Decomposing Modal Superlatives[*]

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1.   Introduction

Gradable adjectives are usually assumed to denote relations between individuals and degrees, as (1) illustrates. They are treated as downward monotonic: e.g., if Maribel's exact height is 156cm, Maribel counts as 156cm tall, as 155cm tall, as 154cm tall, etc.

(1)   Maribel is 156 centimeters tall.

$$\text{IP} \qquad \text{tall}(m, 156cm)$$

NP   VP $\lambda x_e.\text{tall}(x, 156cm)$

m   *Maribel*   V   AdjP $\lambda x_e.\text{tall}(x, 156cm)$

is   DegP   Adj

156 centimeters   *tall*

156cm $\lambda d_d.\lambda x_e.\text{tall}(x, d)$

The comparative morpheme *-er* and the superlative morpheme *-est* operate on this degree argument. Intuitively, the comparative sentence in (2) is true iff John is tall to a degree to which Bill is not (Seuren 1973). The superlative sentence in (3) is true iff John is tall to a degree to which nobody else in the comparison class C is tall (Heim 1999).

(2)   John is tall**er** than Bill $\Leftrightarrow$ $\exists d\ [\text{tall}(j,d) \wedge \neg\text{tall}(b,d)]$ (Seuren 1973)

(3)   John is the tall**est** (in the comparison class C)   (Heim 1999)

$$\Leftrightarrow \quad \exists d [\text{ tall(j,d) } \& \ \forall z \in C [z \neq j \ \rightarrow \ \neg \text{tall(z,d)}]]$$

This paper is concerned with superlatives with modal modifiers like *possible, imaginable, conceivable*, etc., exemplified in (4)-(5). Next to their regular modifier reading in (4a)-(5a), these adjectives have an "as X as possible/imaginable/conceivable" reading (Corver 1997, Larson 2000, Schwarz 2005). This second reading, paraphrased in (4b)-(5b), will be called "modal superlative reading" and will be the focus of the paper.

(4)   I bought the larg<u>est</u> <u>possible</u> present.
        a. "Out of objects that were possible presents, I bought the largest one."
        b. "I bought as large a present as it was possible for me to buy."

(5)   I talked to the few<u>est</u> <u>possible</u> guests.
        a. "Out of the individuals that were possible guests, I talked to the fewest."
        b. "I talked to as few guests as it was possible for me to talk to."

Two interesting restrictions have been observed concerning the modal superlative reading. First, when *possible* is placed postnominally, only the modal superlative reading arises and the regular modifier reading lost (Larson 2000, Schwarz 2005): (6)-(7).

(6)   I bought the larg<u>est</u> present <u>possible</u>.
        a. * "Out of objects that were possible presents, I bought the largest one."
        b. "I bought as large a present as it was possible for me to buy."

(7)   I talked to the few<u>est</u> guests <u>possible</u>.
        a. * "Out of the individuals that were possible guests, I talked to the fewest."
        b. "I talked to as few guests as it was possible for me to talk to."

Second, for the modal superlative reading to arise with prenominal *possible*, the modal adjective has to be in a special local configuration with the superlative morpheme -*est* (Schwarz 2005). In German, each prenominal adjective must carry its own agreement inflection, with this exception: superlative adjectives followed by modal adjectives like *möglich* ('possible') can carry this inflection, as in (8), but do do not need to, as in (9). This choice correlates with semantic interpretation. Example (8) only has the regular modifier reading and example (9) only has the modal superlative reading. That is, for the modal superlative reading to arise, the superlative adjective and *möglich* ('possible') need to "share" the inflection suffix, as if the string was parsed as one complex noun modifier *[Adj+st möglich]+Infl* rather than as two independent adjectives.

(8)   Ich habe das größt.**e**   möglich.**e**   Geschenk gekauft.   (Schwarz 2005)
        I   have the largest.**Infl** possible.**Infl** present   bought
        'Out of the possible presents, I bought the largest one.'   REGULAR MODIFIER

(9)   Ich habe das größt   möglich.**e**   Geschenk gekauft.   (Schwarz 2005)
        I   have the largest   possible.**Infl** present   gekauft
        'I bought as large a present as it was possible for me to buy.' MODAL SUPERLATIVE

Locality between *-est* and prenominal *possible* is required in English too. In (10), the adjective *affordable* intervenes between *-est* and *possible,* and as a consequence the modal superlative reading (10b) is not available. In (11), the use of an analytic superlative makes *-est* and *possible* non-adjacent, and again the reading (11b) is lost.

(10)   I bought the larg*est* **affordable** <u>possible</u> present.   (Schwarz 2005)
            a. "Out of objects that were affordable possible presents, I bought the largest one."
            b. * "I bought as large an affordable present as it was possible for me to buy."

(11)   She rented the <u>most</u> **luxurious** <u>possible</u> car.   (Schwarz 2005)
            a. "Out of objects that were possible cars, she rented the most luxurious one."
            b. * "She rented as luxurious a car as it was possible for her to rent."

There are two main approaches to the modal superlative reading. The first one, due to Larson (2000), sets out to explain the first restriction and takes the source of this reading to be a postnominal reduced relative clause with an infinitival complement, as in (12). The infinitival clause can be optionally elided leaving an ACD gap, producing (6), and then the adjective can optionally be "promoted" to prenominal position, yielding (4).[1] Schwarz (2005) contends that, under such analysis, it is difficult to explain why the promoted *possible* should land in a position local to the superlative morpheme, as the second restriction showed. Schwarz concentrates on the locality restriction and treats *-est possible* as a non-decomposible degree operator, defined in (13):

(12)   I bought the largest present [$_{\text{Reduced RC}}$ possible for me to buy].

(13) $[\![\textit{-est possible}]\!]^w = \quad \lambda P_{<s,dt>}. \ \forall d \ [\ \exists w'[wRw' \ \& \ P(w')(d)=1] \rightarrow P(w)(d)=1 \ ]$

The goal of this paper is to provide a compositional analysis of the sequence Adj+*est possible* and of the modal superlative reading that:
            (i) allows us to reconcile the two observations above about its surface syntax. The string *[-est possible]* (together with some covert material) will be treated as a syntactic unit (with Schwarz 2005, contra Larson 2000), further decomposible (contra Schwarz 2005). This will derive the locality restriction. The modal superlative reading will be analysed as involving a Logical Form (LF) structure with an ACD clause (with Larson 2000, contra Schwarz 2005). This will capture the sensed parallelism between (12), (6) and (4) (see footnote 1), and will partly address the restriction on postnominal *possible*.
            (ii) uses LF structures independently motivated for superlatives and degree constructions,
            (iii) and derives the correct truth conditions "as X as possible (and no more)".

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[1] Larson (2000) notes that this derivation also explains why pre-/postnominal *possible* has a modal superlative reading whereas *potential* and *probable* do not: (i). This is because the former adjective but not latter adjectives allow for an infinitival complement: (ii)-(iii).
(i)   I bought the largest potential / probable present .   * Modal superlative reading.
(ii)   It is possible [PRO to interview that candidate].
(iii)   * It is potential/probable [PRO to interview that candidate].

The proposal in this paper will have some consequences for the bigger picture of comparative and superlative constructions.[2] On the one hand, for the comparative morpheme, it has been argued that we need two lexical entries for *-er* crosslinguistically: a 3-place predicate *-er*, defined in (14), and a 2-place predicate *-er*, given in (15) (Bhatt and Takahashi 2008). The 3-place *-er* occurs in phrasal comparatives non-amenable to a deletion account, e.g. Hindi-Urdu (16). The 2-place *-er* is used *inter alia* for clausal comparatives like (17) and for (18). The semantic computation of (17) and (18) is partially sketched below. Note that, while the measure phrase *156 centimeters* in (1) was assumed to denote a degree point, we need the measure phrase *2 meters* in (18) to provide a set of degrees. An operation is needed that shifts a degree point into the appropriate set of degrees. This operation is formulated in this paper as a type-shifter, defined in (18d).[3]

(14) $[\![\textit{-er}_{\text{3-place}}]\!]^w$ = $\lambda x_e.\lambda P_{<d,et>}.\lambda y_e.\, \exists d\, [P(d)(y)\, \&\, \neg(P(d)(x))]$

(15) $[\![\textit{-er}_{\text{2-place}}]\!]^w$ = $\lambda Q_{<d,t>}.\lambda P_{<d,t>}.\, \exists d\, [P(d)\, \&\, \neg(Q(d))]$

(16) Atif-ne Boman-se zyaadaa kitaabe parh- i   (Hindi-Urdu)
Atif-Erg Boman-than more   books.f read-Pfv.FP1
'Atif read more books than Boman.'

(17) John is taller than Mary is.
a. LF: [-er [(than) 1 Mary is <t_1-tall>]] [2 John is t_2-tall]
b. $[\![\textit{2 John is } t_2\textit{-tall}]\!]^w$ = $\lambda d'.\, \text{tall}(j,d')$
c. $[\![\textit{1 Mary is } t_1\textit{-tall}]\!]^w$ = $\lambda d'.\, \text{tall}(m,d')$
d. $[\![\textit{-er [(than) 1 Mary is <}t_1\textit{-tall>]] [2 John is } t_2\textit{-tall]}]\!]^w = 1$ iff
   $\exists d\, [\text{tall}(j,d)\, \&\, \neg\text{tall}(m,d)]$

(18) John is taller than 2 meters.
a. LF: [-er [(than) 2 meters]] [2 John is t_2-tall]
b. $[\![\textit{2 John is } t_2\textit{-tall}]\!]^w$ = $\lambda d'.\, \text{tall}(j,d')$
c. $[\![\textit{2 meters}]\!]^w$ = $2m$ (Cf. (1))
d. Type shifter $\text{SHIFT}^{\leq}_{d\to<d,t>}$ = $\lambda d''.\lambda d'.\, d'\leq d''$
e. $\text{SHIFT}^{\leq}_{d\to<d,t>}([\![\textit{2 meters}]\!]^w) =$ $\lambda d'.\, d'\leq 2m$
f. $[\![\textit{-er [(than) 2 meters]] [2 John is } t_2\textit{-tall]}]\!]^w = 1$ iff
   $\exists d\, [\text{tall}(j,d)\, \&\, \neg(d\leq 2m)]$

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[2] Thanks to Irene Heim (p.c.) for pointing out the relevance of the comparative data and of the 2-place/3-place discussion.

[3] This is an oversimplification. We could have treated *2 meters* as denoting a set of degrees from the beginning and do some type adaptation in (1) rather than in (18) (cf. Schwarzschild (2005)). However, Pancheva (2006) identifies several languages where the comparison argument is a definite free relative denoting a degree point; this degree is then converted into a set of degrees by an overt (Polish *niz* 'than', see also Romance) or covert element (Russian *cem* 'wh-' comparatives, Polish *jak* 'wh-' comparatives). Thus, the overall observation remains: shifting from a degree point to a set of degrees, as in (18d), is needed. This will be important later in the proposal. I thank Lisa Bylinina for discussion on these issues.

On the other hand, for superlative constructions, it is not clear whether we need to distinguish between a 3-place *-est* and a 2-place *-est*. Two such lexical entries, given in (19)-(20), have been defined in the literature (Heim 1999), but they have been treated as theoretical alternatives to each other. Evidence for 3-place *-est* arguably comes from cases like (21), with the overt comparison argument *among the candidates* (type <e,t>). If the analysis in the present paper is correct, it provides empirical support for a separate 2-place *-est*.

(19) $[\![-est_{3\text{-place}}]\!]^W$ = $\lambda Y_{<e,t>}.\lambda P_{<d,et>}.\lambda x_e.\ \exists d\ [\ P(d)(x)\ \&\ \forall y \in Y[y \neq x \rightarrow \neg(P(d)(y))]\ ]$

(20) $[\![-est_{2\text{-place}}]\!]^W$ = $\lambda \mathcal{Q}_{<dt,t>}.\lambda P_{<d,t>}.\ \exists d\ [\ P(d)\ \&\ \forall Q \in \mathcal{Q}\ [Q \neq P \rightarrow \neg(Q(d))]\ ]$

(21)   John is the tallest among the candidates.

This paper is organized as follows. Section 2 provides background on LF analyses of superlatives. Section 3 presents our proposal using the 2-place lexical entry *-est*. Some attempts with 3-place *-est* are sketched and dismissed in section 4. Section 5 concludes.

2.   Background: LF Analyses of Superlatives

A well-known ambiguity is found in superlatives sentences with a covert comparison class argument *C* (Szabolcsi 1986, Heim 1999). Under the so-called ABSOLUTE reading, sentence (22) can be paraphrased as "John climbed a mountain higher than any other (relevant) mountain". The intuition is that we compare mountains in terms of their height, pick the highest one (Mount Everest if the relevant comparison class is the set of mountains in the world), and assert that John climbed that mountain. Under the so-called RELATIVE reading, (22) is paraphrasable as "John climbed a higher mountain than anybody else (relevant) climbed". Now we compare John to other mountain-climbers in terms of their climbing achievements. Heim's example (23) displays the same ambiguity, each of the answers in (23a,b) corresponding to one of the readings:

(22)   John climbed the highest mountain.

(23)   Who wrote the largest prime number on the blackboard?
        a. Nobody, of course! There is no largest prime number!   ABSOLUTE reading
        b. John did. He was the only one above 100.   RELATIVE reading

Heim (1999) develops two alternative LF-based accounts of this ambiguity, one using 3-place *-est* and one using 2-place *-est*. In both cases, the main idea is that the Degree Phrase *[-est C]* can undergo LF movement out of its host NP, leaving behind a trace of type d. The LF position of *[-est C]* then determines the range of possible choices for the contextual comparison class $[\![C]\!]$, which in turn (partly) determines whether we obtain the absolute or the relative reading.[4] We will present each account in turn, to see in sections 3 and 4 which of the two is best suited to derive the modal superlative reading.

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[4] Both alternatives assume that *the* is semantically vacuous, with an abstract THE or A instead.
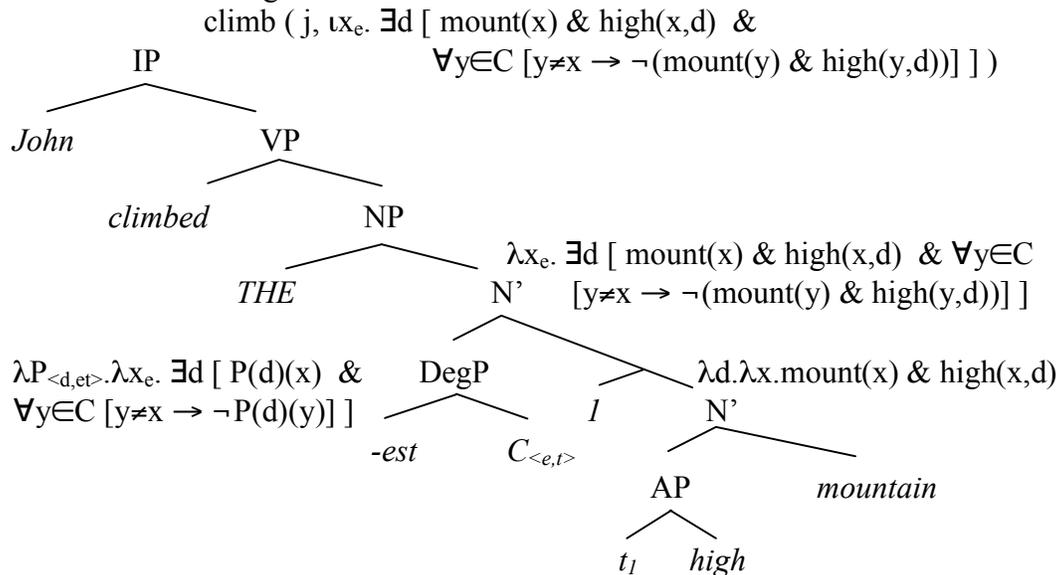
2.1. Analysis of the Absolute / Relative Ambiguity using 3-place *-est*

Heim's (1999) lexical entry for 3-place *-est* including presuppositions is given in (24):

(24) 3-place lexical entry and presuppositions:
$[\![\textit{-est}]\!]$ = $\lambda Y_{<e,t>}.\lambda P_{<d,et>}.\lambda x_e.\ \exists d\ [\ P(d)(x)\ \&\ \forall y \in Y\ [y \neq x \rightarrow \neg(P(d)(y))]\ ]$
Presuppositions:
(a) the third argument, x, is a member of the comparison class, Y.
(b) all members of the comparison class Y have the property P to some degree.

The ABSOLUTE reading is derived by scoping the DegP *[-est C]* within its host NP as in (25). The LF sister of *[-est C]* is the constituent *[1 t_1-high mountain]*, which expresses a $<d,<e,t>>$-property relating mountains to their degrees of height. Note that the presupposition (24b) requires that all members of the comparison class $[\![C]\!]$ –written as the set C in the formulas– have the sister property to some degree. This boils down to requiring that C be a set of mountains. If C equals e.g. {z: z is a mountain on earth}, the absolute reading obtains with *the highest mountain* referring to Mount Everest. [5]
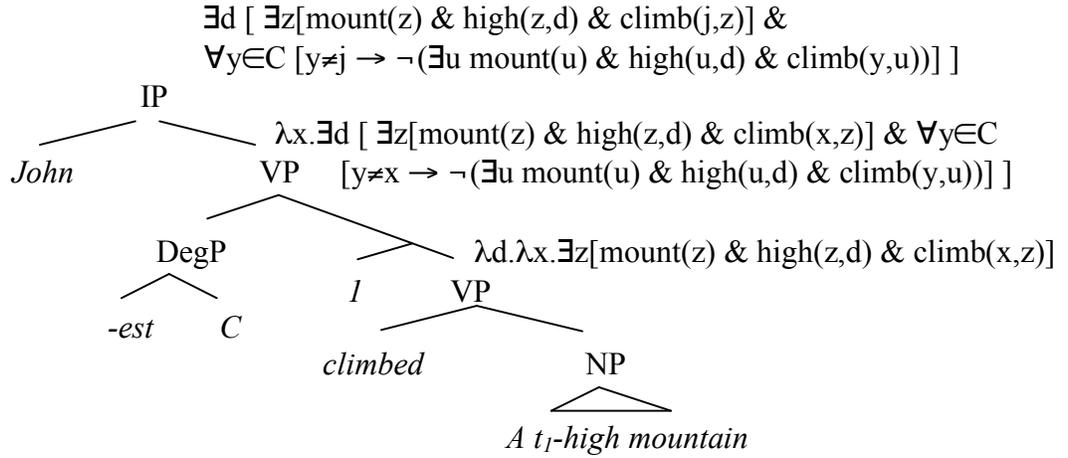
(25) John climbed the highest mountain.

climb (j, $\iota x_e.\ \exists d\ [\ mount(x)\ \&\ high(x,d)\ \&$
$\forall y \in C\ [y \neq x \rightarrow \neg(mount(y)\ \&\ high(y,d))]\ ]\ )$

```
              IP
           /      \
        John      VP
                /     \
           climbed    NP
                    /     \          λxₑ. ∃d [ mount(x) & high(x,d)  & ∀y∈C
                 THE       N'         [y≠x → ¬(mount(y) & high(y,d))] ]
                        /      \
λP<d,et>.λxₑ. ∃d [ P(d)(x) &  DegP        λd.λx.mount(x) & high(x,d)
∀y∈C [y≠x → ¬P(d)(y)] ]    /    \   1      N'
                        -est  C<e,t>    /      \
                                      AP      mountain
                                    /    \
                                   t₁    high
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The RELATIVE reading arises from scoping *[-est C]* outside its host NP and adjoining it under the term to be compared, as in (26). Now the sister constituent, *[1 climbed A t_1-high mountain]*, expresses a $<d,<e,t>>$-property relating mountain climbers to their achievements in terms of heights of mountains climbed. Thus, by (24b), all members of the comparison class C are mountain climbers that have climbed some mountain of some height. The result is comparison among mountain climbers.

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[5] (25) also allows for the relative reading. See Heim (1999), Sharvit and Stateva (2002) and Büring (2007) among others for discussion.

(26)   John climbed the highest mountain.

$$\exists d\ [\ \exists z[\text{mount}(z)\ \&\ \text{high}(z,d)\ \&\ \text{climb}(j,z)]\ \&$$
$$\forall y \in C\ [y \neq j \rightarrow \neg(\exists u\ \text{mount}(u)\ \&\ \text{high}(u,d)\ \&\ \text{climb}(y,u))]\ ]$$

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          IP
    _____|_____          λx.∃d [ ∃z[mount(z) & high(z,d) & climb(x,z)] & ∀y∈C
  John              VP         [y≠x → ¬(∃u mount(u) & high(u,d) & climb(y,u))] ]
               _____|_____
          DegP          _____|_____   λd.λx.∃z[mount(z) & high(z,d) & climb(x,z)]
         __|__         1       VP
       -est   C          _____|_____
                     climbed        NP
                                  __|__
                            A t₁-high mountain
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2.2.   Analysis of the Absolute / Relative Ambiguity using 2-place *-est*

The 2-place *-est* is spelled out in (27). As before, the LF position of *[-est C]* delimits the range of possible comparison classes C. But now focus structure is taken into account to shape C further. This is needed due to examples like (28), where two different relative readings arise: (28a) compares letter recipients whereas (28b) compares letter senders. This extra "shaping" of C is achieved via Rooth's (1985) squiggle operator ~ in (29).

(27) $[\![\text{-}est]\!]\ =\qquad \lambda \mathcal{Q}_{<dt,t>}.\lambda P_{<d,t>}.\ \exists d\ [\ P(d)\ \&\ \forall Q \in \mathcal{Q}\ [Q \neq P \rightarrow \neg(Q(d))]\ ]$
       Presupposition: P is a member of $\mathcal{Q}$.[6]

(28)   a. John wrote the longest letter to MARY.
       b. JOHN wrote the longest letter to Mary.

(29) $[\![\alpha \sim C]\!]$ is felicitous only if C is a subset of the focus semantic value of α.

The RELATIVE reading results when *[-est C]* moves out of the host NP and attains sentential scope, as in (30a). Given (29), C must be constrained as to fulfill the condition in (30b). The final truth conditions are spelled out in (30c), yielding the relative reading.

(30)   JOHN climbed the highest mountain.
       a. LF: [[-est C]   [1[JOHN_F climbed A t₁-high mountain]] ~ C]
       b. C $\subseteq$ $[\![\textit{1[JOHN}_F \textit{ climbed A t}_1\textit{-high mountain]}]\!]^F$
          C $\subseteq$ { λd'. x climbed a d'-high mountain: x∈D_e }
          C $\subseteq$ { λd'. John climbed a d'-high mountain, λd'. Bill climbed a d'-high
                           mountain, λd'. Chris climbed a d'-high mountain, ... }
       c. $\exists d\ [\ \exists z[\text{mount}(z)\ \&\ \text{high}(z,d)\ \&\ \text{climb}(j,z)]\ \&$
                $\forall Q \in C\ [\ Q \neq (\lambda d'.\ \text{John climbed a d'-high mountain})\ \rightarrow\ \neg(Q(d))\ ]\ ]$

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[6] As Heim notes, this presupposition follows from the operator ~ and does not need to be stated in the lexical entry. Although not essential for our examples, I will keep it here. See Romero (in prep.).

To derive the ABSOLUTE reading within Heim's (1999) second LF analysis, an extra assumption is needed: Traces and other empty categories can be focus-marked. This assumption finds empirical support in examples like (31) and (32), which have relative readings similar to those in (28) except that the focused element would have to be a trace or PRO. With this assumption, and allowing for a trace t_2 of type e within the NP, as in (33a),[7] the comparison class C would be constrained as in (33b). The final truth conditions in (33c) correspond to the absolute reading.

(31) a. I met the person that John wrote the longest letter to t_F. Cf. (28a)
   b. I met the person that t_F wrote the longest letter to Mary. Cf. (28b)

(32) How does one impress Mary?
   By PRO_F writing the longest letter to her.   Cf. (28b)

(33) John climbed the highest mountain.
   a. LF: John climbed THE 2 [[-est C] [1[$t_{2,F}$ t_1-high mountain]]~C]
   b. C $\subseteq$ $[\![1[t_{2,F}\ t_1\text{-high mountain}]]\!]^F$
    C $\subseteq$ { $\lambda d'$. x is a d'-high mountain: $x \in D_e$ }
    C $\subseteq$ { $\lambda d'$. Everest is a d'-high mountain, $\lambda d'$. Kilimanjaro is a d'-high
       mountain, $\lambda d'$. Aneto is a d'-high mountain, ... }
   c. John climbed the unique z: $\exists d$ [mount(z) & hight(z,d) &
         $\forall Q \in C$ [Q $\neq$ ($\lambda d'$.z is a d'-high mountain) $\rightarrow$ ¬Q(d)]]

3. Proposal using the 2-place Lexical Entry *-est*

I propose to derive the modal superlative reading using Heim's (1999) 2-place *-est*, repeated in (34) below. The idea is the following. In comparative constructions, the comparison term can be introduced by an overt *than*-phrase/clause, as in (2) and (16)-(18), or by a covert indexical variable C. In the latter case, the value of C is resolved contextually, sometimes with the help of focus, as in (35). Similarly, we would expect that, in superlative constructions, the comparison class argument can be expressed overtly or be introduced by a covert indexical C. Sentence (22) in its absolute and relative readings exemplifies the latter possibility, with the DegP shaped as *[DegP -est C]*. I propose that modal superlative readings arise from the former possibility, with *[1 possible ▲ACD]* overtly expressing the comparison class argument of *-est*.

(34) 2-place lexical entry:
 $[\![\text{-}est]\!]$ = $\lambda \mathcal{Q}_{<dt,t>}.\lambda P_{<d,t>}. \exists d$ [P(d) & $\forall Q \in \mathcal{Q}$ [Q≠P $\rightarrow$ ¬Q(d)]]
   Presupposition: P is a member of $\mathcal{Q}$.

(35) a. John is taller.
   b. John sent more pictures to MARY.
   c. JOHN sent more pictures to Mary.

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[7] Heim (1999) does not spell out absolute LFs with 2-place *-est*. (33a) is my implementation of her ideas.

Let us apply this idea to a first example. (36) in its modal superlative reading has the LF below. The Degree Phrase consists of *-est* plus its comparison class complement XP. This XP is basically a degree relative clause (*(that)1 it was possible for him to climb a t_1-high mountain*) expressed as a reduced relative (*1 possible for him to climb a t_1-high mountain*) with antecedent-contained IP-deletion (*1 possible ▲*), à la Larson (2000). DegP moves out of the host NP to gain sentential scope, as in the relative LF in §2.2. Finally, the ACD gap is resolved, feeding the structure (37) to semantic interpretation.

(36)   John climbed the highest possible mountain.
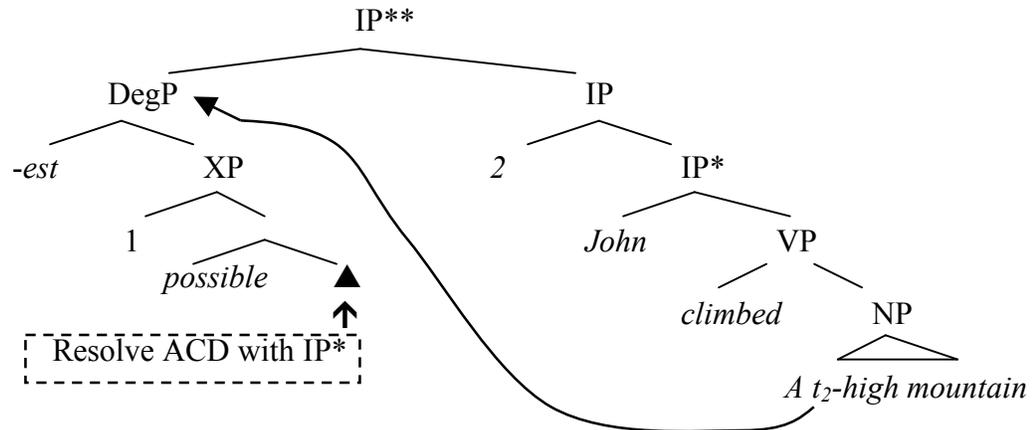
(37)   [-est [1 possible <John climb A t_1-high mountain>]] [2 John climbed A t_2-high mountain]

The semantic computation is spelled out in (38). Parallel to the type-shifter $SHIFT^{\leq}_{d \to <d,t>}$ (18d) turning a degree point into the set of degrees lower or equal to it, a shifter $SHIFT^{\leq}_{<d,t> \to <dt,t>}$ is defined in (38e) turning a set of degree points into the set of corresponding degree sets. The final truth conditions and presupposition are given in (38g). To see more intuitively what the formula says, consider a scenario where John is allowed to climb mountains that are 3000m high or less, but no higher than that. The set of allowed "intervals" will be {$\lambda d''.d''\leq 1m$, $\lambda d''.d''\leq 2m$, ..., $\lambda d''.d''\leq 1000m$, ..., $\lambda d''.d''\leq 2000m$, ..., $\lambda d''.d''\leq 3000m$}. This set is the comparison class in (38f). Now consider the "interval" corresponding to the maximal mountain-height that John climbed in the actual world. This is John's actual "interval" in (38a). The sentence then presupposes that John's actual "interval" is one of the intervals in the comparison class, and asserts that John's actual "interval" contains a degree point that no other "interval" in that class contains. Hence, John climbed as high a mountain as possible (and no higher).

(38)   a. [[*2 John climbed A t_2-high mountain*]] =
                    $\lambda d. \exists x$ [mount(x) & climb(j,x) & high(x,d)]
        b. [[*<John climbed A t_1-high mountain>*]] =1 iff
                    $\exists x$ [mount(x) & climb(j,x) & high(x,g(1))]
        c. [[*possible <John climbed A t_1-high mountain>*]] =1 iff
                    $\Diamond \exists x$ [mount(x) & climb(j,x) & high(x,g(1))]

d. $[\![$ *1 possible <John climbed A t_1-high mountain>* $]\!]$ =
$\qquad$ $\lambda d.\ \Diamond \exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ \text{high}(x,d)]$

e. $\text{SHIFT}^{\leq}_{<d,t>\to<dt,t>} = \lambda D_{<d,t>}.\lambda D'_{<d,t>}.\ \exists d'\ [D(d')\ \&\ D'=\lambda d''.d''\leq d']$

f. $\text{SHIFT}^{\leq}_{<d,t>\to<dt,t>}$ ($[\![$ *1 possible <John climbed A t_1-high mountain>* $]\!]$) =
$\qquad$ $\lambda D'_{<d,t>}.\ \exists d'\ [\ \Diamond\exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ \text{high}(x,d')]\ \&\ D'=\lambda d''.d''\leq d'\ ]$

g. $[\![\text{IP**}]\!]\ =1$ $\quad$ iff
$\qquad$ $\exists d\ [\ \exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ \text{high}(x,d)]\ \&$
$\qquad\qquad$ $\forall D'\ [\ (\exists d'\ [\Diamond\exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ \text{high}(x,d')]\ \&\ D'=\lambda d''.d''\leq d'$
$\qquad\qquad\qquad$ $\&\ D' \neq \lambda d.\exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ \text{high}(x,d)]) \to \neg D'(d)]\ ]$
$\qquad$ Presupposition: (38a) is a member of (38f). That is:
$\qquad\qquad$ $\exists d'\ [\ \Diamond\exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ \text{high}(x,d')]\ \&$
$\qquad\qquad$ $\lambda d.\ \exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ \text{high}(x,d)]\ =\ \lambda d''.d''\leq d'\ ]$

Following Hackl (2009), *most* is underlyingly *many* + *-est*, with *many* defined in (39). *Fewest* is LITTLE + *many* + *-est*, where LITTLE basically amounts to negation and can scope not just over the adjective it originates with but also higher (Heim 2006).[8]

(39) $\quad$ $[\![$ *many* $]\!]$= $\qquad$ $\lambda d_d.\lambda x_e.\ |x| \geq d$ $\qquad\qquad\qquad$ (Adapted from Hackl 2009)

This allows us to analyse examples (40) with *most* and (43) with *fewest* in a way parallel to (36). In (40), after the DegP moves out of the host NP to the top of the clause and ACD is resolved, we have the LF (41) and the abridged semantic derivation in (42):

(40) $\quad$ John climbed the most possible mountains.
$\qquad$ a. Modal superlative reading: "John climbed as many mountains as possible".

(41) $\quad$ [-est [1 possible <John climbed t_1-many mountains>]] [2 John climbed t_2-many mountains]

(42) $\quad$ a. $[\![$ *2 John climbed t_2-many mountains* $]\!]$ = $\lambda d.\ \exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d]$
$\qquad$ b. $\text{SHIFT}^{\leq}_{<d,t>\to<dt,t>}\ =\ \lambda D_{<d,t>}.\lambda D'_{<d,t>}.\ \exists d'\ [D(d')\ \&\ D'=\lambda d''.d''\leq d']$
$\qquad$ c. $\text{SHIFT}^{\leq}_{<d,t>\to<dt,t>}$($[\![$ *1 possible <John climbed t_1-many mountains>* $]\!]$) =
$\qquad\qquad$ $\lambda D'_{<d,t>}.\ \exists d'\ [\ \Diamond\exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d')]\ \&\ D'=\lambda d''.d''\leq d'\ ]$
$\qquad$ d. $[\![(41)]\!] = 1$ $\quad$ iff
$\qquad\qquad$ $\exists d\ [\ \exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d]\ \&$
$\qquad\qquad\qquad$ $\forall D'\ [\ (\exists d'\ [\Diamond\exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d')]\ \&\ D'=\lambda d''.d''\leq d']\ \&$
$\qquad\qquad\qquad\qquad$ $D' \neq \lambda d.\exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d]) \to \neg D'(d)\ ]\ ]$
$\qquad$ Presupposition: (42a) is a member of (42c).

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[8] Scoping of LITTLE is used by Heim (2006) to explain Rullmann's (1995) ambiguity in (i):
(i) $\quad$ Lucinda is driving less fast than is allowed on this highway.
$\qquad$ a. "Lucinda is driving below the maximum speed limit"
$\qquad\qquad$ LF for *than*-clause: wh3 [t_3 LITTLE] 4 [allowed Lu drive t_4 fast]
$\qquad$ b. "Lucinda is driving below the minimum speed limit".
$\qquad\qquad$ LF for *than*-clause : wh3 allowed [t_3 LITTLE] 4 [Lu drive t_4 fast]

(43) is treated in a parallel way, with one important difference. The shifters (18d) and (38e)/(42b) turned (sets of) degree points into (sets of) the corresponding *upper-bound* degree sets or intervals: e.g. 2m was converted into $\lambda d''.d''\leq 2m$. But now we need to turn each degree point into the corresponding *lower-bound* degree set or interval. For example, if John is required to climb a minimum of five mountains, the set of degree points that he is allowed not to climb is $\{6, 7, 8, 9, ...\}$ and the result after shifting should be $\{\lambda d''.d''\geq 6, \lambda d''.d''\geq 7, \lambda d''.d''\geq 8, \lambda d''.d''\geq 9, ...\}$. This is so because we need to compare each allowed degree interval with John's actual interval in (45a), which is lower-bound. The new shifter is defined in (45b). The rest of the computation proceeds as before.[9]

(43)   John climbed the fewest possible mountains.

(44)   [-est [1 possible <LITTLE John climbed t_1-many mounts>]] [2 LITTLE John climbed t_2-many mounts]

(45)   a. $[\![$*2 LITTLE John climbed t_2-many mountains*$]\!]$ =
           $\lambda d.\neg\exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d]$
       b. $\text{SHIFT}^{\geq}_{<d,t>\rightarrow<dt,t>} = \lambda D_{<d,t>}.\lambda D'_{<d,t>}.\ \exists d'\ [D(d')\ \&\ D'=\lambda d''.d''\geq d']$
       c. $\text{SHIFT}^{\geq}_{<d,t>\rightarrow<dt,t>}$ ($[\![$*1 possible <LITTLE John climbed t_1-many mountains>*$]\!]$) =
           $\lambda D'_{<d,t>}.\ \exists d'\ [\ \Diamond\neg\exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d')]\ \&\ D'=\lambda d''.d''\geq d'\ ]$
       d. $[\![(44)]\!] = 1$ iff
           $\exists d\ [\neg\exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d]\ \&$
               $\forall D'\ [\ (\exists d'[\Diamond\neg\exists x[\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d')]\ \&\ D'=\lambda d''.d''\geq d']$
                   $\&\ D'\neq\lambda d.\neg\exists x\ [\text{mount}(x)\ \&\ \text{climb}(j,x)\ \&\ |x|\geq d])\rightarrow\neg D'(d)\ ]\ ]$
       Presupposition: (45a) is a member of (45c).

4.   Some Failed Attempts with the 3-place Lexical Entry *-est*

Could one use the same idea –that *[possible ...]*, and not an indexical C, is the complement of *-est*– while using the 3-place entry of the superlative morpheme, repeated below without presuppositions? This section briefly sketches two possibilities, explaining what would need to be assumed and why they ultimately fail.[10]

(46)   3-place lexical entry:
       $[\![\text{-}est]\!] = \lambda Y_{<e,t>}.\lambda P_{<d,et>}.\lambda x_e.\ \exists d\ [\ P(d)(x)\ \&\ \forall y\in Y\ [y\neq x\rightarrow\neg(P(d)(y))]\ ]$

4.1.   Scoping 3-place *-est* inside the Host NP

A first possibility would be to make 3-place *-est* take scope within its host NP, as we saw

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for the absolute reading in §2.1. Note that, given (46), the DegP *[-est possible (...)]* needs to combine with a sister of type <d,et>. Since we need to end up selecting the smallest amount allowed in (47), let us make the sister constituent correspond to the two place property $[\lambda d_d.\lambda n_e.$ amount(n) & ¬large(n,d)], where amounts would be considered a sort of individuals (type e). The LF would roughly look as in (48), where a covert predicate LARGE would need to be posited. Assume, further, that *[possible (...)]* can be somehow resolved to the comparison class in (49b) and that *many* expresses $\lambda d_d.\lambda x_e.|x|=d$. The resulting truth conditions (ignoring presuppositions) would be (49c), paraphrased in (50).

(47)   John climbed the fewest possible mountains.

(48)   John climbed [A mountains IN [A [-est possible (...)] 1 [[t₁ LITTLE LARGE] AMOUNT]]]

(49)   a. ⟦*1 [[t₁ LITTLE LARGE] AMOUNT]*⟧ = $\lambda d_d.\lambda n_e.$ amount(n) & ¬large(n,d)
        b. ⟦*possible (...)*⟧   =
               $\lambda n'_e.$ ◇¬∃y∃d [mountains(y) & |y|=n' & climb(j,y) & large(n',d)]
        c. ⟦(48)⟧ = 1 iff ∃x [mountains(x) & climbed(j,x) & ∃n [|x|=n &
                       ∃d [¬large(n,d) & ∀n' ∈ ⟦*possible (...)*⟧ [n'≠n → large(n',d)]]]]]

(50)   "Out of the amounts such that it is possible for John to fail to climb that amount of mountains, there is a mountain-sum that John climbed whose cardinality is the smallest of those amounts."

These truth conditions are two weak. In a scenario where the mininum required is to climb 10 mountains and John happens to climb exactly 15 mountains, sentence (47) is judged intuitively false, since John climbed more than that minimum. But the truth conditions in (49c) predict it to be true: since there exist a mountain-sum of cardinality 15 climbed by John, there also exists a mountain-sum of cardinality 10 climbed by John, that is, a mountain-sum climbed by John whose cardinality is the minimum required.

4.2.   Scoping 3-place *-est* out of the Host NP

A second possibility would be to use some of the ingredients in (48) but to scope 3-place *-est* out the host NP, as in the relative reading in §2.2. This would give us the LF in (52). Several problems plague this avenue. First, for *-est* to combine properly, its LF sister would have to denote the <d,et> property in (53a), but it is not clear how to generate this property (in particular, the argument slot λn_e) from the LF syntax. Second, once we allow for this λn_e slot and we combine *-est* with its sister, we end up with the final denotation in (53c), which has a spurious λn_e; we would need to do something with it, perhaps bind it with an ∃-closure. Finally, if we let the DegP *[-est possible (...)]* scope that high and make all these allowances to generate the modal superlative reading, one would expect DegP to also be able to move to the position immediately under *John*. This would derive a relative reading comparing mountain-climbers and their achievements: (54). But this is not a possible reading of sentence (51). Thus, these assumptions would overgenerate.

(51)   John climbed the most possible mountains.

(52)   [-est possible (...)] 1 John climbed [A mountains IN A [[t_1 LARGE] AMOUNT]]

(53)   a. $[\![$ *1 John climbed [A mountains IN A [[t_1 LARGE] AMOUNT]]* $]\!]$ =
           $\lambda d_d.\lambda n_e$. amount(n) & large(n,d) & $\exists$x [mountains(x) & climb(j,x) & $|x|{\geq}n$]
        b. $[\![$*possible (...)*$]\!]$ =
           $\lambda n'_e$. $\Diamond\exists y\exists d$ [mountains(y) & $|y|{\geq}n'$ & climb(j,y) & large(n',d)]
        c. $[\![$(52)$]\!]$ = λn_e. $\exists$d [amount(n) & large(n,d) & $\exists$x [mountains(x) & climb(j,x) &
           $|x|{\geq}n$] & $\forall n' \in [\![$*possible (...)*$]\!]$ [n'$\neq$n → ¬(amount(n') & large (n',d) & $\exists$x
           [mountains(x) & climb(j,x) & $|x|{\geq}n'$])]]

(54)   Missing relative reading with respect to mountain-climbers:
        a. LF: John [-est possible (...)] 1[climbed [A mountains IN A [[t_1 LARGE]
           AMOUNT]]]
        b. Paraphrase: "Out of the mountains climbers for whom it is allowed to climb
           some amount of mountains, John is the one for whom the greatest achievement
           –the largest mountain amount– is allowed."

5.   Concluding Remarks

A compositional analysis of the modal superlative reading has been proposed using the 2-
place lexical entry for *-est* in (34), with the following results.
        First, the proposed account allows us to reconcile the two restrictions initially
observed. On the one hand, the locality requirement follows from the fact that *[-est
[possible* ▲*ACD]]* is a syntactic unit, where *[possible* ▲*ACD]* is the complement of *-est*. If
[possible ▲*ACD]* is not postponed, it remains in situ as direct complement of *-est* and no
adjective can intervene between the two, deriving English (10)-(11). Applying the same
analysis to German (9), *[-st möglich* ▲*ACD]* is the DegP of *gross* 'large'. Thus, we have
one noun modifier *gross*+DegP and not two, which explains the single agreement suffix.
On the other hand, the proposed account partly derives the behaviour of postnominal
possible. If *possible* is postposed, it must be "heavy", introducing a reduced Relative
Clause (RC) with an elided IP. A reduced RC with ellipsis can in principle be interpreted
as ranging over degrees (= modal superlative reading), or as ranging over individuals
(=regular modifier reading). However, it seems that, independently of *-est*, reduced RCs
ranging over individuals do not toletate IP ellipsis: (55a,b) are acceptable, but ellipsis
leads to unacceptability in (55c). I leave this interesting issue for future research.

(55)   a. I bought a present that it was possible for me to buy.
        b. I bought a present possible for me to buy.
        c. * I bought a present possible.

        Second, the proposed analysis uses LF structures independently motivated for
superlatives and degree constructions. The key ingredients are: (i) 2-place lexical entry -

est, (ii) relative LF, (iii) decomposition of *most* as *-est+many* and *fewest* as *-est+LITTLE+ many*, (iv) scope of *LITTLE*, and, last but not least, (v) shifters turning (sets of) degree points into (sets of) degree sets or intervals.

Third, it derives the desired truth conditions "as X as possible (and no more)".

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