論　文

Multihead Comparatives in Japanese*

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1. Introduction

A type of comparative construction such as the one below is called a multihead comparative. It contains more than one comparative head *-er*（or *more*）in one sentence.

（1）**More** dogs ate **more** rats than cats ate mice.　　（Stechow 1984）

As far as I know, there exists little discussion on this construction in the literature. This is partly due to the marginal status of such sentences. Some accept（1）, while many claim that it is not sensible. von Stechow states that the above sentence is a combination of two comparisons. However, Hendriks（1992）points out that the interpretations of the multiple comparisons involved in the sentence are mutually independent; thus, the sentence cannot have proper truth conditions.

Unlike English, an equivalent sentence in Japanese is much less controversial and seems to have truth conditions. Interestingly, the *yorimo*（than）-clause in Japanese can include concrete numbers, making it easier for native speakers to provide grammatical judgments.

（2）［**san-biki**-no　neko-ga　**yon-hiki**-no　hatukanezumi-o
　　three-CL-gen　cat-nom　**four-CL**-gen　mouse-acc
　tabeta　yorimo］（motto）　takusanno inu-ga　（motto）　takusanno
　ate　“than”　（more）　many　dog-nom　（more）　many
　dobunezumi-o　tabeta.
　rat-acc　ate
　Lit. “More dogs ate more rats than **three** cats ate **four** mice.”

The goal of this paper is to show that Japanese multihead comparatives such as（2）are semantically well formed. I will argue that the difference between（1）and（2）arises from the

lexical entries of adjectives in each language. I will adopt a format of gradable adjectives in Japanese that is suggested in Beck et al. (2004), where a gradable adjective such as *nagai* (long) is derived from the lexicon as a comparison. (3) denotes that x has a length that exceeds the contextually given length c. In other words, "long" in Japanese actually means "longer."

(3) $[[nagai]] = \lambda x.\max(\lambda d.\text{long}(d)(x)) > c$ (Beck et al. 2004)

This unconventional assumption with regard to gradable adjectives is the key to understanding multiheaded comparatives in Japanese. Importantly, such lexical entries of gradable adjectives imply that each adjective results in one comparison. If so, there should be multiple comparisons when a sentence contains multiple gradable adjectives. This is the case in (2): There are two instances of *takusanno* (many) in (2), and each one results in a comparison as it denotes "more." Thus, there are two comparisons accommodated simultaneously in the sentence. In other words, multihead comparatives such as (2) are evidence for the suggestion by Beck et al. (2004) that adjectives in Japanese are comparatives per se.

This paper is organized as follows. Section 2 reviews previous discussions on multihead comparatives in English and Dutch. Hendriks (1992) classifies multihead comparatives into two groups, namely, multihead comparatives with sentence-internal comparisons and multihead comparatives with discourse comparisons. She argues that the former cannot have well-formed truth conditions, while the latter have sensible interpretations. On the other hand, Meier (2001) argues that what Hendriks calls sentence-internal comparisons do have proper semantics. The argument is not settled down yet. Section 3 introduces the tools that we need in order to analyze multihead comparatives in Japanese. Beck et al. (2004) argue that *yori* comparatives in Japanese differ from standard *more-than* comparatives in English and other languages. Unlike *than*-clauses in English, *yorimo* (than) -clauses do not denote sets of degrees. Rather, they denote sets of individuals, from which standard degrees of comparisons are pragmatically inferred. Oda (2006) further supports the absence of sets of degrees in *yorimo* (than) -clauses by showing that degrees can overtly appear in *yorimo*-clauses, since the degree positions are not abstracted over. Section 4 analyzes multihead comparatives in Japanese. With the lexical entries of Japanese adjectives suggested by Beck et al., the grammatical status of multihead comparatives in Japanese is expected: Japanese adjectives are comparatives per se. Thus, there are as many comparisons as the number of adjectives in a sentence. I will further show that multihead comparatives in Japanese are considered as multi-head comparatives with discourse comparisons in Hendriks's classification. Section 5 contains some concluding remarks.

2. Multihead comparatives in English and Dutch

In this section, I will discuss the contrasting views of Hendriks（1992）and Meier（2001）on von Stechow's sentence in（1）. Hendriks argues that the sentence does not have proper truth conditions, while Meier states that it has some sensible interpretation. This reflects the controversial grammatical status of the sentence. The issue has not yet been resolved, and in this paper, I will support neither side. However, the arguments of Hendriks（1992）and Meier（2001）provide insight on what makes multihead comparatives possible/impossible.

2.1 von Stechow（1984）

I will first summarize von Stechow's（1984）analysis of his example that is repeated below. Importantly, the comparative morpheme *more* occurs twice in the sentence. There has been some disagreement with regard to the acceptability of this sentence. Some speakers have no problems with the sentence, whereas others find it ungrammatical.

（4）**More** dogs ate **more** rats than cats ate mice.　　（Stechow 1984）

Suppose it is grammatical. If so, what is the intuitive interpretation of the sentence? von Stechow shows the truth conditions of the sentence（in its most easily available reading）as follows. It is a coordination of two comparisons.

（5）The number of dogs that ate rats is greater than the number of cats that ate mice, and the number of rats that were eaten by dogs is greater than the number of mice that were eaten by cats.

The above intuitive paraphrase can be a little more formally represented as follows. I follow von Stechow（1984）, Heim（2000）, and others and assume that a comparative operator takes two sets of degrees and maps them to a larger-than relation. The maximality operator applies to a set of degrees and selects the largest degree of the set. The sentence is a combination of two comparisons that are made using the comparative operators *more* twice.

（6）$[[\text{-er}(\text{more})]] = \lambda D_{\langle d,t\rangle} \lambda D'_{\langle d,t\rangle}.\max(D') > \max(D)$

（7）Let S be a set ordered by $\leq$. Then, $\max(S) = \iota s[s \in S \ \& \ \forall s' \in S\ [s' \leq s]]$

(8) max(λd.d-many dogs ate rats) > max(λd.d-many cats ate mice) ∧
max(λd.dogs ate d-many rats) > max(λd.cats ate d-many mice)

von Stechow also points out that (4) does not have the reading in (9). This reading would be satisfied if there were more rat-eating dogs than mouse-eating cats. However, this comparison is too weak when we consider a model where there are three dogs and they eat the same rat (they share it), and one cat eats two mice. (9) would predict that the sentence is true; however, it is intuitively false.

(9) The number of those 〈x,y〉 such that x is a dog and y is a rat and x ate y is greater than the number of those 〈z,w〉 such that z is a cat and w is a mouse and z ate w.

In summary, von Stechow basically argues that a multiheaded comparative sentence is simply a combination of two comparative sentences and can be analyzed on a par with normal comparatives.

2. 2 Multihead comparatives with sentence-internal comparisons

Hendriks (1992) investigates the matter in more detail and proposes to divide multihead comparatives into two types. She argues that multihead comparatives of one of the two types do not have truth conditions, while those of the other type have proper meanings.

She discusses an example similar to (1) in Dutch. (10) contains two comparative operators, *meer* (more) and the suffix *-er*. Hendriks claims that the sentence is uninterpretable. Thus, it does not have the conjunction reading in (11), contrary to what von Stechow would claim.

(10) (uninterpretable)

?**Meer**	deuren	zijn	hog**er**	dan	ramen	breed	zijn.
more	doors	are	high**er**	than	windows	wide	are

(Hendriks 1992 : 109)

(11) The number of doors that are high is greater than the number of windows that are wide, and the height of doors is greater than the width of windows.

Hendriks points out that the sentence becomes acceptable and interpretable if one of the comparative operators is omitted. This suggests that only one comparison is allowed in a comparative sentence.

Based on the observation in Dutch, Hendriks claims that von Stechow's descriptions in (5) are not correct truth conditions of the sentence. Instead, she argues that it involves "infinite regress"; thus, no semantics is available. The same explanation holds for the Dutch example in (10).

The problem of infinite regress is described as follows. In (1), the number of dogs is compared to the number of cats. The dogs and cats in the example are not just dogs and cats in general; rather, they are a subset of dogs and cats. The dogs must eat more rats than mice that are eaten by particular cats, not just cats in general. Then, we need to know the set of cats in order to define the set of dogs. The particular cats have the ability to eat fewer mice than rats that are eaten by particular dogs, not just dogs in general. Then, we need to know the set of particular dogs in order to define the set of cats. Therefore, the interpretations of the dogs and cats end up being mutually dependent.

(12) The number of [dogs that ate more rats than the catsj ate mice]$_i$ is greater than the number of [cats that ate fewer mice than the dogsi ate rats]$_j$.

(Hendriks 1992 : 117)

The Dutch example runs into the same problem. Hendriks provides the most likely interpretation of the sentence as follows (brackets and indices are added by the author).

(13) The number of [doors that are higher than the windows$_j$ are wide]$_i$ is greater than the number of [windows that are less wide than the doors$_i$ are high]$_j$.

Hendriks refers to the problem of mutual dependency of this sentence as follows: The doors in this comparison have the property of being higher (not high!) …… The height of the doors is compared to the width of the windows…… These windows also distinguish themselves through a certain property. They are less wide than the doors are high. However, these doors are not doors in general but the subset of doors mentioned in the first part of the truth conditions. Similarly, the windows that are mentioned in the first part of the truth conditions refer to the subset of windows as defined in the second part of the truth conditions, and not windows in general (Hendriks 1992 : 115). Owing to this mutual dependency, a precise semantics of this

construction would involve infinite regress.

The problem of mutual dependency of two comparisons is also confirmed in multihead comparatives with nonidentical comparative morphemes.（14）has two different comparative operators, *fewer* and *more*, and it sounds even more awkward than（1）.

（14）?? Fewer dogs ate more rats than cats ate mice.

If the two comparisons made by *fewer* and *more* are independent of each other, the grammatical status would be the same as in（1）. The marginal status of（14）indicates that the two comparisons are somehow related to each other.

Hendriks calls this type of multihead comparatives "multiple sentence-internal comparison." This term is derived from the nature of the comparisons, where the standard of comparison is found within the sentence. Normal *more-than* comparatives such as *John is taller than Mary* fall under this category. Since multiple sentence-internal comparatives are uninterpretable, the following generalization must hold.

（15）Comparatives may contain at most one instance of sentence-internal comparison.（Hendriks 1992 : 113）

In other words, a *than*-clause can contain at most one compared element. This is tested by investigating the possibility of Comparative Deletion（Hendriks 1994）. A compared item in a *than*-clause can be optionally deleted. In the following examples, the blanks indicate the deleted elements.

（16）a. Mary has written more books than John has read _____.
b. More students steal bikes than ____ buy bikes.

When there are two comparative operators in a sentence, its *than*-clause cannot have two Comparative Deletions.

（17）a. *More people have read more books than ____ have written _____
b. *More students steal more bikes than _____ buy _____.

In summary, we have reviewed Hendriks's claim that a sentence-internal comparative sen-

tence allows only one instance of comparison. The next subsection discusses another type of multihead comparatives that are not a subject of the generalization.

2. 3　Multihead comparatives with discourse comparisons

Hendriks points out that there is another type of multihead comparison that involves "discourse comparisons." A brief definition of the discourse comparative is mentioned in Rayner and Banks（1990）.

（18）（Discourse comparisons are the ones）where the associated comparative complement（in English normally introduced by "than" or "as"）is completely absent, and must be inferred from the context.（Rayner and Banks 1990 : 101）

They also point out that the missing *than*-clause is likely to be understood as "than previously," "than the one just mentioned," "than in the case," and the like. An example of single discourse comparison is provided below.

（19）Het begon **harder** te regenen.［Dutch］
it started **harder** to rain（Hendriks 1992 : 111）

The comparison is made between the present state and a previous state. The missing *than*-clause is likely to be interpreted as "than previously." Hendriks argues that discourse comparisons are involved when multihead comparatives are well formed.

Let us consider some examples. The example in（20）has two comparative operators, ***meer***（**more**）and the suffix ***-er*** in ***mooier***（**prettier**）. At least one of them must be an instance of discourse comparison, if we follow Hendriks's abovementioned generalization that a comparative sentence may contain at most one instance of sentence-internal comparison.

（20）John maakte **meer** mensen **mooier** dan ik dacht
John made **more** people **prettier** than I thought
dat hij zou doen.
that he would do（Hendriks 1992 : 110）

Hendriks argues that ***mooier***（**prettier**）is an instance of discourse comparison. This can be

seen in the more spelled out *dan*-clause in (21), where ***mooier*** (**prettier**) appears overtly. (21) has the same meaning as (20), and this is surprising because the ***mooier*** (**prettier**) in the *dan*-clause is again modified by the same comparative suffix ***-er*** as the one in the matrix clause. This implies that ***mooier*** (**prettier**) is not a structurally compared item. The *dan*-clause is used for ***meer*** (**more**) because it requires the presence of this clause.

(21) John maakte meer mensen mooier dan ik dacht
John made more people prettier than I thought
dat hij mensen **mooier** zou maken.
that he people **prettier** would make (Hendriks 1992 : 110)

The difference between the two comparisons can be further confirmed in the following set of sentences. They are made using the matrix clause in (20). Rather unusually, (22) a with the adjective ***mooier*** (**prettier**) is acceptable. It is a discourse comparison, and it can be uttered without the *dan*-clause. On the other hand, (22) b sounds awkward because it requires the *dan*-clause.

(22) a. John maakt mensen **mooier**.
John makes people **prettier**
b. ?John maakt **meer** mensen mooi.
John makes **more** people pretty (Hendriks 1992 : 112)

Let us consider another example of a multihead comparative provided below, where the two comparisons are both discourse comparisons. It has two comparative morphemes, *less* and *more*, and it is grammatically correct without any *dan*-clause.

(23) Steeds **minder** land levert steeds **meer** mais op.
ever **less** land produces ever **more** corn pres.
(Hendriks 1992 : 113)

The comparisons are made with discourse. The most likely interpretations would be comparisons with previous years.

In summary, the behaviors of discourse comparisons differ from sentence-internal comparisons. They do not require overt *than*-clauses (*dan*-clauses in Dutch). A standard of com-

parison is provided from a given discourse.

2. 4　Multihead comparatives with split antecedents

Hendriks considers the fact that the grammatical status of the sentence in（1）is very marginal and denies the earlier mentioned truth conditions that are repeated below. For Hendriks, there is no well-formed semantics for the sentence because of the problem of infinite regress, as discussed in the previous subsection.

（24）The number of dogs that ate rats is greater than the number of cats that ate mice, and the number of rats that were eaten by dogs is greater than the number of mice that were eaten by cats.

Meier（2001）, however, considers the fact that some people accept the sentences, and for those people, the above truth conditions are valid. This subsection reviews Meier（2001）and discusses how the（possible）truth conditions in（1）are derived.

Meier cites Chomsky's（1981）example in（25）, which he calls a case of "split antecedent" : The extraposed *than*-clause is associated with both the bracketed expressions.

（25）［More silly lectures］have been given by［more boring professors］than I would have expected.　（Chomsky 1981 : 81）

This implies that there is a duplication of the *than*-clause in semantics, and each *than*-clause is associated with one comparative morpheme. Meier assumes that the process of the reconstruction of the extraposed *than*-clause can be captured as an instance of syntactic lowering.

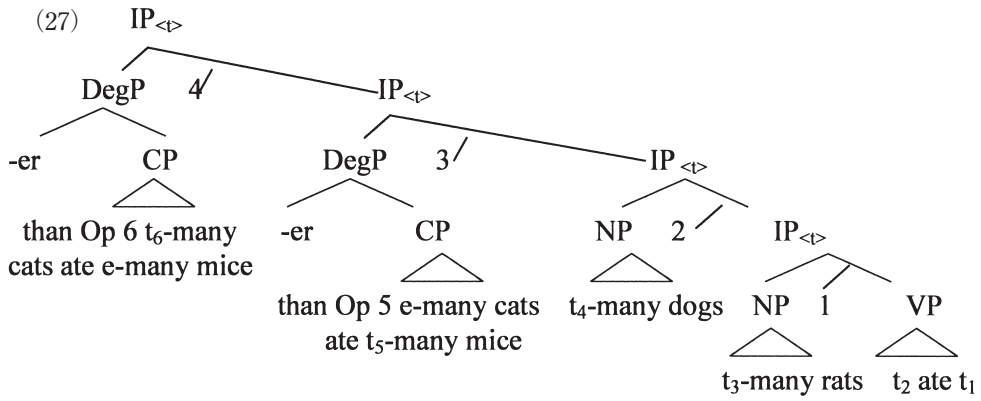
Applied to von Stechow's example, each comparative morpheme has a *than*-clause in LF.

（26）More dogs［than cats ate mice］ate more rats［than cats ate mice］.

The LF structure is given below（slightly modified）[1)]: The subject and the NPs undergo movement for type mismatch and adjoin to type〈t〉nodes. DegPs undergo degree movement, and each comparative morpheme *-er* has a *than*-clause in its complement. Two comparisons reside within one tree. The larger comparison compares the number of cats and the number of dogs. The smaller comparison compares the number of mice and the number of rats, and this com-

parison is included in the second argument of the larger comparison.

(27)



Each comparative morpheme takes two sets of degrees as shown below. Importantly, the degree arguments in the reconstructed *than*-clauses are existentially bound unless they are bound by a lambda operator. In other words, the numbers of mice and cats are somewhat contextually determined when they are not being compared (indicated in bold). This is how the problem of infinite regress is avoided.

(28) -er($\lambda d_6.\exists$**d**[d_6-many cats ate **d-many mice**])(λd_4.-er($\lambda d_5.\exists$**d**[**d-many cats** ate d_5-many mice]))($\lambda d_3.d_4$-many dogs ate d_3-many rats)

The following truth conditions are derived from the above structure (slightly modified)[2].

(29) max(λd_4.max (λd_3. d_4-many dogs ate d_3-many rats)$>d_5$)$>d_6$,
where:
d_5 = the maximal d_5: $\exists$d[d-many cats ate d_5-many mice] and
d_6 = the maximal d_6: $\exists$d[d_6-many cats ate d-many mice]

In a familiar larger-than relationship with two maximal degrees, the truth conditions can be stated as follows.

(30) **max**(λd_4.max($\lambda d_3.d_4$-many dogs ate d_3-many rats)$>$max($\lambda d_5.\exists$d[d-many cats ate d_5-many mice]))$>$**max**($\lambda d_6.\exists$d[d_6-many cats ate d-many mice])

On summarizing the discussion on von Stechow's example, the situation remains unclear. Hendriks discusses the possible ungrammatical reading, whereas Meier presents the possible grammatical reading[3]. This confusion seems to reflect the controversial grammatical status of multihead comparatives. It is not easy to argue for any side unless we have more clear grammatical judgments. However, Meier's truth conditions suggest something very important: the problem of infinite regress can be avoided when certain standard degrees are existentially fixed. Bearing this in mind, in the next section, let us turn to multihead comparatives in Japanese where grammatical judgments are more solid than in English.

3. Japanese comparatives

This section reviews previous researches that provide tools to analyze multihead comparatives in Japanese. More specifically, I will introduce the analysis of the Japanese comparatives proposed by Beck et al.（2004）as well as a piece of evidence for their analysis that is presented in Oda（2006）. The semantics of Japanese comparatives is different from that of English and related languages, which makes a difference when multihead comparatives are constructed.

3. 1　Contextual comparatives: Beck et al.（2004）

Beck et al.（2004）claim that Japanese comparatives cannot be analyzed by the English-based standard analysis of comparatives and propose an alternative framework. Given below is an example of Japanese comparatives, which appears to be similar to *John read more papers than Mary did* in English.

（31）John-wa　［Mary-ga　yonda　　yorimo］ookuno ronbun-o yonda.
　　John-top　Mary-nom read　　"than"　more　paper-acc read
　　"John read more papers than Mary did."

Beck et al., however, observe some differences between Japanese comparatives and English comparatives. For instance, subcomparatives are not available in Japanese, as mentioned in Snyder（1995）.

(32) *Tana-wa [doa-ga hiroi yorimo] takai.
shelf-top door-nom wide "than" tall
"The shelf is taller than the door is wide."

Beck et al. assume that *yorimo*—the standard translation of which is *than*—resembles *compared* to in English, which takes an NP-like element[4]. This is because the *yorimo*-clause in (31) has a gap in the object position. Further, the clause contributes a set of individuals to which a maximality operator can be applied (cf. Jacobsen 1995). It denotes the maximal items that Mary read. Thus, the clause receives a free relative-like interpretation and roughly corresponds to "what Mary read" in English.

(33) *yorimo*-clause:
a. Mary-ga e yonda
b. λx. Mary read x
c. max (λx. Mary read x)

Notably, the *yorimo*-clause does not directly provide the number of papers that Mary read. *Yorimo* is a "context setter" and provides the maximal items that Mary read. The number of papers that Mary read is pragmatically inferred from the items that she read, and it provides the value of *c*, i.e., the comparison degree in the context. Thus, a more precise translation of the sentence is shown in (35): "Compared to what Mary read, John read more papers."

(34) Matrix clause:
∃d[John read d-many papers & d>c]
c = the number provided in the utterance context

(35) For (31):
Compared to what Mary read, John read more papers.

Now, the ungrammatical subcomparative sentence in (32) is accounted for. The ungrammatical status is due to the fact that the embedded clause *doa-ga hiroi* (the door is wide) cannot contribute a set of individuals in the *yorimo*-clause. Without any gap of individual argument, the only option for the clause to contribute a set of individuals is to be interpreted as an internally headed relative clause (IHRC). However, IHRCs are subject to many restrictions, and a

well-formed IHRC cannot be constructed from *doa-ga hiroi*, as demonstrated by the following ungrammatical sentence.（*No* is a nominalizer.）

（36）*John-wa［doa$_i$-ga hiroi no$_i$］-o aketa.
John-top door-nom wide NO-acc opened
“John opened the wide door.”

Moreover, a paraphrase with “compared to” does not work for（32）either. This implies that the *yorimo*-clause is not effective as a context setter.

（37）?Compared to the wide door, the shelf is tall.

Therefore, the ungrammatical status of（32）stems from the ill-formed *yorimo*-clause as a context setter.

Beck et al. do not assume degree movement in the matrix clause either. Therefore, the degree argument in the matrix degree in（34）is existentially bound. Beck et al. investigated some scope data to examine whether degree movement is involved in the matrix clause of comparatives. Their results showed no concrete evidence for degree movement. For instance, compare the following data in English and Japanese.

（38）（That draft is 10 pages.）（Heim 2000）
The paper is required to be exactly 5 pages longer than that.

（39）（Sono sitagaki-wa 10 peeji desu.）（Beck et al. 2004）
（That draft-top 10 pages Cop）
Sono ronbun-wa sore yorimo tyoodo 5 peeji
that paper-top that “than” exactly 5 pages
nagaku-nakerebanaranai.
long-be_required
“The paper is required to be exactly 5 pages longer than that.”

According to Heim（2000）, the English data shows ambiguity, as shown below.

(40) a. required[[exactly 5 pp. -er than that]the paper be t long]
$\forall w \in Acc: \max\{d: long_w(p,d)\} = 15pp$
b. [exactly 5 pp. -er than that][required[the paper be t long]]
$\max\{d: \forall w \in Acc: long_w(p,d)\} = 15pp$ (Heim 2000 : 48)

Importantly, the reading (40) wherein the *5 pages longer than that* takes wide scope over the intentional verb *required* is available. In the case of Japanese, however, such a reading is missing. It has only one reading that corresponds to (40) a, where *nakerebanaranai* (to be required) takes a wide scope. Thus, the paper needs to be exactly 15 pages in any case. This indicates that degree movement in the matrix clause is missing in the example. If this is the case, the lack of degree movement should apply to all the comparative examples.

In summary, the crucial difference between English and Japanese comparatives is that the former is a genuine degree construction, while the latter is not. English comparatives are made by a rigid comparison of two sets of degrees, whereas Japanese comparatives do not involve degree movement, and the comparisons are made by pragmatic inference.

In order to account for the lack of degree movement in Japanese, Beck et al. suggest several possibilities. They first propose a parameter that governs the presence/absence of abstraction over degrees in syntax. The absence of degree movement in Japanese is explained if we assume the negative setting of the parameter in Japanese.

(41) Degree Abstraction Parameter (DAP)
A language {does/does not} have binding of degree variable in the syntax.

They also suggest an alternative analysis in their footnote. It is possible to assume that the degree arguments in Japanese adjectives are bound inside the lexical entries, and adjectives arise from the lexicon as comparatives. The idea can be represented either as (42) or as (42). The differential degree is existentially bound in the former, whereas it is bound by a lambda operator in the latter.

(42) a. $[[takai]] = \lambda x.\max(\lambda d.tall(d)(x)) > c$
b. $[[takai]] = \lambda d'\lambda x.\max(\lambda d.tall(d)(x)) = c + d'$

These lexical entries account for the lack of degree movement in Japanese as well. The direct degree *d* is already bound inside adjectives and cannot move. Another motivation for such

lexical entries comes from adjective sentences with measure phrases, such as the following. The English counterpart, *That shelf is 2 cm tall*, is meaningless, as it is normally impossible to have a bookshelf with a height of 2 cm. The Japanese sentence, however, implies that the shelf is 2 cm taller than something.

(43) Sono hondana-wa 2 senti takai.
that shelf-top 2 cm tall
"That shelf is 2 cm taller (than something)."

The interpretation is straightforwardly accounted for if we assume the lexical entries in (42) b. The measure phrase *2 cm* is plugged into the position that denotes the difference between a direct degree *d* and a contextually given standard degree *c*.

(44) [[takai]] = λd'λx.max(λd.tall(d)(x)) = c + d'
[[2cm takai]] = λx.max(λd.tall(d)(x)) = c + 2 cm
[[sono hondana-wa 2 cm takai]] = max(λd.tall(d)(this shelf)) = c + 2 cm

In this paper, I will adopt the lexical entries suggested in (42). They will play a crucial role in accounting for multihead comparatives in Japanese.

3.2 Overt degree

We have reviewed Beck et al.'s (2004) analysis of Japanese comparatives where a *yorimo*-clause denotes a set of individuals and serves as a context setter. Oda (2006) presents evidence for such an analysis of the *yorimo*-clause. She points out that the *yorimo*-clause allows overt degrees. In the example below, the *yorimo*-clause has an overt degree *san* (three). *Bon* is a classifier (CL) to count the number of papers.

(45) John-wa [Mary-ga e **san-bon** yonda yorimo]
John-top Mary-nom (paper) **three-CL** read "than"
ookuno ronbun-o yonda.
more papers-acc read
Lit. "John read more papers than Mary did **three**."

The equivalent English sentence in (46) is ungrammatical, because the degree argument in the *than*-clause must be bound by a degree operator. Thus, the position cannot be overtly filled. This is shown in the grammatically correct example in (47).

(46) *John read more papers than Mary did **three**.

(47) a. John read more papers than Mary did.
b. John read more papers than [**Op**$_i$ [Mary read **t**$_i$-many papers]
c. [[**Op**$_i$ Mary read **t**$_i$-many papers]] = λd. Mary read d-many papers

The contrast between English and Japanese is naturally accounted for if we follow Beck et al.'s assumption of *yorimo*-clauses as sets of individuals. To see the point, consider the following sentence with an IHRC. The head noun *no* is coindexed with *ronbun* (paper). The IHRC denotes "the paper she read."

(48) Mary-wa [(pro) ronbun$_i$-o yonda no$_i$] -o matometa.
Mary-top paper-acc read NO-acc summarized
"Mary summarized the papers she read."

Now, consider the following sentence that is minimally different from the above sentence in that it contains the measure phrase *san bon* (three CL). The head noun *no* is coindexed with *san-bon-no ronbun* (three papers). The IHRC denotes "the three papers she read."

(48) with the overt measure phrase *san-bon* (3-CL).

(49) Mary-wa [(pro) [**san-bon-no** ronbun-o]$_i$ yonda no$_i$] -o
Mary-top [[**three-CL-gen**. paper-acc] read NO]-acc
summarized.
summarized.
"Mary summarized the **three** papers she read."

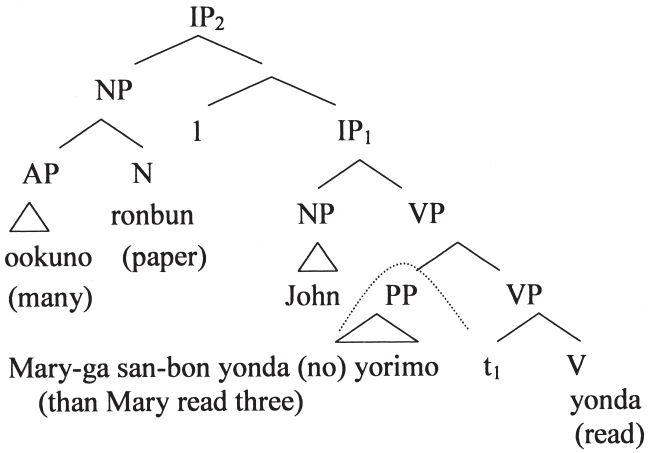
Beck et al.'s analysis of *yorimo*-clauses predicts that the IHRC can appear in *yorimo* clauses. This is borne out.

（50）John-wa［Mary-ga　san-bon-no　ronbun-o　yonda　（no）yorimo］
John-top Mary-nom　three-CL-gen　paper-acc read　（NO）“than”
ookuno ronbun-o　yonda.
more　papers-acc　read
Lit. “John read more papers than Mary did three papers.”

However, *ronbun*（paper）in the *yorimo*-clause sounds redundant because the matrix clause also contains it. Thus, the sentence sounds better without *ronbun* in the *yorimo*-clause, as in（45）. In（45）, there is a gap in the object position, which is bound by a *lambda* operator.

Let us consider the semantics of the sentence. I will discuss the main clause first and then the *yorimo*-clause. In the LF structure, the object undergoes movement due to type mismatch and adjoins to IP. The *yorimo*-clause is adjoined to VP; however, it is not included in the truth conditional calculation. It denotes sets of degrees to help infer the standard degree. PP is a context setter, and it is excluded from the truth conditional calculation（as indicated by the dotted line）.

（51）LF structure of（45）:



Let us consider the truth conditional calculation. Importantly, the adjective *ookuno*（many）already has the semantics of comparison. Thus, it takes two sets of individuals and denotes that the cardinal of the intersection is more than a contextually given degree. In plain English, the truth conditions amount to saying “John read more papers.”

(52) $[[\textit{ookuno}]] = \lambda p_{\langle e,t\rangle}\lambda q_{\langle e,t\rangle}.|\lambda x.p(x) \wedge q(x)| > c$

(53) Main clause:

$[[V]] = [[\textit{yonda}]] = \lambda y \lambda x.\text{read}(y)(x)$

$[[VP]] = [[t_1\ \textit{yonda}]] = \lambda x.\text{read}(g(1))(x)$

$[[IP_1]] = \text{read}(g(1))(J)$

$[[1\ IP_1]] = \lambda y.\ \text{read}(y)(J)$

$[[N]] = [[\textit{ronbun}]] = \lambda y.\text{paper}(y)$

$[[\textit{ookuno}]] = \lambda p_{\langle e,t\rangle}\lambda q_{\langle e,t\rangle}.|\lambda x.p(x) \wedge q(x)| > c$

$[[NP]] = [[\textit{ookuno ronbun}]] = \lambda q.|\lambda x.\text{paper}(x) \wedge q(x)| > c$

$[[IP_2]] = 1$ iff $|\lambda x.\text{paper}(x) \wedge \text{read}(x)(J)| > c$, where c is a contextually given degree.

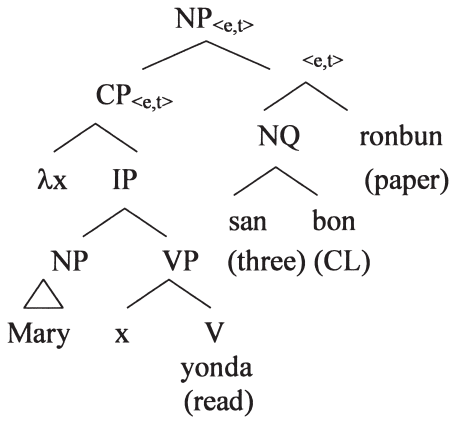
"the cardinal of the paper John read exceeds a contextually given number."

Let us turn to the semantics of the *yorimo*-clause. *Yorimo* (than) is understood as something similar to "compared to." As for the structure of the complement of *yorimo*, I take advantage of the intuitive interpretation that the optional head nominalizer *no* is coindexed with *san-satu-no ronbun* (three papers). Thus, (54) and (54) are intuitively the same. The object position is empty and it is bound by a lambda operator. As a result, the NP complement of *yorimo* denotes a set of three papers that Mary read.

(54) a. John-wa [Mary-ga [san-bon-no ronbun-o]$_i$ yonda(no$_i$) yorimo]
John-top Mary-nom [three-CL-gen paper-acc] read(NO) "than"
ookuno ronbun-o yonda.
more papers-acc read

b. John-wa [Mary-ga e yonda [san-bon-no ronbun] yorimo]
John-top [Mary-nom read [three-CL-gen paper] "than"]
ookuno ronbun-o yonda.
more papers-acc read
Lit. "John read more papers than Mary did three papers."

(55)



(56) $[[CL]] = \lambda d.\lambda p_{\langle e,t\rangle}\lambda x.p(x) \wedge |x| = d$

$[[san\ CL]] = \lambda p_{\langle e,t\rangle}\lambda x.p(x) \wedge |x| = 3$

$[[ronbun]] = \lambda x.\ paper(x)$

$[[NQ\ ronbun]]] = \lambda x.paper(x) \wedge |x| = 3$

$[[CP]] = \lambda x.read(x)(M)$

$[[NP]] = \lambda x.paper(x) \wedge |x| = 3 \wedge read(x)(M)$

Apply a maximality operator:

$[[NP]] = max(\lambda x.paper(x) \wedge |x| = 3 \wedge read(x)(M))$

"three papers that Mary read"

On the basis of "the three papers Mary read" denoted by the *yorimo*-clause, the standard of comparison for the matrix clause is pragmatically inferred as three. Combining the semantics of the matrix clause and the *yorimo*-clause, the whole sentence means "compared to the three books Mary read, John read more books." This captures the intuition correctly.

4. Multihead comparatives in Japanese

This section discusses multihead comparatives in Japanese. I will show that multihead constructions are well formed in Japanese. The fact is understood naturally if we follow our assumption: Japanese comparisons are discourse (contextual) comparisons, and multihead discourse comparisons are possible, as Hendriks argues. A common thread shared between Japanese comparisons and discourse comparisons in Dutch is that they both lack composition-

ally provided standards of comparison. In other words, they do not come with obligatory *than*-clauses. Their standards of comparisons arise from a given discourse (context).

I would like to begin the discussion with the equivalent of (1) in Japanese, which is given in (57). This is grammatical and its grammatical status seems much less controversial than (1). Note that the *yorimo*-clause is scrambled to the sentence-initial position, since it is much easier to comprehend the sentence in this manner. Without the scrambling of the *yorimo*-clause, the sentence is a little difficult to comprehend and its grammatical status could be as marginal as its English counterpart. This is shown in (58).

(57) [Neko-ga hatukanezumi-o tabeta yorimo]$_i$ (motto) takusan-no inu-ga
cat-nom mouse-acc ate "than" ("more") many-gen dog-nom
t_i (motto) takusan-no dobunezumi-o tabeta.
(more) many-gen rat-acc ate
"More dogs ate more rats than cats ate mice."

(58) ?(Motto) takusn-no inu-ga [neko-ga hatukanezumi-o tabeta yorimo]
("more") many-gen dog-nom cat-nom mouse-acc ate "than"
(motto) takusan-no dobunezumi-o tabeta.
("more") many-gen rat-acc ate
"More dogs ate more rats than cats ate mice."

What is the intuitive meaning of (57)? Let us first test the truth conditions by von Stechow for the English equivalent that are denied by Hendriks.

(59) The number of dogs that ate rats is greater than the number of cats that ate mice, and the number of rats that were eaten by dogs is greater than the number of mice that were eaten by cats.

It would be fair to say that the sentence sounds true; however, the conditions are not adequately precise. The comparison between dogs and cats seems to be solid: We counted the number of dogs that participated in rat-eating events and the number of cats that were involved in mouse-eating events. However, the comparison between rats and mice sounds ambiguous: It at least needs to be clarified whether we are counting the number of rats that are eaten by a single dog or the total number of rats eaten by any of the dogs.

Let us now consider the reading that von Stechow claims is missing in the English sentence by repeating the semantics. This reading would be satisfied if we have more rat-eating dogs than mouse-eating cats.

(60) The number of those 〈x,y〉 such that x is a dog and y is a rat and x ate y is greater than the number of those 〈z,w〉 such that z is a cat and w is a mouse and z ate w.

These are not the correct truth conditions either. The problem is the same as we saw in the case of English. The conditions are too weak: If there are three dogs sharing one rat and one cat eats two mice, it satisfies the conditions; however, the sentence is intuitively false.

What can we do to deal with the unclear interpretation of the sentence? Fortunately, there is a unique way of making it easier for native speakers to understand the meaning of the sentence in Japanese: Overt cardinal numbers can be added in the *yorimo*-clause, as we saw in Section 3. 2. With the overt numbers in the *yorimo*-clause, the sentence can be paraphrased in English as "compared to three cats eating four mice, more dogs ate more rats."

(61) [**san-biki**-no neko-ga **yon-hiki**-no hatukanezumi-o
three-CL-gen cat-nom **four-CL**-gen mouse-acc
tabeta yorimo] (motto) takusanno inu-ga (motto) takusanno
ate "than" (more) many dog-nom (more) many
dobunezumi-o tabeta.
rat-acc ate
Lit. "More dogs ate more rats than **three** cats ate **four** mice."
(Compared to three cats eating four mice, more dogs ate more rats.)

The number of cats and rats are now fixed. In this case, the sentence implies that there are more than three dogs and more than four rats. However, this is still ambiguous at least in two ways—namely, distributive and cumulative.

In order to disambiguate the sentence, *sorezore* (each) can be added in the *yori* and matrix clauses. This eliminates the possibility of a cumulative reading, and the sentence only has a distributive reading. A paraphrase in English "compared to three cats eating four mice each, more dogs ate more cats each" would reflect the intuitive meaning.

(62) [**San-biki**-no neko-ga **sorezore** **yon-hiki**-no hatukanezumi-o

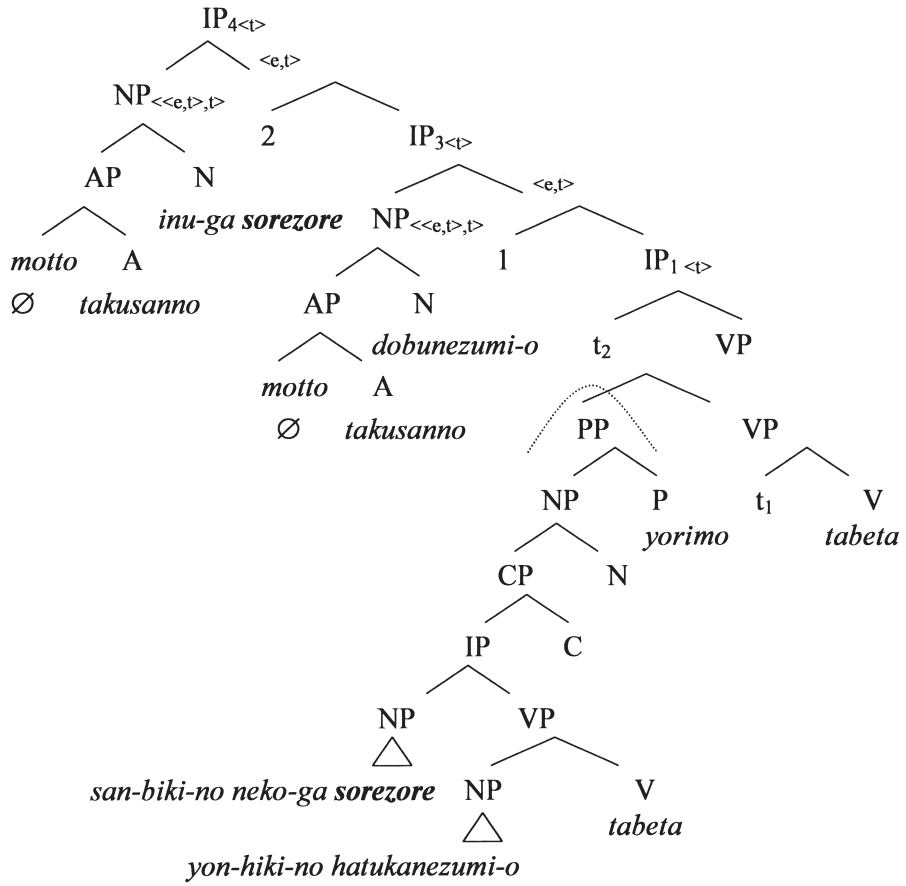
three-CL-gen cat-nom **each** **four-CL**-gen mouse-acc
tabeta yorimo］(motto) takusanno inu-ga **sorezore** (motto)
ate "than" (more) many dog-nom **each** (more)
takusanno dobunezumi-o tabeta.
many rat-acc ate
Lit. "More dogs ate more rats **each** than **three** cats ate **four** mice each."
(Compared to three cats eating four mice each, more dogs ate more cats.)

Now, we are ready to present an intuitive paraphrase of the sentence.

(63) There are three cats and each of them ate four mice. There are more than three dogs and each of them ate more than three rats.

The LF structure of (62) is provided below. The *yorimo*-clause is adjoined to VP, and it is excluded from the truth conditional calculation (as indicated by a dotted line). The two arguments of *tabeta* (ate) are type ⟨⟨e,t⟩,t⟩, and they undergo QR and adjoin to IP.

(64)



Let us compositionally calculate the truth condition. Crucially, the lexical entry of *takusanno* (many) denotes a comparison: It implies that a cardinal of the intersection of two propositions is more than a contextually given number, c. *Takusanno* (many) appears twice in the sentence, and thus, there are two contextually given standard numbers. The *yorimo*-clause provides them concrete values—namely, three for the number of cats, and four for the number of mice.

(65) $[[takusanno(\text{many})]] = \lambda p_{\langle e,t\rangle}\lambda q_{\langle e,t\rangle}.|\lambda x.p(x) \wedge q(x)| > c$

(66) Main clause:

$[[tabeta(\text{ate})]] = \lambda y\lambda x.\text{ate}(y)(x)$

$[[IP_1]] = \text{ate}(g(1))(g(2))$

$[[1\ IP_1]] = \lambda y.ate(y)(g(2))$

$[[takusanno\ (many)]] = \lambda p \lambda q.|\lambda x.p(x) \wedge q(x)| > c$

$[[takusanno\ dobunezumi\ (many\ rats)]] = \lambda q.|\lambda y.rat(y) \wedge q(y)| > c$

$[[IP_3]] = |\lambda y.rat(y) \wedge ate(y)(g(2))| > c$

$[[2\ IP_3]] = \lambda x.|\lambda y.rat(y) \wedge ate(y)(x)| > c$

$[[takusanno\ inu\ (many\ dogs)]] = \lambda q.|\lambda x.dog(x) \wedge q(x)| > c$

$[[IP_4]] = |\lambda x.dog(x) \wedge |\lambda y.rat(y) \wedge ate(y)(x)| > c_{mice}| > c_{cats}$

$c_{cats} := 3$

$c_{mice} := 4$

"The cardinal of x such that x is a dog and x ate more than four y such that y is a rat exceeds 3."

Notice that the problem of infinite regress never occurs in Japanese since the degree of matrix clauses and standard degrees are not mutually dependent. The values of standard degrees are fixed. This is what we have observed in Meier's argument. The difference between Meier's case and our case is that the standard degrees can be overtly mentioned in Japanese.

What is the denotation of the *yorimo*-clause? The problem is that there is only one *yorimo*-clause in the sentence; however, we need to infer two degrees from the single *yorimo*-clause. This problem can be solved by assuming that the *yorimo*-clause can be interpreted ambiguously, either as a set of cats or a set of mice depending on the context. (67) indicates a set of cats, and (67) indicates a set of mice[5].

(67) *Yorimo*-clause

a. λx. x is a cat and three x ate four mice

b. λy. y is a mouse and three cats ate four y

In order to confirm the truth conditions, I will consider three models. In all of them, the numbers of cats and mice are fixed to three and four, respectively. Consider Model 1. There are four dogs and each of them ate more than four rats (in other words, at least five). The truth conditions are satisfied, and the sentence is judged true under the model.

(68) Model 1: (62) is **true**.

Cat_1–4 mice Dog_1–5 rats

Cat_2–4 mice	Dog_2–6 rats
Cat_3–4 mice	Dog_3–7 rats
	Dog_4–8 rats

Consider Model 2. There are four dogs, but one of them did not eat a single rat. The truth conditions are not satisfied because they only include dogs that ate mice. Only three dogs satisfied the requirement. Since we need at least four dogs that ate rats, the sentence is expected to be judged false, and it is intuitively false.

（69）Model 2：（62）is **false**

Cat_1–4 mice	**Dog_1–0 rats**
Cat_2–4 mice	Dog_2–5 rats
Cat_3–4 mice	Dog_3–6 rats
	Dog_4–7 rats

Consider Model 3. There are four dogs; one of them ate only two rats, and the rest of the dogs ate more than four rats. Since the truth condition requires each dog to eat more than four rats, the sentence is expected to be judged false, and it is intuitively false.

（70）Model 3：（62）is **false**

Cat_1–4 mice	**Dog_1–2 rats**
Cat_2–4 mice	Dog_2–5 rats
Cat_3–4 mice	Dog_3–6 rats
	Dog_4–7 rats

In summary, all of the three models discussed above confirm the truth conditions of（62）that are presented at the end of（66）.

We have observed that what appears to be an expression similar to（1）in Japanese is interpretable. Multihead comparatives in Japanese are not what Hendriks calls multiple sentence-internal comparisons. Rather, they are similar to multihead discourse comparisons that can occur more than once in a sentence. Hence, multihead comparatives in Japanese are free from the problem of infinite regress that makes the English sentence in（1）uninterpretable. This is because the denotation of the *yorimo*-clause does not depend on the semantics of the matrix clause. It is determined independently from the matrix clause. This becomes rather clear when

the *yorimo*-clauses have concrete degrees, as shown in (62). The interpretation of the matrix clause is determined on the basis of a given value from the *yorimo*-clause.

In order to confirm our argument, let us consider one more example of multihead comparatives in Japanese. We predict that a sentence similar to (20) in Japanese should allow both "more people" and "prettier" in its *yorimo*-clause, because Japanese comparisons are not sentence-internal comparisons and are basically discourse comparisons, which we call contextual comparisons. This is borne out. The following example has a *yorimo*-clause, where *ookuno* (many) and *utukusiku* (pretty) appear overtly. They do not have any visible comparative morpheme, but they denote "more" and "prettier" by their lexical entries. Note that the *yorimo*-clause is scrambled to the sentence-initial position. Further, the complement clause of *omotteita* (was thinking) is scrambled within the *yorimo*-clause. The sentence is easy to comprehend with this word order.

(71) [[Kare-ga **ookuno** **hito-o** **utukusiku**-sita-daroo-to]$_j$
[[he-nom **mamy** **people-acc** **pretty**-made-would-that]
watasi-ga t_j omotteita yorimo]$_i$ John-ga t_i
I-nom was_thinking "than"] John-nom
motto ookuno hito-o motto utukusiku-sita.
"more" many people "more" pretty-made
Lit. "John made more people prettier than I was thinking that he would make more people prettier."

The denotations for the adjectives "many" and "prettier" would make the point clearer.

(72) a. $[[\textit{ookuno}(\text{many})]] = \lambda p \lambda q.|\lambda x.p(x) \wedge q(x)| > c$
b. $[[\textit{utukusiku}(\text{pretty})]] = \lambda x.\max(\lambda d.\text{pretty}(d)(x)) > c$

I conclude that the Japanese versions of (1) are interpretable and that their semantics is accounted for with Japanese-style adjectives that have comparative semantics. The parallel behaviors between the Japanese data and what Hendriks calls discourse comparisons support our analysis that Japanese comparisons are made contextually rather than compositionally. Importantly, such contextual comparison is brought by each adjective. Thus, when there are two adjectives in a sentence, there reside two comparisons in the sentence.

5. Conclusion

In this paper, I have proposed the semantics of multihead comparatives in Japanese. The intuitive interpretations of multihead comparatives in Japanese are accounted for by assuming the lexical entries of Japanese adjectives that already have comparative semantics when they come out of the lexicon. Japanese adjectives are inherently comparatives and make a comparison with a contextually given degree. Therefore, multihead comparatives in Japanese are clarified as what Hendriks（1992）calls multihead discourse comparisons. This implies that multihead comparatives in Japanese are not a subject of the infinite regress that multihead sentence-internal comparatives in English and Dutch involve. Nevertheless, multihead comparatives are complicated; thus, native speakers may or may not be able to understand them very easily. Overt degrees in *yorimo*-clauses assist in their comprehension. When there are no overt numbers, *yorimo*-clauses will be understood with "some" numbers.

The uncontroversial grammatical status of multihead comparatives in Japanese supports the semantics of Japanese adjectives proposed in Beck et al. It may also supports Hendriks's view indirectly: The contrast between English and Japanese data is captured if we assume that the former involves infinite regress, whereas the latter does not. For those who accept（1）, Meier's truth conditions would be relevant. This implies that if（1）is grammatical in any case, it is so for the same reason that the Japanese data is: Standard degrees are not dependent on matrix degrees.

Notes

*I would like to thank Sigrid Beck and Yael Sharvit for variable comments and suggestions. Any remaining error is mine. This work was supported by Tokyo Keizai University, Grant #C07−04, 2007.

1）Meier's original notation is provided below. She lets the DegPs and NPs adjoin to the CP.
（i）[CP[DegP2 -er[CP than4 e4 many cats ate e many mice]]4[CP[DegP1 -er[CP than3 e many cats ate e3 many mice]]3[CP1[NP2 t4 many dogs]2[CP[NP1 t3 many rats]1…
[VP t2 ate t1]]]]]

2）Meier's original notation is provided below.
（i）[the max n:[the max m: n-many dogs ate m-many rats＞m^*]＞n^*],
where:
m^* = the maximal m^*: ∃d[d-many cats ate m^*-many mice]and
n^* = the maximal n^*: ∃d[n^*-many cats ate d-many mice].

3）Hendriks and Meier discuss why von Stechow's example is sometimes grammatical or ungrammatical, contrary to their arguments. However, neither of their discussions sounds plausible

enough.

Hendriks（1994）assumes two possible reasons why（1）can sometimes be judged to be grammatical:（A）The sentence can be understood as a comparison of a rat-eating event by dogs and a mouse-eating event by cats. However, Hendriks herself admits that this would provide a wrong prediction（see the rat-sharing case by dogs in Section 2. 1）.（B）The second occurrence of more is vacuous. However, this would imply that（1）means the same as *More dogs ate rats than cats ate mice*. This is intuitively not very convincing.

Meier admits the fact that the grammatical status of the sentence is controversial; however, it is as grammatical as other multihead comparative sentences. Moreover, Meier points out that Hendriks's *fewer-more* example（14）is marginal because of contextual flow. She presents a similar sentence that is much more acceptable and argues that multihead comparative sentences are possible.

（i）Last time, fewer boys ate more pizzas than girls ate candies.

4）For this reason, I have placed the gloss "than," the translation of *yorimo*, in quotes throughout the paper.

5）Marques（2006）has a similar idea for dealing with multiheaded comparative sentences in Portuguese. There are two *mais*（more）in（i）, whereas there is only one clausal clause to be compared. Marques assumes that two compared items can be derived from one clause by assuming that the relative pronoun *que*（what）links two variables as in（ii）, so that the *than*-clause identifies the number of countries that sent soldiers to Iraq and also the number of soldiers that were sent.

（i）

Este	ano,	**mais**	paises	enviaram	**mais**	solados	para
this	year	more	countries	sent	more	soldiers	to
o	Iraque		do que	em	qualquer	outra	altura.
the	Iraq		of-the what	at	any	other	time

"This year, more countries sent more soldiers to Iraq than any other time."

（ii）

que$_{ij}$	~~x_i~~	~~paises~~	~~enviaram~~	~~y_j~~	~~soldados~~	~~para o~~	
what	~~x_i~~	~~counties~~	~~sent~~	~~y_j~~	~~soldiers~~	~~to the~~	
~~Iraque~~	em	qualquer	outra	altura.			
Iraq	at	any	other	time			

References

Beck, Sigrid, Toshiko Oda and Koji Sugisaki（2004）"Comparative constructions in Japanese and English," *Journal of East Asian Linguistics* 13 : 289–344.

Chomsky, Noam（1981）*Lectures on Government and Binding*. Dordrecht: Foris Publications.

Heim, Irene and Angelika Kratzer（1998）*Semantics in Generative Grammar*. Blackwell, MA.

Heim, Irene（2000）"Degree Operator and Scope," *Proceedings of SALT X*, 40–64.

Hendriks, Petra（1992）"Multiple Comparison," *Language and Cognition* 2, 107–118.

Jacobsen, Pauline（1995）On the Quantificational Force of English Free Relatives. In *Quantification in Natural Languages*, eds. Emmon Back, Eloise Jelinek, Angelika Kratzer and Barbara H. Partee,

451–486. Dordrecht: Kluwer.

Hendriks, Petra（1994）"Multi Head Comparison and Infinite Regress," In J. Nevis & V. Samiian（eds.）, *Proceedings of WECOL* 1992, vol. 5. Fresno: California State University, 117–131.

Hendriks, Petra and Helen de Hoop（2001）"Opitimality Theoretic Semantics," *Linguistics and Philosophy* 24 : 1, 1–32.

Meier, Cécile（2001）"Multihead comparatives and result clause constructions with 'split antecedents'." Audiatur Vox Sapientiae. A Festschrift for Arnim von Stechow. Eds. Caroline Féry and-Wolfgang Sternefeld. Berlin: Akademie-Verlag. 348–371.

Marques, Rui（2006）"Multi-headed comparatives in Portuguese," *Journal of Portuguese Linguistics 5*, 5–35.

Oda, Toshiko（2006）"Overt Degree Arguments in Comparatives," *Proceedings of the 8th Seoul International Conference on Generative Grammar*: 213–228.

Rayner, M. and A. Banks（1990）"An Implementable Semantics for Comparative *Constructions," Comuputational Linguistics* 16. 2, 86–112.

Snyder, William（1995）*Language Acquisition and Language Variation: The Role of Morphology*, Ph. D. dissertation, MIT.

Stechow, Arnim von（1984）Comparing semantic theories of comparison. *Journal of Semantics* 3:1–77.