semantic compositon. This might be because it is difficult to capture the differential degree without assuming degrees or scales. Thus, this thesis only reviews the scalar analysis here.

called a *scale*. We can think of positive degrees extending in one direction and negative degrees extending in the other, as with real numbers. For example, in the antonym pair *tall/short*, *tall* extends in a positive direction and *small* extends in a negative direction. The scales are thus directional.

The structure of scales also distinguishes between *relative GAs* (e.g., *tall* and *big*) and *absolute GAs* (e.g., *full* and *spotted*) (Kennedy, 2007b; Kennedy & McNally, 2005; Rotstein & Winter, 2004; Rusiecki, 1985; Yoon, 1996). Absolute GAs, which can be modified either with *completely* or *slightly* (e.g., *The rod is completely full / slightly spotted*), have a bounded scale. On the other hand, relative GAs, which cannot be modified with either adverb, have an open scale (e.g., **completely tall / *slightly big*). Assuming these elements (i.e., degrees, dimensions, and scales), the degree-based approach holds that comparison takes place by comparing degrees along a scale.

Under this approach, there are two kinds of analysis of the semantic type of GAs. Under the more standard analysis, GAs are taken to be a relation between a degree and an individual (type ⟨d,et⟩), as shown in (25) (Alrenga *et al*., 2012; Cresswell, 1976; Kennedy & McNally, 2005; von Stechow, 1984a; see Beck (2011) for a recent overview of degree semantics).[11]

25. [[*tall*]] = λd.λx.tall(x) ≥ d

Under the other analysis, GAs directly encode a measure function from an individual to a degree (type ⟨e,d⟩) (Bartsch & Vennemann, 1972; Kennedy, 1999; Kennedy, 2007a), as shown in (26).

26. [[*tall*]] = λx.tall(x)

[11] This thesis adopts the following semantic types: *e* for individual entities, *t* for truth values, and *d* for degrees.

A consequence of these analyses is that GAs must combine with some other expression in order to be converted into a property of individuals (type ⟨e,t⟩). In comparative constructions in English, the comparative morphemes *-er* and *more* play this role. On the other hand, in Japanese, which does not have overt comparative morphemes, either null comparative morphology (Beck *et al.*, 2004; Ishii, 1991; Kennedy, 2007a; Utlan, 1972), inherently comparative GAs (Beck, 2011; Kikuchi, 2002; Oda, 2008), or the standard marker *yori* 'than' (Kubota, 2011; Sawada & Grano, 2011) has the function of resolving the type mismatch.[12]

Let us review the standard analysis of English comparatives (Heim, 1985, 2000, 2001; von Stechow, 1984a), taking (27) as an example, which expresses a comparison with a degree.

27. Sally is taller than 6 feet.

Assuming that GAs are relations between degrees and individuals (type ⟨d,et⟩), the semantics of the comparative morpheme can be represented in (28) (Beck, 2011; Heim, 2000, 2001).

28. Comparative morpheme (comparison to a degree, type ⟨d,⟨dt,t⟩⟩)
[[*-er*]] = λd.λP.max(P) > d (Beck, 2011: (16))

max in (28) is a maximality operator that picks out the unique maximal degree from a set of degrees, as in (29) (Rullman, 1995; von Stechow, 1984a).

29. max(P) = ιd:P(d)=1 & ∀d'[P(d')=1 → d'≤ d]

[12] See also Alrenga *et al.*(2012) and Kennedy (2007c) for the proposal that universally a standard marker like *than* contributes to resolving the type mismatch.

The underlying syntactic structure of (27) is (30).

30. Sally is [$_{AP}$ [$_{DegP}$ -er than 6 feet] tall] (underlying structure)

Here, the comparative morpheme *-er* forms a constituent with the *than*-phrase (e.g., Bresnan, 1973; Cresswell, 1976; Heim, 1985). In order to derive the surface structure in (27), the adjectival head is moved to join the comparative morpheme. The Logical Form is represented in (31).

31. [$_{DegP}$ -er than 6 feet] [1 [Sally is [t1 tall]]] (Logical Form)

The DegP (type ⟨⟨d,t⟩,t⟩) cannot be the degree argument of the GA (type ⟨d,et⟩), and thus undergoes Quantifier Raising (Bhatt & Takahashi, 2011; Hackl, 2001; Lechner, 2001, 2004). This Logical Form yields the meaning of (27), as shown in (32).

32. a. [[*-er than 6 feet*]] = λP.max(P) > 6 feet
    b. [[1 [Sally is [t1 tall]]]] = λd.tall (Sally) ≥ d
    c. [[(27)]] = max(λd.tall(Sally) ≥ d) > 6 feet

In the case of clausal comparatives where the complement of *than* is a clause, on the other hand, the comparative morphme is given slightly different semantics from (28), as in (33).

33. comparative morpheme for clausal comparatives (type ⟨dt,⟨dt,t⟩⟩)
    [[*-er*]] = λP1.λP2. max(P2) > max(P1) (Beck, 2011: (29))

Let us see the derivation of clausal comparaives, taking the subcomparative construction in (34) as an example, because this construction is considered to be the semantically

most transparent (Bresnan, 1973).

34. This shelf is higher than that desk is wide.

The Logical Form is represented in (35), and this yields the meaning of (34) as shown in (36).

35. [-er than [2 [that desk is t2 wide]]] [1 [this shelf is t1 high]]

36. a. [[2 [that desk is t2 wide]]] = λd'.wide (this desk) ≥ d'

b. [[1 [that shelf is t1 high]]] = λd.high (this shelf) ≥ d

c. [[(34)]] = max(λd.high (this shelf) ≥ d) > max(λd'.wide (that desk) ≥ d')

In the case of bare form GAs like *tall* in (37), their semantics are derived by combining a GA with a null degree morpeme *pos*.

37. Tom is tall.

Under the $GA_{\langle e,d\rangle}$ approach, for example, *pos* has the semantics in (38) (type ⟨ed,et⟩) (Bierwisch 1989; Cresswell, 1976; Kennedy, 1999, 2007b; Kennedy & Levin, 2008, etc.).

38. $[[pos]] = \lambda g_{\langle e,d\rangle}.\lambda x_{\langle e\rangle}.g(x) > stnd(g)$

This representation says that *pos* takes the GA *g* (type ⟨e,d⟩) as an argument and returns '$\lambda x_{\langle e\rangle}.g(x) > stnd(g)$' (type ⟨e,t⟩). Here, *stnd* is a function from the GA meaning to a degree that returns a standard of comparison for the GA: the minimal degree required to "stand out" in the context relative to the kind of measurement expressed by the GA (Kennedy, 2007b). For example, (39) shows the derivation of the semantics of (37).

39. [[*Tom is tall*]] = [[*pos*]]([[*tall*]])([[*Tom*]])

= [λx.tall(x) > stnd(tall)](Tom)

= tall(Tom) > stnd(tall)

'Tom's height is greater than a contextually determined standard.'

Here, *pos* takes the GA *tall* and *Tom* as arguments, and the semantics above are assigned to the sentence.

The analysis of MPs depends partly on which analysis of GAs we adopt. Under the ⟨d,et⟩ analysis of GAs, the most accepted and straightforward account is one in which the MP is assumed to be type ⟨d⟩ and directly saturates the degree argument of the GA, yielding a property of individuals (type ⟨e,t⟩) (Cresswell, 1976; Heim, 2000; von Stechow, 1984b). On the other hand, under the ⟨e,d⟩ analysis of GAs, the MP (type ⟨d⟩) cannot directly saturate the degree argument of the GA. Therefore, either the MP must be a more complex type than ⟨d⟩, or there must be extra structure involved to resolve the type mismatch between the type ⟨e,d⟩ GA and the type ⟨d⟩ MP (Kennedy & Levin, 2008; Sawada & Grano, 2011; Svenonius & Kennedy, 2006).

As we saw in Section 1.1, Japanese comparatives are different from English comparatives in that they lack overt comparative morphology. In addition to this, there are other more substantive differences between comparatives in these languages (Beck *et al.*, 2004). One is that Japanese, unlike English, does not allow subcomparatives, as shown in (40).

40. *Kono tana-wa [ano tsukue-ga hiroi yori] takai
this shelf-TOP that desk-NOM wide than tall
'This shelf is taller than that door is wide.'

As we saw in (34), which corresponds to the translation of (40), subcomparatives are

possible in English. This type of comparative compares two sets of degrees and requires degree variable binding, as we saw in (36) (repeated here as (41)).

41. a. [[2 [that desk is t2 wide]]] = λd'.wide (this desk) ≥ d'
    b. [[1 [that shelf is t1 high]]] = λd.high (this shelf) ≥ d
    c. [[(34)]] = max(λd.high (this shelf) ≥ d) > max(λd'.wide (that desk) ≥ d')

In Japanese, however, the *yori*-phrase cannot have a degree abstraction structure, and thus subcomparatives are not allowed (Beck *et al.*, 2004; Kennedy, 2007a).[13]

As another difference between Japanese and English compararives, Beck *et al.* (2004) argued that Japanese lacks an implicit comparison (e.g., *this building is tall*) because the semantics of comparatives in Japanese are already introduced in the lexical entries of adjectives. I will discuss this point in detail in Section 2.3.1, presenting a piece of evidence against Beck *et al.*'s argument.

2.3 MP comparatives

In this section, we review proposed theoretical analyses of MP comparatives. In order to acquire this construction, as we saw in Chapter 1, English and Japanese children need to determine the range of possible interpretations associated with MP+GA constructions, as shown in (42) and (43): English allows both differential and absolute interpretations, while Japanese only allows a differential one.

42. a. This building is 10 meters taller (than that building). (differential)
    b. This building is 10 meters tall. (absolute)
43. a. Kono biru-wa ano biru-yori 10-meetoru takai.

[13] For the reason the *yori*-phrase cannot have degree abstraction structure, Beck *et al.* (2004) argued that Japanese lacks binding of degree variables in the syntax. On the other hand, Kennedy (2007a) argued that the (null) comparative morphology in Japanese only selects a standard of type *e*, unlike the comparative morphology in English, which selects both types *e* and *d*. For more detail, refer to these studies.

this building-TOP that building-than 10-meter tall

'This building is 10 meters taller than that building.' (differential)

b. Kono biru-wa 10-meetoru takai.

this building-TOP 10-meter tall

#'This building is 10 meters tall.' (#absolute)

'This building is 10 meters taller.' (differential)

Here, we review three kinds of analyses to seek an account of such variation: *the lexical analysis* (Beck, 2011; Beck *et al.*, 2004; Kikuchi, 2002; Oda, 2008), the analysis of Schwarzschild (2005) and the analysis of Sawada and Grano (2011).

2.3.1 The lexical analysis

The lexical analysis attributes the difference in the range of the possible interpretations between English and Japanese, as shown in (42) and (43), to the lexical meaning of GAs (Beck, 2011; Beck *et al.*, 2004; Kikuchi, 2002; Oda, 2008). As we reviewed in Section 2.2, the English GA *tall* can be represented as in (44), where GAs are taken to be a relation between a degree and an individual (type ⟨d,et⟩) (Alrenga *et al*., 2012; Cresswell, 1976; Kennedy & McNally, 2005; von Stechow, 1984a).

44. $[[tall]] = \lambda d.\lambda x.\text{tall}(x) = d$

In Japanese, on the other hand, the semantics of comparatives are claimed to be already introduced in the lexical entry of GAs. For example, Oda (2008) proposed the semantics in (45) for the Japanese GA *takai* 'tall.'

45. $[[takai]] = \lambda d'.\lambda x.\max(\lambda d.\text{tall}(d)(x)) = c+d'$

Here, two types of degree arguments are assumed: a direct degree *d* and a differential

degree *d'*. *c* stands for a contextually provided degree. *max* is a maximality operator, as in (46) (Rullmann, 1995; von Stechow, 1984a).

46. max (S) = ιs[s∈S & ∀s'∈S [s' ≤ s]] (Oda, 2008: (32))
(S is a set of degrees ordered by ≤)

Accordingly, the derivation of the semantics of the Japanese MP comparative in (43b) is as follows:

47. [[*Kono biru-wa 10-meetoru takai*]]
= [[*takai*]]([[*10-meetoru*]])([[*kono biru*]])
= (λd'.λx.max(λd.tall(d)(x)) = c+d')(10m)(this building)
= max(λd.tall(d)(this building)) = c+10m
'The maximal degree of height that this building reaches is larger than the contextually provided degree by 10 meters.'

Here, *takai* 'tall' takes *10-meetoru* '10 meters' and *kono biru* 'this building' as arguments, and the differential interpretation is assigned to the sentence. Thus, in this analysis GAs in Japanese are originally comparative, which accounts for why the MP+GA construction in Japanese lacks the absolute interpretation.

The lexical analysis assumes that when the sentence in (43b) is deprived of the MP, as in (48), it has a comparative interpretation.

48. Kono biru-wa takai.
this building-TOP tall
the lexical analysis: 'This building is taller.'
this thesis: 'This building is tall.'

This judgment is different from mine, since this thesis takes the GA *takai* in (48) as positive, just like in the English sentence *this building is tall*. As the interpretation of this sentence is crucial for the lexical analysis that claims that Japanese GAs are originally comparative, let us discuss it.

As a piece of evidence for the comparative interpretation of (48), Oda (2008) refers to Kennedy's (2005) observation that the Japanese sentence in (49) is comparative.

49. Kono peepaa-wa ano peepaa yori nagai.
    this paper-TOP that paper than long
    'This paper is longer than that one.' (Kennedy, 2005: (12))

Kennedy used a *crisp judgment test* (Kennedy, 2007a) in order to learn whether the GA is comparative or not. This test uses a different feature of comparison between positive and comparative constructions (i.e., implicit vs. explicit comparison). In positive ones, the subject individual must have a degree of the relevant property that stands out relative to a contextually determined standard. On the other hand, comparatives simply require an asymmetric ordering between the degrees to which two objects possess the relevant property. This difference results in different predictions about the acceptability of these constructions in contexts that involve slight differences between the compared objects. For example, in the context of (50), both constructions in (a) and (b) are acceptable because compared to the 200-word essay, the 600-word essay is significantly longer. On the other hand, in the context of (51), while the comparative sentence in (a) is acceptable, the positive sentence in (b) is infelicitous. This is because the difference between the two essays is subtle and the 600-word essay is not judged as standing out in length.

50. CONTEXT: a 600-word and a 200-word essay

a. This essay is longer than that one.

b. Compared to that essay, this one is long. (Kennedy, 2007a: (51))

51. CONTEXT: a 600-word essay and a 597-word essay

a. This essay is longer than that one.

b. #Compared to that essay, this one is long. (Kennedy, 2007a: (52))

Thus, comparative but not positive constructions allow for a crisp judgment. Similarly, Kennedy (2005) applied this test to the Japanese sentence in (49) and found that this sentence is acceptable in both contexts represented in (50) and (51). He then concluded that (49) is comparative.

Based on Kennedy's (2005) observation, Oda concluded that the main clause of the sentence in (49) (i.e., (52)) is comparative.

52. Kono peepaa-wa nagai.
this paper-TOP long
'This paper is longer.' (Oda's (2008) analysis)

However, we cannot conclude that (52) is comparative just based on the fact that (49) is comparative. The sentence in (49) includes the standard phrase marked with *yori* 'than.' This is a comparative marker that signals comparison. Indeed, several previous studies have argued that it is the standard phrase that contributes to the semantics of comparison (Alrenga *et al.*, 2012; Kennedy, 2007c; Kubota, 2011; Moore, 1999; Sawada & Grano, 2011).

Moreover, Sawada (2009) showed that even though the sentences in (53) and (54) have the same main clause (i.e., *Taro-wa se-ga takai*), they have different interpretations: the sentences in (53) express an explicit comparison while the sentences in (54) express an implicit one.

53. a. Taro-wa Ziro-**yori** se-ga takai. (explicit)
Taro-TOP Ziro-than height-NOM tall
'Taro is taller than Ziro.'

b. Ziro-ni **kurabe(-te)** Taro-wa se-ga takai. (explicit)
Ziro-DAT compare-TE Taro-TOP height-NOM tall
'Taro is taller than Ziro.' (Sawada, 2009: (8))

54. a. Ziro-ni **kurabe-tara** Taro-wa se-ga takai. (implicit)
Ziro-DAT compare-COND Taro-TOP height-NOM tall
'Compared to Ziro, Taro is tall.'

b. Ziro-ni **kurabe-ru-to** Taro-wa se-ga takai. (implicit)
Ziro-DAT compare-PRES-COND Taro-TOP height-NOM tall
'Compared to Ziro, Taro is tall.' (Sawada, 2009: (8), (9))

He argued that the sentences in (54) express an implicit comparison based on his observation that the sentences in (54) but not those in (53) imply (55a) and (55b).[14]

55. a. Ziro is short.

b. Taro is not definitely tall. (Sawada, 2009: (10))

Given that the sentence meaning is changed by how the standard (e.g., *Ziro*'s height in the examples above) is expressed, we cannot conclude that (52) is comparative just because (49) is comparative. In order to find out what interpretation (52) has, therefore, we need to examine the interpretation of the construction itself.

Let us then consider the interpretation under the situation in (56).

56. CONTEXT: a 600-word essay and a 597-word essay

[14] Sawada (2009) (and Sawada and Grano (2011)) assumed that the construction in (52) is positive without presenting any reasons.

Koko-ni 2-hon-no peepaa-ga aru.
here-at 2-CL-GEN paper-NOM be
'Here are two papers.'
(Pointing to the 600-word essay) Kono peepaa-wa nagai.
this paper-TOP long
'This paper is long.'

Here, the target construction, which is underlined, is preceded by the introducing sentence 'Here are two papers.' By adding this, we can define the comparison set as the set of the two papers. In this context, the target construction sounds odd. Instead, using an explicitly comparative construction such as (57) sounds more natural.

57. Kono peepaa-wa sono peepaa-yori nagai.
this paper-TOP that paper-than long
'This paper is longer than that paper.'

This is because the comparative in (57) allows for a crisp judgment. On the other hand, the target construction does not. This suggests that the target construction is a positive construction (i.e., 'this paper is long').

Given that the construction represented in (52) is a positive one, this would undermine the crucial assumption of the lexical analysis that this construction is comparative. In order to maintain that Japanese GAs are originally comparative, we must then account for why the sentence in (52) expresses an implicit comparison.

2.3.2 Schwarzschild (2005)

Next, let us review Schwarzschild's (2005) analysis of MP comparatives, which is based on the following observations about the distribution of MPs. First, the set of GAs that allow MPs with an absolute interpretation is idiosyncratic and varies from language

to language. On the other hand, any GAs can be used with a differential interpretation. For example, in English, *tall* permits both absolute and differential interpretations as in (58), whereas *heavy* is acceptable only with the differential one, as shown in (59).

58. a. 10 meters tall
    b. 10 meters taller
59. a. *5 lb heavy
    b. 5 lb heavier

In French, *haut* 'high' is grammatical with an absolute interpretation as in (60a), whereas *grand* 'tall' is not as in (60b). However, *grand* is acceptable with a differential degree as shown in (60c).

60. a. haut de 1.27 m
    '1.27 m high' (Schwarzschild, 2005: (10))
    b. *grand de 1.27 m
    '1.27 m tall' (Schwarzschild, 2005: (12))
    c. est plus grand que Marie de 2 centimètres
    is more tall than Marie by 2 centimeters
    'is 2 cm taller than Marie' (Schwarzschild, 2005: (13))

Moreover, Schwarzschild generalized that if a language allows an MP with an absolute interpretation, it also allows it with a differential one, but not vice versa. In other words, in some languages MPs are generally banned in positive constructions, whereas MPs are acceptable in comparative constructions. However, there are no languages in which an absolute interpretation is allowed to the exclusion of a differential one. In Spanish, for example, MPs are acceptable only in comparative constructions, as shown in (61).

61. a. *Juan es dos metros alto.
Intended: 'Juan is 2 meters tall.'
b. Juan es dos centímetros más alto que Jorge.
'Juan is 2 centimeters taller than Jorge.' (Sawada & Grano, 2011: (4))

Thus, languages differ with respect to the availability of an absolute interpretation, whereas a differential interpretation is allowed regardless of language and of GA type.

Based on the observations above, Schwarzschild hypothesized that the meaning of a lexical GA is not compatible with the meaning of an MP, though the meaning of its comparative form is. In order to capture this, he proposed that MPs are not arguments of GA but rather are predicates of scalar intervals, which are sets of degrees. For example, the MP *2 centimeters* has a meaning such as (62), where its argument is an interval *I* on the appropriate scale.[15]

62. $[[\textit{2 centimeters}]] = \lambda I \subset D_{\text{linear extent}}.2\text{cm}(I)$ (Grano & Kennedy, 2012: (22))

In his analysis, comparatives express relations between individuals and intervals: *a is more G than b* is true only if there is a positive difference (i.e., an interval) between *a* and *b* on the scale of *G*. As a consequence, MPs readily occur in comparative constructions, and their semantic contribution is to measure the extent of the interval. For example, setting aside the detailed composition, the comparative in (63a) has the meaning in (63b).

63. a. taller than Kim

[15] Schwarzschild (2005) did not spell out the meanings of all the parts of the construction so as not to discuss its syntax more deeply than necessary. Reviewing his analysis, on the other hand, Grano and Kennedy (2012) tried to give the semantics. I thus cite the semantics given by Grano and Kennedy (2012) when reviewing Schwarzschild (2005).

b. $\lambda I.\lambda x.[I= \{d \mid height(x) \geq d \wedge height(K) < d\}]$

(Grano & Kennedy, 2012: (23))

(63b) selects for intervals, and the MP in (62) may be introduced via predicate modification and existential closure, as illustrated in (64).

64. $\lambda x.\exists I\ [2cm(I) \wedge I = \{d \mid height(x) \geq d \wedge height(K) < d\}]$

(Grano & Kennedy, 2012: (24))

Thus, (64) is true of an object *x* just in case there is an interval that measures two centimeters and that is equal to the set of degrees that *x*'s height includes but that Kim's height does not. For GAs in the positive form, on the other hand, Schwarzschild assumed type ⟨d,et⟩. Consequently, they are not compatible with MPs, since they expect an argument that denotes a degree, not a set of degrees.

As a matter of fact, however, MPs are not always banned in positive constructions (e.g., *Tom is 2m tall*). In order to capture this, Schwarzschild proposed *the Homonym Rule.* This is a lexically-governed type-shifting rule that takes a relation between an individual and a degree and replaces the degree argument with an interval argument as in (65).

65. Homonym Rule:

If A has meaning A' that relates individuals to degrees (type ⟨d,et⟩), then A has a secondary meaning relating individuals to set of degrees (intervals).

The secondary meaning is given by: $[\lambda I.\lambda x.I = \{d \mid [[A]](d,x)\}]$

The Homonym Rule applies to a lexically idiosyncratic set of GAs. In English, for example, it applies to *tall, wide, deep, thick, old, long*, and *high*. The GA *tall* then undergoes the rule, and it allows composition with an MP as represented in (66).

66. a. Kim is 2 meters tall.

b. ∃I [2m(I) ∧ I = {d | height(K) ≥ d}] (Grano & Kennedy, 2012: (24))

Schwarzschild thus accounted for the generalization that if a language allows an MP with an absolute interpretation, it also allows it with a differential one, but not vice versa.

However, there are some data that his analysis cannot account for. For Japanese, Schwarzschild only mentioned that it is a Spanish-type language, where MPs are allowed only in comparative constructions, without discussing how the meaning of Japanese MP comparatives is derived. Arguing against this categorization, Sawada and Grano (2011) showed that a certain type of GAs in Japanese do license an absolute interpretation, as illustrated in (67).

67. a. Kono sao-wa 5-do magat-teiru.
this rod-TOP 5-degree bend-TEIRU
'This rod is 5 degrees bent.'
NOT: 'This rod is 5 degrees more bent.'

b. Kono fusuma-wa 3-senti ai-teiru.
this sliding door-TOP 3-centimeters open-TEIRU
'This door is 3 centimeters open.'
NOT: 'This door is 3 centimeters more open.'

(Sawada & Grano, 2010: (7))

In these sentences, only the absolute interpretation is available. Sawada and Grano pointed out that the GAs that give rise to an absolute interpretation are those that are associated with a lower-closed scale (i.e., absolute GAs) (cf. Section 2.2). On the other hand, open-scale GAs (i.e., relative GAs) such as *takai* 'tall' or *nagai* 'long' do not

license an absolute interpretation.[16]

These two types of GAs can be distinguished by an entailment test: whereas the negation of a GA that has a lower-closed scale entails its antonym, the same pattern of entailment is not licensed with an open-scale GA, as shown in (68).

68. a. Kono sao-wa magat-tei-nai. => Kono sao-wa massugu-da.
this rod-TOP bend-TEIRU-NEG this rod-TOP straight-PRED
'this rod is not bent.' 'This rod is straight.'

b. Taro-wa se-ga takaku-nai. ≠> Taro-wa se-ga hikui.
Taro-TOP height-NOM tall-NEG Taro-TOP height-NOM short
'Taro is not tall.' 'Taro is short.'

(Sawada & Grano, 2011: (11), (12))

In addition, patterns of adverbial modification also help to sort GAs between these types of GAs (e.g., *partially bent* vs. **partially tall*).

The predicates in (67) are deverbal, but Sawada and Grano presented three pieces of evidence to argue that they nonetheless have the same basic interpretation as GAs. First, the [verb+*teiru*] predicates have a stative meaning just like GAs. Second, similarly

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[16] Besides the sentences in (67), Sawada and Grano (2010) presented the sentence in (i) as an example that allows an absolute interpretation.

(i) Kono tokei-wa 2-fun hayai.
this clock-TOP 2-minute fast
'This clock is 2 minutes fast.'
NOT: 'This clock is 2 minutes faster.' (Sawada & Grano, 2010: (7c))

As pointed out by Shoichi Takahashi (p.c.), however, this sentence seems to have the differential interpretation: this clock is 2 minutes faster than the accurate time. Moreover, applying the entailment test illustrated in (68) to (i), we find that the negation of the GA *hayai* 'fast' does not entail its antonym, just like an open-scale GA, as shown in (ii).

(ii) Kono tokei-wa hayaku-nai. ≠> Kono tokei-wa osoi.
this clock-TOP fast-NEG this clock-TOP slow
'This clock is not fast.' 'This clock is slow.'

Therefore, this thesis does not cite (i) as an example that allows an absolute interpretation.

to ‘genuine’ lexical adjectives, the [verb+*teiru*] forms can be used attributively. Third, the intensifier *totemo* ‘very’ can modify the [verb+*teiru*] predicates.

Sawada and Grano further demonstrated that even in other Spanish-type languages (in Schwarzschild’s classification), lower-closed-scale GAs in the bare, positive form can be modified by an MP, giving rise to an absolute interpretation, as shown in (69).

69. a. Esta varilla está doblada noventa grados. (Spanish)
this rod is bent ninety degrees
‘This rod is ninety degrees bent.’

b. i hwoychori-nun i-to (cengto) hwies-ta. (Korean)
this rod-TOP two-degree about bent-DECL
‘This rod is (about) two degrees bent.’

c. Etot prut pognut na p’at’ gradusov. (Russian)
this rod bent by five degrees
‘This rod is five degrees bent.’ (Sawada & Grano, 2011: (13)-(15))

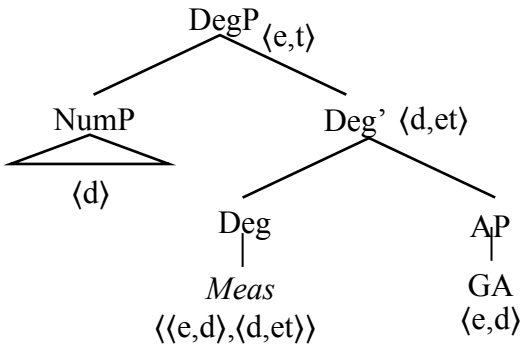
Thus, the scale structure of GAs cross-linguistically determines whether the absolute interpretation is available or not. Neither the lexical analysis nor Schwarzschild’s analysis takes account of this point, and these analyses cannot account for why the sentences in (67) and (69) license an absolute interpretation.

2.3.3 Sawada and Grano (2011)

Based on the observations on the distribution of MPs that Schwarzschild (2005) made, Sawada and Grano (2011) proposed a uniform account of English and Japanese MP comparatives. Their account involves two crucial assumptions. First, MPs are introduced by a null functional head called *Meas*. The Deg head *Meas* was originally proposed by Svenonius and Kennedy (2006) and has the syntax and semantics defined

in (70) and (71), where GAs are taken to directly encode measure functions from individuals to degrees (type ⟨e,d⟩).[17]

70.



71. The semantics of *Meas* proposed by Svenonius and Kennedy (2006)

[[*Meas*]] = $\lambda g_{\langle e,d \rangle}$: g is a function from objects to measurable degrees.

$\lambda d.\lambda x.g(x) \geq d$ (Sawada & Grano, 2011: (36))

Under this analysis, the presence of an MP is associated with *Meas*, which relates an adjective with the MP. *Meas*, then, imposes a semantic restriction on its complement, allowing only adjectives associated with scales that have measurable degrees (i.e., GAs). Adopting this analysis, Sawada and Grano imposed an additional semantic restriction on *Meas* such that it can only combine with adjectives that have a minimum element, as represented in (72).

72. The semantics of *Meas* proposed by Sawada and Grano (2011)

[[*Meas*]] = $\lambda g_{\langle e,d \rangle}$: g is a function from objects to measurable degrees and g has a minimum element. $\lambda d.\lambda x.g(x) \geq d$ (Sawada & Grano, 2011: (51))

[17] Svenonius and Kennedy (2006) and Grano and Kennedy (2012) proposed *Meas* based on their observation that there are syntactic phenomena that are sensitive to the presence of MPs (i.e., degree questions in Northern Norwegian and transitive comparatives in Mandarin Chinese). For further details, refer to these papers.

This accounts for why lower-closed-scale GAs can be directly combined with *Meas*, giving rise to an absolute interpretation as shown in (67) (repeated here as (73)), because they have a built-in minimum element.

73. a. Kono sao-wa 5-do magat-teiru.
this rod-TOP 5-degree bend-TEIRU
'This rod is 5 degrees bent.'
NOT: 'This rod is 5 degrees more bent.'

b. Kono fusuma-wa 3-senti ai-teiru.
this sliding door-TOP 3-centimeters open-TEIRU
'This door is 3 centimeters open.'
NOT: 'This door is 3 centimeters more open.'

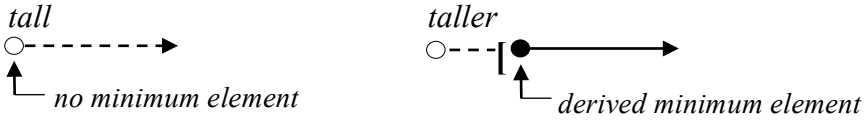
(Sawada & Grano, 2010: (7))

In (73a), for example, *Meas* takes the GA and MP as arguments, and the semantics below are assigned to the DegP *5-do magat-teiru* '5 degrees bent.'

74. [[*5-do magat-teiru*]] = [[*Meas*]]([[*magat-teiru*]])([[*5-do*]])
= [λg.λd.λx.g(x) ≥ d](bent)(5 degrees)
= λx.bent(x) ≥ 5 degrees

The representation in (74) denotes a property that is true of an object just in case the degree of its bentness exceeds 5 degrees. This is the absolute interpretation of (73a).

As a second crucial assumption, Sawada and Grano adopted the theory of comparative semantics developed by Kennedy and McNally (2005) and Kennedy and Levin (2008): comparative morphology turns a basic measure function into *a difference function* that has a scale with a minimum element as illustrated in (75).

75. 

The derived minimum element corresponds to the degree introduced by the standard of comparison. Under this approach, comparative GAs and lower-closed-scale GAs constitute a natural class in that both are associated with scales that have a minimum element. With comparative GAs, the standard of comparison provides a minimum element; with lower-closed-scale GAs, the minimum element is built into the lexically specified scale. Thus, comparative GAs satisfy the selectional requirement of *Meas*.

In English, comparative morphemes such as *-er* and *more* have the function of yielding a difference function. Assuming that these morphemes are of type ⟨⟨e,d⟩,⟨e,ed⟩⟩ and take two arguments—one provided by the main clause and one provided by the standard phrase—we can represent the semantics of the comparative morphemes as illustrated in (76).[18]

76. $[\![\text{-}er/more]\!] = \lambda g.\lambda x.\lambda y.g_{g(x)'}(y)$

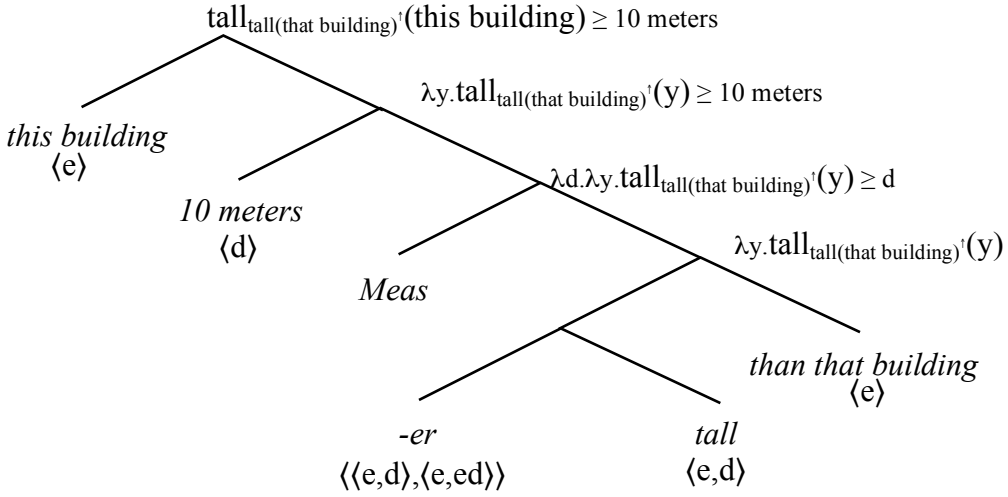
Here, *-er* /*more* takes a GA *g* and an entity *x* and returns a difference function '$\lambda y.g_{g(x)'}(y)$,' which maps entities to a derived measure function '$g_{g(x)}$.' The minimum element of the derived scale is the degree of some property that *x* has. For Japanese, Sawada and Grano proposed the semantics of *yori* 'than' in (77), which yields a difference function.

77. $[\![yori]\!] = \lambda x.\lambda g.\lambda y.g_{g(x)'}(y)$ (Sawada & Grano, 2011: (57))

[18] Sawada and Grano (2011) did not spell out the semantics of the comparative morphemes in English.

Given the lexical entries adopted for *Meas*, GAs and comparative morphemes, the Logical Form of the MP comparative *this building is 10 meters taller than that building* is presented in (78) (and similarly for Japanese MP comparatives with an overt *yori* phrase, taking into account differences in word order).

78.



As we saw in (69), the availability of an absolute interpretation is sensitive to scale structure in other languages also (repeated here as (79)).

79. a. Esta varilla está doblada noventa grados. (Spanish)
this rod is bent ninety degrees
'This rod is ninety degrees bent.'

b. i hwoychori-nun i-to (cengto) hwies-ta. (Korean)
this rod-TOP two-degree about bent-DECL
'This rod is (about) two degrees bent.'

c. Etot prut pognut na p'at' gradusov. (Russian)
this rod bent by five degrees
'This rod is five degrees bent.' (Sawada & Grano, 2011: (13)-(15))

Taking account of this fact, Sawada and Grano assumed that the selectional restriction

of *Meas* is universal. In other words, *Meas* in (72) applies to all languages, regulating the range of possible combinations of an MP and a GA. Moreover, they assumed that in English (and other languages such as French) a lexically idiosyncratic set of open-scale GAs overrides the selectional restriction of *Meas*, making it possible for such GAs to combine with an MP in the positive form (e.g., *10 meters tall*). Languages such as Japanese, Spanish, Korean and Russian, on the other hand, do not have such a set of exceptional lexical items. In Spanish, Korean, and Russian, therefore, the combination of an MP and an open-scale GA in the bare, positive form results in an ill-formed expression as in (61a) (repeated here as (80)).

80. *Juanes dos metros alto. (Spanish)
Intended: 'Juan is two meters tall.' (Sawada & Grano, 2011: (4))

Unlike Spanish, Korean, and Russian, however, such a combination in Japanese is grammatical, as shown in (43b) (repeated here as (81)), but yields a differential interpretation.

81. Kono biru-wa 10-meetoru takai.
this building-TOP 10-meter tall
'This building is 10 meters taller.'

Sawada and Grano accounted for the Japanese construction (i.e., MP comparative without the standard phrase) by assuming that this language has a covert mechanism of 'scale shift' (cf. de Swart, 1998; Moens, 1987), which coerces the scale associated with an open-scale GA such as *takai* 'tall' into a scale that includes a minimum element (just like comparative GAs in English). Thus, when open-scale GAs appear with an MP in Japanese, the covert coercion operator C_S in (82) is inserted to resolve the clash between *Meas* and the open-scale GA, and coerces the meaning of the GA into having a

contextually determined implicit standard as its minimum element.

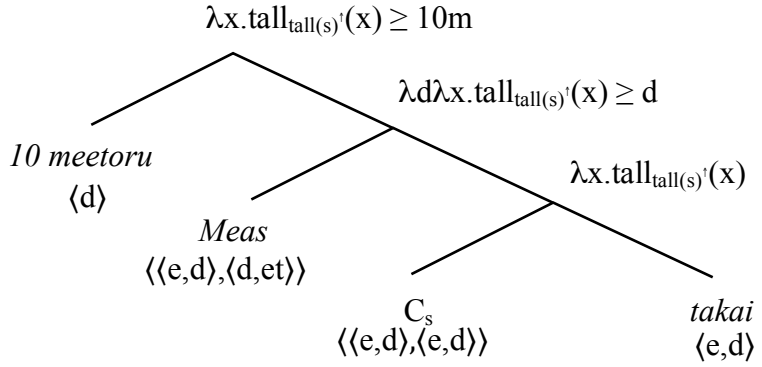
82. $[[C_S]]([[ADJ]]) = \lambda g.\lambda x.g_{g(S)'}(x)$

(where *s* stands for a contextually determined object)

(Sawada & Grano, 2011: (72))

Therefore, the derivation of Japanese MP comparatives without an overt *yori* phrase (e.g., *10 meetoru takai* '10 meters tall') proceeds as in (83) (a variation of (73) in Sawada and Grano (2011)).

83.



This analysis nicely accounts for the fact that the combination of an MP and an open-scale GA in Japanese (especially when there is no overt *yori* phrase) has a differential interpretation. In order for such a GA to combine with an MP, scale shift via coercion is necessary, and it essentially converts the semantics of the GA to that of the comparative GA and gives rise to a derived minimum element that satisfies the requirement of *Meas*.

To sum up, Sawada and Grano uniformly accounted for MP comparatives in English and Japanese. For the English MP comparatives in (42) (repeated here as (84)), comparative morphology like *-er* and *more* derives a difference function. Its scale has the standard of comparison as the minimal element (i.e., the height of that building in (84a); the contextually determined height in (84b)). Then, the comparative GAs can

combine with *Meas*.

84. a. This building is 10 meters taller than that building.
    b. This building is 10 meters taller.

For the Japanese MP comparatives in (43) (repeated here as (85)), they gave slightly different accounts of the construction with and without an overt standard phrase. When there is a standard phrase, as in (85a), *yori* 'than' derives a difference function just like the English MP comparatives. On the other hand, without a *yori*-phrase, as in (85b), the covert coercion operator derives a difference function.

85. a. Kono biru-wa ano biru-yori 10-meetoru takai.
       this building-TOP that building-than 10-meter tall
       'This building is 10 meters taller than that building.'
    b. Kono biru-wa 10-meetoru takai.
       this building-TOP 10-meter tall
       'This building is 10 meters taller.'

2.4 Summary

In this chapter, we reviewed theoretical analyses of comparatives. First, we reviewed analyses of comparative constructions in general following the degree-based approach. Among many variations of the analyses of comparatives, we reviewed the standard analysis in particular (von Stechow, 1984a).

Next, we reviewed analyses of MP comparatives. First, we reviewed the lexical analysis that attributes the variation represented in the MP+GA constructions to different lexical entries of GAs in English and Japanese (Beck, 2011; Beck *et al.*, 2004; Kikuchi, 2002; Oda, 2008). In this analysis, GAs in Japanese are taken to be originally comparative. Next, we reviewed Schwarzschild (2005), who proposed that the meaning

of a lexical GA is not compatible with the meaning of an MP, while the meaning of its comparative form is. He further argued that English has a type-shifting rule that allows a lexically idiosyncratic set of GAs to occur with an MP in non-comparative constructions, while Japanese does not. We lastly reviewed Sawada and Grano (2011), who posited a null Deg head called *Meas* to introduce an MP. For the variation above, they assumed that in English there is a lexically idiosyncratic set of open-scale GAs that can combine with *Meas*. On the other hand, Japanese does not have such a set, but has a covert mechanism called "scale shift" that introduces a comparative meaning.

These studies thus accounted for the different range of possible interpretations associated with the MP+GA constructions in English and Japanese. I do not intend to conclude which account is the best here. This question requires us to examine many other grammatical phenomena besides the form-meaning mapping of the MP+GA constructions, which would lie beyond the scope of this dissertation. However, in Chapter 5 I adopt the analysis of Sawada and Grano (2011) in order to explain the acquisition of MP comparatives. This is simply because it allows us to explain the acquisition well if we assume that *Meas* imposes a semantic restriction on its complement.

Chapter 3: Developmental background

3.1 Introduction

In this chapter, we review previous developmental studies on each part of MP comparatives: GAs, comparatives without an MP (hereafter, *simple comparatives*), and MPs. Our review follows Syrett (2016), who provided a recent overview of the acquisition of comparatives and the related grammatical elements.

3.2 Gradable adjectives

Let us begin with the acquisition of GAs. The meaning of GAs is quite complex, because unlike nouns, the mapping is not just between a word and an object but between a word and a comparison between at least two objects. Moreover, the meaning depends on what a speaker takes as a referent. The same flower, for example, can be described as both *big* (e.g., bigger than the flower beside it) and *little* (e.g., smaller than most other flowers stored in the speaker's mental knowledge). This is because the standard of comparison for GAs is contextually determined. Adults shift it based on the *comparison class* determined by the context (e.g., the set of flowers right in front of one's eyes or the set of flowers stored in one's knowledge). In spite of the complex meaning, however, a number of studies in developmental psychology have demonstrated that children are able to set the standard by appealing to a variety of aspects of the context and allow it to shift with the context.

Ebeling and Gelman (1988) demonstrated that children as young as 2.5 years of age can use both perceptual and stored mental information for objects. Given two objects of the same kind but of different sizes, children were asked whether one of them was little or big. Young children were more successful when they were asked to make judgments about the size of familiar objects (e.g., a mitten) than unfamiliar-shaped objects, but overall children showed above-chance performance. In their experiments, children were also able to appeal to their stored mental standards for objects. They were

shown normatively big objects (e.g., a 10 cm egg) and normatively little objects (e.g., a 10 cm box of cereal), and asked to judge whether they were big or little. Most children successfully judged the normatively big objects as big and the normatively little objects as little.

Barner and Snedeker (2008) demonstrated that four-year-olds are able to shift the standard of comparison based on a comparison class when making judgments about tallness (see also Smith *et al.* (1986)). They investigated how children (3;11–4;11) make judgments about the height of a set of novel objects named *pimwits*. In their Experiment 1 (the baseline assessment), children were presented with nine *pimwits* ranging in one-inch intervals from one to nine inches and whose average height was 5 inches. They were asked to place all of the *tall pimwits* into a red plastic circle. The average minimum selection for *tall* judgments was 7.19 inches. In their Experiment 2, the authors added four short *pimwits* (0.5, 1, 1.5, and 2 inches) to the set of *pimwits* used in Experiment 1, and reduced the average height of the objects from 5 to 3.85 inches (*short-distractor condition* in their terms).[19] The authors expected that if children take account of all of the objects, the average minimum height for tallness would decrease. The children performed as expected. The average minimum selection for *tall* judgments was 5.44 inches. In their Experiment 3, four additional objects were mixed in with the original nine objects as in Experiment 2, but here the four objects were perceptually different from the original ones and given a new label, *tulvers*. Asked to place all of the *tall pimwits* into the circle, the children did not show the standard shift. The average minimum height of objects called *tall* was 6.89 inches, which was not significantly different from the value in Experiment 1 but significantly higher than in Experiment 2. On the other hand, in Experiment 4, when the perceptually-different four objects were called *pimwits*, the average minimum height shifted to 5.69 inches just like in

[19] Experiment 2 actually had another condition: *the tall-distractor condition*, where four tall *pimwits* were added to the original set of objects and the average height was increased from 5 to 6.15 inches. However, the authors reported on follow-up experiments only in the short-distractor condition, and left it an open question whether children's performance can be generalized to both polar directions. Thus, we review only the short-distractor condition here.

Experiment 2, which was significantly different from Experiment 1. The average minimum height of objects called *tall* from these four experiments is represented in Figure 5.

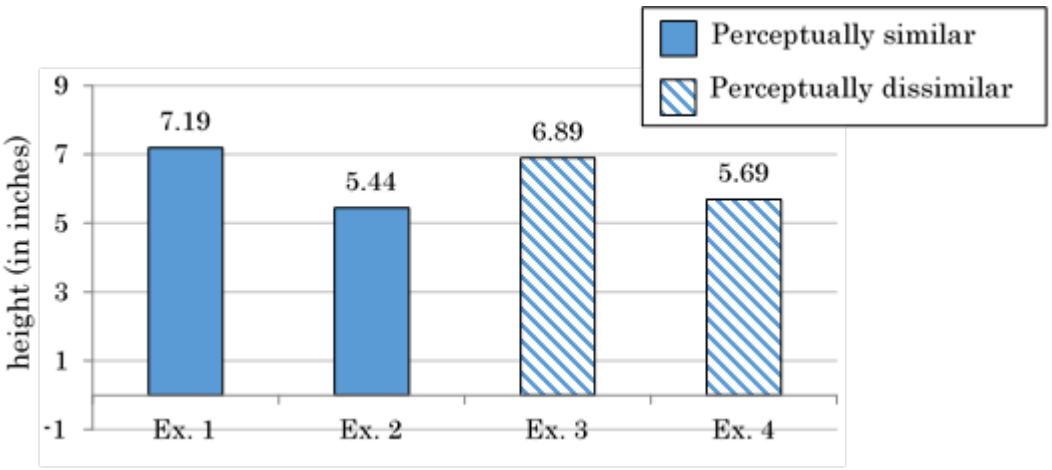


Figure 5. Average minimum height of *tall* judgments (Barner & Snedeker, 2008)

We can see that children assigned the standard around the midpoint of the series of the objects.[20, 21] In short, these experiments show that four-year-olds are able to appropriately shift the standard, taking account of the entire set of the same-kind objects (based on the label) at least in an experimental task.

Syrett (2007), Syrett *et al*. (2006), and Syrett *et al*. (2010) investigated whether children allow the standard of comparison to shift with the context for all GAs or only for certain kinds of GAs. These studies reported that by three years of age, children are sensitive to differences among GAs and are able to set the standard based on their denotation. As we saw in Section 2.2, there are two types of GAs: *relative* and *absolute* GAs. These are different with respect to the role of context and the standard. While relative GAs (e.g., *long* and *big*) have a context-dependent standard, absolute GAs (e.g., *full* and *spotted*) make reference to the fixed standard. Absolute GAs can be further

[20] In these experiments, children were also asked to make judgments about shortness by placing all of the *short pimwits* into a red plastic circle. Barner and Snedeker (2008) found that children did not demonstrate an ability to appropriately set and shift the standard of comparison for shortness. Thus, we do not review their judgments about shortness here.

[21] Syrett *et al.* (2006) replicated the same judgment patterns for other GAs, such as *big* and *long*.

divided into two types: *maximum* and *minimum standard* GAs. For maximum standard GAs (e.g., *full*), the standard indicates the total presence of a property. For example, only if a glass is completely filled with water can the glass be described as full. On the other hand, for minimum standard GAs (e.g., *spotted*), it indicates the existence of some degree of a property. For example, if there is at least one spot on the floor, the floor is described as spotted. These distinctions can be captured by the structure of scales, as we reviewed in Section 2.2 (Kennedy, 2007b; Kennedy & McNally, 2005; Rotstein & Winter, 2004; Rusiecki, 1985; Yoon, 1996). While relative GAs have an open scale (in other words, they are *open-scale GAs*), absolute GAs have a bounded scale. For absolute GAs, while maximum standard GAs have a upper-closed scale, minimum standard GAs have a lower-closed scale.

In an experiment of Syrett and her colleages, children three to five years of age were shown a series of two objects at a time and asked by a puppet to give him *the X one*, where *X* was one of the target GAs (e.g., *long*, *spotted*, and *full*). A singular definite determiner phrase of the form *the* ϕ forces the presupposition that there is an object that satisfies the property encoded by ϕ (the *existence* presupposition) and that the object uniquely statifies ϕ (the *uniqueness* presupposition) (cf. Abbott, 1999; Birner & Ward, 1994; Heim, 1990; Kadmon, 1990; Neale, 1990; Roberts, 2003; Russell, 1905; Strawson, 1950, etc.). In the *long* task (relative GA), participants were shown two different-sized rods and asked to give the puppet *the long one*. This request is felicitous because we can determine one object that satisfies the property *long* by setting an appropriate standard. Just like adults, no matter how long two rods were, children correctly gave the puppet the longer one. In the *spotted* task (absolute, minimum standard GA), participants were shown two spotted disks, one with some spots, one with more, and asked to give him *the spotted one*. This request is infelicitous because there are two spotted disks, thereby violating the uniqueness presupposition. Here again, like adults, children did not hand over the more spotted one and correctly rejected the request, saying that both of the items had the property. Thus, chidren appropriately

responded to requests including relative and minimum standard GAs. On the other hand, they behaved differently from adults in the *full* task (absolute, maximum standard GA). They were shown two jars, neither of which was full and one of which was fuller than the other one, and asked to give the puppet *the full one*. This request is infelicitous because neither of the items is maximally full, which violates the existence presupposition. While adults rejected the request, saying that neither of them was full, children handed over the fuller one.[22] Thus, children's response pattern to the infelicitous *full* request seems similar to the *long* request (i.e., giving the puppet the longer or the fuller object).

However, Syrett and her colleagues concluded for the following two reasons that children treated these two kinds of GAs differently: (i) Children who had seen the maximally full object earlier in the series of tasks did not show this pattern and correctly rejected the request. (ii) Their analysis of reaction times indicates that children took significantly longer to hand over the fuller container that was not actually full than they did to give the puppet a maximally full container or the longer member of pairs in response to the *long* request. The longer reaction time for the infelicitous *full* request reflects their hesitation to hand over the not-full container. Nevertheless, they finally handed it over, unlike adults. This difference can be accounted for by assuming that children more willingly tolerate imprecision than adults, at least in experimental tasks. Thus, children gave the puppet the fuller one when they had not seen the maximally full object earlier in the series of tasks. Moreover, they took longer to respond to such infelicitous cases because they were aware that neither of the items satisfied the description and assessed which of the objects was close enough to have the property denoted by *full*. Based on these observations, Syrett and her colleagues concluded that despite the non-adult-like response pattern to the infelicitous *full* request, children are

[22] Syrett and her colleagues also reported that children responded similarly to other absolute GAs. For the minimum standard GA *bumpy*, they appropriately rejected an infelicitous request. On the other hand, for the maximum standard GA *straight*, they mistakenly responded to an infelicitous request, handing over the straighter one.

able to distinguish the maximum standard GA from the relative GA. These findings thus demonstrate that children are senstive to the scale structure of GAs and able to set the standard based on the denotation.

As we have shown in our review, there have been many previous studies on the acquisition of GAs in English. On the other hand, there are few in Japanese apart from Kawahara (2013). Investigating three-to-six-year-olds, he demonstrated that by the age of six years, Japanese children are also able to appeal to a variety of information when setting the standard. First, they are able to set normative standards (Ebeling & Gelman, 1988). Asked the question in (86), most children answered 'big' just like adults.

86. Kuma-san-tte ookii-no chiisai-no?
bear-HONORIFICS-PART big-Q little-Q
'Are bears big or little?

Based on this response, Kawahara concluded that Japanese children understand that a bear is a big animal and that they are able to use their stored mental information for objects when making judgments about the size.

Moreover, he conducted an experiment similar to those on children's understanding of relative and absolute GAs in Syrett (2007), Syrett *et al.* (2006) and Syrett *et al.* (2010), and demonstrated that Japanese children are also able to set the standard based on the context and the scale structure of GAs. For example, in Experiment 2 of his study, children were shown two differently sized rods and asked to give a puppet the long one, as in (87).

87. Relative GA *nagai* 'long'
Nagai-no to-tte.
long-one pass-PART
'Pass me the long one.'

They then gave him the longer one as adults did, regardless of how long the two rods were. When shown two bent wires and asked to give him the bent one (i.e., an infelicitous request), as in (88), on the other hand, they either said that they could not decide which wire was the bent one or else handed over both.

88. Absolute, minimum standard GA *magatteru* 'bent'

Magatteru-no to-tte.
bent-one pass-PART
'Pass me the bent one.'

Similarly, when shown two curly wires and asked to give him the straight one (i.e., an infelicitous request), as in (89), they did not hand over the straighter one and correctly rejected the request itself.[23]

89. Absolute, maximum standard GA, *massuguna* 'straight'

Massuguna-no to-tte.
straight-one pass-PART
'Pass me the straight one.'

This pattern of response demonstrates that Japanese children understand the differences among GAs and are able to set the standard based on the denotation.

To sum up, the previous studies introduced in this section showed that young children are able to use a variety of information when making judgments about the

[23] Unlike the experiment of Syrett and her colleagues, where in response to the infelicitous request for *the straight one* English children mistakenly handed over the straighter one, in the experiment of Kawahara (2013), Japanese children appropriately rejected such requests. Given the analyses of Syrett and her colleagues on the order of presentation of objects, this could be because in Kawahara's experiment the Japanese participants were always presented with a maximally straight wire early in the sequence of items. In other words, they had already seen the maximal standard and understood that both of the wires were not straight.

relative properties of objects. First, they are able to evaluate object size based on perceptual and stored mental information for objects. Second, children are also able to set the standard of comparison based on the context and shift it when the context changes. Lastly, children are sensitive to the difference among GAs regarding the scale structure and able to set the standard, making reference to the denotation.

3.3 Simple comparatives

Let us move to the developing comprehension and production of simple comparatives. This topic was actively studied in the field of psychology from the 1960s to the 1970s, and it was found that children behave differently from adults in their production and interpretation. For production, many studies reported that English children produce comparatives that differ markedly from the adult-like forms up through at least six years of age (cf. Clahsen & Temple, 2002; Feider, 1973; Finch-Williams, 1981; Gathercole, 1979, 1985, 2009; Graziano-King, 1999; Graziano-King & Cairns, 2005; Hohaus & Tiemann, 2009; Layton & Stick, 1979; Tiemann *et al*., 2010). For example, they express comparisons using both *more* and *-er* morphemes, as in (90) and (91); and they combine the standard marker *than* with GAs that lack the corresponding comparative morphology, as in (92).

90. (be)cause it's gonna be **more dirtier** #huh Ma?
    Sarah age 4;10, file 129, line 897 (Brown, 1973; MacWhinney, 2000)
91. Put it **more further** away.
    Olga age 4;3 (Feider, 1973)
92. I wan(t) (t)a make the **prettiest than** the whole wide world.
    Adam age 5;2 (Brown, 1973; MacWhinney, 2000)

For interpretation, they appear to attend only to the main clause, ignoring the standard phrase. For example, in (93), children seem not to interpret the entire sentence,

excluding any information about the standard phrase, and instead seem to interpret it as asserting that Tom is tall (cf. Bishop & Bourne, 1985; Clark, 1970; Donaldson & Wales, 1970; Gathercole, 1979, 1985, 2009; Moore, 1999; Piaget, 1928; Townsend, 1974, 1976; Wales & Campbell, 1970).

93. Tom is taller than Bill (is).

Even if they take account of the standard phrase, children seem to fail to correctly incorporate the information. For example, Bishop and Bourne (1985) asked four- to seven-year-olds to choose from among four pictures the one in which "the horse is taller than the wall." With this task, even children aged four and five years had difficulty, choosing the picture in which the GA in the positive form *tall* could be applied to both objects in the scene (i.e., both the horse and the wall are tall).

Based on the findings above, many researchers concluded that it takes a long time to acquire comparatives and that the acquisition proceeds in stages (Clark, 1970; Donaldson & Wales, 1970; Gitterman & Johnson, 1983; Graziano-King & Cairns, 2005; Hohaus & Tiemann, 2009; Hohaus *et al.*, 2014; Tiemann *et al*., 2010). For example, Hohaus and Tiemann (2009), Hohaus *et al.* (2014) and Tiemann *et al.* (2010) claimed that there is an order in children's production, based on their research using the Child Language Data Exchange System (CHILDES) (MacWhinney, 2000): basic comparatives (e.g., *Tom is taller*), followed by phrasal and clausal comparatives (e.g., *Tom is taller than Bill (is)*) and superlatives (e.g., *Tom is the tallest*), and finally MPs (e.g., *Tom is exactly 1.70m tall*) and degree questions (e.g., *How tall is Tom?*).

As we reviewed the previous approaches to children's non-adult behavior in Section 1.4.1, however, examining the previous experiments on children's understanding of comparatives allows us to find that their poor performance does not necessarily imply non-adult grammatical knowledge. The previous experiments require a high cognitive load, and it is likely that their actual linguistic knowledge was masked

by the tasks. For example, in the task used in Bishop and Bourne (1985), children must compare four pictures while keeping the test sentence in mind. This experimental design requires high working memory load, which could have caused their poor performance. For another example, Piaget (1928) reported that even nine- and ten-year-olds were unsuccessful in solving the following question: "Edith is fairer than Suzanne. Edith is darker than Lili. Which of the three has the darkest hair?" He then concluded that children do not understand simple comparatives until a very late age. Although his finding might shed partial light on their linguistic knowledge, solving such a question requires more than an understanding of comparatives (e.g., logical reasoning).

Actually, the finding that children appear to ignore the standard phrase can be accounted for by their immature processing capacity. Children are known to incrementally process a sentence like adults, but they often get stuck in the initial analysis of a sentence unlike adults, even when they have to reanalyze the initial commitment (cf. Omaki & Lidz, 2014). The state of being stuck in the initial parse has been documented in children's misinterpretations of locally ambiguous sentences (Choi & Trueswell, 2010; Trueswell *et al*., 1999). For example, Trueswell *et al*. (1999) examined five-year-olds' interpretations of sentences like (94) using act-out tasks.

94. Put the frog on the napkin into the box.

In this sentence, the PP *on the napkin* could be temporarily ambiguous between the modifier and the destination. This sentence was provided under the situation where there were two frogs, one of which was on a napkin (i.e., the frog (B)), an empty napkin, and an empty box, as illustrated in Figure 6.

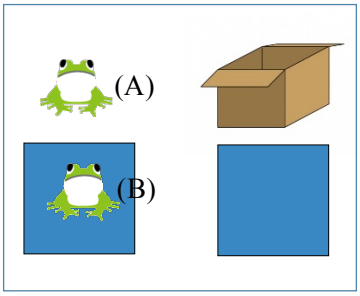


Figure 6. Two-referent context used in Trueswell *et al*. (1999)

In this case, upon hearing *the frog*, a listener would not be sure which frog is being referred to and would interpret the PP *on the napkin* as a modifier. However, Trueswell and his colleagues found that children mistakenly interpreted the PP as the destination and that this interpretation often persisted even after they encountered the second PP *into the box*. For example, children made an error such that they first moved the frog (A) to the empty napkin and then moved it to an empty box. This suggests that these children could not revise their initial syntactic analysis and interpretation.[24]

Let us now return to children's interpretation of comparatives. Upon hearing the beginning of the sentence in (93) *Tom is tall...*, both adults and children may think that the speaker is talking about the height of Tom and mistakenly interpret the sentence as 'Tom is tall.' They would then build a syntactic structure corresponding to the interpretation. Even if they would build an incorrect syntactic structure, adults are able to revise the representation based on the next part of the sentence. Upon encountering the *-er* in (93) afterwards, they revise this representation and correctly interpret the sentence as a comparative. On the other hand, even after encountering the comparative morpheme, children would be unable to revise this representation, or else unable to inhibit this response based on the initial structure, and would appear to be stuck in the positive interpretation. This might be the reason why they appear to parse only the main

[24] Meroni and Crain (2003) later showed that children can correctly interpret (94) if the experimental design is appropriately modified. For more detail, see Meroni and Crain (2003).

clause.

Moreover, Gor and Syrett (2015) and Syrett and Lidz (2011) demonstrated using the TVJT (Crain & McKee, 1985; Crain & Thornton, 1998) and act-out tasks that children as young as four years of age are able to correctly interpret comparatives as in (95).

95. a. Sheriff Woody fed more bear cubs than Jessie.
    b. The monkey pushed the rock further than the elephant did.

In addition to English children, Kawahara (2014) demonstrated using the TVJT that Japanese children as young as four years old are also able to correctly interpret simple comparatives such as (96).

96. a. Baikinman-wa Anpanman-yori hayaku hashit-ta nya.
       Baikinman-TOP Anpanman-than fast run-PAST MODAL
       'Baikinman ran faster than Anpanman.'
    b. Anpanman-wa Baikiman-yori osoku hashit-ta nya.
       Anpanman-TOP Baikinman-than slow run-PAST MODAL
       'Anpanman ran slower than Baikinman.'

As we saw in Section 1.4.1, the TVJT makes it possible to examine whether children allow the target interpretation for a construction under a child-friendly context. Act-out tasks, on the other hand, ask children to manipulate toys as they are told by an experimenter. Children generally like playing with dolls, and the task itself is familiar to them. Thus, if an experimental task is appropriately designed, even four-year-olds are able to correctly interpret simple comparatives.

This conclusion might make one wonder why children produce comparatives in a non-adult-like way, as we have seen in (90)–(92), even though they can correctly

interpret comparatives. This kind of production-comprehension asymmetry is not rare, and has often been reported in the literature on language acquisition and development. An example is relative clauses (e.g., the dog that caught the ball). While they may not be productive in children's utterances until later in development, and while children may appear to misinterpret them in act-out tasks (Sheldon, 1974; Tavakolian, 1981), children demonstrate the ability to correctly interpret relative clauses when certain contextual features of the experiment are controlled for (Hamburger & Crain, 1982) or when morphosyntactic cues help to disambiguate interpretation (Guasti *et al*., 2008). Thus, children's non-adult production does not necessarily imply a non-adult knowledge of comparatives.

3.4 Measure phrases

MP comparatives in English include MPs such as *10 cm* and *two*, as shown in (97).

97. a. Tom is **10 cm** taller than Bill.
    b. Mary has **two** more apples than Susan.

These MPs are constructed either from the combination of a numeral and a word expressing a unit of measurement or just from a numeral. As numerals are thus an essential part of MPs, let us begin by reviewing previous studies on the acquisition of numerals. Children first learn to recite the beginning of the number-word list around age 1 to 1;5 (i.e., one, two, three, four, etc.) (Fuson, 1988). At this point, the number words lack meaning and are just placeholders. A major challenge for children is to fill these placeholders with the exact-number meanings. Children learn the meaning of *one*, *two*, and *three* in order (Sarnecka & Lee, 2009; Wynn, 1990, 1992). They then come to understand that the last number spoken in counting indicates the cardinality of the set around age 3;6 to 4;0 (*the cardinal principle*) (Gelman & Gallistel, 1978). At this point,

children are considered to understand numbers (Carey, 2009; Hurford, 1987; Klahr & Wallance, 1976). Japanese children also follow a similar path of development. They start with the recitation of the number-word list, and at around age 3;5 they acquire the cardinal principle (Maruyama, 1993; Nakazawa, 1981, 1982, 1983).

While children start using numerals at an early stage of development (even though they do not understand the meaning), it takes a long time before they start producing MPs in the form of numeral+unit combinations (e.g., 10 cm). Snyder (1995), Snyder and Das (1995), and Snyder *et al.* (1995) investigated children's use of positive constructions including this type of MP, as in (98).

98. This building is 20 meters tall.

Examining the CHILDES transcripts of spontaneous speech from 14 English-speaking children (MacWhinney & Snow, 1985, 1990), they found that the majority of them did not produce the MPs even at ages between four and six.

However, this finding does not necessarily suggest that children do not understand MPs in the form of the numeral+unit combination. First, it is likely that they do not yet have adult-like lexical knowledge of units of measurement such as *meters*, *centimeters*, etc. This could cause their non-productive use of such MPs. Moreover, Syrett (2013) demonstrated that at least by four years of age, children are beginning to comprehend important aspects of the semantics. In Experiment 1 of Syrett (2013), children (3;6–5;3, mean: 4;3) participated in the TVJT. In a story, for example, a character was forced to decide which set of objects she would buy (e.g., huge strawberries weighing three pounds each vs. small strawberries weighing three pounds all together) and ultimately chose the small strawberries. After listening to the story alongside the child, a puppet told what happened in the story and said that the character bought *the 3-pound strawberries* (i.e., the huge strawberries). The children correctly rejected the puppet's statement, and they appear to have been aware that the attributive MP *the 3-pound*

cannot be used to refer to bunches of strawberries that all together weighed three pounds.

In her Experiment 2, children (4;0–5;11, mean: 4;7) were shown certain amounts of objects, which were described with either an attributive (e.g., *3-pound strawberries*) or a pseudopartitive MP (e.g., *3 pounds of strawberries*), depending on a condition. In a story, a quantity was removed, leaving some of the objects. Following the story, children were asked about what was left after the subtraction was performed, as in (99).[25]

99. Do I still have…

    a. 3-pound strawberries (Attributive condition)

    b. 3 pounds of strawberries (Pseudopartitive condition)

It was found that children varied their "yes" and "no" responses based on the MP in the target question: they affirmatively responded to (99a), while they negatively responded to (99b).[26] This pattern of response indicates that they make a clear distinction between the attributive and pseudopartitive MPs. Thus, although it takes a long time before children start producing MPs in the form of the numeral+unit combination, by at least four years of age, children begin to understand these types of MPs, varying their interpretation with the syntactic environment in which the MP appears.

In Japanese, MPs are constructed either from the combination of the numeral+unit combination or from the numeral+classifier combination, as shown in (100).

[25] Preschoolers can solve similar subtraction problems involving cardinality (cf. Baroody *et al*., 2009; Hughes, 1981; Starkey & Gelman, 1982; Zur & Gelman, 2004).

[26] In this experiment, in fact, there were many children who mistakenly answered *no* to the question in the Attributive condition. They seem to have interpreted (99a) as a simple question about the number of strawberries present. Nevertheless, there were significant differences between their patterns of response in the Attributive and Pseudopartitive conditions. In the Attributive condition, they overall affirmatively responded to the target question, while in the Pseudopartitive condition, they overall negatively responded to it. Syrett (2013) then concluded that the difference between the conditions must be due to children's recognition that the two types of MPs measure out quantities differently.

100. a. Tom-wa Bill-yori **10 cm** takai.
Tom-TOP Bill-than 10 cm tall
'Tom is 10 cm taller than Bill.'

b. Mary-no-ringo-wa Susan-no-yori **2-ko** ooi.
Mary-GEN-apple-TOP Susan-GEN-than 2-CL many
'Mary has two more apples than Susan.'

As far as I know, there are no studies on the acquisition of Japanese MPs in the form of the numeral+unit combination. Given that English and Japanese children follow a similar path of development in the acquisition of the concept of number, however, I assume that Japanese children, like English children, are also beginning to comprehend such MPs around four years.

On the other hand, there are numerous studies of the acquisition of numeral classifiers (Matsumoto, 1985a, b, 1987; Sanches, 1977; Yamamoto & Keil, 2000). Yamamoto and Keil (2000) examined three to five-year-olds' comprehension of numeral classifiers using a point-to-a-picture game. Showing children a card, as illustrated in Figure 7, on which two instances of the same item are drawn, an experimenter counted items in one of three pictures, saying "one-CL, two-CL," and asked the child which item the experimenter counted, taking the classifier as a hint.

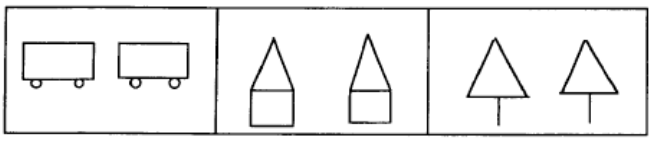


Figure 7. Representative picture stimuli of Experiment 1 of Yamamoto & Keil (2000)

Yamamoto and Keil tested 11 numeral classifiers that are frequently used in Japanese: the classifier *-ri* for human beings, three animal classifiers *-hiki*, *-too*, and *-wa*, three shape-specific classifiers *-hon*, *-mai*, and *-ko*, three functional classifiers *-dai*, *-soo*, and

-ki, and the default inanimate classifier *-tsu*. They found that when classifiers from different domains were compared (e.g., animal classifiers vs. shape classifiers vs. functional classifiers), even young children were able to comprehend the tested numeral classifiers. Six-year-olds can comprehend all the tested classifiers. Five-year-olds and four-year-olds cannot reliably comprehend the classifier *-ki* for airplanes, but they can comprehend the rest of the classifiers. Three-year-olds can comprehend only three classifiers: *-too* for large animals, *-hon* for one-dimensional objects, and *-ri* for human beings. This result shows that children at the age of four start comprehending almost all the test numeral classifiers. To sum up, young children learning English and Japanese acquire the concept of numbers around four years of age and start understanding each type of MP.

3.5 Summary

In this chapter, we reviewed previous studies on the developing comprehension and production of each part of MP comparatives: GAs, simple comparatives, and MPs. These studies suggest that English and Japanese children may possess a command of the components of MP comparatives at least by five years of age. However, a command of the subparts does not ensure proper compositionality of the whole. The next chapter examines children's interpretation of the target construction.

Chapter 4: Children's interpretation of MP comparatives

4.1 Introduction

This chapter presents a series of experiments investigating English and Japanese children's interpretations of MP comparatives. Experiment 1 explores Japanese children's interpretation of MP comparatives *without* an overt standard phrase. As stimulus sentences, I used the construction including the GAs, *takai* 'tall,' *nagai* 'long,' and *ooi* 'many.' Experiments 2a and 2b investigate Japanese children's interpretations of the construction *without* an overt standard phrase, including *negative-polar GAs* (*negative GAs* in short), *sukunai* 'few' and *hikui* 'short.' Experiment 3 explores English children's interpretations of MP comparatives *without* an overt standard phrase. As stimulus sentences, I used the construction, including the GAs, *tall*, *long*, and *many*. Experiment 4 investigates English and Japanese children's interpretations of the construction *with* an overt standard phrase including *tall*, *long*, and *many* (*takai, nagai*, and *ooi* in Japanese). Experiment 5 investigates whether or not English and Japanese children assign the conjunctive interpretation 'X is MP (tall) AND taller (than Y)' to MP comparatives. Lastly, Experiment 6 investigates whether or not Japanese children can correctly find the difference between two numbers.

4.2 Experiment 1: MP comparatives without an overt standard phrase in Japanese

4.2.1 Participants

All participants in all experiments reported in this thesis were native speakers of their language. Participants in Experiment 1 included 16 Japanese-speaking children (4;2–6;2, mean: 5;3) and 16 Japanese-speaking adults. They were recruited in Kanagawa and Tokyo in Japan. Experiments on children were run in their local preschools.

4.2.2 Stimuli and procedure

Experiment 1 was carried out in collaboration with Kristen Syrett and Takuya

Goro (Arii *et al.*, 2016, 2017). We investigated Japanese children's interpretation of MP comparatives without an overt standard phrase, as shown in (101). (The '#' here stands for a numeral, such as 'two.')

101. a. X-wa #-kirari takai/nagai.
X-TOP #-kirari tall/long
'X is # kiraris taller/longer.'

b. X-no-ringo-wa #-ko ooi.
X-GEN-apple-TOP #-CL many
'X has # more apples.'

The target sentences thus include the GAs, *takai* 'tall,' *nagai* 'long,' and *ooi* 'many.'

The participants were engaged in a series of trials that asked them to compare amounts or extents. The experimental session consisted of two tasks whose order of presentation was counterbalanced across participants. In Task 1, they were asked to compare the height or length of two individuals according to a novel unit of measurement called a *kirari*. This unit was portrayed by yellow stars, which were either aligned vertically on a tree for height or horizontally along a log for length, as illustrated in the left and center pictures in Figure 8.

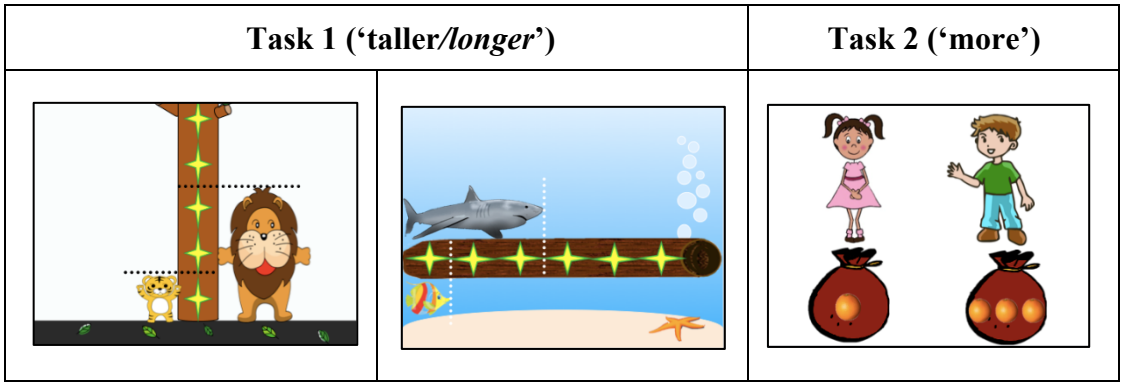


Figure 8. Example of representative images appearing in Tasks 1 and 2 of Experiment 1

This novel unit was used because it did not require children to rely on their lexical knowledge of units of measurement (e.g., meter, feet, etc.).

This task followed a brief training session to acclimate participants to using the novel unit to measure objects and making judgments based with it. All child participants had no difficulty with this training. In Task 2, participants were asked to compare amounts of objects or substances (e.g., oranges, piles of sand, etc.), as illustrated in the right picture in Figure 8. Stimuli were presented via a series of PowerPoint slides.

This experiment was designed as a version of the TVJT (Crain & McKee, 1985; Crain & Thornton, 1998), using a prediction mode (Boster & Crain, 1993; Chierchia *et al.,* 1998). For example, in Task 1, the participant and puppet were first shown an animal (e.g., the tiger in Slide 1 in Figure 9) against a tree marked with kiraris, and this animal's height was confirmed.

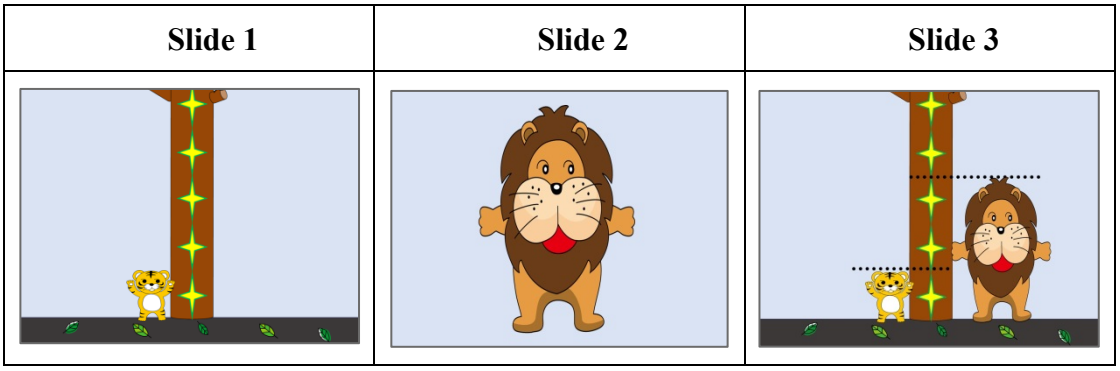


Figure 9. Examples of slides used in tasks of Experiment 1

They were then shown another animal (e.g., the lion in Slide 2 in Figure 9) on a different screen, and the puppet made a prediction about the difference in height/length between the two animals (e.g., *Raion-wa 2-kirari takai-to omou-yo!* 'I think the lion is 2 kiraris taller!'). The experimenter then suggested that they place the lion against the tree and the tiger to see if the puppet was right. This makes the standard of comparison explicit. The next slide was then shown (e.g., Slide 3 in Figure 9), with the two animals

side by side next to the tree. The puppet reminded the participant of his prediction (e.g., 'Remember, I said that the lion is 2 kiraris taller!'), and asked the participant whether the prediction was right or wrong. The participant provided a yes/no answer, and was often encouraged to provide a justification for his/her response. Task 2 proceeded in the same manner, with the quantities being compared shown side by side in the final slide (e.g., the right picture in Figure 8) and the participant being reminded of the puppet's prediction (e.g., 'Remember, I said that the boy has 2 more oranges!').

We adopted the prediction mode in order to prevent children's possible bias. If they are first shown the Slide 3 in Figure 9, they are likely to be biased toward focusing on the absolute height of the animal in question and then to take the MP in the stimulus sentence as an absolute measurement. The same can be said about when they are asked to compare the lengths of animals or the amounts of objects (i.e., 'long' and 'more' tasks in Figure 8). Our experimental design prevents this possible outcome by giving the participant the stimulus sentence before showing the last slide (e.g., the Slide 3 in Figure 9).

We used the three types of trials within each task: Differential, Absolute, and Neutral (control), as illustrated in Figure 10.

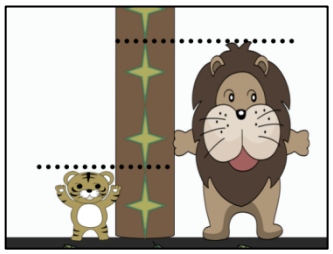
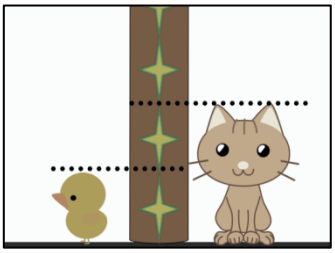
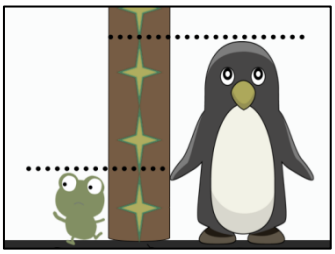
Differential	**Absolute**	**Neutral (control)**
		
'The lion is 2 kiraris taller.'	'The cat is 2 kiraris taller.'	'The penguin is 1 kiraris taller.'
Differential: True, Absolute: False	Differential: False, Absolute: True	Differential: False, Absolute: False

Figure 10. Three types of test trials, based on interpretation of an MP in Experiment 1

In the Differential trials, the sentence was true under a differential interpretation (i.e., '2 kiraris taller') but false under an absolute interpretation (i.e., '1 kirari tall'). In the Absolute trials, on the other hand, the sentence was false under a differential interpretation but true under an absolute interpretation. In the Neutral trials, the sentence was false under both interpretations. If children assign an adult-like differential interpretation to the target construction, then they should accept the puppet's utterances in the Differential trials and reject them in the Absolute and Neutral trials. Each task had either 12 or 13 trials, including one to three filler items, and an equal number of test trial types. In the filler items, simple comparatives were used as a stimulus sentence as shown in (102).[27]

102. a. Risu-no-hooga hikui.
squirrel-GEN-PART short
'The squirrel is shorter.'

b. Otokonoko-no-mikan-no-hooga ooi.
boy-GEN-orange-GEN-PART many
'The boy has more oranges.'

4.2.3 Results

In the filler items, the adult and child participants correctly responded to the filler items, which were comparatives involving no MPs. In the target trials, on the other hand, the children showed non-adult-like response. The result in terms of percentage correct for each trial type for the Japanese participants is presented in Figure 11. Here, error

[27] The morpheme *-hooga* in (102) introduces the presupposition that one of the members of the contextually salient comparison class is focused on. For example, the sentence in (102a) has the presupposition that not the other animal but the squirrel is the shorter one. For more detail, see Matsui and Kubota (2012).

bars represent standard errors.

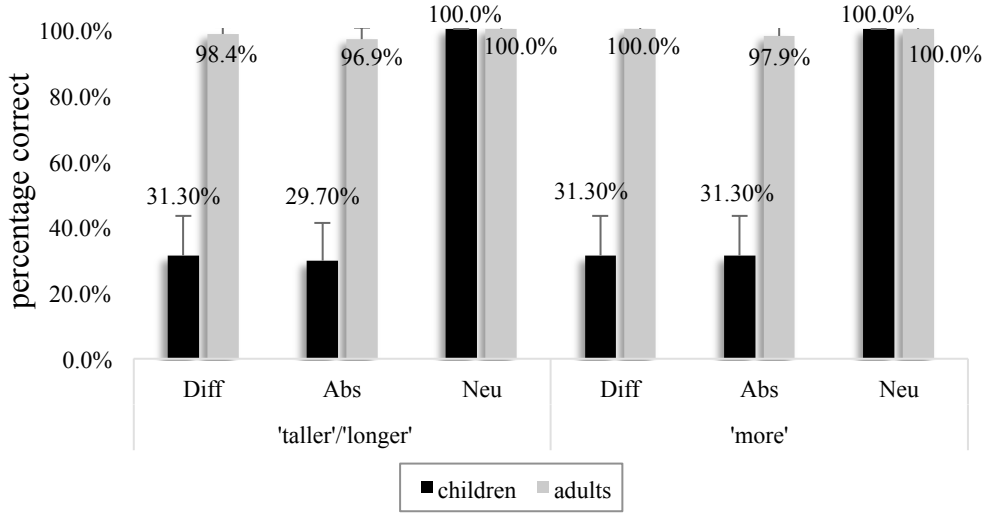


Figure 11. Percentage correct for Japanese participants in Experiment 1

For the Neutral trials, the children demonstrated perfect performance, just like adults. This indicates that they had no difficulty with the task itself and were not providing the same affirmative response across the board. On the other hand, for the Differential and Absolute trials, their performance was significantly worse than adults.'

The result in terms of overall percentage correct for the Differential and Absolute trials for the Japanese participants is presented in Figure 12. We exclude the Neutral trials as controls here.

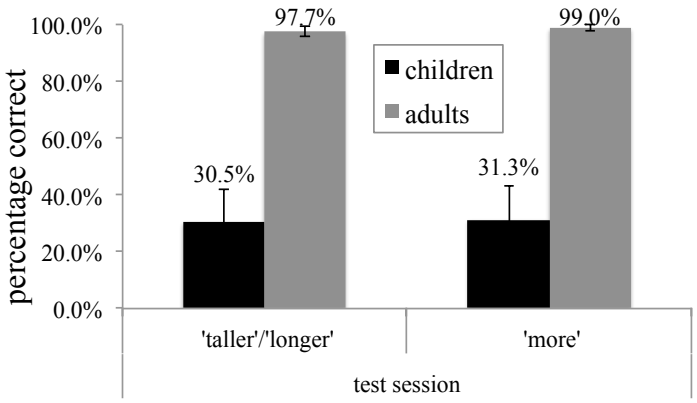


Figure 12. Overall percentage correct in the Abs and Diff trials for Japanese participants in Experiment 1

As the figures indicate, the Japanese adults demonstrated near-ceiling performance, correctly interpreting the stimulus sentence throughout the trials and in both tasks. However, the Japanese children performed significantly worse. The overall low percentage of correct responses indicates that they *incorrectly rejected* the puppet's utterance in the Differential trials, and *incorrectly accepted* it in the Absolute trials. The difference between the adults and children was significant ($t(62) = 8.14$, $p < 0.0001$). Among the Japanese children, five performed at an adult-like level in the Differential trials. The rest of children consistently rejected the sentences in the Differential trials and accepted them in the Absolute trials. There was no difference between the two tasks ('taller'/'longer' vs. 'more') for either the adults or the children (adults: $t(30) = 0.65$, $p = 0.52$, children: $t(30) = 0.05$, $p = 0.96$). Moreover, single-factor ANOVAs found no difference between the three GA items (i.e., *takai* 'tall' vs. *nagai* 'long' vs. *ooi* 'many') (adults: $F(2,45) = 1.22$, $p = 0.30$, children: $F(2,45) = 0.0026$, $p = 0.99$).

4.2.4 Discussion

Experiment 1 showed that the Japanese children assigned a non-adult interpretation to the target sentences. They incorrectly rejected the puppet's utterance in the Differential trials and incorrectly accepted in the Absolute trials. This pattern of response appears to indicate that they consistently interpreted the MP comparative 'absolutely' (e.g., 'The lion is 2 kiraris tall' not '…taller'). On the other hand, they correctly responded to the filler items, which were simple comparatives. This indicates that they were able to accurately make comparisons with such comparatives. Therefore, it was the presence of the MP that hindered their performance.

Given that Japanese children assign the absolute interpretation, they seem to have a positive construction like *the lion is 2 kiraris tall* in English as the underlying

representation for MP comparatives. If this is the case, children's performance would be improved when they are given an MP comparative including a negative GA like *hikui* 'short' and *sukunai* 'few.' As we saw in our review of Schwarzschild's (2005) observation of MP modification in Section 2.3.2, in languages that allow an absolute interpretation (e.g., English), a lexically idiosyncratic set of GAs can occur with an MP in a positive construction. This set of GAs are all *positive-polar GAs* (*positive GAs* for short) like *tall* and *long*. In other words, negative GAs in the positive, bare form generally ban an absolute interpretation even in such languages (Winter, 2005). In English, for example, negative GAs like *narrow*, *shallow*, *young*, and *short* do not allow MP modification in the positive construction, as shown in (103).

103. a. ten meters wide/*narrow/deep/*shallow
b. five years old/*young/long/*short (Winter, 2005: (1b))

This property of negative GAs is considered a universal rule. Thus, child grammar could include this property as innate knowledge. In this case, if children mistakenly interpret MP comparatives as a positive construction, an absolute interpretation of MP comparatives including a negative GA could be blocked. It is thus possible that children would show better performance when interpreting MP comparatives including a negative GA than those including a positive GA. Experiments 2a and 2b test this hypothesis by examining Japanese children's interpretation. These experiments examine their interpretation of MP comparatives including *sukunai* 'few' and *hikui* 'short,' respectively.

4.3 Experiment 2a: MP comparatives including *sukunai* 'few'

4.3.1 Participants

This experiment involved 16 Japanese-speaking children (3;10–6;6, mean: 5;3) and 16 Japanese adults. Three additional children were excluded due to either a 'yes'

response bias or their lack of knowledge of the meaning of *ooi* 'many' and *sukunai* 'few.'

4.3.2 Stimuli and procedure

The experimental session consisted of two tasks whose order of presentation was counterbalanced across participants. In Task 1, the target statement is an MP comparative including *ooi* 'many,' which serves as a control for Task 2. In Task 2, the target statement is an MP comparative including *sukunai* 'few.'

The experimental design used in these tasks was almost the same as Task 2 ('more') of Experiment 1, except that I used a story in which a comparison was made more explicitly than in the previous experiment. In one trial, a puppet was asked to compare the amount of objects that two characters had, and then was asked how many more/fewer objects one had than the other. The participant was then asked whether or not the puppet's answer was correct. For example, in Task 1, an experimenter first introduced two animals, say, a dog and a cat, to the participant and the puppet. These two animals decided to compete with each other for fishing. Finally, the dog caught three fish and the cat caught two, as depicted in Figure 13.

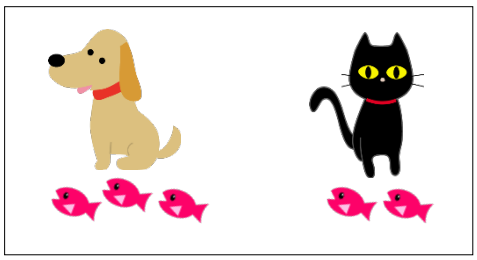


Figure 13. An example of representative images of Experiment 2a

After confirming that the dog caught more fish than the cat, the experimenter then asked the puppet how many more fish the dog caught, as in (104).

104. Inu-no-sakana-wa nan-ko ooi-kana?

dog-GEN-fish-TOP how many-CL many-Q

'How many more fish does the dog have?'

The puppet's answer was different depending on the trial type. In the Differential trial, the puppet correctly answered, saying *1-ko* 'one' under the situation in Figure 13. In the Absolute trial, he said *3-ko* 'three,' which is the number of fish that the dog caught. In the Neutral trial, he said *2-ko* 'two,' which is false under both differential and absolute interpretations. The participant was then asked to judge whether the puppet was right or wrong. If s/he correctly interprets (104), the participant would accept the statement in the Differential trial and reject it in the Absolute and Neutral trials.

Task 2 used the same scenario as Task 1, but used an MP comparative including *sukunai* 'few' as the target statement. For example, after confirming that the cat caught fewer fish than the dog in Figure 13, the puppet was asked how many *fewer* fish the cat caught, as in (105).

105. Neko-no-sakana-wa nan-ko sukunai-kana?
cat-GEN-fish-TOP how many-CL few-Q
'How many fewer fish does the cat have?'

In the same manner as Task 1, the puppet's answer was different depending on the kind of trials. In the Differential trial, the puppet correctly answered, saying *1-ko* 'one.' In the Absolute trial, he said *2-ko* 'two,' the number of fish that the cat caught. In the Neutral trial, he said *3-ko* 'three,' which is false under both differential and absolute interpretations.

Each task had 11 trials, including two filler items and an equal number of test trial types. In the filler items, the puppet was just asked which animal had more/fewer objects (*Docchi-ga ooi/sukunai?* 'Which has more/fewer?'), and the participant was then asked to judge whether the puppet's answer was right or wrong.

4.3.3 Results and discussion

On the filler items, the child participants showed adult-like performance regardless of the polarity of GAs. For bipolar adjective pairs, it is known that children generally master positive ones earlier than negative ones (Donaldson & Wales, 1970; Ehri, 1976; Ryalls, 2000; Townsend, 1976). However, the children in this experiment comprehended the meaning of *sukunai* 'few' as well as that of *ooi* 'many.'

On the other hand, they performed significantly worse on the target items for both GAs. The result in terms of overall percentage correct for each trial for Task 1 (*ooi* 'many') is presented in Figure 14, and the result for Task 2 (*sukunai* 'few') is presented in Figure 15.

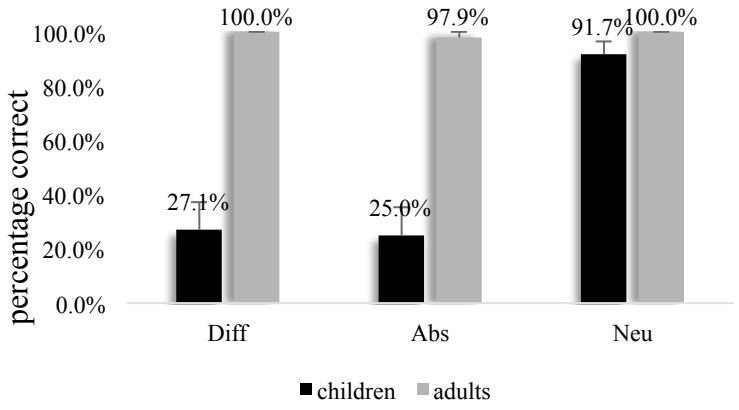


Figure 14. Percentage correct for Task 1 (*ooi* 'many') in Experiment 2a

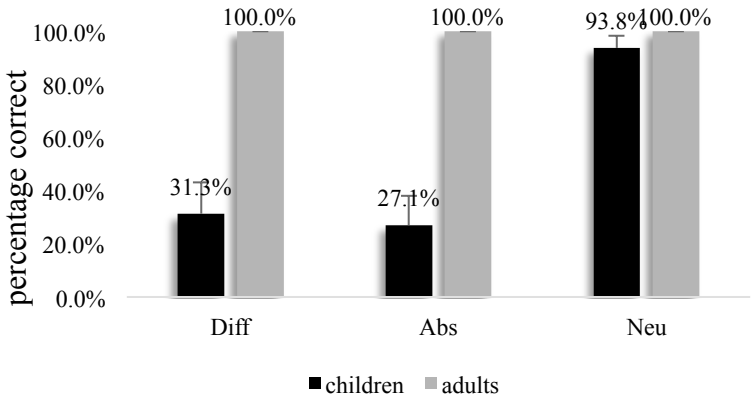


Figure 15. Percentage correct for Task 2 (*sukunai* 'few') in Experiment 2a

As the figures indicate, adults demonstrated near-ceiling performance, correctly responding to the statements throughout the trials and in both tasks. As before, children correctly rejected the statement in the Neutral trials in both tasks. On the other hand, they performed significantly worse on the Differential and Absolute trials in both tasks. They incorrectly rejected the statement in the Differential trials and accepted in the Absolute trials.

The results in terms of overall percentage correct for the Differential and Absolute trials are presented in Figure 16.

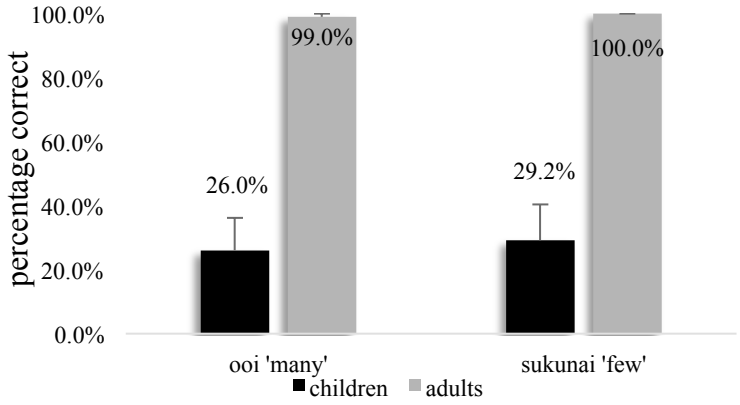


Figure 16. Overall percentage correct in the Abs and Diff trials in Experiment 2a

The difference between the adults and children was significant for both tasks (*ooi* 'many': $t(30) = 7.2$, $p < 0.0001$; *sukunai* 'few': $t(30) = 6.2$, $p < 0.0001$). There was no significant difference between the two tasks for children ($t(30) = 0.20$, $p = 0.838$).

We are thus led to conclude that Japanese children assign an absolute interpretation to an MP comparative including the negative GA *sukunai* 'few.' They interpret the target sentences in (104) and (105) (repeated here as (106) and (107)) in the same manner (i.e., 'How many fish does the dog/cat have?').

106. Inu-no-sakana-wa nan-ko ooi-kana?
dog-GEN-fish-TOP how many-CL many-Q
'How many more fish does the dog have?'

107. Neko-no-sakana-wa nan-ko sukunai-kana?
cat-GEN-fish-TOP how many-CL few-Q
'How many fewer fish does the cat have?'

The next section investigates their interpretation of an MP comparative including another negative GA, *hikui* 'short.'

4.4 Experiment 2b: MP comparatives including *hikui* 'short'

4.4.1 Participants

In this experiment 31 Japanese children (5;2–6;3, mean: 5;9) and 32 Japanese adults participated. Half were assigned to Task 1 (15 children (5;4–6;3, mean: 5;10) and 16 adults) and half to Task 2 (16 children (5;2–6;3, mean: 5;9) and 16 adults).

4.4.2 Stimuli and procedure

In Experiment 2b, participants were asked to compare the height of individuals. In Task 1, an MP comparative including *takai* 'tall' was used as a stimulus sentence, which served as a control for Task 2. In Task 2, on the other hand, a construction including *hikui* 'short' was used.

This experiment adopted forced-choice tasks. In both tasks, the participant was shown the picture in Figure 17, where there are four horses, each with a tie of a different color.

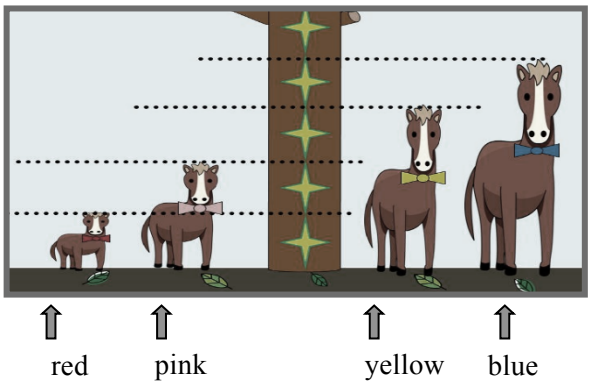


Figure 17. Example of representative images of Experiment 2b

As in Experiment 1, a tree marked with kiraris was used to measure their heights. In Task 1, pointing to the horse with a red tie, an experimenter first confirmed that the height of this horse is one kirari. The participant was then asked the question in (108) and asked to point to the horse in question.

108. 2-kirari takai-no-wa dore?
2-kirari tall-one-TOP which
'Which one is 2 kiraris taller?'
(Intended: 'Which horse is 2 kiraris taller than the horse with a red tie?')

If s/he correctly interpreted the sentence in (108), the participant would point to the horse with a yellow tie, which is two kiraris taller than the horse with a red tie. If s/he assigned an absolute interpretation (i.e., 'Which one is two kiraris (tall)?'), on the other hand, the participant would point to the horse with a pink tie, which is two kiraris tall.

On the other hand, in Task 2, pointing to the horse with a yellow tie, the experimenter first confirmed that the height of this horse is three kiraris. The participant was then asked the question in (109) and asked to point to the horse in question.

109. 2-kirari hikui-no-wa dore?
2-kirari short-one-TOP which

'Which one is 2 kiraris shorter?'

(Intended: 'Which horse is 2 kiraris shorter than the horse with a yellow tie?')

If s/he correctly assigned a differential interpretation, the participant would point to the horse with a red tie. If s/he assigned an absolute interpretation, on the other hand, the participant would point to the horse with a pink tie. Each task had eight trials, including two filler items and six target trials. In the filler items, participants were just asked which animal is the tallest/shortest.[28]

4.4.3 Results and discussion

In the filler trials, both children and adults showed a perfect performance in Tasks 1 and 2 (Task 1: adults 100%, children 100%; Task 2: adults 100%, children 100%). On the other hand, in the target trials, a contrast was found between the two groups. The result in terms of percentage correct for Tasks 1 and 2 is presented in Figure 18.

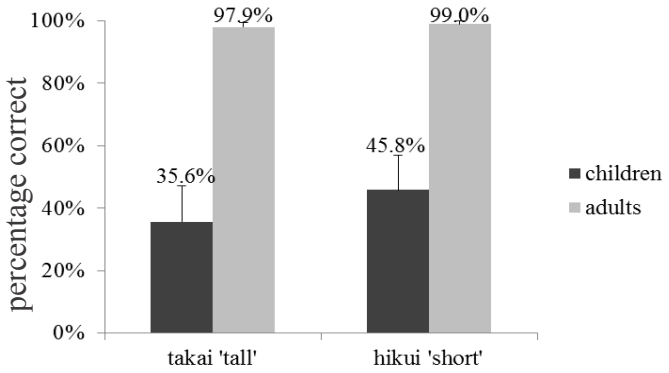


Figure 18. Overall percentage correct for the children and adults in Experiment 2b

Adults demonstrated near-ceiling performance, correctly interpreting the target sentence throughout the trials and in both conditions. In Task 1 (*takai* 'tall'), responding to the test sentence in (108), they correctly pointed to the horse with a yellow tie, while

[28] The experimental design of Experiment 2b is quite different from that of Experiment 2a. The difference was not intentional. I tried a variety of experimental designs in an attempt to elicit correct responses from children. This resulted in the different experimental design.

in Task 2 (*hikui* 'short'), responding to (109), they correctly pointed to the horse with a red tie.

On the other hand, children performed significantly worse on both tasks. Only six children behaved in an adult-like way, while most children incorrectly responded in both tasks by choosing the horse with a pink tie. This indicates that they mistakenly assigned the target sentences an absolute interpretation (i.e., 'Which one is two kiraris (tall)?'). The difference between the adults and the children was significant for both tasks (*takai* 'tall': $t(29) = 5.6$, $p < 0.0001$; *hikui* 'short': $t(30) = 4.8$, $p < 0.0001$). There was no significant difference between the two tasks for children ($t(29) = 0.65$, $p = 0.52$).

Experiments 2a and 2b thus showed that Japanese children assign an absolute interpretation to MP comparatives including the negative GAs, *sukunai* 'few' and *hikui* 'short.' This indicates that they access an absolute interpretation regardless of the polarity of GAs. Given that negative GAs in the positive form ban an absolute interpretation in adult grammar, it is not the positive construction that child Japanese has as the underlying representation for the absolute interpretation.

What then could be the source of Japanese children's difficulty in Experiments 1 and 2? One possibility is that their difficulty is caused by the lack of a comparative morpheme to signal comparison in Japanese. They might then take the MP as an absolute measurement. If this is the case, English children should show better performance than Japanese children in interpreting MP comparatives, because English has a comparative morpheme. Experiment 3 tested this hypothesis by examining English children's interpretations of MP comparatives.

4.5 Experiment 3: MP comparatives without an overt standard phrase in English

4.5.1 Participants

English-speaking children and adults were recruited in New Jersey in the United States. Participants in this experiment included 16 American English-speaking children (4;1–5;4, mean: 4;9) and 27 American English-speaking adults. Four additional adults

and one additional child were excluded due to non-native speaker status.

4.5.2 Stimuli and procedure

Experiment 3 was carried out in collaboration with Kristen Syrett and Takuya Goro (Arii *et al.*, 2016, 2017). The same experimental design as Experiment 1 was used, except for the verbal stimuli. Participants were given the MP comparatives without a *than*-phrase in (110) as a stimulus sentence.

110. a. X is # chipanis taller/longer.
     b. X has # more apples.

The target sentences include the GAs *tall*, *long*, and *many*. Instead of the novel unit of measurement *kirari*, a novel unit *chipani* was used.[29]

English children are frequently exposed to the occurrence of comparatives without an overt standard phrase in the input. To illustrate this point, Arii *et al.* (2016, 2017) conducted a search of child-directed speech from six major corpora in the CHILDES database (MacWhinney, 2000), including Adam and Sarah (Brown, 1973), Naomi (Sachs, 1983), Nina (Suppes, 1974), Peter (Bloom *et al.*, 1974, 1975), and Shem (Clark, 1979). Using the CLAN program, we focused on a list of frequent GAs in the comparative *-er* form that are also known to occur early in children's production: *big, close, easy, early, fast, happy, high, nice, old, tall,* and *wide*. This search yielded 499 occurrences. 45.5% of them featured the comparative adjective in utterance-final position (that is, with no standard phrase following), and only 22.0% included a standard phrase. Thus, the input in English clearly indicates to the child that a standard phrase is optional.[30]

[29] The difference in phonological form was based on the phonotactics of these languages and what seemed more natural in each language.

[30] In Japanese, on the other hand, it is difficult to search for comparative constructions in the CHILDES database because of the lack of comparative morphemes. Thus, we did not conduct a

4.5.3 Results and discussion

The results in terms of percentage correct for each trial type for the English participants are presented in Figure 19.

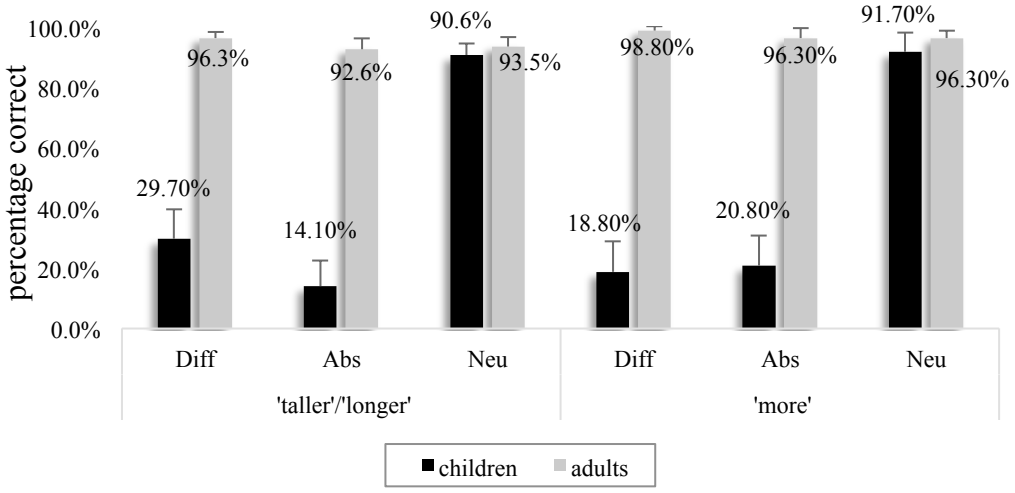


Figure 19. Percentage correct for English participants in Experiment 3

For the Neutral trials, children showed near-perfect performance, just like adults. This indicates that they had no difficulty with the task itself and were not providing the same affirmative response across the board. On the other hand, for the Differential and Absolute trials, their performance was significantly worse than adults.'

The results in terms of overall percentage correct for the Differential and Absolute trials for the English participants are shown in Figure 20. We exclude the Neutral trials as controls here.

search of child-directed speech in Japanese.

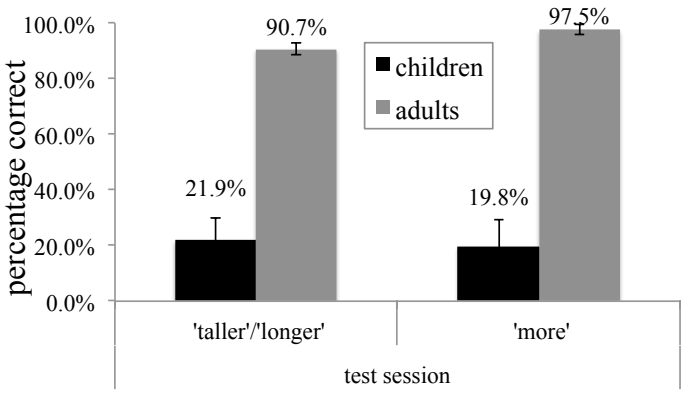


Figure 20. Overall percentage correct in the Abs and Diff trials for English participants in Experiment 3

As the figures indicate, English adults demonstrated near-ceiling performance, correctly interpreting the stimulus sentence throughout the trials and in both tasks. However, children performed significantly worse. The overall low percentage of correct responses indicates that they *incorrectly rejected* the puppet's utterance in the Differential trials, and *incorrectly accepted* it in the Absolute trials. The difference between the adults and children was significant ($t(83) = 14.72$, $p < 0.0001$). Among the children, only three performed at an adult-like level in the Differential trials. The rest of the children consistently rejected the sentences in the Differential trials and accepted them in the Absolute trials. There was no difference between the two tasks (*taller/longer* vs. *more*) for either the adults or the children (adults: $t(51) = 1.16$, $p = 0.25$; children: $t(30) = 0.17$, $p = 0.87$). Moreover, single-factor ANOVAs show that there was no difference between the three GA items (i.e., *taller* vs. *longer* vs. *more*) (adults: $F(2,78) = 2.85$, $p = 0.06$; children: $F(2,45) = 0.06$, $p = 0.94$).

Experiment 3 showed that English children assigned a non-adult interpretation to the target sentences, incorrectly rejecting the puppet's utterance in the Differential trials and incorrectly accepting it in the Absolute trials. This indicates that they interpret the MP comparatives in the absolute sense, just as Japanese children do. In other words, the

children from both languages assign an absolute interpretation regardless of the presence or absence of comparative morphology. On the other hand, both English and Japanese children correctly interpreted the filler items, which were simple comparatives. In both languages, therefore, it was the presence of the MP that hindered their performance.

Given that English and Japanese children assign an absolute interpretation in the same manner, they seem to share the source of difficulty. One possibility is that the children's difficulty is caused by their incremental processing of the target sentence and their failure to revise an incorrect syntactic representation, as discussed in Section 3.3. Consider the target sentences in English used in Experiment 3, repeated here.

111. a. X is # chipanis taller/longer.
b. X has # more [nouns].

Children do not know the absolute height of X or the amount of objects that X has when they hear the sentences. However, upon hearing the beginning of the sentence (i.e., *X is # chipanis tall/long* in (111a); *X has #* in (111b)), children may posit that the MP expresses an absolute measurement because they have been accustomed to a numeral frequently denoting the exact cardinality of a set. They would therefore build the syntactic structure corresponding to the absolute interpretation. Even though they encounter the *-er* morpheme afterwards, they would be unable to revise this interpretation or inhibit the response based on the initial structure, and would thus appear to be stuck in the absolute interpretation. The same explanation can be applied to the Japanese sentences in Experiments 1 and 2, repeated below.

112. a. X-wa #-kirari takai/nagai/hikui.
X-TOP #-kirari tall/long/short
'X is # kiraris taller/longer/shorter.'

b. X-no [noun]-wa #-ko ooi/sukunai.
X-GEN [noun]-TOP #-CL many/few
'X has # more [nouns].'

We can test this hypothesis by investigating English and Japanese children's interpretation of MP comparatives with an overt standard phrase as in (113) and (114).

113. a. X is # chipanis taller/longer than Y.
b. X has # more [nouns] than Y.

114. a. X-wa Y-yori #-kirari takai/nagai.
X-TOP Y-than #-kirari tall/long
'X is # kiraris taller/longer than Y.'
b. X-no [noun]-wa Y-no-yori #-ko ooi.
X-GEN [noun]-TOP Y-GEN-than #-CL many
'X has # more [nouns] than Y.'

In contrast to the word order of the English sentences, in the Japanese sentences the *yori* standard phrase precedes the MP. Thus, children should encounter a signal early in the utterance that a comparison between individuals is being made, and therefore should not be led down the garden path. If Japanese children correctly interpret the sentences in (114) while English children cannot correctly interpret those in (113), then this would suggest that English and Japanese children's non-adult performance in Experiments 1–3 is due to their incremental processing of the target sentences. Experiment 4 tests this hypothesis.

4.6 Experiment 4: MP comparatives with an overt standard phrase in English and Japanese

4.6.1 Participants

18 American English-speaking children (3;9–6;3, mean: 4;8) and 16 Japanese-speaking children (4;4–6;3, mean: 5;4) participated in this experiment. Six additional English children and ten additional Japanese children were excluded due to a 'yes' response across all trials.[31]

4.6.2 Stimuli and procedure

Experiment 4 was carried out in collaboration with Kristen Syrett and Takuya Goro (Arii *et al.*, 2016, 2017). The same experimental design as Experiments 1 and 3 was used. The only difference between the previous experiments and Experiment 4 was in the target sentences. In Experiment 4, we introduced an overt standard phrase, as shown in (113) and (114).

4.6.3 Results

The results of Experiment 4, which examined Japanese and English children's interpretation of MP comparatives without an overt standard phrase, are presented below, paired with those from Experiments 1 and 3 for comparison. The results for the English children are presented in Figure 21 and the results for the Japanese children are presented in Figure 22.

[31] This number collapses over both the 'taller' and 'more' tasks. Children who exhibited a 'yes' bias for one task were not tested on the subsequent task, and were therefore excluded from data analysis. Also excluded were children who were tested on both tasks but whose overall responses, particularly to the Neutral trials, indicated a response bias.

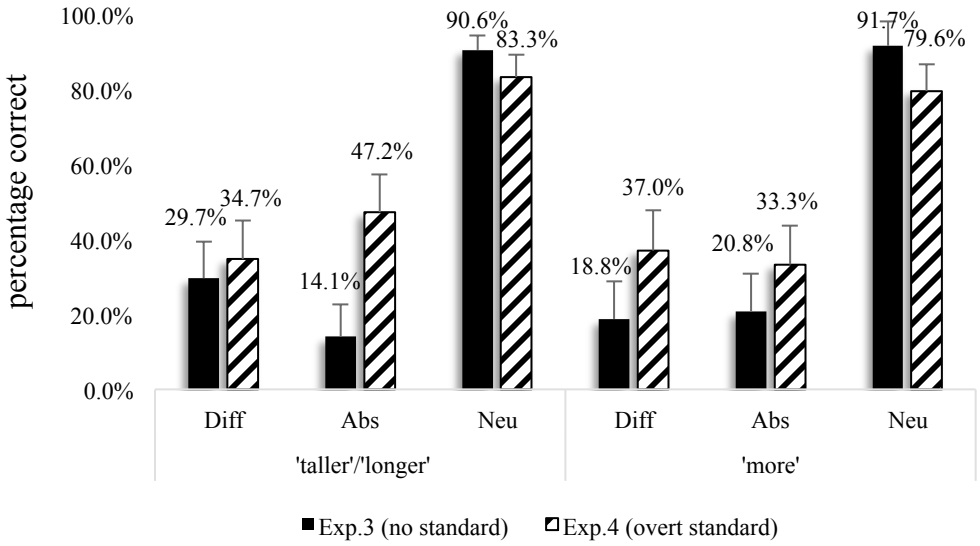


Figure 21. Percentage correct for the English children in Experiments 3 and 4

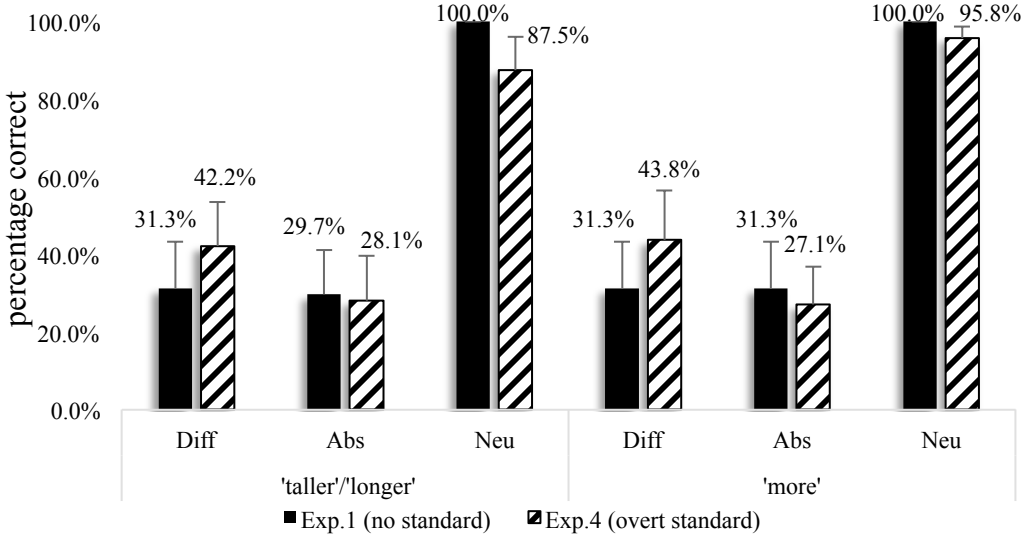


Figure 22. Percentage correct for the Japanese children in Experiments 1 and 4

As the figures show, on the Neutral trials children from both languages demonstrated perfect or near-perfect performance, just as in Experiments 1 and 3. On the other hand, for the Differential and Absolute trials, adding the standard phrase to the test sentences generally brought about little change in either group. In the Differential and Absolute trials, for the Japanese children there was no difference in performance between Experiments 1 and 4 ($t(62) = 0.50$, $p = 0.62$). For the English children, the difference

between Experiments 3 and 4 was marginally significant ($t(66) = 1.96$, $p = 0.05$). This marginal effect was caused by the fact that for the *taller/longer* Absolute trials, English children were slightly more successful when they were provided the standard phrase, although their performance was still much worse than that of the adults in Experiment 3. As before, there was no difference between the *taller/longer* items and the *more* items for either group (English: *taller/longer*, $t(32) = 1.53$, $p = 0.13$; *more*, $t(32) = 1.20$, $p = 0.24$; Japanese: *taller/longer*, $t(30) = 0.50$, $p = 0.62$; *more*, $t(30) = 0.20$, $p = 0.85$). Moreover, there was no difference among the three GAs, either (English: $F(2,51) = 0.14$, $p = 0.87$, Japanese: $F(2,36) = 0.00031$, $p = 1.00$).

4.6.4 Discussion

The English and Japanese children in Experiment 4, who were this time given an explicit standard phrase that should have signaled comparison to a salient standard in the context, were still not able to appropriately interpret the target construction. They interpreted the target sentences absolutely, incorrectly rejecting the Differential trials and incorrectly accepting the Absolute trials. Recall that Japanese and English children correctly rejected the Neutral trials, in which the target sentence was false under either interpretation. Given their response to the Differential and Absolute trials, it is likely that they interpreted the test sentence absolutely in the Neutral trials too. Japanese children thus assign an absolute interpretation even to MP comparatives with an overt standard phrase like (114) (repeated here as (115)), where the *yori*-phrase precedes the MP. We cannot therefore account for the experimental findings in Experiments 1–3 by children's failure to revise an incorrect syntactic representation.

115. a. X-wa Y-yori #-kirari takai/nagai.
X-TOP Y-than #-kirari tall/long
'X is # kiraris taller/longer than Y.'
b. X-no [noun]-wa Y-no-yori #-ko ooi.

X-GEN [noun]-TOP Y-GEN-than #-CL many

'X has # more [nouns] than Y.'

Let us assume for the moment, then, that children are trying to correctly interpret all of the information.

To sum up, English and Japanese children's absolute interpretation for MP comparatives has been shown to be quite robust. They consistently assign the non-adult interpretation regardless of the kind of GA, regardless of the presence or absence of comparative morphology and regardless of the presence or absence of an overt standard phrase. Moreover, Experiments 2a and 2b show that they assign the absolute interpretation regardless of the polarity of GAs. This suggests that the underlying representation for the absolute interpretation is not a positive construction. Children from these languages thus assign an absolute interpretation in the same manner, even though there are several significant differences in linguistic forms in English and Japanese (i.e., presence/absence of a comparative morpheme, word order, etc.). This indicates that their difficulties have a common source. Given that they were able to correctly interpret simple comparatives (e.g., *X is taller than Y*), we are led to conclude that the presence of the MP hindered their performance.

In fact, we are not the first to report children's absolute interpretation of MP comparatives. Donaldson (1963) and Duthie (1963) (later referenced by Clark (1970)) anecdotally observed that English children sometimes seem to interpret sentences like (116) as expressing that Tom is four years old.

116. Tom is four years younger than Dick.

Our finding confirmed this previous observation by systematically investigating children's interpretations through formal, systematic experimentation.

Experiment 4 has shown that children's absolute interpretations cannot be

accounted for by their incremental processing of the target sentences. What then could be the source of their difficulty? Let us consider another possibility. In the literature on children's interpretation of nominal modifiers, such as attributive adjectives and relative clauses, it is well known that children make a non-compositional, conjunctive interpretation when target sentences are presented in an infelicitous context, or they require heavy demands on processing. For example, when asked to point to "the second green ball" in a series of green and red balls, children might point to the ball that is in the second ordinal position and is green, rather than the intended target (the second of the green balls) (Hamburger & Crain, 1982; Matthei, 1982; Roeper, 1972). Similarly, when asked to act out the sentence *The cow bumps into the dog that jumps over the pig*, children manipulate toys so that the cow first bumps into the dog and then jumps over the pig (Sheldon, 1974; Tavakolian, 1981). These findings suggest that children might posit syntactic representations that are wildly different from those of adults.

In the current case, they might likewise assign MP comparatives the conjunctive representation (e.g., for *X is MP taller than Y*, 'X is MP tall AND taller than Y'). Let us consider this possibility. Recall that in the Neutral trial the target sentence was false under either the absolute or differential interpretation. For example, in a Neutral trial where a frog is one kirari tall and a penguin is three kiraris tall (as in Figure 10, repeated here as Figure 23), the statement *the penguin is 1 kirari taller (than the frog*) is false under both a differential interpretation (1 kirari taller) and an absolute (1 kirari tall) interpretation.

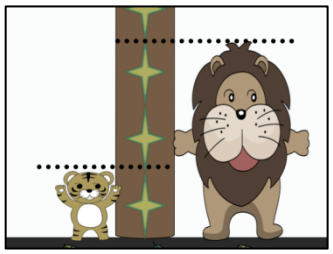
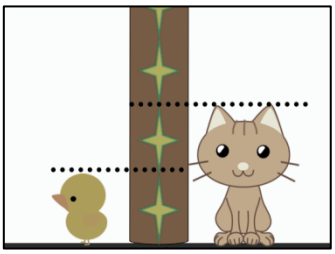
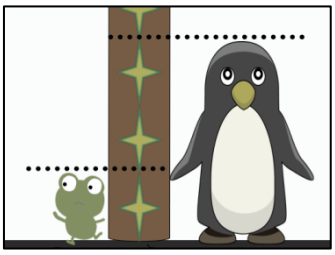
Differential	Absolute	Neutral (control)
		
The lion is *2 kiraris taller* *(than the tiger).*	*The cat is* *2 kiraris taller* *(than the chick).*	*The penguin is* *1 kirari taller* *(than the frog).*
Differential: True, Absolute: False	Differential: False, Absolute: True	Differential: False, Absolute: False

Figure 23. Three types of test trials, used in Experiments 1, 3, and 4

In this trial, children robustly responded to the puppet's statements correctly by rejecting such a description of the scene. It is possible, however, that they were doing this because they were positing an incorrect, conjunctive representation for the construction. In this case, they might interpret (117a) as (117b) (and similarly for Japanese, taking into account differences in word order).

117. a. The penguin is 1 chipani taller (than the frog).
b. The penguin is 1 chipani (tall) AND taller (than the frog).

The conjunction in (117b) is false in the Neutral trial, depicted in Figure 23, because although the penguin is taller than the frog, it is not one chipani tall. As the conjunction of the true and false propositions yields a truth value of *false*, children would reject this statement in the Neutral trial.

This strategy could also account for children's responses to the Differential and Absolute trials. In the Differential trial, as depicted in Figure 23, the lion is three

chipanis tall, the tiger one chipani tall. The target statement, *the lion is two chipanis taller (than the tiger)*, is false when interpreted as a conjunction ('two chipanis (tall) AND taller (than the tiger)'), because the lion is not two chipanis tall. In the Absolute trial, the cat is two chipanis tall and the chick is one chipani tall. Thus, the target statement, *the cat is two chipanis taller (than the chick)* is true when interpreted as a conjunction ('two chipanis (tall) AND taller (than the chick)'), because the cat is two chipanis tall AND taller than the chick. Thus, we can account for children's response pattern found in the previous experiments by assuming that they mistakenly interpret the puppet's statement as a conjunction. Experiment 5 tests this hypothesis.

4.7 Experiment 5: Conjunctive interpretation

4.7.1 Participants

In this experiment 23 American English-speaking children (4;0–5;8, mean: 4;9), 16 American English-speaking adults, 33 Japanese children (4;1–6;2, mean: 5;5), and 16 Japanese adults participated. Ten additional English children and four additional Japanese children were excluded due to response bias (English: nine 'yes' and one 'no'; Japanese: three 'yes' and one 'no'). One additional English adult was excluded due to non-native speaker status.

4.7.2 Stimuli and procedure

Experiment 5 was carried out in collaboration with Kristen Syrett and Takuya Goro (Arii *et al.*, 2017). This experiment used the same experimental methodology as Experiments 1, 3 and 4. As in Experiment 4, the test sentences in Experiment 5 included an overt standard phrase marked with *than/yori* so as to give children enough lexical material for them to posit two distinct propositions, according to the possible conjunctive representation. However, in addition to the three types of trials used in the previous experiments, we introduced a new trial type, as shown in Figure 24.

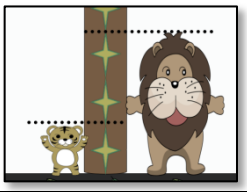
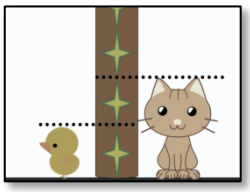
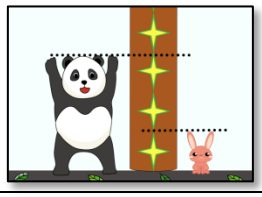
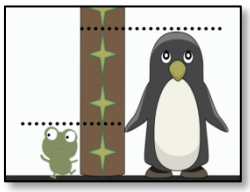
Differential	**Absolute-taller (Previous version)**	**Absolute-shorter (New version)**	**Neutral (control)**
			
The lion is 2 chipanis taller…	*The cat is 2 chipanis taller…*	*The rabbit is 1 chipani taller…*	*The penguin is 1 chipani taller…*
Differential True, Absolute False, Conjunction False	Differential False, Absolute True, Conjunction True	Differential False, Absolute True, Conjunction False	Differential False, Absolute False Conjunction False

Figure 24. Four types of test trials, used in Experiment 5

The "Absolute-taller" trials are the same as the Absolute trials in the previous experiments: the test sentence is true under both the absolute interpretation (*the cat is two chipanis tall*) and the conjunctive interpretation (*the cat is two chipanis (tall) and taller (than the chick)*). Like the Absolute-taller and Neutral trials, the new 'Absolute-shorter' trial type differs from the Differential trials in that the differential interpretation of the target sentence is false. It has in common with the Absolute-taller trials the fact that the absolute interpretation of the test sentence is true. This allows us to determine whether children are simply disregarding the comparative markers (i.e., comparative morphemes; standard phrases). However, it differs from the previous Absolute-taller trials in that the conjunctive interpretation is false in the new trials. We accomplished this difference by making the height of the animal in the subject position smaller than that of the animal in the standard phrase. The Neutral trials function as controls since the statement is false under all of the target interpretations. There were three items of each trial type, for a total of 12 trials in the experimental session. This time, we only used as target sentences MP comparatives including *taller/longer*

(*takai*/*nagai* in Japanese) in order to focus on the differences between these four trials in one task.

4.7.3 Results

Both English and Japanese adults demonstrated near-ceiling performance (English adults: 98.3%; Japanese adults: 99.0% overall average correct). The children, on the other hand, performed significantly worse (English: 44.2% overall correct, $t(37) = 8.45$, $p < 0.0001$; Japanese: 53.3% overall correct, $t(47) = 7.40$, $p < 0.0001$), as in the results of the earlier experiments. While they performed well on the Neutral trials (English: 77%; Japanese: 81%), their performances were worse on the other trials (English: 37.2% in the Differential trials, 25.9% in the Absolute-taller trials, 40.0% in the Absolute-shorter trials; Japanese: 46.5% in the Differential trials, 25.5% in the Absolute-taller trials, 63.3% in the Absolute-shorter trials).

In order to analyze children's responses for response type and a potential conjunctive interpretation, let us first focus on children who had correctly rejected at least two of the three Neutral trials, since accepting these trials would indicate that the child was not accessing any of the potential interpretations (i.e., differential, absolute, conjunctive). It turned out that 18 of the 23 English children and 28 of the 33 Japanese children reliably rejected the Neutral trials. Among these, there was one group of children who seemed to assign a correct, adult-like differential interpretation: they accepted the statements in the Differential trials and consistently rejected them in the other trials where the differential interpretation was false. Four English children and seven Japanese children performed in this way, and appear to have acquired the target syntax-semantics representation of MP comparatives at this point.

Most children (13 English and 11 Japanese children), however, assigned an absolute interpretation, rejecting the statements in the Differential and Neutral trials but accepting them in the Absolute-taller and Absolute-shorter trials. That is, these children accepted the puppet's statement only when the MP reflected the absolute measurement

of the subject individual, regardless of whether the subject's height exceeded the standard or not. For all of these children, it is clear that they consistently did not access a conjunctive representation. If they had, they would have accepted the statements in the Absolute-taller trials but rejected them in the other trials. In fact, none of the English children responded in this way, and only five of the Japanese children did so.

The rest of the children (one English and five Japanese children) showed response patterns that cannot be classified. The responses for these children seemed to reflect a variable treatment of the target statement, in that the child sometimes seemed to be comparing the subject individual to the other individual indicated in the standard phrase, and sometimes accessing an absolute interpretation.

Let us next focus on children who mistakenly accepted the Neutral trials (5 of the 23 English children and 5 of the 33 Japanese children). Interestingly, three of the English children and four of the Japanese children accepted the target statements in the Differential, Absolute-taller, and Neutral trials, but rejected them in the Absolute-shorter trials. They only accepted the statements in the trials where the subject exceeded the standard. Their response pattern indicates that they may have ignored the MP altogether and only attended to the comparative GA when making their judgment. In other words, they seem to interpret *X is MP taller than Y* as 'X is taller than Y.' I refer to this type of non-adult interpretation as a s*imple comparative interpretation*. The rest of the children (two English and one Japanese children) showed unclassifiable responses.

To sum up, all the child participants (23 English children and 33 Japanese children) were classified by their interpretations as shown in Table 1.

Response type	English	Japanese	Total
Differential (correct)	4	7	11
Absolute ('MP tall')	13	11	24
Conjunctive ('MP and taller')	0	5	5
Simple comparative ('taller')	3	4	7
Unclassifiable	3	6	9
TOTAL number of children	23	33	56

Table 1 Response types exhibited by child participants in Experiment 5

Putting together the children who did and did not show correct responses to the Neutral items, there were three English children and six Japanese children whose response patterns cannot be classified. Our efforts to categorize these children neatly into the categories in Table 1 were in vain.

4.7.4 Discussion

Experiment 5 demonstrated that children are by and large *not* appealing to a conjunctive representation when interpreting MP comparatives. When they are behaving in a non-adult-like way, the most frequent interpretation they seem to access is the absolute one, although other interpretive strategies seem to have manifested themselves across a subset of children. What is important here is that most children accepted the target statement in the Absolute-taller trials and the Absolute-shorter trials: their non-adult response patterns cannot be due to the conjunctive strategy, because if they had accessed the conjunctive representation, they would have rejected the target statement in the Absolute-shorter trials. Thus, we cannot attribute the children's absolute interpretation to the conjunctive interpretation.

We thus need another account of the children's absolute interpretation. There is another possible account that attributes their non-adult performance to an extra-grammatical factor: their absolute interpretation is due to their immature

arithmetical capacity. If they do not correctly understand the difference between the heights of two individuals or the difference between the amounts of two sets of objects in the first place, children cannot perform correctly in the previous experiments. Let us consider this possibility.

In order to understand the difference between two numbers, we need to perform subtraction. Previous studies found that preschoolers are successful in addition and subtraction problems with small numbers (Baroody *et al*., 2009; Hughes, 1981; Starkey & Gelman, 1982; Wynn, 1992; Zur & Gelman, 2004). Wynn (1992) reported that even five-month-old infants can solve addition and subtraction problems with small numbers of items. They understand 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. This type of subtraction is called *separating*, in which one quantity is taken away from another to find out what is left.

There is another type of subtraction called *comparing*, in which two quantities are compared to find the difference. This is the kind of subtraction that we need to do in order to correctly perform in the Experiments 1–5. There are two strategies for comparing (Shimada, 2015). For example, suppose that we want to know the difference between the cardinalities of two sets X and Y. One strategy is to make a one-to-one correspondence. We can calculate the difference by matching the objects in each set one to one and counting the number of unmatched objects. In this case, we do not have to know the total number of objects in each set. The other strategy is to find the difference based on the total number of objects in each set. If the set X is smaller than the set Y, we can calculate the difference by subtracting the number of objects in X from the number of objects in Y.

For these two types of subtraction, it has been reported that children have more difficulty solving the latter type (i.e., comparing subtraction) than the former (Duthie, 1963; Gibb, 1956; Hudson, 1983; Nunes & Bryant, 1996; Riley *et al*., 1983). For example, it has been reported that children mistakenly answer the following question:

"When Tom has three apples and Bob has two apples, how many more apples does Tom have than Bob?" This type of arithmetic question is known as as a *comparison problem* (Nunes & Bryant, 1996). For the answer, children are known to mistakenly give the absolute number of apples that Tom has (i.e., three). This absolute answer is similar to what we found in Experiments 1–5. Indeed, comparison problems usually accompany an MP comparative as a question, and children could assign to the question "how many more apples does Tom have than Bob?" the absolute interpretation "how many apples does Tom have?" Thus, we cannot tell whether children's difficulty with the comparison problem is due to their arithmetical ability or to their non-adult interpretation of MP comparatives. Likewise, we cannot tell which factor causes children's difficulty with Experiments 1–5. Experiment 6 examines children's ability to perform comparing subtraction.

4.8 Experiment 6: Understanding the difference

4.8.1 Participants

In this experiment, 20 Japanese-speaking children (4;1–6;1, mean: 5;0) and 16 Japanese-speaking adults participated. Two additional children were excluded due to excessive failures in filler tasks.

4.8.2 Stimuli and procedure

This experiment consisted of two tasks whose order of presentation was counterbalanced across participants. Task 1 is a version of the TVJT (Crain & McKee, 1985; Crain & Thornton, 1998), serving as a control for Task 2. In this task, a puppet was asked to compare the number of objects that two characters had, and then was asked how many more objects one had than the other. The child was then asked whether or not the puppet's answer was correct. Here, real objects were used for comparison in order to make it easier to compare (e.g., candies). For example, an experimenter first introduced a dog and a cat to the child and the puppet. She then gave the animals

candies. The dog got three and the cat got two, as illustrated in Figure 25.

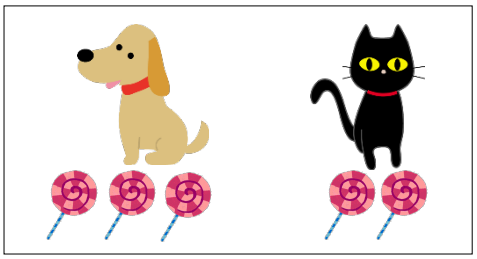


Figure 25. Example of representative images appearing in Tasks 1 and 2 of Experiment 6

After confirming that the dog had more candies than the cat, the experimenter asked the puppet how many more candies the dog had, as in (118).

118. Inu-no-kyandii-wa nan-ko ooi-kana?
dog-GEN-candy-TOP how many-CL many-Q
'How many more candies does the dog have?'

Following the previous experiments, I used three types of trials: Differential, Absolute and Neutral. In the Differential trial, the puppet correctly answered 'one.' In the Absolute trial, he answered 'three,' which is the number of candies that the dog had, and in the Neutral trial he answered 'two,' which is false under both the differential and absolute interpretations. If s/he correctly assigns a differential interpretation to the stimulus sentence, the participant would accept the puppet's answer in the Differential trial and reject it in the Absolute and Neutral trials. On the other hand, if s/he interprets the target sentence absolutely, the participant would accept it in the Absolute trial and reject it in the Differential and Neutral trials. Child participants were encouraged to provide a justification for their response.

Task 2 used the same scenario as Task 1 but used an act-out task (Chomsky, 1969). For example, after giving the animals candies, as shown in Figure 25, and

confirming which had more candies, the experimenter said that she felt sorry for the cat because the cat had less candies. She then gave the participant a box of extra candies and asked her/him to arrange for them to have the same number of candies, saying (119).

119. Jaa onaji-ni shi-te.
then the same-at do-IMP
'Can you arrange for them to have the same number of candies?'

If s/he correctly understands the difference, the participant would either take out another candy from the box and give it to the cat or take away a candy from the dog.

The most important difference between Tasks 1 and 2 is that Task 2 did not use an MP comparative as a stimulus sentence and instead used the imperative in (119). Comparing their performance in these tasks thus allows us to determine whether or not children have difficulty finding the difference between two numbers. If they cannot correctly find it, they would fail to perform correctly on both tasks. If they correctly understand the difference but cannot correctly interpret MP comparatives, on the other hand, they would only perform correctly on Task 2.

Experiment 6 consisted of 15 trials, including nine Task 1 trials, three Task 2 trials and three filler items. Task 1 included an equal number of test trial types: Differential, Absolute, and Neutral. In filler items, participants were asked to perform separating subtraction. For example, a dog had three cookies and ate some of them. The participant was not able to see him eating. S/he was then shown the remaining cookies and asked to guess how many cookies the dog ate. I excluded from the analysis children who wrongly answered more than twice on the filler tasks.

4.8.3 Results and discussion

For the filler items, all of the adults and children demonstrated perfect

performance. This indicates that the child participants had no difficulty with performing separating subtraction, which is compatible with previous findings (Baroody *et al*., 2009; Hughes, 1981; Starkey & Gelman, 1982; Wynn, 1992; Zur & Gelman, 2004).

Task 1 (TVJT), on the other hand, exhibited a clear contrast between adults and children that replicates the findings of Experiments 1–5. The results in terms of overall percentage correct for each type of trial for the adults and children are presented in Figure 26.

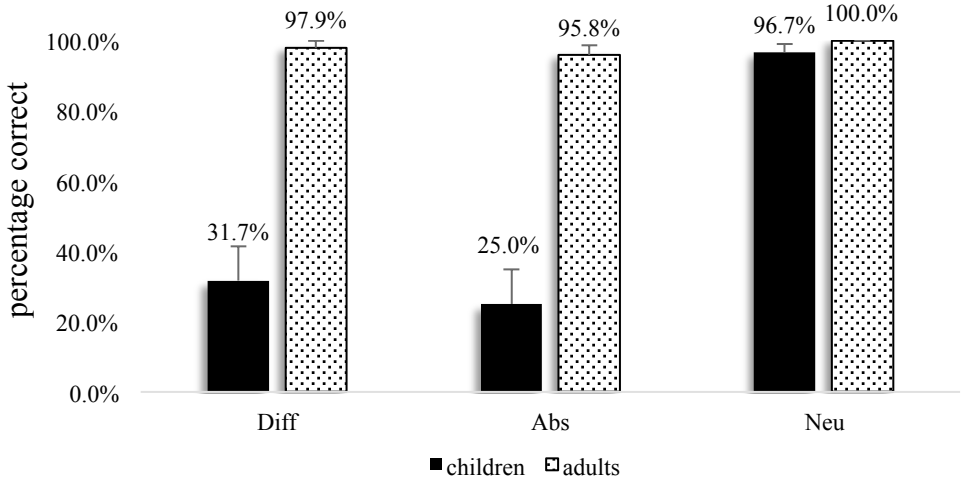


Figure 26. Percentage correct for the Japanese children and adults in Task 1 on Experiment 6

For the Neutral items, both adults and children correctly rejected the puppet's answer. The adults also demonstrated near-ceiling performance in the Differential and Absolute trials. On the other hand, the children performed significantly worse in these two types of trials. The low percentage of correct responses in the Differential and Absolute trials indicates that children incorrectly rejected the puppet's utterance in the Differential trials and incorrectly accepted it in the Absolute trials. In terms of the overall percentage correct on the Differential and Absolute trials, the difference between the adults and children was significant ($t(34) = 6.2551$, $p < 0.0001$). Among the children, only five performed at an adult-like level. Three children showed a mixed response, sometimes

accepting the Differential and the Absolute trials and other times rejecting these types of trials. The rest of the children consistently rejected the sentences in the Differential trials and accepted them in the Absolute trials.

For Task 2 (act-out task), on the other hand, all of the adults and children demonstrated perfect performance. Under the situation illustrated in Figure 25, they appropriately gave the cat a candy or took away a candy from the dog. Note that in this task, we cannot know which strategy children use in order to determine the difference: making a one-to-one correspondence or calculating the difference based on the total number of objects in each set. Whichever strategy they use, however, the children's perfect performance indicates that children aged four to six years have the ability to perform comparing subtraction. Therefore, we cannot attribute children's absolute interpretations of MP comparatives to their immature arithmetical capacity.

4.9 General discussion

The series of experiments presented in this chapter has shown that children's absolute interpretations of MP comparatives is consistent and robust both in English and in Japanese. They consistently interpret them absolutely regardless of the presence or absence of the standard phrase (Experiments 1, 3 and 4). They do so regardless of the kind of GAs (i.e., English: *tall, long,* and *many*; Japanese: *takai, nagai*, and *ooi*) and of the polarity (i.e., Japanese: *hikui* 'short' and *sukunai* 'few') (Experiments 2a and 2b). This non-adult-like pattern of response appears to persist well into five to six years of age. Given that they are able to correctly interpret simple comparatives (e.g., *X is taller than Y*), it is the presence of the MP that hinders their performance. Moreover, children from both languages behaved in the same manner, even though there are several significant differences in linguistic forms between English and Japanese (i.e., presence/absence of a comparative morpheme, word order, etc.). This would suggest that English and Japanese children share the source of difficulty.

At first glance, their absolute interpretation seems to have a positive construction

like *the lion is 2 chipanis tall* as the underlying representation. Given that children (at least Japanese children) assign an absolute interpretation regardless of the polarity of GAs, however, such a positive construction is not likely to be the underlying representation. Moreover, their non-adult performance cannot be attributed to extra-grammatical factors (e.g., incremental processing; arithmetical ability) (Experiments 4 and 6), nor to the conjunctive interpretation (Experiment 5).

Nor can we account for children's non-adult interpretation through parameter mis-setting under the Principle and Parameters approach (Chomsky, 1981, 1995), as discussed in Section 1.3. Suppose that there is a parameter distinguishing grammars that allow only an absolute measurement from grammars that allow both absolute and differential measurements. Given that English and Japanese children consistently assign an absolute interpretation to MP comparatives, we can assume that the default setting of the parameter is the value that only yields an absolute measurement. English and Japanese children can then set the parameter to the other value by conservatively learning that their target grammar allows a differential measurement based on the linguistic input. They then have to learn that the absolute interpretation is not possible for MP comparatives. Given that such negative evidence is not available, however, we would be faced with a learnability problem.

Interestingly, examining the results of Experiments 1, 3, and 4, which were run on English and Japanese children, it was found that almost all English and Japanese children did not allow both absolute and differential interpretations at the same time. In other words, they did not show a response pattern of consistently accepting the Absolute and Differential trials but rejecting the Neutral ones. In fact, I found only one Japanese child in Experiment 4 responding in this manner. This suggests that English and Japanese children by and large expunge the absolute interpretation as a consequence of acquiring the differential one. Assuming such a causal relationship between two interpretations, the next chapter proposes an account of the acquisition of MP comparatives.

Chapter 5: The acquisition of MP comparatives

5.1 Introduction

The previous chapter has shown that children's absolute interpretation of MP comparatives is quite robust in both English and Japanese. We thus have to explain how children learn the correct, differential interpretation and unlearn the absolute one. This chapter proposes an account.

As reported in Section 4.9, I found that almost no English and Japanese children allowed absolute and differential interpretations at the same time. This suggests that they seem to expunge the absolute interpretation as a consequence of acquiring the differential one. If there is such a causal relationship between the two interpretations, it would lead us to an ideal situation for a theory of language acquisition. If child grammar allows the two interpretations at the same time at some point of development, conversely, children have to learn that the absolute interpretation is not possible for MP comparatives. As I discussed in Section 1.3, however, such negative evidence is not likely to be available, and we would be faced with a learnability problem. Thus, if there is a causal relationship between the two interpretations, as the experimental results suggest, we do not have to solve such a problem. This dissertation assumes the causal relationship between the two interpretations.

This causal relationship is reminiscent of the grammatical approach, which was reviewed in Section 1.4.2.2. This approach explains the acquisition of target grammatical knowledge on the basis of positive evidence alone, assuming a grammatical model in which the target grammar is a consequence of another grammatical property. This chapter proposes a grammatical account such that children learn the differential interpretation and, as a consequence, unlearn the absolute interpretation based on positive evidence alone. In this account, children's absolute interpretation is attributed to their wrong setting of the standard of comparison. When interpreting the MP comparative *X is MP taller (than Y)*, they set the standard as the

absolute zero by default and interpret it as 'X is MP taller than the absolute zero.' This is the underlying representation for their absolute interpretation. In this case, when they come to be able to correctly set the standard, children can correctly take the MP as a differential measurement rather than an absolute one. This account is possible when there is a grammatical model that regulates the setting of the standard. As such a model, I adopt the theoretical device proposed by Sawada and Grano (2011), which was reviewed in Section 2.3.3. Moreover, I propose a maturational account of the fact that it takes a long time to acquire MP comparatives. In the previous chapter, we found that even five- and six-year-olds still have difficulties interpreting MP comparatives. I argue that this delay is caused by their immature processing capacity.

5.2 The absolute zero as the standard of comparison

Here I assume the theoretical device proposed by Sawada and Grano (2011), as reviewed in Section 2.3.3. Let us briefly review their proposal again, as my proposal crucially relies on it. First, the Deg head *Meas* requires its internal argument to have a salient measurement system and imposes a selectional restriction on the predicate with which it combines: the scale of the GA has a minimal element. Furthermore, this selectional restriction of *Meas* is universal. The lexical entry for *Meas* is repeated here as (120).

120. [[*Meas*]] = $\lambda g_{\langle e,d\rangle}$: g is a function from objects to measurable degrees and g has a minimum element. $\lambda d.\lambda x.g(x) \geq d$ (Sawada & Grano, 2011: (51))

Based on the proposal of Sawada and Grano (2011), I further assume that English and Japanese children's grammatical knowledge is nearly adult-like, with the exception of one small difference regarding the selectional restriction of *Meas*. I propose that *Meas* in child grammar not only selects for a measurable scale with a minimum element, but also *requires the minimum element to be "absolute zero,"* as shown in (121).

121. [[$Meas_{child}$]] = $\lambda g_{\langle e,d\rangle}$: g is a function from objects to measurable degrees and **g's minimum element is absolute zero.** $\lambda d.\lambda x.g(x) \geq d$

Thus, children assume a more restrictive selectional requirement for *Meas* than adults. I speculate that the absolute zero is the most salient and useful minimum value for children. It is consistent across contexts and the majority of counting and measuring events have the absolute zero as their minimum value. Given this privileged status of the absolute zero, children might take the minimal element as the absolute zero.[32]

Let us then consider how $Meas_{child}$ would account for children's non-adult interpretation of MP comparatives. First, let us turn to MP comparatives without an overt standard phrase as in (122).

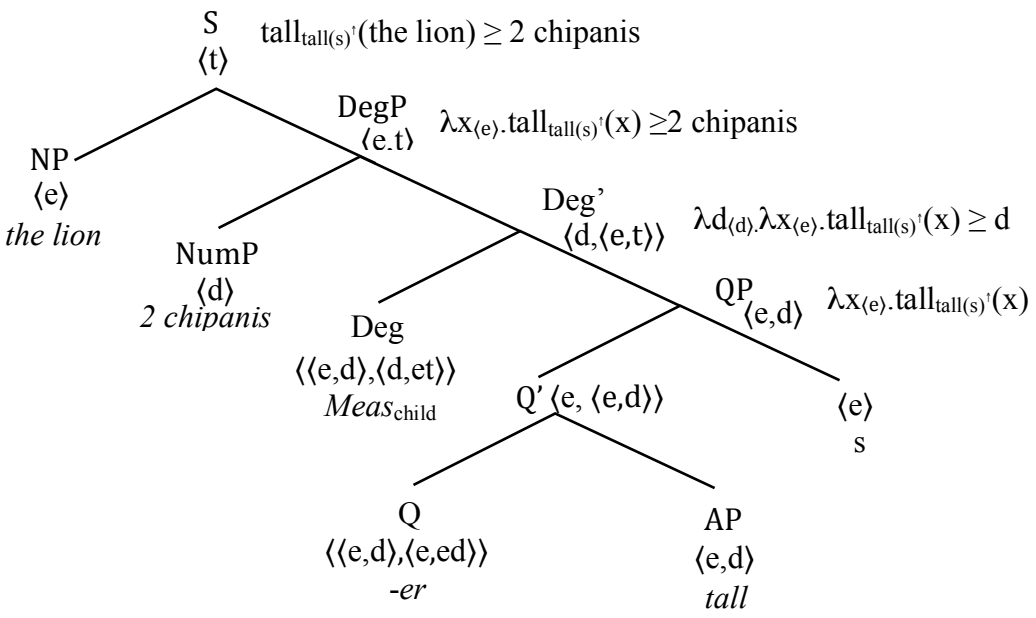
122. a. The lion is 2 chipanis taller.

b. Raion-wa 2-kirari takai.
lion-TOP 2-kirari tall
'The lion is 2 kiraris taller.'

Assuming that comparative morphology (i.e., *-er* and *more* in English; *yori* 'than' in Japanese) turns a basic measure function into a difference function (Kennedy & Levin, 2008; Kennedy & McNally, 2005; Sawada & Grano, 2011) and that it is of type $\langle\langle e,d\rangle,\langle e,ed\rangle\rangle$ and takes two arguments (i.e., the one provided by the main clause and the one provided by the standard phrase) (Bhatt & Takahashi, 2011; Hackl, 2001; Lechner, 2001, 2004), I propose that child English generates the LF in (123) for the sentence in (122a).

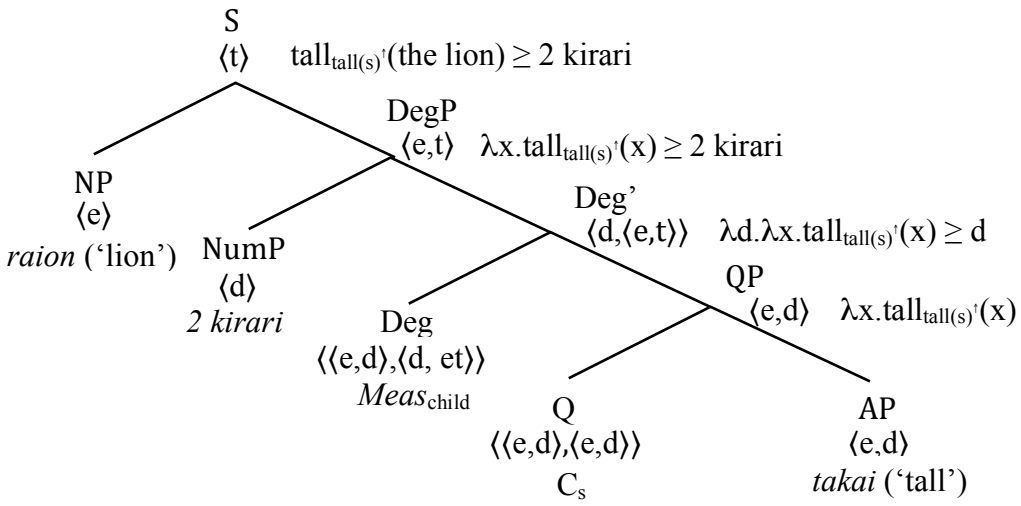
[32] Regarding the concept of zero, around four years of age, children begin to understand zero as a quantity and include it as an empty set at the low end of a numerical continuum or number line (Merritt & Brannon, 2013).

123.



Here, *s* stands for a contextually determined object and *tall(s)* stands for its height, namely, the contextually determined standard. The scale associated with the difference function $\lambda x.tall_{tall(s)'}(x)$ has this standard as its minimum element. Child Japanese has essentially the same LF for the sentence in (122b), except that the covert coercion operator C_s, instead of the comparative morpheme *-er*, is combined with the GA as shown in (124).

124.



Just like English, in this case, the scale associated with the difference function $\lambda x.\text{tall}_{\text{tall(s)}}$ has *tall(s)* as its minimum element.

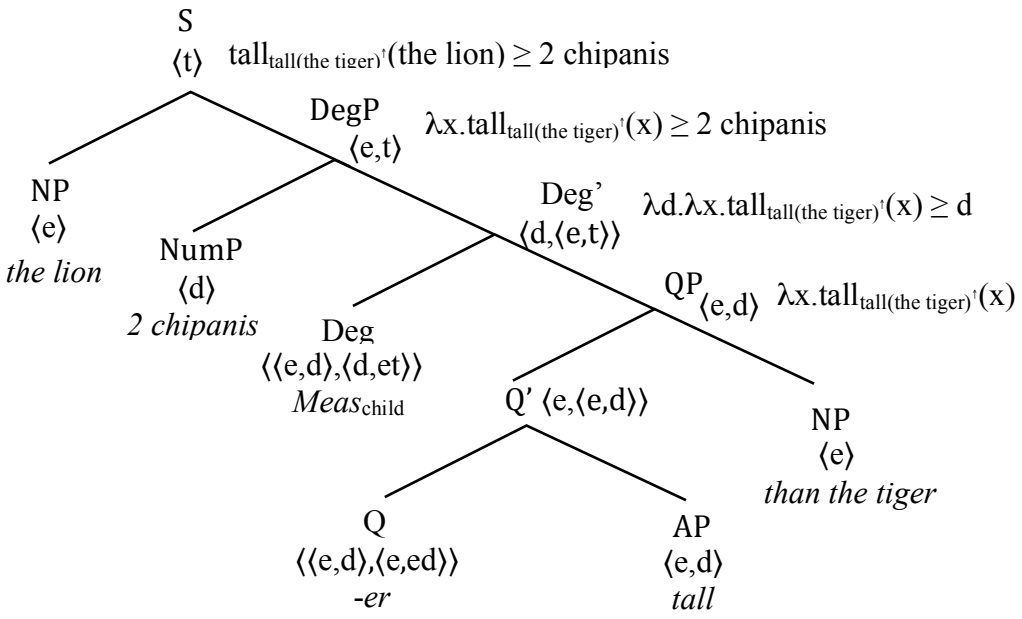
Either in English or in Japanese, therefore, the scale associated with the derived difference function has its minimum element. Unlike with adults, however, the selectional restriction of $Meas_{\text{child}}$ requires the minimum element to be the absolute zero. The only way to satisfy this requirement is to set *tall(s)* as the absolute zero, disregarding the presence of a contextually accessible standard. This yields the representation '$\text{tall}_{\text{abs zero}}$(the lion) $\geq$ 2 chipanis,' resulting in the interpretation 'the lion is 2 chipanis taller than the absolute zero.' This is the underlying representation of the children's absolute interpretation. In other words, children assign MP comparatives the same comparative semantics as adults do, but they wrongly set the standard as the absolute zero.

In the case of MP comparatives with an overt standard phrase as in (125), on the other hand, the explicit *than/yori* phrase supplies the standard of comparison, as illustrated in (126) (and similarly for Japanese, taking into account differences in word order).

125. a. The lion is 2 chipanis taller than the tiger.

b. Raion-wa tora-yori 2-kirari takai.
lion-TOP tiger-than 2-kirari tall
'The lion is 2 kiraris taller than the tiger.'

126.



Here again, *Meas*$_{\text{child}}$ requires the minimum element of the derived scale to be the absolute zero. Setting the value of *tall(the tiger)* to be zero, however, contradicts children's world knowledge (i.e., the height of the tiger cannot be zero) as well as the visual and linguistic input indicating that there is an individual serving as the standard of comparison. Moreover, under the assumption that children's grammatical knowledge is nearly the same as that of adults except for the selectional restriction of *Meas*, children would not look for some contextual standard that would satisfy the selectional requirement because of the principle of *Interpretive Economy* in (127).

127. Interpretive Economy

Maximize the contribution of the conventional meanings of the elements of a sentence to the computation of its truth conditions. (Kennedy, 2007b: (66))

Following Kennedy (2007b) and Sawada and Grano (2011), I assume that this principle regulates semantic computation in child and adult grammar in the same manner. In the current case, therefore, the derived minimum element (i.e., the height of the tiger)

should be chosen as the standard of comparison, but the semantic requirement of $Meas_{child}$ contradicts this situation, requiring instead the absolute zero. As a result, children cannot directly generate a coherent interpretation of the target sentence.

Upon encountering such a contradiction, children then use some strategy for interpretation because they are forced to make a response in the experimental situation. This strategy might vary from child to child, as children try to reconcile the conflicting linguistic information under the duress of memory and/or processing load. Below, I consider several possibilities for such strategies.

One possible strategy is to ignore the standard phrase marked with *than/yori* and generate the LFs in (123) and (124), respectively, for the test sentences in (125a) and (125b), which yield an absolute interpretation (i.e., 'X is MP taller than the absolute zero'). The experimental results suggest that the majority of children use this strategy. Note that under this account, I do not claim that children fail to process the overt standard phrase. Instead, it is because they compute the compositional meaning of the whole sentence that they notice the conflict between the selectional restriction of $Meas_{child}$ and the overt standard phrase, which makes them reanalyze the sentence using this strategy.

Another possible strategy is to ignore the MP and interpret the test sentence as a simple comparative (e.g., *the lion is taller than the cat*). This is the simple comparative interpretation found in Experiment 5, where MP comparatives with an overt standard phrase were used as stimulus sentences. Without an MP, $Meas_{child}$ is not introduced into the structure and children are not forced to set the minimal element as the absolute zero. If they use this strategy, they would accept the test sentence only when the subject is taller than the standard, regardless of the height of the subject. On the other hand, when the subject is shorter than the standard (e.g., Absolute-shorter trial in Experiment 5), they would reject it. Moreover, some of the children excluded from the analysis in Experiment 4 due to a 'yes' bias might also have used this strategy. The experimental results show that the number of children excluded due to a 'yes' bias was significantly

larger in Experiment 4 than in Experiments 1 and 3 (six English children and ten Japanese children in Experiment 4; one English child and no Japanese children in Experiments 1 and 3). In Experiments 1 and 3, the target sentence did not include an overt standard phrase, and children might not have had to resolve the conflict between the selectional restriction of $Meas_{child}$ and the overt standard, yielding an absolute interpretation. In Experiment 4, on the other hand, the test sentence did include the overt standard phrase, and children might have faced this conflict. They might then ignore the MP in order to construct a coherent LF.[33]

It is also possible that children might resort to some kind of non-compositional strategy, rather than ignoring some parts of the sentence and then compositionally computing the meaning of the resultant structure. Some children might assign the conjunctive interpretation 'X is MP (tall) and taller than (than Y).' Indeed, Experiment 5 found that five Japanese children assigned the conjunctive interpretation, while there were no such English children, as shown in Table 1 (repeated here as Table 2).

Response type	English	Japanese	Total
Differential (correct)	4	7	11
Absolute ('MP tall')	13	11	24
Conjunctive ('MP and taller')	0	5	5
Simple comparative ('taller')	3	4	7
Unclassifiable	3	6	9
TOTAL number of children	23	33	56

Table 2 Response types exhibited by child participants in Experiment 5

[33] Under the theoretical account that I assume here, in the absence of an MP (namely, *Meas*) a comparative GA must combine with *pos* in order to derive a property of individuals (Kennedy & Levin, 2008; Sawada & Grano, 2011). Thus, if children decide to disregard the MP and *Meas*, they will need to insert *pos* to resolve a type mismatch. I assume that children have no problem with this procedure, given that children correctly interpret GAs both in the positive and comparative forms elsewhere, as reviewed in Sections 3.2 and 3.3 (e.g., Barner & Snedeker, 2008; Ebeling & Gelman, 1988; Gor & Syrett, 2014; Kawahara, 2013, 2014; Syrett, 2007; Syrett *et al.*, 2006, 2010; Syrett & Lidz, 2011).

The difference between English and Japanese children might be caused by the differences in word order between these two languages. As can be seen in (125), in contrast to English, the *yori* standard phrase precedes the MP in Japanese. Japanese children then encounter the standard phrase earlier than English children. Because of this, Japanese children might be more likely to take in the standard phrase for the interpretation and assign the conjunctive interpretation. There might be also children who disregard the GA and simply take the MP as an absolute measurement ('X=MP'). This non-compositional interpretation cannot be distinguished from the absolute interpretation 'X is MP taller than the absolute zero,' and children who assigned this interpretation might be categorized under the 'Absolute' response in Table 2.[34] Besides these interpretations, there are too many logical possibilities, and I cannot specify them all.

This analysis can also account for why children assign an absolute interpretation to MP comparatives including a negative GA like (128), which are the stimulus sentences used in Experiments 2a and 2b.

128. a. Neko-no-sakana-wa nan-ko sukunai-kana?
cat-GEN-fish-TOP how many-CL few-Q
'How many fewer fish does the cat have?'

b. 2-kirari hikui-no-wa dore?
2-kirari short-one-TOP which
'Which one is 2 kiraris shorter?'

These sentences do not include the overt standard phrase, and child Japanese generates an LF like (124) for the sentences in (128), setting the standard as the absolute zero. It

[34] Even though we cannot distinguish between these two interpretations, in the last part of this section I will argue that the majority of children compositionally derive the absolute interpretation 'X is MP taller than the absolute zero' for MP comparatives without an overt standard phrase.

then yields the interpretations: 'How many fewer fish does the cat have than zero?' for (128a) and 'Which one is 2 kiraris shorter than zero?' for (128b). The resultant interpretations wildly contradict children's world knowledge: one cannot have fewer fish than zero; the height of the relevant horse is clearly not below ground level. Upon encountering such a contradiction, they might ignore the GA in these sentences, yielding the interpretations 'How many fish does the cat have?' and 'Which one is 2 kiraris?' They then responded absolutely, accepting the Absolute and Neutral trials and rejecting the Differential trials.

This analysis also expects that English and Japanese children "happen to" correctly interpret the MP constructions in (129), even though the selectional restriction of *Meas* in their grammar is slightly different from adult grammar.

129. a. This rod is 5 degrees bent.

b. Kono sao-wa 5-do magat-teiru.
this rod-TOP 5-degree bend-TEIRU
'This rod is 5 degrees bent.'

As we saw in Section 2.3.3, lower-closed-scale GAs like *bent* can be directly combined with *Meas*, giving rise to an absolute interpretation. This is because the absolute zero as the minimal element is built into the lexically specified scale. Given that children are sensitive to the difference in the scale structure (Kawahara, 2013; Syrett, 2007; Syrett *et al*., 2006, 2010), they would correctly take the MP in (129) as an absolute measurement. This point is left to be confirmed in future research.

I thus uniformly accounted for English and Japanese children's non-adult-like interpretations by making a single assumption about the selectional restriction of *Meas*. $Meas_{child}$ requires the absolute zero as its minimum, and children set the standard of comparison as the absolute zero. For MP comparatives without an overt standard phrase, then, they interpret them as 'X is MP taller than the absolute zero.' For MP

comparatives containing one, on the other hand, they cannot directly generate a coherent interpretation because the $Meas_{child}$'s requirement contradicts the standard introduced by the overt standard phrase. As a result, they assign various non-adult interpretations either by ignoring some part of the sentence or by interpreting it non-compositionally.

For the underlying representation of MP comparatives without an overt standard phrase, I proposed the comparative 'X is MP taller than the absolute zero.' However, it is also possible that children assign the non-compositional 'X=MP' interpretation. As discussed above, we cannot distinguish between these interpretations. Nevertheless, I argue that the majority of children compositionally derive the absolute interpretation 'X is MP taller than the absolute zero' for such MP comparatives, because we cannot explain the acquisition of MP comparatives if children assign the non-compositional, absolute interpretation. Suppose that children non-compositionally assign the 'X=MP' interpretation. Children then learn that the MP can express a differential measurement based on linguistic input. In this case, they have to learn that the absolute interpretation 'X=MP' is impossible in their target grammar. Given that such negative evidence is not likely to be available, as discussed in Section 1.3, we would be faced with a learnability problem. I thus maintain that the underlying representation is the compositionally-derived comparative 'X is MP taller than the absolute zero.'

This grammatical account crucially relies on the assumption that child grammar has *Meas*, even though children first assume a slightly different lexical entry from adults.' How, then, have children acquired the functional category in the first place? It is possible that child grammar innately has it. In this case, why is the lexical entry for $Meas_{child}$ different from *Meas* in adult grammar? Is there a parameter distinguishing grammars in which *Meas* just requires a minimal element from grammars in which *Meas* requires the absolute zero as a minimal element? I am not going to seriously pursue these questions here, and tentatively assume that such categorial knowledge is innate.

5.3 Revising the selectional requirement of *Meas*

Let us then turn to how English and Japanese children eventually acquire MP comparatives, learning the differential interpretation and unlearning the absolute one. Under the account proposed in the previous section, what they have to do is to relax the selectional requirement of *Meas*. For the selectional requirement, children first assume a more restrictive one than adults, requiring the minimum element to be the absolute zero. As a result, they set the standard of comparison as the absolute zero even when the context or the overt standard phrase indicates a different degree (i.e., the derived minimum element) as the standard. In order to learn to set the derived minimum element as the standard, they have to revise the selectional requirement of *Meas*, just requiring the minimum element.

They might realize the need to relax the selectional restriction of *Meas* by hearing MP comparatives with an overt standard phrase. Such a learning process might be prompted especially when the standard of comparison is either salient or focused on in the context or when they recognize a different approach to reconciling the contradiction between the absolute zero and their real-world knowledge. For example, when an adult has one candy and a child has three candies, the adult speaker says "You have two more candies than me." In this case, the child would notice that the absolute interpretation 'you have two more candies than zero' is wrong since s/he has three. Encountering such an occasion, children might realize that the minimal element does not necessarily have to be the absolute zero. Thus, children might revise the selectional restriction of *Meas* only on the basis of positive evidence.

After revising the selectional restriction of *Meas*, then, children come to be able to set the standard in an adult-like way. When there is an overt standard phrase, they take the degree as the minimal element. When there is not, on the other hand, they take a salient contextually retrievable standard as the minimal element. In this case, they do not choose the absolute zero, because *Meas* in their grammar no longer requires the minimal element to be the absolute zero. Once they come to be able to correctly set the

standard, then, they can generate a differential interpretation. As a result, they cease assigning an absolute interpretation to MP comparatives. In this account, then, children expunge the absolute interpretation as a consequence of acquiring the differential interpretation.

Note that I am not arguing that the minimal element cannot be the absolute zero in adult grammar. Actually, when lower-closed scale GAs are directly combined with *Meas*, as we saw in (129), the minimal element is the absolute zero. With this type of GA, the absolute zero is built into the lexical entry. Because of the principle of Interpretive Economy in (127) (repeated here as (130)), we do not have to look for some contextual standard that would satisfy the selectional requirement of *Meas*.

130. Interpretive Economy

> Maximize the contribution of the conventional meanings of the elements of a sentence to the computation of its truth conditions. (Kennedy, 2007b: (66))

Thus, when the absolute zero is built into the lexical item or overtly expressed as the standard (e.g., *This building is 20 meters taller than the ground level*), it can be the minimal element. What children have to learn, therefore, is that the minimal element does not necessarily have to be the absolute zero.

I thus explained that children acquire MP comparatives by relaxing the selectional requirement of *Meas*. If children start out with the most restrictive hypothesis, they can acquire the correct knowledge on the basis of positive evidence alone. This learning strategy has been assumed in various approaches to language acquisition. Within the Principles and Parameters approach (e.g., Chomsky, 1981, 1986), this idea is often adopted as *the Subset Principle* to explain syntactic acquisition. This principle forces children to choose the parameter value that yields the most restrictive grammar until positive evidence shows that the parameter setting cannot generate possible sentences in the target language (e.g., Berwick, 1985; Clark, 1992; Fodor, 1992, 1994; Manzini &

Wexler, 1987; Roeper & de Villiers, 1992; Wexler, 1993). Moreover, this learning strategy has also been adopted in studies on semantics acquisition as *the Semantic Subset Principle*, which states that children assume as a default the scope interpretation that yields the narrowest truth conditions (Crain *et al*., 1994; Goro, 2007; Goro & Akiba, 2004; Jing *et al*., 2005). In the current case, similarly, children have the most restrictive hypothesis as the default assumption. They first assume the most restrictive minimum element, that is, the absolute zero as the standard of comparison. They then revise the lexical entry for *Meas* by hearing MP comparatives with a standard phrase.

5.4 The delay in the acquisition of MP comparatives

In this account, the input of MP comparatives with an overt standard phrase is crucial to acquiring MP comparatives. Such input seems not to be frequent in the CHILDES database. The CHILDES corpus research presented in Section 4.5.2 shows that in child-directed speech, comparatives with a standard phrase are not frequent compared with comparatives without a standard phrase (Arii *et al.*, 2016, 2017). Moreover, although numerals are frequent in the input, they most often appear in a count list and other linguistic forms, not in comparatives (Syrett, *et al.*, 2012). However, children should receive much more of such input when they learn subtraction at school. As discussed in Section 4.7.4, children learn comparing subtraction through comparison problems (e.g., "When Tom has three apples and Bob has two apples, how many more apples does Tom have than Bob?"). Such problems usually accompany an MP comparative as a question. Thus, children are explicitly given such crucial input for revising the lexical entry for *Meas*. Nevertheless, it takes time before they come to be able to solve the comparison problems (Duthie, 1963; Gibb, 1956; Hudson, 1983; Nunes & Bryant, 1996; Riley et al., 1983), even though they have the arithmetical ability to perform comparing subtraction, as Experiment 6 showed. Moreover, we found that even five- and six-year-olds still have difficulties interpreting MP comparatives in the series of experiments. This suggests that even though children are explicitly given

the crucial input for revising the lexical entry for *Meas*, they cannot use it for a long time.

This might be because it requires heavy demands on processing to revise it. In order to realize the need to relax the selectional restriction of *Meas*, children have to achieve the following tasks. First, they have to notice that adults assign a different interpretation to MP comparatives from the absolute interpretation. Second, they have to notice the contradiction between the absolute zero and the overtly expressed standard. Lastly, they have to realize that they can resolve the contradiction by relaxing the selectional restriction of *Meas* such that the minimal element does not necessarily have to be the absolute zero. Thus, revising the lexical entry seems to require heavy demands on processing. This might be the reason why it takes time before children come to be able to use the crucial input to revise the lexical entry for *Meas*. In order to revise it, they have to wait for their processing resources to mature.

5.5 Summary and discussion

This chapter proposed a grammatical account of how children acquire MP comparatives. I assume that children and adults share the same Degree Phrase structure, in which *Meas* selects for a GA that has a minimal scalar element. The difference between them lies in what constitutes the minimal value: for children, it has to be the absolute zero. As a consequence, children mistakenly set the standard of comparison as the absolute zero. For MP comparatives without an overt standard phrase, then, they assign the comparative interpretation 'X is MP taller than the absolute zero.' For MP comparatives with an overt standard phrase, on the other hand, the semantic requirement of $Meas_{\text{child}}$ contradicts the overtly expressed standard, and they assign various non-adult interpretations either by ignoring some part of the sentence or by interpreting it non-compositionally.

In order to acquire the correct interpretation, children have to revise the selectional restriction of *Meas*. They achieve this on the basis of positive evidence alone

(i.e., MP comparatives with an overt standard phrase), because they first assume the most restrictive minimum element. All that they then have to do is to relax the selectional restriction, learning that the minimal element does not necessarily have to be the absolute zero. After they revise the lexical entry for *Meas*, they come to be able to correctly set the standard of comparison. As a consequence, they no longer assign an absolute interpretation to MP comparatives.

This account has several advantages. First, this explains the acquisition of MP comparatives on the basis of positive evidence alone, because children start out with the most restrictive hypothesis. In order to unlearn the absolute interpretation, thus, they do not have to count on negative evidence showing that such an interpretation is impossible for MP comparatives. Second, the idea of a selectional restriction of *Meas* makes it possible to isolate the cause of children's non-adult interpretations and to minimize the difference between adults and children. Third, the theory of *Meas* also allows us to account for the fact that children's non-adult interpretations are restricted to MP comparatives and do not extend to comparative constructions in general, because the theory associates the presence of an MP with a unique functional head. Since the functional head *Meas* is not included in constructions without an MP (e.g., simple comparatives), children do not have any problem with interpreting such constructions. Finally, the assumption that the selectional restriction of *Meas* is universal allows us to account for the similar behavior of English and Japanese children.

This thesis also proposed a maturational account of the delay in the acquisition of MP comparatives. This acquisition process takes a long time. Even though they should be explicitly given the input crucial to revising the lexical entry for *Meas*, children seem not to be able to use it for a long time. This might be because revising the lexical entry requires heavy demands on processing, so in order to revise it, they have to wait for their processing resources to mature.

Thus, I explained the acquisition of MP comparatives, resorting to both grammatical and maturational approaches. The crucial component of this account is

Sawada and Grano's (2011) proposal concerning the selectional restriction of *Meas*. This theoretical device was originally proposed to account for the form-meaning mapping of the MP+GA constructions in adult grammar. In this sense, this account is in line with the previous approaches to children's non-adult behavior that count on an independently proposed theoretical device, as reviewed in Section 1.4.2 (Borer & Wexler, 1987, 1992; Goro, 2007: Grodzinsky & Reinhart, 1993; Hyams, 1986; Reinhart, 2006; Zhou & Crain, 2009).

Chapter 6: Concluding remarks

This thesis investigated English and Japanese children's interpretation of MP comparatives and proposed an account of the acquisition of the correct interpretation. When an MP modifies a GA, we can find cross-linguistic variation regarding the possible interpretations. When modifying a GA, an MP can express both absolute and differential measurements in English while it only expresses the differential one in Japanese. Children from these languages then have to learn what interpretation is possible and what is impossible for the GA+MP constructions.

Chapter 2 reviewed previous theoretical studies on comparatives. We first reviewed analyses of comparative constructions in general. Next, we reviewed analyses of MP comparatives: the lexical analysis, Schwarzschild (2005), and Sawada and Grano (2011). Chapter 3 reviewed previous literature on the developing comprehension and production of each part of MP comparatives: the GA, comparatives without an MP, and MPs.

Chapter 4 examined English and Japanese children's interpretations of MP comparatives through a series of experiments. Experiment 1 found that Japanese children consistently assign an absolute interpretation to MP comparatives without an overt standard phrase. Experiments 2a and 2b investigated Japanese children's interpretations of the construction including a negative GA (*sukunai* 'few' and *hikui* 'short') in order to examine the underlying representation for the absolute interpretation. We then found that they also interpret such MP comparatives absolutely, and this finding led us to conclude that the underlying representation in child grammar is *not* a positive construction (e.g., *the lion is 2 kiraris tall*). Experiment 3 investigated English children's interpretation of MP comparatives without an overt standard phrase in order to test the hypothesis that Japanese children's non-adult interpretation is due to the lack of a comparative morpheme to signal comparison in the language. We then found that English children also assign an absolute interpretation, regardless of the presence of

comparative morphology in English, and rejected the hypothesis. Experiment 4 investigated English and Japanese children's interpretations of MP comparatives with an overt standard phrase in order to test the hypothesis that the source of children's difficulty is their incremental processing of the target sentence and their failure to revise an incorrect syntactic representation. We then found that both English and Japanese children assign an absolute interpretation regardless of the difference in word order between these two languages, and abandoned the hypothesis. Experiment 5 tested the hypothesis that English and Japanese children assign the non-compositional, conjunctive interpretation 'X is MP (tall) AND taller than (than Y).' We then found that although some Japanese children interpreted MP comparatives in this manner, most children assigned an absolute interpretation. We then concluded that the children's absolute interpretation found in Experiments 1–4 cannot be accounted for by the conjunctive interpretation. Experiment 6 investigated Japanese children's arithmetical ability to perform the comparing subtraction, which is necessary to correctly respond to the experimental tasks of Experiments 1–5. We then found that children have the ability, and concluded that we cannot attribute their non-adult interpretation to their immature arithmetical capacity.

To sum up, the series of experiments showed the children's absolute interpretation for MP comparatives is consistent and robust both in English and Japanese. They interpret them absolutely regardless of the presence or absence of a standard phrase and regardless of the kind of GA and polarity. This non-adult-like pattern of response appears to persist well into five to six years of age. Given that they are able to correctly interpret simple comparatives (e.g., *X is taller than Y*), it is the presence of the MP that hinders their performance. Moreover, the same response pattern found in English and Japanese children suggests that English and Japanese children have a common source of difficulty. Their non-adult performance cannot be attributed to extra-grammatical factors (e.g., incremental processing; arithmetical ability) nor to the conjunctive interpretation. We then have to explain how children acquire the adult-like, differential

interpretation and expunge the absolute one.

Chapter 5 proposed a grammatical account of the acquisition of MP comparatives. This account is based on the theoretical device that was originally proposed by Sawada and Grano (2011) in order to account for the form-meaning mapping of the MP+GA constructions in adult grammar. In this account, children's absolute interpretation is attributed to the lexical entry of null Deg head *Meas* in child grammar, which is slightly different from that in adult grammar. Here, I assume that children and adults share the same Degree Phrase structure, in which *Meas* selects for a GA that has a minimal scalar element. The difference between them lies in what constitutes the minimal value: for children, it has to be the absolute zero. As a result, children mistakenly set the standard of comparison as the absolute zero. For MP comparatives without an overt standard phrase, they assign the comparative interpretation 'X is MP taller than the absolute zero.' For MP comparatives with an overt standard phrase, on the other hand, the semantic requirement of $Meas_{\text{child}}$ contradicts the overtly expressed standard, and they assign various non-adult interpretations, either by ignoring some part of the sentence or by interpreting it conjunctively.

In order to acquire the correct interpretation, they only have to relax the selectional restriction, learning that the minimal element does not necessarily have to be the absolute zero. They achieve this on the basis of positive evidence alone (i.e., MP comparatives with an overt standard phrase), because they first assume the most restrictive minimum element. Once they revise the lexical entry for *Meas*, they are able to correctly set the standard of comparison. As a consequence, they no longer assign an absolute interpretation to MP comparatives.

Chapter 5 also proposed a maturational account of the delay in the acquisition of MP comparatives. This acquisition process takes a long time. Even though they should be explicitly given the crucial input for revising the lexical entry for *Meas*, children seem not to be able to use it for a long time. I proposed that this could be because it requires heavy demands on processing to revise the selectional restriction of *Meas*. In

order to revise the lexical entry, they have to wait for their processing resources to mature.

Note that in this proposal, children are almost always faithful to the selectional restriction of *Meas* when interpreting MP comparatives. This suggests that children interpret this construction compositionally, rather than directly associating it as a whole with a differential interpretation. This point relates to a question about the acquisition of form-meaning correspondence in general: Do children assign meaning to subparts, which are then composed to yield a whole construction in the syntax and semantics, or does a process of associating phrasal "constructions" with their meanings characterize young children's acquisition of semantics, as proposed in some versions of Construction Grammar (e.g., Goldberg, 2006)? Construction Grammar assumes that people's knowledge of language consists of systematic collections of form-meaning pairings that are learned on the basis of the input they hear around them. In the current case, children should encounter utterances and corresponding contexts that would allow them to associate the relevant phrasal forms with a differential interpretation (e.g., hearing "I want one more apple" when the speaker has more than one apple, or comparing how many more apples one's sibling has to the number of apples one has oneself). The experimental findings reported in Chapter 4, however, suggest that children do not immediately use such an opportunity to acquire a differential interpretation in English or Japanese.

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Appendices

Appendix A. Experiment 1: MP comparatives without an overt standard phrase in Japanese

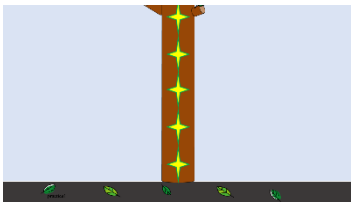
A1: Training session

Below is the scenario, which was given to the participants in Japanese.

Experimenter:

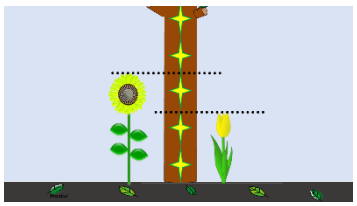
Now, I'm going to introduce you to some animals and I want to see how tall they are. Do you think you could do that?

In order to do this, we're going to use this tree marked with these funny stars **[Slide 1]**. We call these stars *kirari* (*chipani* for English participants). Can you say that?



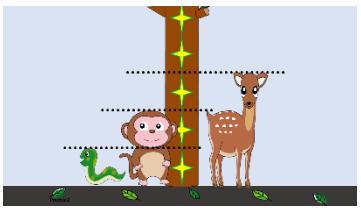
Slide 1

Wow, look at those flowers! **[Slide 2]** How about you help me measure them? How many kiraris tall is the sunflower? How tall is the tulip? Which flower is shorter?



Slide 2

Look! There are a snake, a monkey, and a deer! **[Slide 3]** We can see how tall each of them is! Which one is the tallest? How many kiraris is he? Is the monkey taller than the deer?



Slide 3

A2: Task 1 (*takai* 'tall'/*nagai* 'long')

Here, MP comparatives without an overt standard phrase were used as a stimulus sentence. They included either *takai* 'tall' or *nagai* 'long.' Three versions of tests with different order of items were used. In each version, for the target stimuli, the order of

items was pseudorandomized with respect to the three types of items: Differential, Absolute, and Neutral. For filler items, simple comparatives were used (e.g., "I think the squirrel is shorter"). Below is the list of stimuli, which were given to the participants in Japanese.

ver. 1

	Type	**Subject**	**Standard**	**Correct response**	**Stimuli**
1	Filler	3	1	TRUE	The squirrel is shorter.
2	Neu	3	1	FALSE	Experimenter: Here is a tiger. She is 1 kirari tall. Now look at this lion! Mr. Mouse, what do you think about the lion? Mouse: I think **the lion is 1 kirari taller**. Experimenter: Let's put the lion next to the kirari tree to see if Mr. Mouse is right! What did you say? Mouse: I said **the lion is 1 kirari taller**. Was I right?
3	Abs	2	1	FALSE	The cat is 2 kiraris taller.
4	Diff	3	1	TRUE	The gorilla is 2 kiraris taller.
5	Neu/ *longer*	3	1	FALSE	The shark is 1 kirari longer.
6	Neu	3	1	FALSE	The penguin is 1 kirari taller.
7	Abs	2	1	FALSE	The panda is 2 kiraris taller.
8	Diff	3	1	TRUE	The bear is 2 kiraris taller.

9	Abs/ *longer*	2	1	FALSE	The fishy is 2 kiraris longer.
10	Neu	3	1	FALSE	The deer is 1 kirari taller.
11	Abs	2	1	FALSE	The turtle is 2 kiraris taller.
12	Diff	3	1	TRUE	The crocodile is 2 kiraris taller.
13	Diff/ *longer*	3	1	TRUE	The dolphin is 2 kiraris longer.

ver.2	1	2	3	4	5	6	7	8	9	10	11	12	13
	Filler	Diff	Neu	Abs	Diff/ *longer*	Diff	Neu	Abs	Neu/ *longer*	Diff	Neu	Abs	Abs/ *longer*
ver.3	1	2	3	4	5	6	7	8	9	10	11	12	13
	Filler	Abs	Neu	Diff	Abs/ *longer*	Abs	Neu	Diff	Neu/ *longer*	Abs	Neu	Diff	Diff/ *longer*

A3: Task 2 (*ooi* 'many')

Here, MP comparatives without an overt standard phrase were used as a stimulus sentence. They included *ooi* 'many.' Just like Task 1, three versions of tests with different order of items were used. For filler items, mass nouns were used (e.g., sand, chocolate, and cotton). The second and third filler items had both true and false versions in order to allow the experimenter to elicit variable responses (*right* or *wrong*) based on how participants responded to the preceding stimulus sentence. Below is the list of stimuli, which were given to the participants in Japanese.

ver. 1

	Type	**Subject**	**Standard**	**Correct response**	**Stimuli**

1	Filler	less	More	TRUE	Suzie has less sand.
2	Neu	3	1	FALSE	Experimenter: This girl has a bag of oranges. Let's peek inside and see how many oranges she has. She has 1 orange. Here comes a boy. He has a bag of oranges, too. Then, Mr. Mouse, could you tell me about the boy's oranges?" Mouse: I think **the boy has 1 more oranges**. Experimenter: In order to check whether what the puppet has said is true or false, let's see. What did you say? Mouse: I said **the boy has 1 more oranges**. Was I right?
3	Abs	2	1	FALSE	He has 2 more melons.
4	Diff	3	1	TRUE	He has 2 more strawberries.
5	Filler	less	More	TRUE/ FALSE	She has more/less chocolate.
6	Neu	3	1	FALSE	He has 1 more fish.
7	Abs	2	1	FALSE	He has 2 more eggs.
8	Diff	3	1	TRUE	He has 2 more onions.
9	Filler	less	More	TRUE/ FALSE	He has more/less cotton.
10	Neu	3	1	FALSE	He has 1 more baseballs.
11	Abs	2	1	FALSE	He has 2 more cookies.
12	Diff	3	1	TRUE	He has 2 more peaches.

ver.2	1	2	3	4	5	6	7	8	9	10	11	12
	Filler	Diff	Neu	Abs	Filler	Diff	Neu	Abs	Filler	Diff	Neu	Abs
ver.3	1	2	3	4	5	6	7	8	9	10	11	12
	Filler	Abs	Neu	Diff	Filler	Abs	Neu	Diff	Filler	Abs	Neu	Diff

Appendix B. Experiment 2a: MP comparatives including *sukunai* 'few'

In Task 1, MP comparatives including *ooi* 'many' were used as a stimulus sentence. In Task 2, on the other hand, MP comparatives including *sukunai* 'few' were used. For each task, I used three versions of tests with different order of items. For filler items, I used a simple comparative as a stimulus sentence. Below is the list of stimuli, which were given to the participants in Japanese.

B1: Task 1 (*ooi* 'many')

ver.1

	Type	**Subject**	**Standard**	**Correct response**	**Stimuli**
1	Abs	3	2	FALSE	Experimenter: Here are a doggy and a kitty! They went fishing. They decided to compete with each other for the number of fish they caught. The doggy caught 3 fish. The kitty caught 1 fish. Which has more? Right. Then, Pikachu, **how many more fish does the dog have?** Pikachu: **3**!
2	Neu	3	1	FALSE	1
3	Diff	4	3	TRUE	1

4	Filler	3	2	TRUE	Experimenter: Here are a fox and a squirrel! They went catching insects. They decided to compete with each other for the number of ladybirds they caught. The fox got these ladybirds and the squirrel got these ladybirds. Then, Pikachu, **which has more?** Pikachu: **The fox!**
5	Abs	3	1	FALSE	3
6	Neu	4	3	FALSE	3
7	Diff	3	2	TURE	1
8	Filler	3	1	FALSE	Pig
9	Abs	4	3	FALSE	4
10	Neu	3	2	FALSE	2
11	Diff	3	1	TURE	2

ver. 2

1	2	3	4	5	6	7	8	9	10	11
Neu	Abs	Diff	Filler	Neu	Abs	Diff	Filler	Neu	Abs	Diff

ver. 3

1	2	3	4	5	6	7	8	9	10	11
Diff	Neu	Abs	Filler	Diff	Neu	Abs	Filler	Diff	Neu	Abs

B2: Task 2 (*sukunai* 'few')

ver. 1

	Type	**Subject**	**Standard**	**Correct response**	**Stimuli**

1	Abs	2	3	FALSE	Experimenter: Here are a doggy and a kitty! They went picking flowers. They decided to compete with each other for the number of flowers they got. The doggy got 3 flowers. The kitty got 1 flower. Which has fewer flowers? Right. The cat has fewer flowers. Then, Pikachu, **how many fewer flowers does the cat have?** Pikachu: **3**!
2	Neu	1	3	FALSE	3
3	Diff	3	4	TRUE	1
4	Filler	2	3	TRUE	Squirrel
5	Abs	1	3	FALSE	1
6	Neu	3	4	FALSE	4
7	Diff	2	3	TURE	1
8	Filler	3	1	FALSE	Pig
9	Abs	3	4	FALSE	3
10	Neu	2	3	FALSE	3
11	Diff	1	3	TURE	2

ver. 2

1	2	3	4	5	6	7	8	9	10	11
Neu	Abs	Diff	Filler	Neu	Abs	Diff	Filler	Neu	Abs	Diff

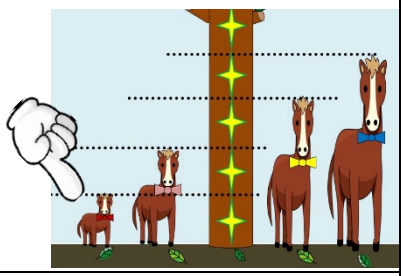
ver. 3

1	2	3	4	5	6	7	8	9	10	11
Diff	Neu	Abs	Filler	Diff	Neu	Abs	Filler	Diff	Neu	Abs

Appendix C. Experiment 2b: MP comparatives including *hikui* 'short'

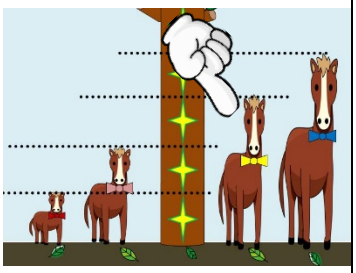
In Task 1, MP comparatives including *takai* 'tall' were used as a stimulus sentence. In Task 2, on the other hand, the construction including *hikui* 'short' was used. For filler items, I used a superlative. Below is the list of stimuli, which were given to the participants in Japanese. Here, the height of animals is represented as "#K" for short (e.g., 3K: 3 kiraris)

C1: Task 1 (*takai* 'tall')

	Type	**Correct answer**	**Stimuli**
1	Filler	The bear	Experimenter: Here are four animals: a cat, a raccoon, a dog and a bear. Then, **which one is the tallest?**
2	Target	The horse with a yellow tie (3K)	Experimenter: Here are four horses. These horses have ties of different colors. The height of this horse (pointing to the horse with a red tie) is 1 kirari. Then, **which one is 2 kiraris taller?** (Intended: 'Which one is 2 kiraris taller than the horse with red tie (1K)?') 
3	Target	The penguin with a blue tie (4K)	Which one is 3 kiraris taller? (Intended: 'Which one is 3 kiraris taller than the penguin with a red tie (1K)?')
4	Target	The frog with	Which one is 2 kiraris taller?

		a yellow tie (3K)	(Intended: 'Which one is 2 kiraris taller than the frog with a red tie (1K)?')
5	Filler	The cat	Which one is the shortest?
6	Target	The fox with a blue tie (4K)	Which one is 3 kiraris taller? (Intended: 'Which one is 3 kiraris taller than the fox with a red tie (1K)?')
7	Target	The rabbit with a yellow tie (3K)	Which one is 2 kiraris taller? (Intended: 'Which one is 2 kiraris taller than the rabbit with a red tie (1K)?')
8	Target	The tiger with a blue tie (4K)	Which one is 3 kiraris taller? (Intended: 'Which one is 3 kiraris taller than the tiger with a red tie (1K)?')

C2: Task 2 (*hikui* 'short')

	Type	**Correct answer**	**Stimuli**
1	Filler	The bear	Which one is the tallest?
2	Target	The horse with a red tie (1K)	Experimenter: Here are four horses. These horses have ties of different colors. The height of this horse (pointing to the horse with a yellow tie) is 3 kirari. Then, **which one is 2 kiraris shorter?**  (Intended: 'Which one is 2 kiraris shorter than the horse with a yellow tie (3K)?')
3	Target	The penguin	Which one is 1 kirari shorter?

		with a pink tie (2K)	(Intended: 'Which one is 1 kirari shorter than the penguin with a yellow tie (3K)?)
4	Target	The frog with a red tie (1K)	Which one is 1 kirari shorter? (Intended: 'Which one is 2 kiraris shorter than the frog with a yellow tie (3K)?')
5	Filler	The cat	Which one is the shortest?
6	Target	The fox with a pink tie (2K)	Which one is 1 kirari shorter? (Intended: 'Which one is 1 kirari shorter than the fox with a yellow tie (3K)?')
7	Target	The rabbit with a red tie (1K)	Which one is 2 kiraris shorter? (Intended: 'Which one is 2 kiraris shorter than the rabbit with a yellow tie (3K)?')
8	Target	The tiger with a pink tie (2K)	Which one is 1 kirari shorter? (Intended: 'Which one is 1 kirari shorter than the tiger with a yellow tie (3K)?')

Appendix D. Experiment 3: MP comparatives without an overt standard phrase in English

The same experimental design as Experiment 1 was used, except the verbal stimuli, which were given to the participants in English. Here, MP comparatives without an overt standard phrase were used as stimulus sentences.

Appendix E. Experiment 4: MP comparatives with an overt standard phrase in English and Japanese

The same experimental design as Experiments 1 and 3 was used. The only difference between the previous experiments and Experiment 4 was in the target sentences. Experiment 4 used MP comparatives with an overt standard phrase as

stimulus sentences.

Appendix F. Experiment 5: Conjunctive interpretation

This experiment used the same experimental methodology as Task 1 in Experiments 1, 3, and 4. In addition to the three types of trials used in the previous experiments, this experiment used a new trial type: Absolute-shorter trials. We used three versions of tests with different order of items. Below is the list of stimuli. To Japanese participants, all the stimuli were given in Japanese.

ver. 1

	Type	Subject	Standard	Correct response	Stimuli
1	Diff	3	1	TRUE	The gorilla is 2 chipanis taller than the fox.
2	Abs-taller	3	1	FALSE	The turtle is 3 chipanis taller than the tiger.
3	Neu	3	1	FALSE	The rhino is 1 chipani taller than the goat.
4	Abs-shorter	1	2	FALSE	The rat is 1 chipani taller than the cat.
5	Diff	3	2	TRUE	The bear is 1 chipani taller than the chick.
6	Abs-taller	3	2	FALSE	The penguin is 3 chipanis taller than the frog.
7	Neu	3	2	FALSE	The pig is 2 chipanis taller than the raccoon.

8	Abs-shorter	1	3	FALSE	The rabbit is 1 chipani taller than the panda.
9	Diff	2	1	TRUE	The crocodile is 1 chipani taller than the bird.
10	Abs-taller	2	1	FALSE	The hippo is 2 chipanis taller than the koala.
11	Neu	2	1	FALSE	The elephant is 1 chipanis taller than the owl.
12	Abs-shorter	2	3	FALSE	The cat is 2 chipanis taller than the polar bear.

ver. 2

1	2	3	4	5	6	7	8	9	10	11	12
Abs taller	Neu	Abs Shorter	Diff	Abs taller	Neu	Abs Shorter	Diff	Abs taller	Neu	Abs Shorter	Diff

ver. 3

1	2	3	4	5	6	7	8	9	10	11	12
Neu	Abs-shorter	Diff	Abs-taller	Neu	Abs-shorter	Diff	Abs-taller	Neu	Abs-shorter	Diff	Abs-taller

Appendix G. Experiment 6: Understanding the difference

Task 1 is a version of the TVJT, serving as a control for Task 2. Task 2, on the other hand, used act-out tasks. I used two versions of tests with different order of items. In filler items, participants were asked to do the separating subtraction. Below is the list of stimuli, which were given to the participants in Japanese.

ver. 1

	Type	Sbj	Stnd	Correct response	Stimuli
1	Task 1 Neu	3	1	FALSE	Experimenter: Here are a kitty and a doggy! Let's give them some candies. Which has more? Pikachu: The dog! Experimenter: Right! The dog has more cadies. Then, Pikachu, **how many more candies does the dog have?** Pikachu: **1!**
2	Task 1 Diff	3	1	TRUE	2
3	Task 1 Abs	2	1	FALSE	2
4	Task2	2	1	Give the standard animal (the tiger) 1 candy/ Remove 1 candy from the subject animal (the lion)	Experimenter: Here are a lion and a tiger. Let's give them some candies. Which has more? Pikachu: The lion! Experimenter: Right! The lion has more candies. I feel sorry for the tiger, because he has less candies. Then, (the participant's name), **can you arrange for them to have the same number of candies?**
5	Filler	3	2	1	How many cookies did the rabbit eat?

6	Task 1 Neu	3	1	FALSE	1
7	Task 1 Diff	3	1	TURE	2
8	Task 1 Abs	2	1	FALSE	2
9	Task 2	3	1	Give the standard animal 2 candies/ Remove 2 candies from the subject animal	Can you arrange for them to have the same number of apples?
10	Filler	2	1	1	How many cookies did the bear eat?
11	Task 1 Neu	3	1	FALSE	1
12	Task 1 Diff	3	1	TURE	2
13	Task 1 Abs	2	1	FALSE	2
14	Task 2	3	2	Give the standard animal 1 candy/ Remove 1 candy from the subject animal	Can you arrange for them to have the same number of apples?
15	Filler	3	1	2	How many cookies did the lion eat?