

Japanese Comparatives Are Semantically Conjuncts: A Dynamic View*

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Abstract This paper develops a differential-based semantics of comparatives, arguing that no generalized-quantifier-type degree operator is involved in Japanese comparatives, and the *yoru* ‘than’-clause introduces a degree variable, which is dynamically bound by the existential quantifier associated with a differential in the main clause. This approach accounts for the Japanese stacking comparative such as ‘A is fat(ter) than B is fat than C is fat(ter) than D is fat than E is fat(ter) than D is fat,’ meaning [the difference between A’s fatness and B’s fatness] > [the difference between C’s fatness and D’s fatness] > [the difference between E’s fatness and F’s fatness].

Keywords: comparison of differences, dynamic semantics, stacking comparatives

1 Introduction

In usual comparatives, degrees associated with individuals are compared, and the truth conditions of sentence *A is taller than B*, for instance, are: A’s height > B’s height, or there is a degree d such that A’s height = B’s height + d , where d denotes the difference between the two degrees.¹ Comparatives are also used to compare differences.

- (1) Mary swam as many more laps than Joan (swam) as Linda (swam).
(Bresnan 1973: 341)
- (2) John is (much) taller than Mary than Bill is. (Bhatt and Pancheva 2004: 4)

(1) means that Mary surpassed Joan in the number of swimming laps, and so did Linda, and the difference between the numbers of laps of Mary’s swimming and of Joan’s swimming was almost the same as the difference between the numbers of laps of Linda’s and Joan’s. Likewise (2) is interpreted as ‘John is taller than

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¹ Throughout the present paper, I use the function ‘+’ in a very naïve sense without giving a formal definition.

Mary and so is Bill, and the difference between John's height and Mary's height is greater than the difference between Bill's height and Mary's height.'

Japanese also has comparatives of differences.^{2,3}

- (3) [Chris-ga David-yori(mo) futot-tei-ru]-yori(mo), Andy-wa
 -NOM -than get.fat-PROG-PRES-than -TOP
 Bill-yori(mo) futot-tei-ru.
 -than get.fat-PROG-PRES
 'Andy is fatter than Bill, and Chris is fatter than David, and the difference between Andy's fatness and Bill's fatness is greater than the difference between Chris' fatness and David's fatness.'

The language has no comparative morpheme, and a simple comparative sentence like *A is fatter than B* is expressed as 'A is fat than B.' In (3), the embedded comparative clause 'Chris is fat than David' is headed by *yori(mo)* 'than' and adjoins to the matrix comparative. The whole sentence compares the extent to which Andy's fatness exceeds Bill's fatness with the extent to which Chris's fatness exceeds David's fatness.

Interestingly enough, another comparative clause can be adjoined to the em-

2 Almost certainly, *yori* and *yorimo* are allomorphs. In the present paper, *yori* is used, but *yorimo* is alternatively usable. The successive use of *yorimo* makes the sentence slightly degraded, however.

3 Instead of typical Japanese adjectives such as *taka(i)* 'tall/high', I use the verbal predicate *futot-tei*, where the root verb is *futo(r)* 'get.fat' and the progressive morpheme *-tei* denotes the result state, and the verbal complex means 'being fat.' The reason why I do not use typical adjectives is that they are difficult, if not completely impossible, to use in the complement position of *yori*. Incidentally note that Beck, Oda and Sugisaki (2004) argue with examples like (i) that Japanese lacks comparative subdeletion, and claim that the language does not have binding of degree variables in the syntax.

- (i) *Kono tana-wa [ano doa-ga hiro-i]-yori(mo) (motto) taka-i.
 this shelf-TOP that door-NOM wide-PRES-than more tall-PRES
 'This shelf is taller than that door is wide.' Beck, Oda and Sugisaki (2004: 290)

The ungrammaticality of (i) might be due to another factor, however, for if a verbal predicate is used instead, we can make a subdeletion sentence like (ii).

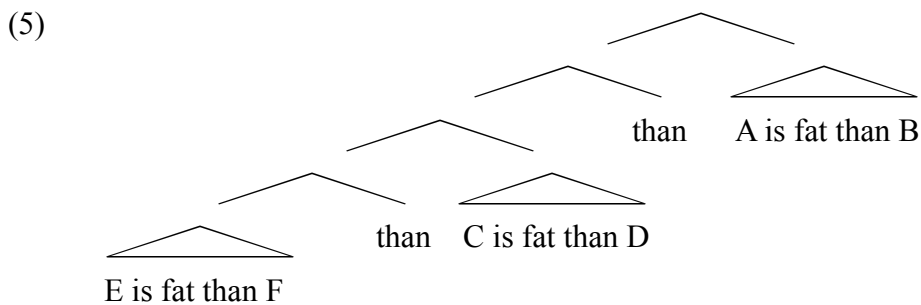
- (ii) ?Kono zubon-wa [John-ga futot-tei-ru]-yori zutto ooki-i.
 this trouser-TOP -NOM get.fat-PROG-PRES-than much big-PRES
 'This pair of trousers is much bigger than John is fat.'

As discussed in section 3, the present study is along the same line with Beck et al.'s approach in that Japanese has no degree operator movement in syntax, but it is not necessarily the reason of the ungrammaticality of (i). My tentative speculation is that the adjective-*yori* sequence is filtered out for some surface reason.

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bedded comparative clause as in (4), which is structured as in (5).⁴

- (4) [[Eric-ga Frank-yori futot-tei-ru]-yori, Chris-ga David-yori
 -NOM -than get.fat-PROG-PRES-than -NOM -than
 futot-tei-ru]-yori, Andy-wa Bill-yori futot-tei-ru.
 get.fat-PROG-PRES-than -TOP -than get.fat-PROG-PRES
 ‘[the difference between A’s fatness and B’s fatness] > [the difference
 between C’s fatness and D’s fatness] > [the difference between E’s fatness
 and F’s fatness]’



The sentence might sound strange, but it improves when the *yori* before *Andy* is stressed, followed by an intonation break. As the translation given in (4) shows, the sentence means that Andy, Chris, and Eric outweigh Bill, David, and Frank, respectively, and the difference between A’s fatness and B’s fatness is greater than the other two differences, and the difference between E’s fatness and F’s fatness is the least.

Stacking comparatives like (5) are impossible in English, as shown in (6), the intended interpretation of which is ‘A is taller than B, C is taller than B, D is taller than B, and the difference between A’s height and B’s height is greater than the difference between C’s height and B’s height, and the latter difference is greater than the difference between D’s height and B’s height.’

- (6) *A is (much) taller than B than C is than D is.

The immediate questions that arise are how stacking comparatives like (3) and (4) are computed, and why (6) is impossible.

In order to account for stacking comparatives like (3) and (4), I would like to

⁴ Structure (5) is not very precise. (4) contains the topic phrase ‘Andy-Topic’, which is generated above IP. The *yori* ‘than’-clause before *A*, thus, should be assumed to adjoin to the top-most IP/CP. Since the semantic contribution of the topic marker is ignored throughout this paper, this point is not important.

propose in section 3 that Japanese clausal comparatives are semantically conjuncts: the matrix and the embedded comparatives are combined by conjunction. It follows from this that the comparative-clause-stacking is recursively possible. I would also like to propose that clause-taking *yori* introduces a degree variable, which is, in the dynamic fashion, bound by the existential quantifier associated with a differential in the higher comparative clause. The ungrammaticality of English sentences like (6) is discussed in section 4, where following Heim's (2006) analysis that the comparative operator *-er* is a generalized quantifier, I would like to suggest that a structural parallel be required between the restrictive clause and the nuclear scope.

2 *Yori, izyooni* and their clausal complements

Japanese has two types of *than*: *yori* and *izyooni*, both of which can take either a phrasal or a clausal complement. Stacking comparatives like (3) and (4) are also possible with *izyooni*. Examples in (7) basically mean that Andy is fatter than Bill, but there is a difference between *izyooni* and *yori*. As Hayashishita (2007) points out, the truth of the complement of *izyooni* is entailed. In (7b) and (7d), that Bill is fat is entailed, while (7a) is interpreted just like the English counterpart.

- (7) a. Phrasal *yori*: no entailment.
 Andy-ga Bill-yori futot-tei-ru.
 -NOM -than get.fat-PROG-PRES
- b. Phrasal *izyooni*: That Bill is fat is entailed.
 Andy-ga Bill-izyooni futot-tei-ru.
 -NOM -than get.fat-PROG-PRES
- c. Clausal *yori*: That Bill is fat is entailed.
 [Bill-ga futot-tei-ru]-yori Andy-ga futot-tei-ru.
 -NOM get.fat-PROG-PRES-than -NOM get.fat-PROG-PRES
- d. Clausal *izyooni*: That Bill is fat is entailed.
 [Bill-ga futot-tei-ru]-izyooni Andy-ga futot-tei-ru.
 -NOM get.fat-PROG-PRES-than -NOM get.fat-PROG-PRES

Hayashishita (2007) analyzes the *izyooni* comparative as a case of comparative of deviation (COD) in the sense of Kennedy (2001), and (7b) and (7d) are paraphrased as 'Bill's fatness is greater than the contextually specified value *c*, and Andy's fatness is also greater than *c*, and the difference between Andy's fatness

and c is greater than the difference between Bill's and c .' Assuming that a phrasal complement is dealt with as clausal in LF, he defines the denotation of *izyooni* as $\lambda P_{\langle dt \rangle} \lambda Q_{\langle dt \rangle} (\text{Max}(Q) > \text{Max}(P))$, where P and Q are the set of degrees denoted by the embedded and the matrix clauses, respectively.

Interestingly, when *yoru* takes a clausal complement, the entailment that Bill is fat also obtains, as in (7c). This leads to the conclusion that the phrasal complement of *yoru* in (7a) is not derived from the clausal one in (7c) via deletion or the like.⁵ The fact that both (7c) and (7d) have the entailment suggests that the degree predicate in the clausal complement has the *pos*-head, which introduces the contextually specified standard, just like 'bare' degree expressions. Hayashishita's COD analysis thus can be extended to cases like (7c), but I will propose a different definition of clause-taking *yoru/izyooni*, since his definition cannot be used for stacking comparative examples.

3 A dynamic semantics for Japanese comparatives

3.1 Outline

Following Hayashishita's COD analysis, the truth conditions of the matrix and embedded clauses in (7c) are represented as in (8a) and (8b), respectively. (8a) states that there is a difference d_4 such that Andy's fatness is greater than the contextually specified value d_c by d_4 , and ditto with (8b).

- (8) a. matrix clause: $\exists d_4[\text{Andy's fatness} = d_c + d_4]$
 b. embedded clause: $\exists d_2[\text{Bill's fatness} = d_c + d_2]$

The truth conditions of (7c) that I would like to propose are (9), which is read as: Andy's fatness is greater than d_c by d_4 , and that difference, d_4 , is greater than the maximal value of the difference between Bill's fatness and d_c by d_3 .

- (9) $\exists d_4[\text{Andy's fatness} = d_c + d_4] \wedge$
 $\exists d_3[d_4 = \max(\lambda d_2[\text{Bill's fatness} = d_c + d_2]) + d_3]$

There are two important points here. First, (9) has a conjunction structure,

5 I do not discuss so-called reduced phrasal *yoru* as (i), where the complement of *yoru* is dative-marked. See Bhatt and Takahashi (2008) for relevant discussions.

(i) John-ga [Sue-ni]-yoru Mary-ni ooku-no hon-o age-ta.
 -NOM -DAT-than -DAT many-GEN book-ACC give-PAST
 'John gave more books to Mary than to Sue.'

where ‘[John’s fatness = $d_c + d_3$]’ and ‘[Mary’s fatness = $d_c + d_2$]’ correspond to the matrix and the embedded sentences, respectively. This amounts to saying that comparative clauses are conjuncts in semantics. Second, the semantics of *yoru* has a large contribution. Roughly, it translates into ‘ $\exists d_4[d_3 = \max(\dots) + d_4]$ ’, where a new differential d_4 is introduced. This means that whenever you use (clausal) *yoru*, you get a difference. The degree variable d_4 is bound by the existential quantifier associated with the matrix clause. This is guaranteed by assuming that *yoru* itself has an index. In this regard, *yoru* is anaphoric. Other necessary tools come from dynamic semantics, which will be given in the next subsection.

3.2 Formal devices and derivation

In this paper I assume, using Chierchia’s (1995) dynamic semantics, that dynamic binding applies to degree variables as well as individuals.⁶ Thus (10) holds (see Appendix for the definitions of symbols). I also assume that Japanese clausal comparatives are represented as conjuncts as in (11).

- (10) $\exists d[\uparrow\phi] \underline{\wedge} \uparrow\psi = \exists d[\uparrow\phi \underline{\wedge} \uparrow\psi]$
 (11) $\| [B]\text{-}yoru A \| \rightsquigarrow A \underline{\wedge} B$

Ignoring the compositional semantics of the verb and the progressive morpheme (see footnote 3), the gradable predicate *futotei* is assumed to translate into δ_{fat} of type $\langle e, d \rangle$.

3.2.1 Absolute constructions: A – d_c

As argued in von Stechow 1984, Klein 1991, and Kennedy 2007 among others, the contextually specified value of a standard of comparison is provided by the null morpheme *pos*. In the dynamic setting, I define *pos* as follows.

- (12) $\| pos_n \| =_{def} \lambda g \lambda x \exists d_n [\uparrow g(x) = d_c + d_n]$

The null morpheme *pos* is indexed, indicating the difference between the object’s degree and the standard.

With this, the truth conditions of the absolute sentence *Andy-ga futotteiru* ‘Andy is fat’ are represented as in (13), which is read: there is a differential

⁶ There are some precursors applying dynamic views to the semantics of degree expressions such as Barker 2002 and Brasoveanu 2008.

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degree d_2 such that Mary's fatness is greater than the contextually specified value d_c by d_2 .

(13) $\| \text{Andy-ga futotteiru-pos}_2 \| \rightsquigarrow \exists d_2 [\uparrow \delta_{\text{fat}}(a) = d_c + d_2]$

3.2.2. Phrasal comparatives: A – B

DP-taking *yor*i is defined as (14), and a comparative sentence like *Andy-ga Bill-yori futotteiru* 'Andy is fatter than Bill' is represented as in (15).⁷

(14) DP-taking *yor*i:
 $\| \text{yor}_n \| =_{\text{def}} \lambda y \lambda g \lambda x \exists d_n [\uparrow g(x) = g(y) + d_n]$

(15) $\| \text{Andy-ga Bill-yori}_2 \text{ futtoteiru} \| \rightsquigarrow \exists d_2 [\uparrow \delta_{\text{fat}}(a) = \delta_{\text{fat}}(b) + d_2]$

Like the definition of *pos*, the index on *yor*i indicates an existentially bound difference.

3.2.3. Clausal comparatives: (A – d_c) > (B – d_c)

Let us consider how the logical representation of (7c), repeated as (16), is derived.

(16) [Bill-ga futot-tei-ru]-yori Andy-ga futot-tei-ru.
 -NOM get.fat-PROG-PRES-than -NOM get.fat-PROG-PRES
 '(lit.) Andy is fat than Bill is fat.'

As defined in (17), clause-taking *yor*i introduces a degree discourse marker. The index m that the degree discourse marker bears is superscripted on *yor*i.

(17) Clause-taking *yor* _{n} ^{m} :
 $\| \text{yor}_n^m \| =_{\text{def}} \lambda P \exists d_n [\uparrow d_m = \max(\downarrow P) + d_n]$, d_m is a discourse marker of type d , and P is a set of degrees of type $\langle d, cc \rangle$.

The truth conditions of the embedded absolute expression in (16) are $\exists d_2 [\uparrow \delta_{\text{fat}}(a) = d_c + d_2]$ of type cc . This combines with *yor*i, but the function 'max' in (17) requires a dynamic version of a set of degrees of type $\langle d, cc \rangle$, so the embedded CCP must be shifted. This type shifting is carried out by Dekker's (1993)

7 The definition of the DP-taking *izyooni* should be different from (14) because of the presence of entailment. The entailment part is easily incorporated as in $\lambda y \lambda g \lambda x \exists d_n [\uparrow g(x) = g(y) + d_n \wedge \uparrow g(y) > d_c]$.

Existential Disclosure (ED) given in (18). The resulting representation (19) then combines with *yorī*, as in (20).

(18) Existential Disclosure (ED): For any discourse marker α_n and CCP A,
 $\lambda\alpha_n A = \lambda u[A \wedge \uparrow\alpha_n = u]$

(19) $\lambda d_2[\uparrow\delta_{\text{fat}}(\mathbf{b}) = d_c + d_2]$

(20) $\| [\text{Bill is fat}_2\text{]}\text{-yorī}^4 \| \rightsquigarrow \exists d_3[\uparrow d_4 = \max(\lambda d_2[\uparrow\delta_{\text{fat}}(\mathbf{b}) = d_c + d_2]) + d_3]$

The matrix clause of (16) translates just like (13), and conjoins with (20) by (11), as in (21). This is the dynamic version of (9).

(21) $\| [\text{Bill is fat-pos}_2\text{]}\text{-yorī}^4 \text{ Andy is fat-pos}_4 \| \rightsquigarrow$
 $\exists d_4[\uparrow\delta_{\text{fat}}(\mathbf{a}) = d_c + d_4] \wedge \exists d_3[\uparrow d_4 = \max(\lambda d_2[\uparrow\delta_{\text{fat}}(\mathbf{b}) = d_c + d_2]) + d_3]$
 $= \exists d_4 \exists d_3[\uparrow\delta_{\text{fat}}(\mathbf{a}) = d_c + d_4 \wedge \uparrow d_4 = \max(\lambda d_2[\uparrow\delta_{\text{fat}}(\mathbf{b}) = d_c + d_2]) + d_3]$

By dynamic bidding in (10), the degree variable d_4 in the second conjunct is dynamically bound by the existential quantifier associated with the difference between Andy's fatness and the standard value given in context.

A SALT 21 reviewer casts a doubt on the COD analysis like (21), for the truth conditions predict that (16) can be true in the context where Bill's actual weight exceeds Andy's since nothing guarantees that the matrix and subordinated clauses share the same standard value. I think this prediction is actually borne out, contrary to the reviewer's skepticism. Suppose that Andy is a 10-year-old boy and Bill is an adult man, and Bill is slightly fatter than the average adult man, but Andy's obesity is much greater than the average weight of boys of age 10. In this context, (16) can be felicitously uttered.

3.2.4. Stacking comparatives: $(A - d_c) > (B - d_c) > (C - d_c)$

Another absolute expression can be added to the embedded sentence in (16).⁸

⁸ When an intonation break is present before *Bill*, the two embedded clauses are interpreted as being juxtaposed, as '(lit.) Andy is fat [than Bill is fat] or [than Chris is fat].'

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- (22) [[Chris-ga futot-tei-ru]-yori [Bill-ga futot-tei-ru]]-yori
 -NOM get.fat-PROG-PRES-than -NOM get.fat-PROG-PRES-than
 Andy-ga futot-tei-ru.
 -NOM get.fat-PROG-PRES
 ‘(lit.) Andy is fat [than Bill is fat [than Chris is fat]].’

The sentence means that Andy is fatter than Bill and Bill is fatter than Chris, and they are all fat. The logical representation of (22) easily obtains by ED and dynamic binding, as illustrated in (23).

- (23) a. $\|$ [Chris is fat-*pos*₂]-yori⁴ Bill is fat-*pos*₄ $\| \rightsquigarrow$
 $\exists d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(b) = d_c + d_4 \wedge \uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = d_c + d_2]) + d_3]$
- b. ED applies to $\exists d_4$, the difference between Bill’s fatness and d_c .
 $\lambda d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(b) = d_c + d_4 \wedge \uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = d_c + d_2]) + d_3]$
- c. $\|$ [[Chris is fat-*pos*₂]-yori⁴ Bill is fat-*pos*₄]-yori⁶ $\| \rightsquigarrow$
 $\exists d_5 [\uparrow d_6 = \max(\lambda d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(b) = d_c + d_4 \wedge$
 $\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = d_c + d_2]) + d_3]) + d_5]$
- d. $\|$ [[Chris is fat-*pos*₂]-yori⁴ Bill is fat-*pos*₄]-yori⁶
 Andy is fat-*pos*₆ $\| \rightsquigarrow$
 $\exists d_6 \exists d_5 [\uparrow \delta_{\text{fat}}(a) = d_c + d_6 \wedge$
 $\uparrow d_6 = \max(\lambda d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(b) = d_c + d_4 \wedge$
 $\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = d_c + d_2]) + d_3]) + d_5]$

(23d) says that Andy’s fatness is greater than d_c by d_6 , and d_6 is greater than the maximal difference between Bill’s fatness and d_c . This amounts to saying that Andy is fatter than Bill. The relation between Bill’s and Chris’s fatnesses in the embedded clause is also represented in the same way in (23d).

3.2.5. Clausal comparatives: (A – B) > (C – D)

Now let us move to (3), repeated as (24), where both the matrix and the embedded clauses are comparatives.

- (24) [Chris-ga David-yori futot-tei-ru]-yori, Andy-wa
 -NOM -than get.fat-PROG-PRES-than -TOP
 Bill-yori futot-tei-ru.
 -than get.fat-PROG-PRES
 ‘(lit.) Andy is fat than Bill [than [Chris is fat than David]].’

The logical representation of (24) obtains through the following steps.

- (25) a. $\| \text{David-yori}_2 \text{ Chris is fat} \| \rightsquigarrow \exists d_2 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_2]$
 b. ED: $\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_2]$
 c. $\| [\text{David-yori}_2 \text{ Chris is fat}]\text{-yori}_3^4 \| \rightsquigarrow$
 $\exists d_3 [\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_2]) + d_3]$
 d. $\| \text{Bill-yori}_4 \text{ Andy is fat} \| \rightsquigarrow \exists d_4 [\uparrow \delta_{\text{fat}}(a) = \delta_{\text{fat}}(b) + d_4]$
 e. $\| [\text{David-yori}_2 \text{ Chris is fat}]\text{-yori}_3^4 \text{ [Bill-yori}_4 \text{ Andy is fat}] \| \rightsquigarrow$
 $(25d) \wedge (25c)$
 $= \exists d_4 [\uparrow \delta_{\text{fat}}(a) = \delta_{\text{fat}}(b) + d_4] \wedge$
 $\exists d_3 [\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_2]) + d_3]$
 $= \exists d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(a) = \delta_{\text{fat}}(b) + d_4 \wedge$
 $\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_2]) + d_3]$

First, as shown in 3.2.2, the comparative with DP-taking *yori* is represented as in (25a). To combine with clause-taking *yori*, ED applies, and then the resulting representation combines with the *yori* as in (23c). The matrix clause is also represented as in (25d). (25d) and (25c) are dynamically conjoined, yielding the final representation in (25e), which correctly states that the difference between Andy’s fatness and Bill’s fatness, d_4 , is greater than the maximal difference between Chris’s fatness and David’s fatness by d_3 .

3.2.6. Stacking comparatives: (A – B) > (C – D) > (E – F)

Recursive applications of ED and dynamic binding also derive logical representations of stacking comparatives like (4), repeated as (26).

Japanese comparatives are conjuncts

- (26) [[Eric-ga Frank-yori futot-tei-ru]-yori, Chris-ga David-yori
 -NOM -than get.fat-PROG-PRES-than -NOM -than
 futot-tei-ru]-yori, Andy-wa Bill-yori futot-tei-ru.
 get.fat-PROG-PRES-than -TOP -than get.fat-PROG-PRES
 ‘(lit.) Andy is fat than Bill [than [Chris is fat than David [than [Eric is fat
 than Frank]]]]’.

The embedded clausal comparative ‘Chris is fat than David [than [Eric is fat than Frank]]’ is processed in the same way as (24) is.

- (27) $\|$ [Frank-yori₂ Eric is fat]-yori₃⁴ [David-yori₄ Chris is fat] $\| \rightsquigarrow$
 $\exists d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_4 \wedge \uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(e) = \delta_{\text{fat}}(f) + d_2]) + d_3]$

The existential quantifier binding d_4 is wiped off by ED, and combines with clause-taking *yori*, resulting in (28a). As illustrated in (28c), this is dynamically conjoined with the matrix comparative ‘Andy is fat than Bill’ in (28b).

- (28) a. $\|$ [[Frank-yori₂ Eric is fat]-yori₃⁴ [David-yori₄ Chris is fat]]-yori₅⁶ $\|$
 $\rightsquigarrow \exists d_5 [\uparrow d_6 = \max(\lambda d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_4 \wedge$
 $\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(e) = \delta_{\text{fat}}(f) + d_2]) + d_3]) + d_5]$
- b. $\|$ Bill-yori₆ Andy is fat $\| \rightsquigarrow \exists d_6 [\uparrow \delta_{\text{fat}}(a) = \delta_{\text{fat}}(b) + d_6]$
- c. (28b) \wedge (28a)
 $= \exists d_6 \exists d_5 [\uparrow \delta_{\text{fat}}(a) = \delta_{\text{fat}}(b) + d_6 \wedge \uparrow d_6 = \max(\lambda d_4 \exists d_3 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_4$
 $\wedge \uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(e) = \delta_{\text{fat}}(f) + d_2]) + d_3]) + d_5]$

The differential variables d_2 , d_4 , and d_6 denote $(\delta_{\text{fat}}(e) - \delta_{\text{fat}}(f))$, $(\delta_{\text{fat}}(c) - \delta_{\text{fat}}(d))$ and $(\delta_{\text{fat}}(a) - \delta_{\text{fat}}(b))$, respectively, and d_6 is greater than d_4 , which is greater than d_2 . This correctly captures the interpretation of (26).

3.3. More complicated cases

Adding one more comparative to (26) gives us (29).

- (29) [Gale-ga Henry-yori futot-tei-ru]-yori,
 -NOM -than get.fat-PROG-PRES-than
 [Eric-ga Frank-yori futot-tei-ru]-yori,
 -NOM -than get.fat-PROG-PRES-than
 [Chris-ga David-yori futot-tei-ru]-yori,
 -NOM -than get.fat-PROG-PRES-than
 Andy-wa Bill-yori futot-tei-ru.
 -TOP -than get.fat-PROG-PRES

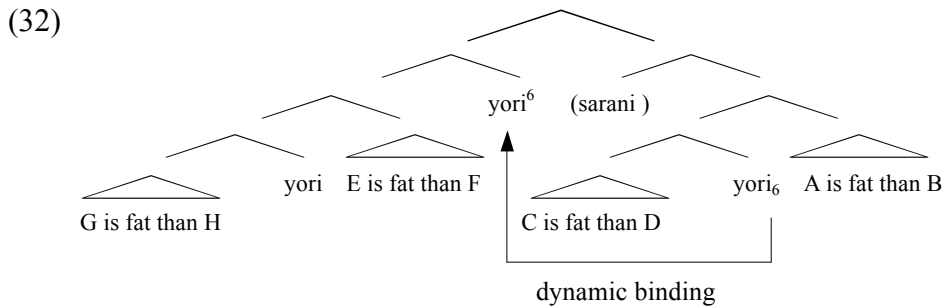
- (30) $(A - B) > (C - D) > (E - F) > (G - H)$

Interpretation (30) is possible with (29). This reading derives when the existential quantifier associated with the difference between $\delta_{fat}(a)$ and $\delta_{fat}(b)$ dynamically binds the degree discourse marker denoting the maximal difference between $\delta_{fat}(c)$ and $\delta_{fat}(d)$.

A SALT 21 reviewer asked whether (29) can have the interpretation in (31).

- (31) $((A - B) > (C - D)) > ((E - F) > (G - H))$

This interpretation is actually possible if the topic marker attaching to *Andy* is replaced with nominative *-ga*, and an intonation break takes place before *Chris*. Using an emphatic adverbial expression like *sarani* ‘furthermore, even’ before *Chris* makes this interpretation easier to get. The sentence is structured as in (32).



- (33) a. $\| [G \text{ is fat than } H]\text{-yori } E \text{ is fat than } F \| \sim\sim\sim$
 $\exists d_4 \exists d_3 [\uparrow \delta_{fat}(e) = \delta_{fat}(f) + d_4 \wedge$
 $\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{fat}(g) = \delta_{fat}(h) + d_2]) + d_3]$

- b. $\| [C \text{ is fat than } D]\text{-yori } A \text{ is fat than } B \| \rightsquigarrow$
 $\exists d_7 \exists d_6 [\uparrow \delta_{\text{fat}}(a) = \delta_{\text{fat}}(b) + d_7 \wedge$
 $\uparrow d_7 = \max(\lambda d_5 [\uparrow \delta_{\text{fat}}(c) = \delta_{\text{fat}}(d) + d_5]) + d_6]$
- c. ED to (33a):
 $\lambda d_3 \exists d_4 [\uparrow \delta_{\text{fat}}(e) = \delta_{\text{fat}}(f) + d_4 \wedge$
 $\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(g) = \delta_{\text{fat}}(h) + d_2]) + d_3]$
- d. $\| [(33c)]\text{-yori}^6 \| \rightsquigarrow$
 $\exists d_8 [\uparrow d_6 = \max(\lambda d_3 \exists d_4 [\uparrow \delta_{\text{fat}}(e) = \delta_{\text{fat}}(f) + d_4 \wedge$
 $\uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(g) = \delta_{\text{fat}}(h) + d_2]) + d_3]) + d_8]$
- e. (33b) \wedge (33d)
 $\exists d_8 \exists d_7 \exists d_6 [\uparrow \delta_{\text{fat}}(e) = \delta_{\text{fat}}(f) + d_7$
 $\wedge \uparrow d_7 = \max(\lambda d_5 [\uparrow \delta_{\text{fat}}(g) = \delta_{\text{fat}}(h) + d_5]) + d_6$
 $\wedge \uparrow d_6 = \max(\lambda d_3 \exists d_4 [\uparrow \delta_{\text{fat}}(e) = \delta_{\text{fat}}(f) + d_4$
 $\wedge \uparrow d_4 = \max(\lambda d_2 [\uparrow \delta_{\text{fat}}(g) = \delta_{\text{fat}}(h) + d_2]) + d_3]) + d_8]$

There is nothing new in translations (33a) and (33b) (see derivations in (25)). What is new here is ED. In the examples so far, ED applies to the existential quantifier associated with the matrix difference, like $\exists d_4$ or $\exists d_7$ in (34a, b). As in (33c), it applies to $\exists d_3$, the one associated with the difference between the matrix and the embedded clauses. The resulting representation then combines with *yori*⁶, which introduces discourse marker d_6 . (33d) means that d_6 is greater than the $\max((\delta_{\text{fat}}(e) - \delta_{\text{fat}}(f)) - (\delta_{\text{fat}}(g) - \delta_{\text{fat}}(h)))$ by d_8 . By dynamic binding, d_6 is bound by $\exists d_6$, which is introduced by *yori*₆, denoting a degree of $((\delta_{\text{fat}}(a) - \delta_{\text{fat}}(b)) - (\delta_{\text{fat}}(c) - \delta_{\text{fat}}(d)))$. So, interpretation $((A - B) > (C - D)) > ((E - F) > (G - H))$ derives by assuming nothing additional.

The fact that (32) has the reading in (33e) is very important, for it strongly suggests that dynamic binding actually works. In the examples in the previous subsections, free degree variables introduced by *yori* are bound by an existential quantifier in the higher clause. It might be argued, based on this fact, that those degree variables are pronominal and bound by c-commanding quantifiers. If so, it could be concluded that we do not have to adopt dynamic semantics. In (32), however, the position where a degree variable is introduced is clearly not c-commanded by the existential quantifier whose c-command domain is [Andy is fat than Bill than Chris is fat than David]. In other words, interpretations like (33e) suggest the necessity of a dynamic approach.

3.4. A speculation on difference-comparing comparatives in English

Another SALT 21 reviewer happened to point out an example like (34).

- (34) A is a greater extent more expensive than B than C is, than D is more expensive than E than F is.

The interpretation of this sentence is $((A - B) > (C - B)) > ((D - E) > (F - E))$, which is identical to interpretation (31) of example (29). Notice that this is a comparative denoting a difference of differences, but not a stacking comparative. As given in (6), repeated as (35), no stacking comparative is possible in English. The question is why (34) is fine while (35) is ungrammatical.

- (35) $(A - B) > (C - B) > (D - B)$
 *A is (much) taller than B than C is, than D is.

My speculation is this. In the Bresnan-Heim analysis (Heim 2006), the *-er* morpheme and the *than*-clause make a constituent and the former is analyzed as a generalized quantifier, where the complement of *than* serves as restriction. Here I suppose that there is an LF condition that the restriction and the nuclear scope of the *-er* operator must be structurally parallel at LF. Relevant LF structures are given in (36) to (39), and in all good cases the restrictions and the nuclear scopes share the same structure, while such a parallel does not hold in the stacking case in (38).

- (36) A is taller B is.
 -er (B is d-tall) (A is d-tall)
- (37) A is (much) taller than B than C is. $(A - B) > (C - D)$
 -er (-er (B is d-tall) (C is d-tall))
 (-er (B is d-tall) (A is d-tall))
- (38) LF of *(35) $(A - B) > (C - B) > (D - B)$
 -er
 (-er
 (-er (B is d-tall)(D is d-tall))
 (-er (B is d-tall)(C is d-tall))
 (-er (B is d-tall) (A is d-tall))

Japanese comparatives are conjuncts

- (39) LF of (34) $((A - B) > (C - B)) > ((D - E) > (F - E))$
 -er
 (-er
 (-er (E is d-expensive) (F is d-expensive))
 (-er (E is d-expensive) (D is d-expensive)))
 (-er
 (-er (B is d-expensive) (C is d-expensive))
 (-er (B is d-expensive) (A is d-expensive)))

Japanese comparatives have no generalized quantifier operator, so that such restriction does not apply.

4. Differential Numerals

Before concluding this paper, I would like to mention how to deal with differential numerals, as in (40) and (41).

- (40) Andy-ga 5kg futot-tei-ru.
 -NOM get.fat-PROG-PRES
 ‘Andy is 5 kg fatter than the contextually provided degree.’

- (41) Andy-ga Bill-yori 5kg futot-tei-ru.
 -NOM -than get.fat-PROG-PRES-
 ‘Andy is 5 kg fatter than Bill.’

There are several ways to go, and I would like to suggest two possibilities. One idea is that ED wipes off the existential quantifier binding the difference-denoting degree variable. In this case, movement of the numeral to the top of the sentence must be assumed. (40), for example, is computed as in (42).

- (42) a. 5 kg [Andy is fat-*pos*]
 b. 5kg [$\exists d_2[\uparrow\delta_{\text{fat}}(a) = d_c + d_2]$]
 c. 5kg [$\lambda d_2[\uparrow\delta_{\text{fat}}(a) = d_c + d_2]$]
 d. $\uparrow\delta_{\text{fat}}(a) = d_c + 5\text{kg}$

The other is to assume that difference-denoting numerals such as 5 kg are translated into a CCP containing a degree discourse marker, $\uparrow d_2 = 5 \text{ kg}$, via lexical translation rules, rather than type shifting such as $d \Rightarrow cc$. This CCP is dynamically conjoined to the matrix clause and then the discourse marker is bound by an existential quantifier, as in (43). I leave the choice open here.

$$(43) \exists d_2 [\uparrow \delta_{\text{fat}}(a) = d_c + d_2 \wedge \uparrow d_2 = 5 \text{ kg}]$$

5. Concluding remarks

To the best of my knowledge, the syntax/semantics of stacking comparatives has never been discussed, and in fact no language with stacking comparatives has been reported so far. In this paper, I showed that Japanese has stacking comparatives and their semantic properties are accounted for in the framework of dynamic semantics.

There is at least one serious problem in the present analysis, however. As extensively argued by Schwarzschild and Wilkinson 2002, Heim 2006, Gajawsky 2008, and Schwarzschild 2008 among others, the maximal operator in the *than*-clause does not provide the adequate value when QPs are involved in it. The definition of clausal *yor*i that I proposed also contains the max operator, so it should be revised somehow. Furthermore, I have noticed that besides the presence or absence of entailment, phrasal and clausal complements of *yor*i have different truth conditions when QPs are involved. (44a) and (44b) are minimal pairs with respect to the complement of *yor*i. The former is interpreted just like the English counterpart *Andy is fatter than most women (are)*. On the other hand, (44b) is interpreted as true only in the situation where most women are fat, and Andy is fatter than the fattest woman among those women.

- (44) a. [hotondo-no-josee]-yori Andy-ga futot-tei-ru.
 most-GEN-woman-than -NOM get.fat-PROG-PRES
 ‘Andy is fatter than most women.’
- b. [hotondo-no-josee-ga futot-tei-ru]-yori
 most-GEN-woman-NOM get.fat-PROG-PRES
 Andy-ga futot-tei-ru.
 -NOM get.fat-PROG-PRES
 ‘(lit.) Andy is fat than most women are fat.’

My definitions of DP-taking and clausal *yor*i’s do not work for either case. I leave this problem for future research.

Appendix

Definitions of dynamic semantics (Chierchia 1995)

Domains: For each type a , D_a are the denotations of entities of type a .

- a. $D_e = U_e$, where U_e is the domain of individuals.
- b. $D_t = \{0, 1\}$
- c. $D_d = U_d$, where U_d is the domain of degrees.
- d. $D_{\langle a, b \rangle} = D_b^{D_a}$
- e. $D_{\langle s, a \rangle} = D_a^\Omega$, where Ω is the set of all possible assignments to discourse markers.

Interpretation functions:

- a. $\| \wedge \alpha \|^{g, \omega} = \lambda \omega' \| \alpha \|^{g, \omega'}$
That is, $\| \wedge \alpha \|^{g, \omega}$ is that function h in D_a^Ω such that for any $\omega' \in \Omega$,
 $h(\omega') = \| \alpha \|^{g, \omega'}$
- b. $\| \vee \alpha \|^{g, \omega} = \| \alpha \|^{g, \omega}(\omega)$

Context Change Potentials (CCPs) : $\uparrow \phi = \lambda p[\phi \wedge \vee p]$ of type $cc = \langle \langle s, t \rangle, t \rangle$

Truth (the assertion operator \downarrow): $\downarrow A = A(\wedge T)$, where $\| \wedge T \|^{g, \omega} = \Omega$.

Dynamic conjunction and existential quantification:

- a. $A \underline{\wedge} B = \lambda p[A(B(\wedge p))]$
- b. $\underline{\exists} x A = \lambda p \exists x [A(p)]$

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