Superlative Displacement in 'Sandwich' Scenarios

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Abstract

This paper seeks to reconcile the 'movement' analysis of superlative and comparative degree quantifiers with a class of apparent counterexamples. Superlative and comparative degree quantifiers compare the extent to which a target term and alternatives to the target instantiate a gradable property. On the movement analysis, the target and the gradable property are determined by the scope of the degree quantifier in the syntactic structure. As a structural consequence, terms in the scope of the degree quantifier are indifferent to the presence of the degree quantifier. This leads to incorrect empirical predictions in some contexts, apparently undermining the movement account. I provide an analysis of these contexts in which the unexpected interaction of degree quantifiers with other terms in their scope is a side effect of quantification over situations inherent in the degree quantifier itself. This solution applies uniformly to superlative and comparative constructions, unlike other approaches to this phenomenon.

1 Introduction

Some analyses of superlative constructions in English and other languages admit variation in the position of the superlative morpheme in the semantic composition, connecting divergent readings of the superlative to different syntactic scope configurations. This analysis is known to make incorrect predictions in contexts known as 'sandwich' scenarios, described in detail in section 2. This drawback has engendered other types of analyses that seek to decouple readings of the superlative from the syntactic scope of the superlative morpheme. In this paper, I consider how a scope-based analysis might be modified to make correct predictions in sandwich scenarios. In section 2 I describe the problem in detail and in section 3 propose

a situation theoretic proposal that seeks to reconcile the sandwich problem with the scope-based analysis of the superlative. Section 4 extends the analysis to modal environments (so called 'upstairs de dicto' readings of superlatives). Section 5 shows that unlike the in situ approach, the solution I provide fulfils a desideratum articulated by Büring (2007a), which is that it extends naturally to comparative constructions, which display a similar pattern.

Superlative sentences like (1) display an 'absolute' and a 'relative' reading (Ross 1964, Heim 1985, 1999, Szabolcsi 1986). On the absolute reading, we compare mountains and assert that Alex climbed the highest one. On the relative reading, we compare Alex with other mountain climbers and assert that Alex exceeds the others in terms of how high a mountain they climbed. The two readings have different truth conditions: Alex might exceed all others in terms of how high a mountain she climbed without having necessarily climbed the absolute highest mountain.

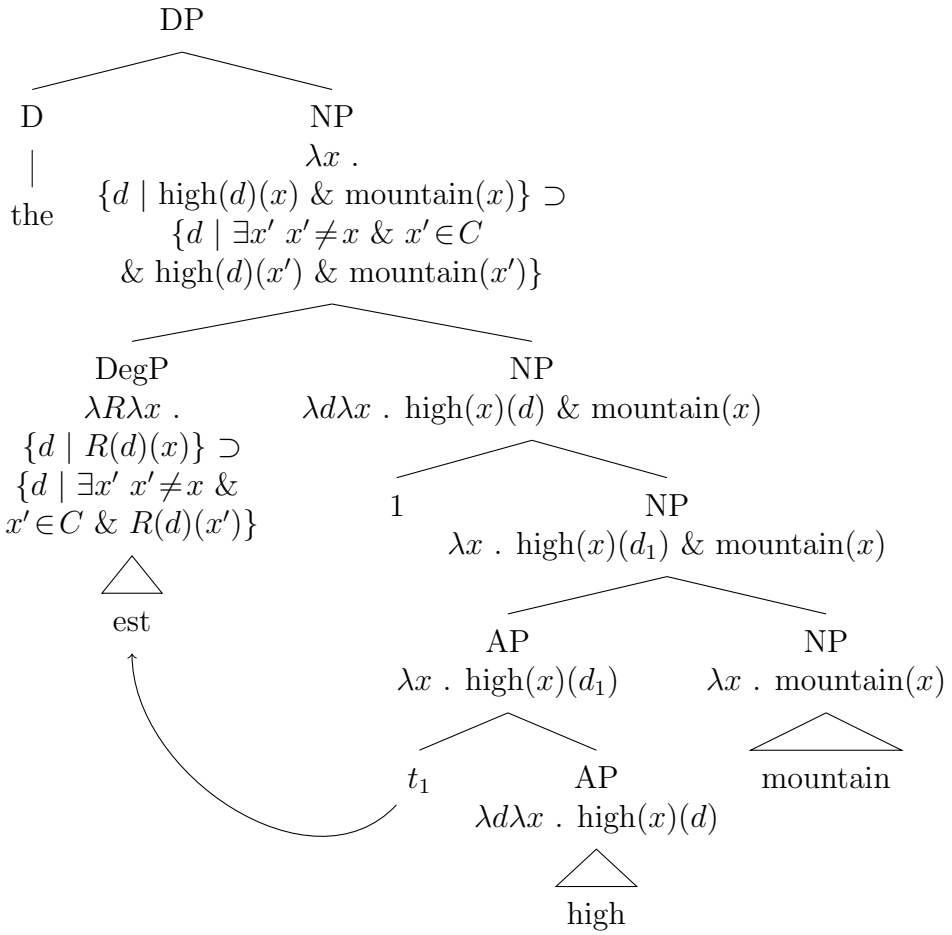
(1) Alex climbed the highest mountain.

There is no full consensus regarding whether these two readings represent structurally different semantic compositions, or represent different ways of restricting the comparison that *est* makes in one and the same structure. I define *est* as in (2), building on Heim's (2006) analysis of the comparative; this definition makes a compositional analysis of the 'inverse' superlative *least* possible, as I describe in detail in section 2. According to this definition, *est* combines with a degree relation and an individual—the 'target' of comparison—and is true if the set of degrees to which the individual bears the degree relation is a superset of the set of degrees to which some other individual bears the degree relation. This definition has a contextual index C representing the 'contrast set' from which the target of comparison and its alternatives are drawn. Also, this definition is based on the premise that degree descriptions are downward monotone; if a degree description holds of a degree d then it holds of every degree less than d (Cresswell 1976, Heim 1999).

(2) $[\![\text{est}]\!]^C = \lambda R_{\langle d,\langle e,t\rangle\rangle} \lambda x_e \ . \ \{d \mid R(d)(x)\} \supset \{d \mid \exists x' \ x' \neq x \ \& \ x' \in C \ \& \ R(d)(x')\}$

The absolute reading of the example in (1) involves moving *est* away from the adjective *high* to a position in which it applies to the whole NP *high mountain*. I follow Heim and Kratzer's (1998) implementation of the semantic correlate of movement, in which movement is accompanied by insertion of an abstraction index indexed to the trace of movement. The abstraction index abstracts a predicate over the variable denoted by the trace. In this case, it derives from a predicate of individuals (the NP denotation) a relation between degrees and individuals. *est* then applies to this relation, deriving a predicate of individuals which, however, can only hold of one individual—that individual that exceeds the others in C in terms of the degree relation. The definite article then picks out this individual.

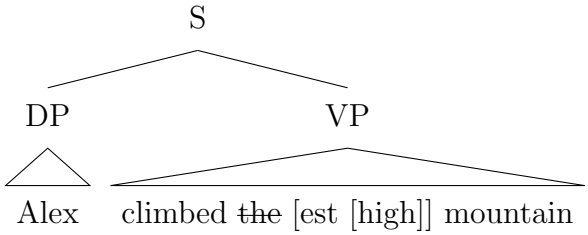
(3)



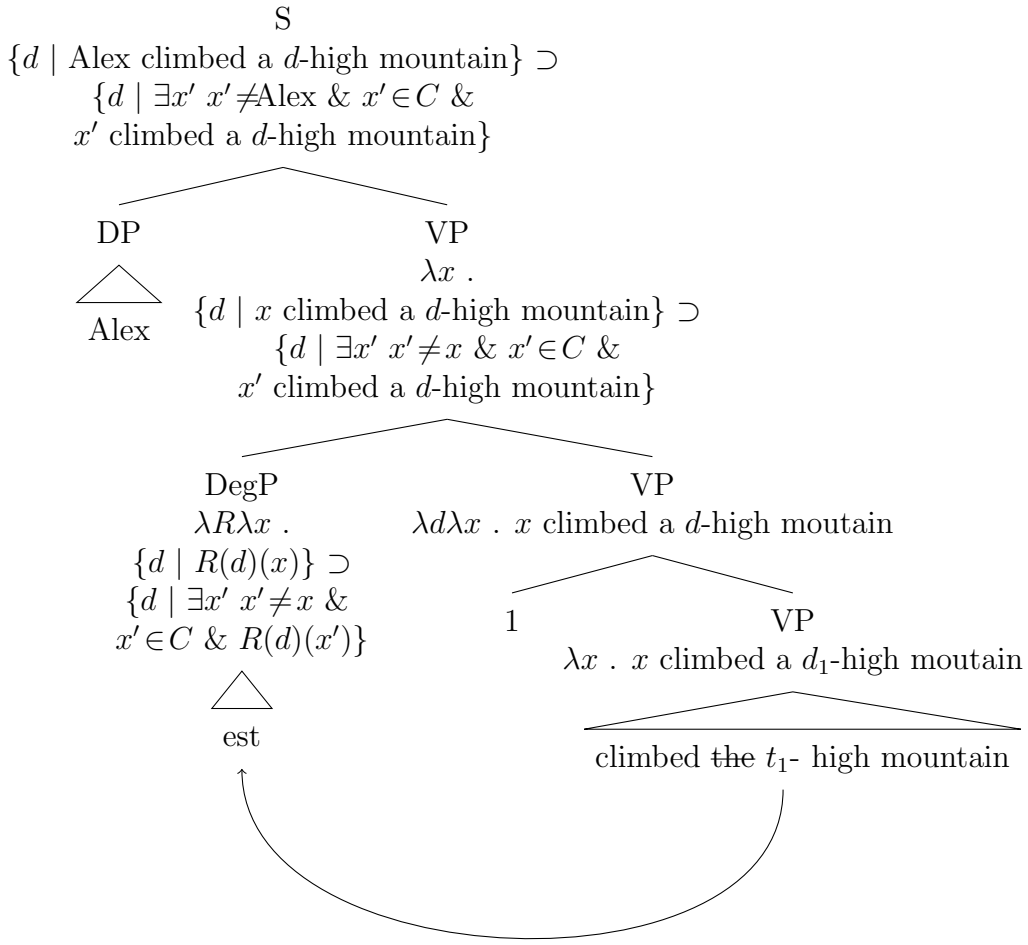
It is not immediately evident that the relative reading involves more than this structurally speaking. Although intuitively (1) can compare mountain climbers rather than mountains, this effect can be generated by contextually identifying C with the set of mountains climbed

by the various mountain climbers we are interested in. Then we indirectly compare mountain climbers, but are directly still comparing mountains. Following Sharvit and Stateva (2002), I refer to this as the 'DP-internal' analysis of the superlative, since although *est* moves from its base position in this view, it remains within the superlative DP. It is also possible, however, to derive from (1) a logical form that encodes the relative reading, by moving *est* to a DP-external position and taking the contrast set C to contain the relevant mountain climbers. Starting from the structure in (4), the relative reading arises by moving *est* to a position between the subject and the VP, deriving a degree relation at that level. When *est* applies to this degree relation, it derives a description of an individual who climbed a higher mountain than anyone else in C. According to (5), this person is Alex. I refer to this approach as the 'DP-external' analysis of (relative readings of) superlatives.

(4)



(5)



The analysis in (4) and (5) for the relative reading of (1) contains a peculiarity: it is crucial for the correct result that the definite article that appears overtly in (1) is not interpreted as such. Otherwise, the description with respect to which we compare mountain climbers would be one that refers to the same unique mountain across mountain climbers, which would subvert the relative reading. It must be possible, if this approach is correct, to construe *the* vacuously in superlative constructions.

Heim (1999) claims that the DP-external approach is nonetheless vindicated by sentences like (6). This sentence has a reading that describes the results of a survey we have taken of a group of mountain climbers, who have each named the height such that they need to climb a mountain that high, for example to qualify for membership in a mountain climbing club, without having any particular mountain in mind, and Alex named the greatest height.

(6) Alex needs to climb the highest mountain.

In this case, we are not describing the highest mountain in some contrast set, since (6) does not assert the existence of any particular mountains. But LF movement of *est* over the modal verb *need* as depicted in (7) derives the reading of (6) that is true in the situation described above. We are comparing Alex with others in terms of how high a mountain they need to climb. Sharvit and Stateva (2002) call this an 'upstairs de dicto' reading of (6), 'upstairs' because the superlative is interpreted above the modal and 'de dicto' because existential quantification over mountains obtains below the modal. On the DP-internal approach, it would appear to be impossible in this case to collect a salient set of mountains for the purposes of comparison, since no one has a need involving any particular mountains.

(7) Alex [est [$\lambda d \lambda x$. x needs to climb a d-high mountain]]

On the other hand, Sharvit and Stateva (2002) point out that the DP-external approach to relative readings gives rise to false predictions for the interpretation of the inverse superlative *least* in a certain type of context they call a 'sandwich scenario'. I describe the 'sandwich problem' in the following section, then in sections 3-4 develop an analysis of the meaning of the superlative morpheme *est* and of the quantity adjective *little* underlying superlative *least* that makes the correct predictions in sandwich scenarios even in the context of the DP-external analysis. Section 5 extends this analysis to the comparative.

2 The sandwich problem

The sandwich problem arises in the interpretation of the negative superlative *least* or *fewest* (*fewest* for count nouns, *least* elsewhere; I assume these are synonymous and cite *least* by default). Jespersen (1949) and Bresnan (1973) suggest that *least* is morphologically comprised of the components *little* and *est*. Parallel to this morphological composition, Stateva (2000), Hackl (2009) and others take *least* to be semantically composed of the superlative morpheme

est and the underlying quantificational adjective *little*, based on Rullmann's (1995) similar analysis of comparative *less* as consisting of *-er* and *little*.[1] Heim (2006), Büring (2007b, 2009), Solt (2015) and others characterize *little* as the degree-predicate negator $\lambda d_d \lambda D_{\langle d,t\rangle}$. $\neg D(d)$. It combines with a degree predicate and a degree, and asserts that the degree predicate does not hold of that degree. However, this definition does not accommodate the fact that *little* does not exclude the value *d*. Although *little* cannot combine with a measure phrase (cf. *Ida weighs 55kg little), it can combine with *that*, which appears to function referentially, as in Beck's (2012) example (8a). If *that* refers to the degree 55 kg, then (8a) asserts that Ida weighs 55 kg. But the characterization of *little* mentioned above generates the truth condition in (8b), which requires her weight to be strictly less than 55 kg. Beck claims that (8a) imposes the truth condition in (8c)—that her weight is less than or equal to the degree that *that* refers to.

(8) a. Ida weighs that little.
b. $\neg$weight(Ida)$\geq[\![$that$]\!]$
c. weight(Ida)$\leq[\![$that$]\!]$

These considerations implicate the definition for *little* in (9).

(9) $[\![\text{little}]\!] = \lambda d_d \lambda D_{\langle d,t\rangle}$. $\max(D) \leq d$

In terms of the meanings for *est* and *little* spelled out above, *least* consists of the base quantificational adjective *little* with *est* in its degree argument position. In a sentence like (10a), the complex *est+little* is base generated in the degree argument position of the gradable term whose degree argument it binds, here the adjective *high*, as sketched in (10b)

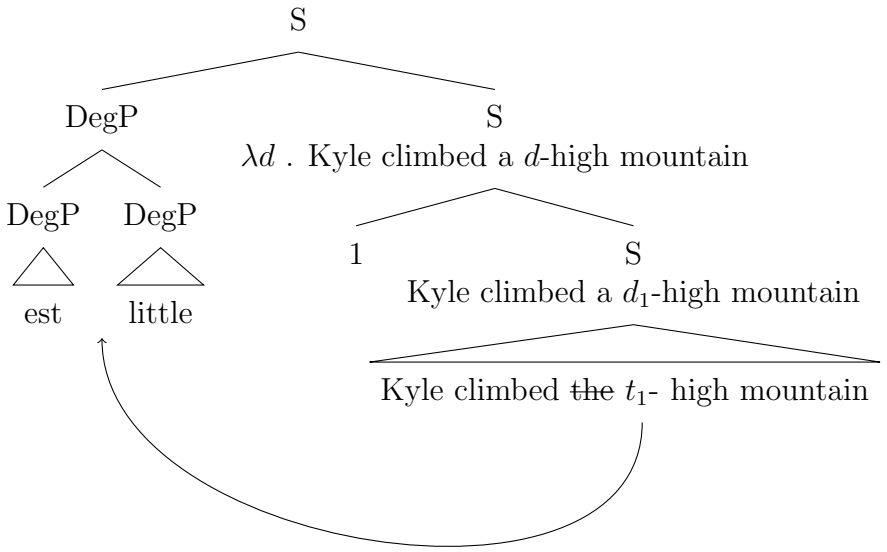
(10) a. Kyle climbed the least high mountain.
b. Kyle climbed the [[[est [little]] high] mountain]

[1]This view is motivated by 'split scope' readings of *least* and *less*, where the superlative/comparative part has wider scope than *little*, as in (ia) in a context where all the test takers need to answer a certain number of questions right, and Alex is most in terms of how *few* questions she needs to answer right, that is, she has the greatest margin for error. This reading corresponds to the scope configuration in (ib).

(i) a. Alex needs to answer the fewest questions right on the test.
b. Alex est [$\lambda d \lambda x$ x needs to answer d-few questions right on the test]

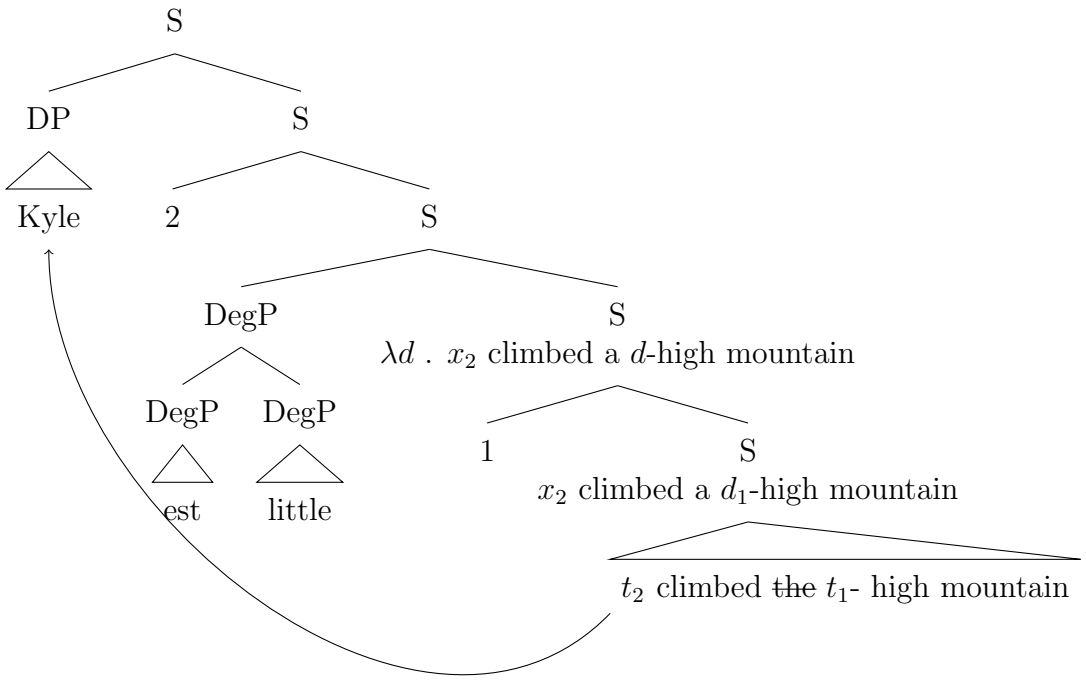
On the DP-external approach to the interpretation of superlatives, the derivation of the LF of (10a) proceeds as follows. First, [est [little]] moves to a left peripheral position above the base position of the target of comparison (Kyle), as shown in (11); this is where *little* will ultimately have scope. Recall as well that the definite article in (10b) makes no semantic contribution to the structure derived by degree quantifier movement.

(11)



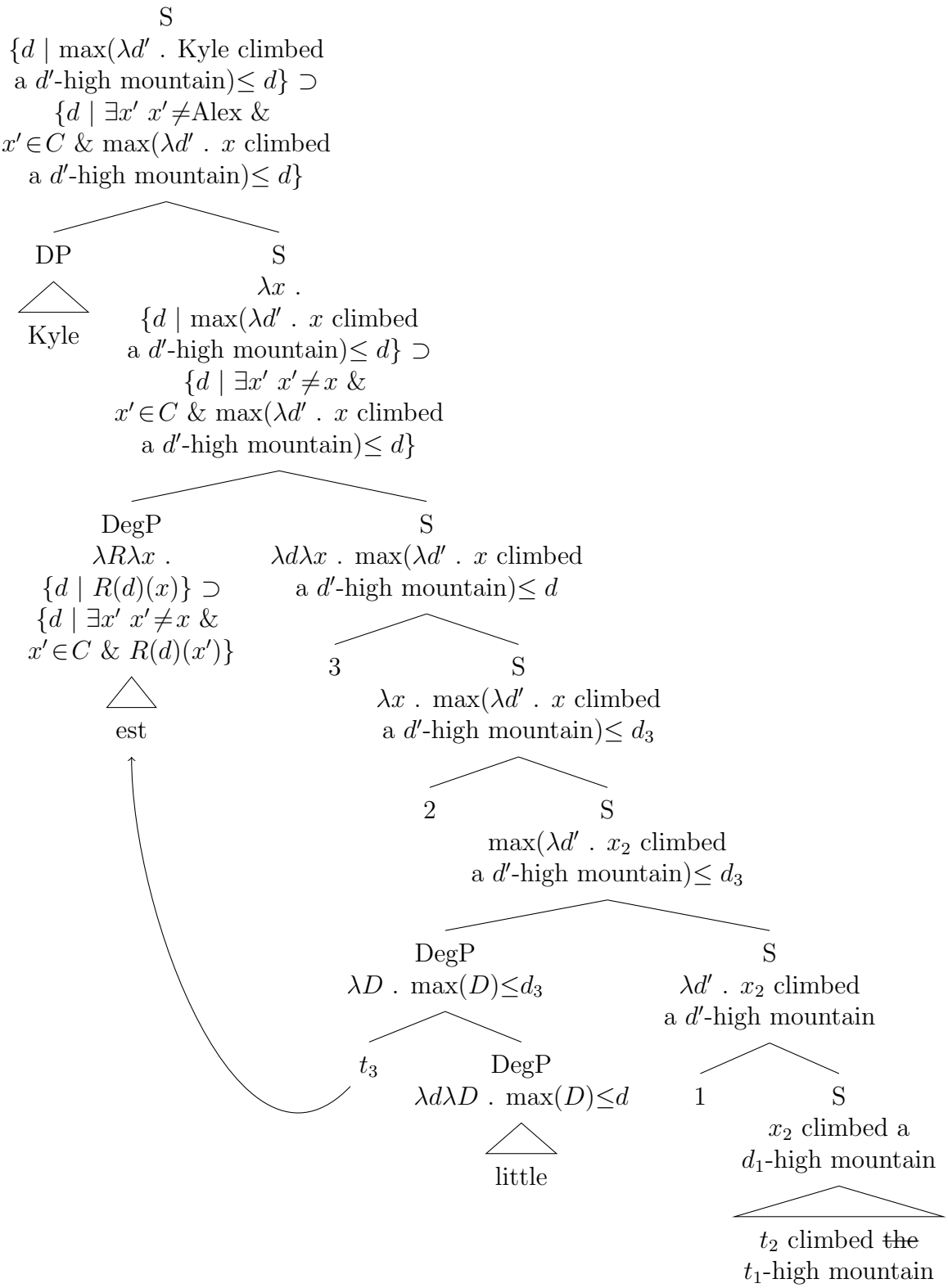
Subsequently, the target of comparison itself moves, accompanied by abstraction of a predicate over individuals, as illustrated in (12).

(12)



From there, [est] alone moves, without *little*, to a position between the target of comparison and the individual predicate created by movement of the target of comparison in the previous step, again accompanied by degree predicate abstraction, deriving a degree relation, as illustrated in (13). This structure involves interpolating the superlative degree quantifier and its degree abstraction index '3' between the moved target of comparison *Kyle* and its degree abstraction index '2'. While this step does not extend the tree in Chomsky's (1995) sense, it represents a type of 'tucking in' whose semantic interpretation is discussed in Bhatt and Takahashi 2007 and Lechner 2017. This structure is fully composable and derives the formula repeated for perspicuity in (14).

(13)



(14) $\{d \mid \max(\lambda d' \text{ . Kyle climbed a } d'\text{-high mountain}) \leq d\}$
$\supset \{d \mid \exists x' \neq \text{Kyle } \max(\lambda d' \text{ . } x' \text{ climbed a } d'\text{-high mountain}) \leq \text{d}\}$

Suppose that Kyle climbed a 1000m mountain, Parker a 1500m mountain, and Alex a 2000m mountain. The maximum degree such that Kyle climbed a mountain that high is 1000m. The set of degrees greater than or equal to the maximum degree such that Kyle climbed a mountain that high is the set {1000, 1002, ...∞}, i.e., the interval (1000,∞). (14) requires that this set properly contains the set of degrees greater than the maximum degree such that someone else climbed a mountain that high. The relevant alternative is the person who climbed the next highest mountain, Parker. The maximum degree such that she climbed a mountain that high is 1500m. The set of degrees greater than or equal to 1500m is the interval (1500, ∞). Since Alex's set is a superset of Parkers, (14) is true, as desired.

However, as Sharvit and Stateva point out, this approach fails to make the correct prediction in a similar situation: suppose that in addition to the 1000m mountain that Kyle climbed, she also climbed a 2500m mountain. Intuitively, it remains the case that Kyle climbed the least high mountain, since no one climbed a shorter mountain than the shortest mountain Kyle climbed. Yet, the formula in (14) is false in this situation. The reason is that the set of degrees greater than the degree such that Kyle climbed a mountain that high is no longer the interval (1000,∞) but rather the interval (2500,∞), since for all degrees up to 2500, there is a mountain that high that Kyle climbed. Now Kyle's interval is no longer a superset of the the interval (1500,∞), which is the interval including all degrees greater than the degree for which we can find someone else who climbed a mountain that high, here Parker. In fact, now Parker is predicted to be the one who climbed the least high mountain. Her interval—(1500,∞)—is a superset of the interval containing all the degrees higher than the degree such that we can find someone else who climbed a mountain that high, which is the interval starting at the height of Alex's mountain, namely (2000,∞). Sharvit and Stateva (2002) refer to this as a 'sandwich' scenario, since the heights of the mountains that Parker and Alex climbed are sandwiched between the heights of the two mountains Kyle climbed. In this scenario, the DP-external analysis has no way of making the higher mountain that Kyle climbed irrelevant to the determination of the interval including all the degrees greater

than the degree such that Kyle climbed a mountain that high. Sandwich scenarios seem to undermine the movement analysis.

I claim in the following two sections that the problem facing the movement analysis in sandwich scenarios is not movement itself but the fact that the definitions of *little* and superlative *est* above do not take the aspectual structure of the degree descriptions they apply to into account. I provide a refinement of the definition of the superlative morpheme that gives it a situation argument, so that although it cannot make reference to mountains on the relative reading of (10a), it can make reference to mountain climbing situations, which enables it to make the correct predictions in sandwich scenarios.

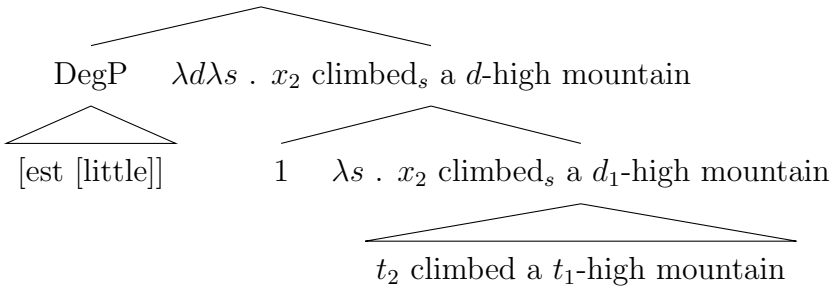
3 Degrees and situations

A possible route toward accommodating sandwich scenarios in a DP-external analysis of the superlative involves allowing the superlative morpheme to bind a spatio-temporal index of the underlying degree description, giving that spatio-temporal index wide scope over *little*. I refer to such an index as a 'situation' argument. Building on Lewis (1975) and Barwise and Perry 1983, Kratzer (1989, 1998, 2008) develops a notion of a situation as a part of a possible word, closely related to the notion of an 'eventuality' familiar from Davidson (1967), Bach (1986) and elsewhere. The idea is that the superlative assertion in (10a) compares, on one hand, the degrees such that there is a situtation in which Kyle climbed a mountain whose maximum height is less than or equal to that, and on the other hand, the degrees such that there is a situation in which someone else climbed a mountain whose maximum height is less than or equal to that. The degrees such that there is a situation in which Kyle climbed a mountain whose maximum height is less than or equal to that start at 1000m in the sandwich scenario described above. The situation in question is the one in which she climbs the lower of the two mountains she climbed and the degrees in question comprise the interval (1000,∞). This is a superset of the degree sets associated with the other mountain

climbers ((1500,∞) for Parker and (2000,∞) for Alex). There is another situation of her climbing the higher mountain but the 'lower' situation suffices to verify the assertion in (10a) in the sandwich scenario. Below, I show how *little* and *est* must be interpreted in order to implement this idea. In section 4, then, I extend the analysis to sandwich scenarios in upstairs de dicto contexts, which provide crucial impetus for a DP-external analysis of the superlative.

According to these premises, when *least* (that is, [est [little]]) in (10a), moves to a position commanding the constituent t_2 *climbed a* t_1*-high mountain* (t_1 the trace of *least* and t_2 the trace of *Kyle*, which has moved to a higher position; see below), it derives not a degree predicate but a relation between a degree and a situation, as depicted in (15). I give situations the variable name s. I take the situation argument to be an argument of the verbal head of the sentence describing that situation (*climbed* below), as an eventuality argument would be, and notate it as a subscript of that verb.

(15)

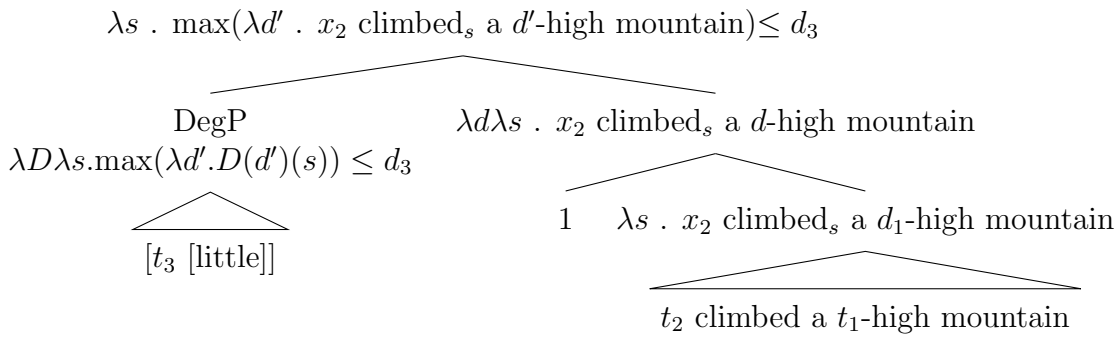


I propose that *little* has the same core meaning as before, but binds the situation argument of its complement, as defined in (16). I give situations the logical type s In reference to the fact that they are parts of possible worlds.

(16) $\llbracket \text{little} \rrbracket = \lambda d_d \lambda D_{\langle d,\langle s,t\rangle\rangle} \lambda s_s \text{ . } \max(\lambda d' \ D(d')(s)) \leq d$

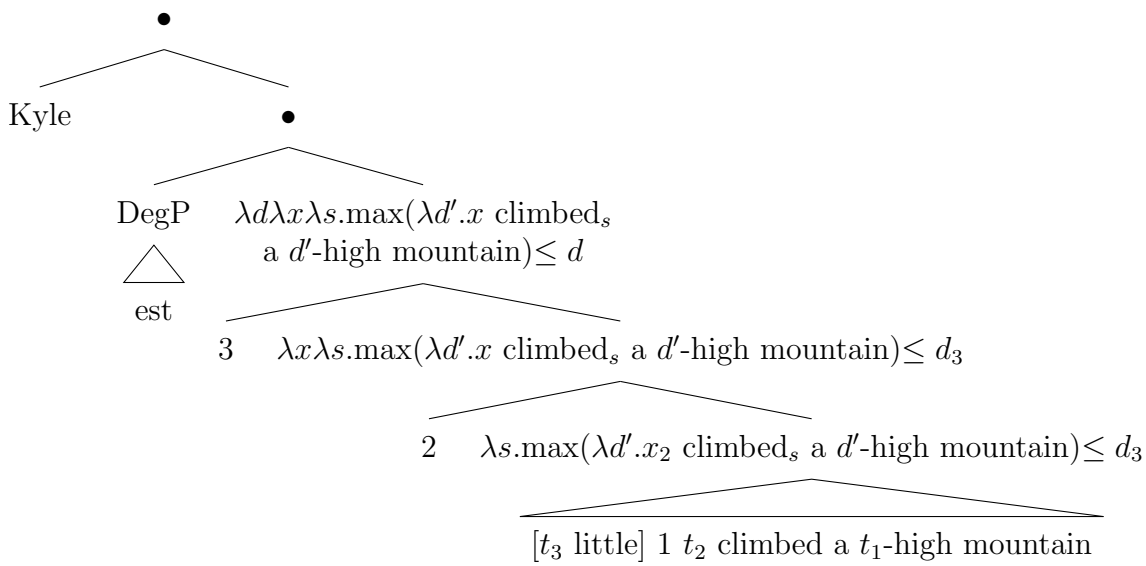
The tree in (15) can be composed as in (17) once *est* has moved, leaving a degree-denoting trace t_3.

(17)



The tree below expands the tree above to include the landing site of *Kyle* and interpolation of superlative *est* on analogy to the steps in (12) and (13).

(18)

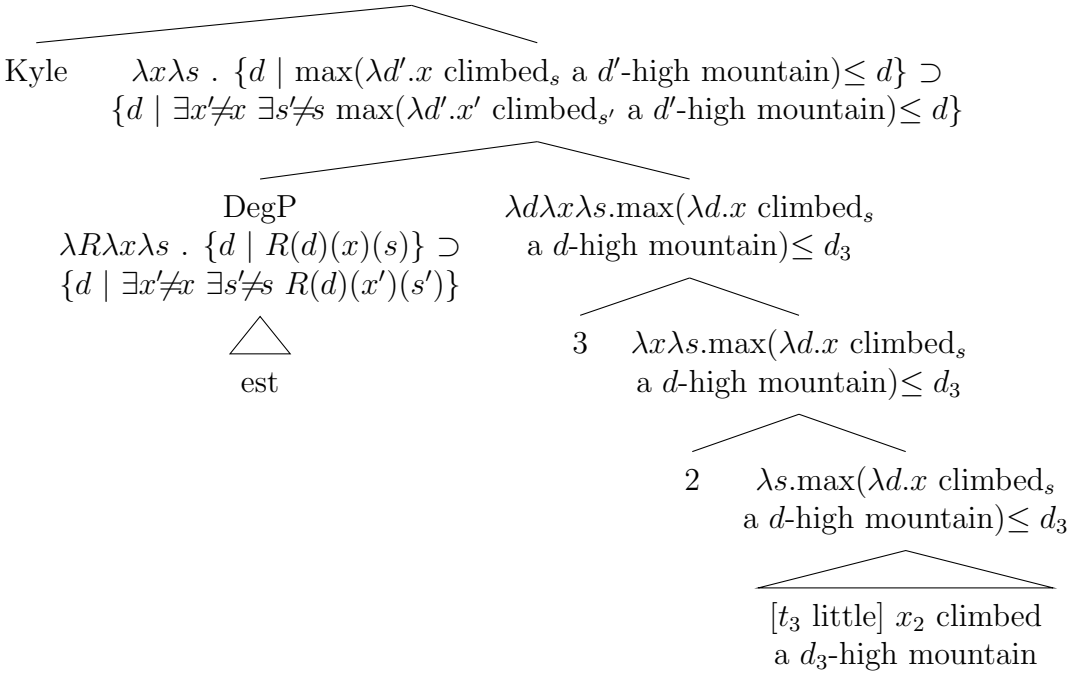


At this juncture it is evident that we require a definition for superlative *est* that is equipped to handle the situation argument of the node it is applied to in (18). I propose the definition in (19), which, when provided with a degree-individual-situation relation R and an individual x, derives a situation description. That description describes a situation s in the following way: the degrees that x bears R to in s contain all the degrees that some other individual bears R to in some other situation.

(19) $[\![\text{est}]\!] = \lambda R_{\langle d,\langle e,\langle s,t\rangle\rangle\rangle}\lambda x_e\lambda s_s \,.\, \{d \mid R(d)(x)(s)\} \supset \{d \mid \exists x' \neq x \; \exists s' \neq s \; R(d)(x')(s')\}$

Attributing this definition to *est* in (18) results in the composition in (20).

(20) λs . $\{d \mid \max(\lambda d'.\text{Kyle climbed}_s \text{ a } d'\text{-high mountain}) \leq d\} \supset$
$\{d \mid \exists x' \neq Kyle\ \exists s' \neq s\ \max(\lambda d'.\ x' \text{ climbed}_{s'} \text{ a } d'\text{-high mountain}) \leq d\}$



It is important for the situation argument of *climb* to ultimately be projected above the superlative (rather than being existentially closed by the superlative) since adverbial quantifiers that bind this situation argument have scope above the superlative, as when you say *When Kyle climbs the highest mountain, no one is surprised.*[2] This argument is ultimately closed by a covert default unselective existential quantifier ('existential closure' per Heim 1983), deriving the statement in (21).

(21) $\exists s$ $\{d \mid \max(\lambda d'.\text{Kyle climbed}_s \text{ a } d'\text{-high mountain}) \leq d\} \supset \{d \mid \exists x' \neq Kyle\ \exists s' \neq s$ $\max(\lambda d'.\ x' \text{ climbed}_{s'} \text{ a } d'\text{-high mountain}) \leq d\}$

This statement is true if there is a situation in which all the degrees greater than or equal to the maximal degree such that Kyle climbed a mountain that high in that situation contain all the degrees greater than or equal to the maximal degree such that someone else climbed a mountain that high in some other situation. There is such a situation, namely the one in which Kyle climbed the lower of the two mountains she climbed. In that siutation, 1000m is greater than or equal to the maximal degree such that Kyle climbed a mountain that high,

[2] I am grateful to an anonymous reviewer for bringing this point to my attention.

as is 1001, 1002, etc. Now Kyle's set is (1000,∞), corresponding to the 'non-heights' of the lower of the two mountains she climbed.

There is also a situation in which she climbed a higher mountain, as well as a complex situation consisting of her climbing both mountains, but the existence of these situations does not impact the fact that the lower mountain climbing situation verifies (21). It does raise the question, though, of whether there are guidelines that tell us how to distinguish situations, that set this analysis on some formal footing. Situations that are not distinguishable by the guidelines in question should not support sandwich scenarios. The following remarks expand on this issue, showing that what qualifies as a situation for the interpretation of *least* does not admit much pragmatic flexibility, but rather is tightly connected to the underlying description.

Buidling on Lewis (1975), Barwise and Perry 1983 and Kratzer (1989), Berman (1987) develops an analysis of adverbial quantification in Barwise and Perry's situation semantics (see also von Fintel 1994, Kratzer 1998, 2008 and others). As mentioned above, situations are parts of possible worlds in Kratzer's framework, corresponding closely to possible eventualities in models that put eventualities in much the same role, that of distinguishing occurrences of eventualities/situations meeting the same description. Berman points out that with nothing further said, the idea that adverbial quantifiers quantify over situations predicts that it should be possible to say *A man sneezed (exactly) twice* if in fact he only sneezed once, since with nothing further said, nothing prevents us from counting the situation in which he sneezed in the living room as distinct from the larger situation in which he sneezed in the house containing the living room. It seems that quantificational adverbs like *twice* are restricted to only the 'miminal' situations that meet their domain description. The definition of minimality in (22) is modelled after Berman's (1987, p. 65). For some situation description P, a situation is a minimal P-situation if and only if P holds of no proper subpart of the situation. See Taylor 1977 and Cresswell 1977 for similar notions in interval-semantic terms.

(22) For all situations $s \in D_s$ and descriptions $P \in D_{\langle s,t \rangle}$:
s is a **minimal** P-situation iff $P(s)$ and $\forall s' \in D_s$ if $s' \sqsubseteq s$ and $P(s')$ then $s = s'$

Existential closure, applied to the function derived in (20) has only those situations in its domain that minimally satisfy that function. On this view, the sentence *Kyle climbed a mountain* cannot describe a situation s in which she climbed two mountains, because such a situation contains a sub-situation in which she climbed a mountain, making s non-minimal. Consequently, that situation description cannot hold of a situation in which Kyle climbs both the taller and the shorter mountain that she climbed, precluding an interpretation of (10a) that associates with Kyle the interval (2500,∞), corresponding to the 'non-heights' of the higher of the two mountains she climbed in the non-minimal situation containing both mountains (non-minimal, that is, with respect to the description *Kyle climbed a so-and-so high mountain*).

Zucchi (1993), von Fintel (2004) and Kratzer (2008) note that the notion of minimality sketched above fails to identify a minimal situation for subpart homogeneous predicates, that is, descriptions like *snow falls*, which, when it holds of any situation, holds of all subparts of it (down to a certain level of granularity). Yet, they note, quantificational adverbs, whose domain is restricted by minimality, may be restricted by homogeneous situation descriptions, as in (23), Kratzer's (2008) example (28a).

(23) When snow falls around here, it takes ten volunteers to remove it.

A minimal situation of snow falling is a situation of a single snowflake falling, but that is not what it takes ten volunteers to remove. Rather, the quantificational adverb in (23) (hidden *always*) ranges over situations in which some appreciable quantity of snow falls. Addressing this, Kratzer (2008) defines a notion of 'exemplification' of a proposition p by a situation s defined in (24), that obtains if whenever there is a part of s in which p is not true, then s is a minimal situation in which p is true. Kratzer's 'proposition' (a description of worlds) is parallel to 'situation description' in the present work (a description of parts of

worlds). I define exemplification in the currency of situation-descriptions adopted previously.

(24) For all situations $s \in D_s$ and descriptions $P \in D_{\langle s,t \rangle}$: s **exemplifies** P iff $\forall s'\ s' \sqsubseteq s$ and $\neg P(s') \rightarrow s$ is a minimal P-situation

A situation in which snow falls exemplifies the situation description *Snow falls* by virtue of falsifying the antecedent of the conditional in (24), since for any subpart (value for s' in (24)) we pick, it is not true that it is not a snow falling situation. Therefore, no subpart (above the relevant level of granularity) verifies the antecedent of the conditional in (24), verifying the condition as a whole.

Suppose the table in (25) records the amount of snow that fell in Chicago, Milwaukee and Minneapolis on each day last weekend. In this context, (26a) and (26c) are true and (26b) is false.

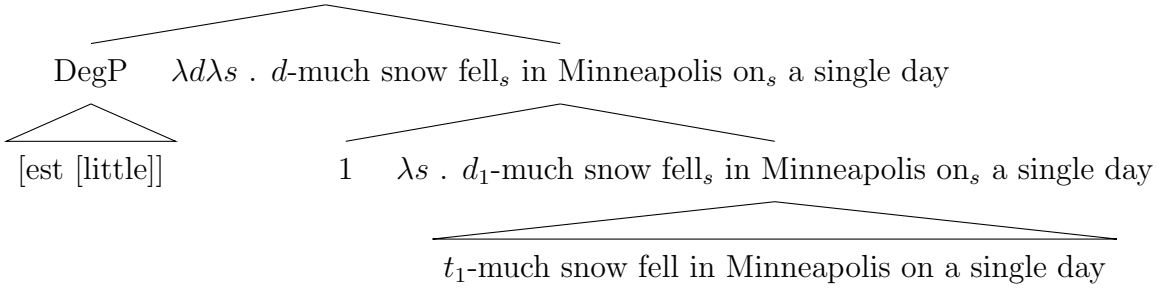
(25)

	Saturday	Sunday
Chicago	3”	5”
Milwaukee	4”	6”
Minneapolis	2”	24”

(26) a. Last weekend, the least snow fell in Chicago. [true]
b. Last weekend, the least snow fell in Minneapolis. [false]
c. Last weekend, the least snow fell on a single day in Minneapolis. [true]

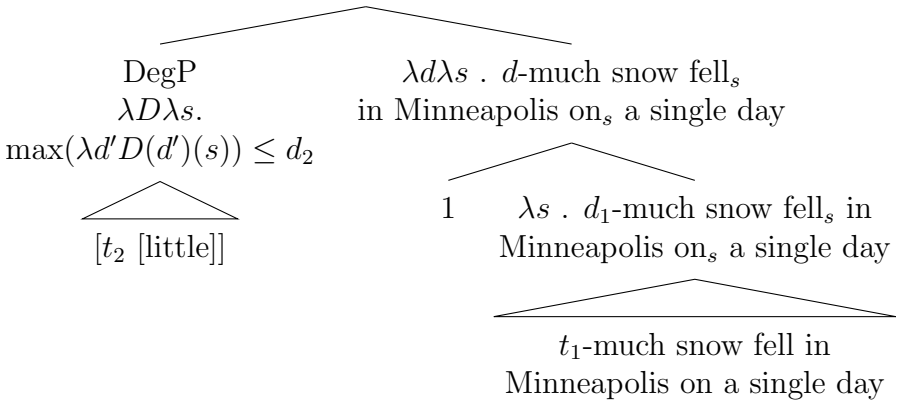
Following Bresnan (1973), Hackl (2000), Solt (2015) and others I attribute to *snow* a hidden quantity adjective, represented as *much* in the formulas below, that introduces a degree argument that measures out the quantity of the individual argument of *snow*. Also, I make the situation variable a subscript of both the verb *fall* and the preposition *on*, to represent the fact that the snow-falling situation takes place on the day in question. That is, the node at the apex of the triangle in (27) is to be read “λs . d_1-much snow fell in Minneapolis in s and s is temporally confined to a single day”.

(27)



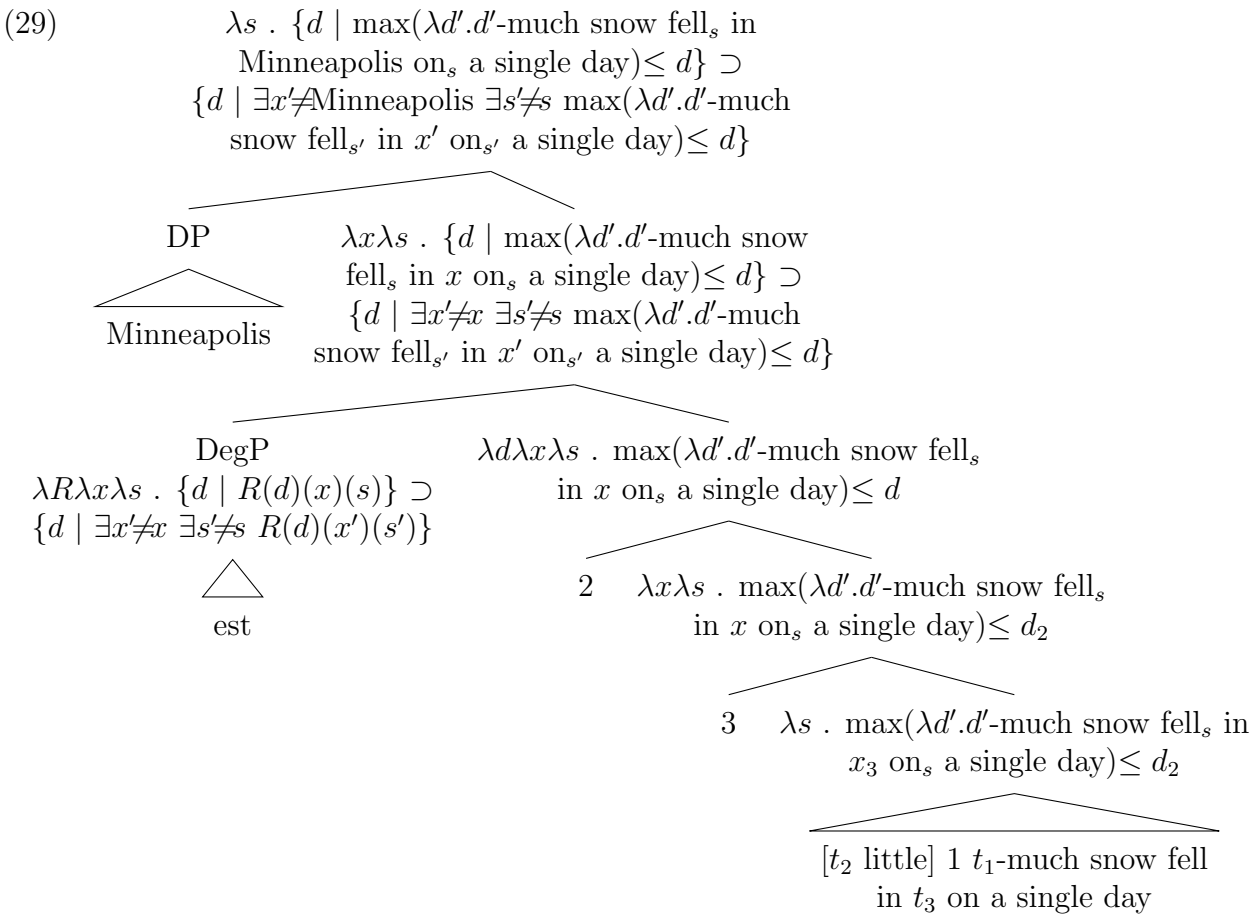
Movement of *est* to a higher position (see the tree to follow) leaves a degree-denoting trace in its base position, which enables the composition of the tree in (27) as in (28).

(28) λs . max($\lambda d'$. d'-much snow fell$_s$ in Minneapolis on$_s$ a single day)$\leq d_2$



After movement of *est* and the target of comparison *Minneapolis*, the sentence composes fully as in (29). Ultimately, the description derived in (29) undergoes existential closure.

(29)



There is situation that falls on a single day in which the degrees greater than or equal to the maximum amount that it snowed in Minneapolis in that situation comprise the interval (3, ∞). Replacing Minneapolis with another city does not yield a larger interval, so the derivation in (29) correctly predicts (26c) to be true in the sandwhich scenario depicted in (25). It is interesting in this connection that (26b) is false. Since the truth of (26c) shows that is possible to construe each day as a separate situation of snow falling, it is unclear why those situations are not available in the evaluation of (26b). It seems like it should be possible to affirm the cliam in (26b) by pointing to the snow falling situation that transpired on in Minneapolis on Saturday, in which less snow fell than in any other snow falling situation. That situation is apparently not visible to the evaluation of a situation description that does not provide the descriptive content that would distinguish the Satuday situation from the Saturday+Sunday situation; (26b) is missing the qualification *on a single*

day. The absence of this explicit qualification makes it impossible to confine the potential values for s in (26b) to single days. It appears that it is not possible to pragmatically 'zoom in' on a topic situation that is smaller than what the description being evaluated calls for. Whatever force is at work here, its effect is felt equally by the DP-external analysis of the superlative advocated here and the DP-internal analysis. In the DP-external analysis, the contrast set C contains snow falling situations (30), while in the DP-internal analysis it contains quantities of snow (31). Since, from the perspective of the DP-internal analysis, the quantity of snow that fell in Minneapolis on Saturday is available as a potential target of comparison for (26c), it is unclear why it is not available as a potential target of comparison in (26b), where it would verify that assertion, contrary to fact.

(30) $C = \left\{ \begin{array}{l} \text{the situation of snow falling in Chicago on Saturday} \\ \text{the situation of snow falling in Chicago on Sunday} \\ \text{the situation of snow falling in Milwaukee on Saturday} \\ \text{the situation of snow falling in Milwaukee on Sunday} \\ \text{the situation of snow falling in Minneapolis on Saturday} \\ \text{the situation of snow falling in Minneapolis on Sunday} \end{array} \right\}$

(31) $C = \left\{ \begin{array}{l} \text{the snow that fell in Chicago on Saturday} \\ \text{the snow that fell in Chicago on Sunday} \\ \text{the snow that fell in Milwaukee on Saturday} \\ \text{the snow that fell in Milwaukee on Sunday} \\ \text{the snow that fell in Minneapolis on Saturday} \\ \text{the snow that fell in Minneapolis on Sunday} \end{array} \right\}$

The explanation for this effect would appear to be pragmatic and therefore compatible with both the DP-internal and DP-external analysis of relative readings of the superlative. The sentence in (26a) is relevant to the question of how much snow fell in each city. An answer that 'zooms in' on one particular day would be viewed as underinformative if on another day much more snow fell, since the snow that fell later is pertinent to the question. Conversely, the sentence in (26c) contains descriptive content (*on a single day*) that makes the sentence relevant to the question of how much snow fell on each day in each city. In this case, it is no longer underinformative to zoom in on a single day. Whether we are zooming in on the snow that fell on that day or the snowfall situation on that day is not

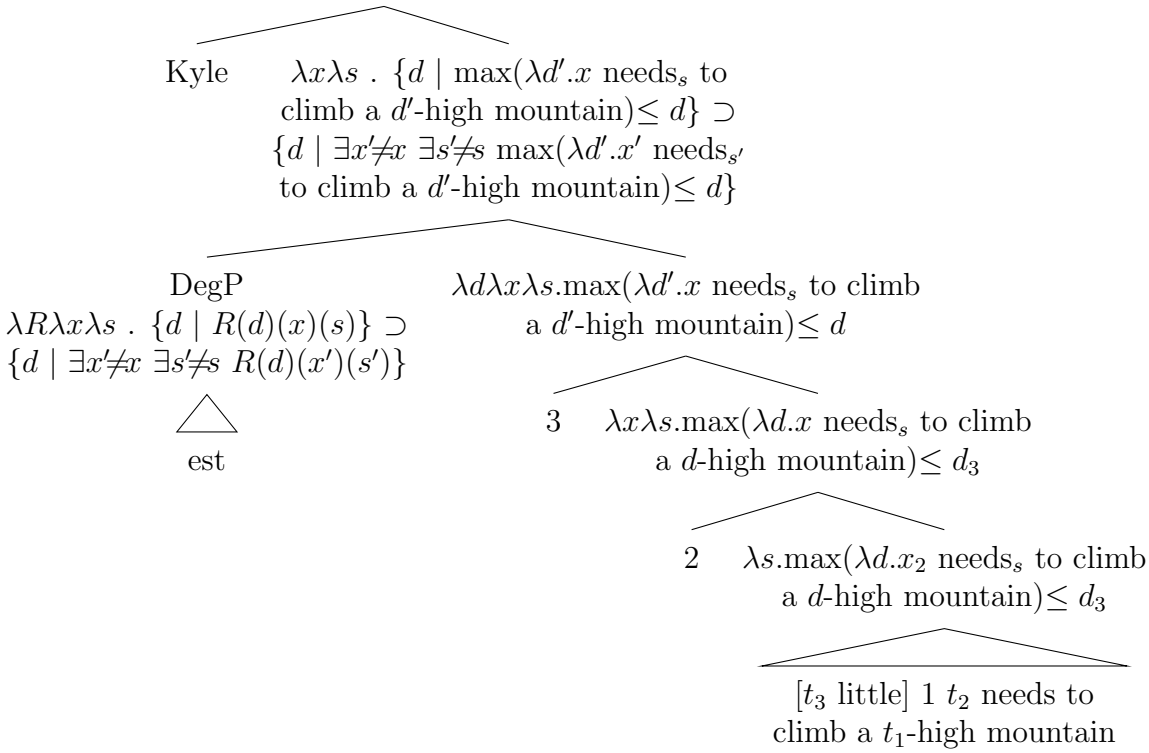
evident on the basis of that pattern in (26) alone. The situation theoretic view, however, reconciles the DP-external analysis of the superlative with sandwich scenarios, and therefore inherits whatever advantages the DP-external analysis brings with it. The crucial evidence supporting the DP-external analysis of superlatives comes from intensional sentences. I turn to these below.

4 Upstairs de dicto configurations

As mentioned in section 1, the main empirical motivation for the DP-external approach to the absolute/relative contrast is found in upstairs de dicto contexts like (32a). (32a) has a reading that describes the results of a survey we have taken of a group of mountain climbers, who have each named the height such that they need to climb a mountain that high, for example to qualify for membership in different mountaineering clubs, without having any particular mountain in mind, and Kyle named the least height. In this case, we are not describing the least high mountain in some contrast set, since (32a) does not assert the existence of any particular mountains. But LF movement of *least* over the modal verb *need* as depicted in (32b) derives the reading of (32a) in which we are comparing Kyle with others in terms of their mountain climbing needs, as desired.

(32) a. Kyle needs to climb the least high mountain.

b. λs . $\{d \mid \max(\lambda d'.$Kyle needs$_s$ to climb a d'-high mountain)$\leq d\} \supset \{d \mid \exists x' \neq Kyle\ \exists s' \neq s\ \max(\lambda d'.\ x'$ needs$_{s'}$ to climb a d'-high mountain)$\leq d\}$



The sandwich problem arises here, too. Suppose that to fulfil the requirements for membership in a mountain climbing club, Alex needs to climb some mountain that is at least 2000m. Parker wants to join a different club that only requires her to climb a 1500m mountain. Kyle wants to join yet a different club that has a more complex membership requirement: she needs to climb a 1000m mountain in the winter and a 2500m mountain in the summer distinct from the mountain she climbed in the winter. No one is required to climb any particular mountain; the requirements pertain only to heights and everyone is allowed to exceed their requirements, but it is part of Kyle's requirements that she climb two distinct mountains. In my judgment, (32a) is true in the situation, meaning that the fact that Kyle needs to climb a higher mountain in addition to the less high mountain she needs to climb is not relevant to the judgment of (32a); only the lesser height seems to matter. Once again, the version of the movement analysis that Szabolcsi (1986) and Heim (1999)

articulate makes (32b) true if the set of degrees greater than or equal to the maximum height such that Kyle needs to climb a mountain that high that includes all the degrees greater than or equal to the maximum height such that someone else needs to climb a mountain that high. The set of degrees greater than or equal to the maximum height such that Kyle needs to climb a mountain less high than that starts at the height of her 'greater need' all other things being equal, since only there does it become the case that it is not necessary for her to climb a mountain higher than that. The sandwich problem therefore arises in upstairs de dicto contexts as well.

The tractability of the DP-exteral analysis in this case hinges on the question of whether a given need-situation encompasses every need that one has at that time, and by analogy, whether a 'must' situation encompasses every requirement, etc. Consider a denotation for *need* as in (33) on the model of the analysis of necessity modals in Kratzer 1981, 1991, 2012. *Need* contributes universal quantification over possible worlds compatible with a modal base. It holds of an individual-situation relation P, an individual x, and a situation if and only if every world compatible with what the individual needs in that (need) situation has a subpart (itself a situation) in which x has property P. Recall that situations are parts of possible worlds.

(33) $\lambda P_{\langle e,\langle s,t\rangle\rangle}\lambda x_e\lambda s_s$. $\forall w$ if w conforms to what x needs in s, then $\exists s'$ $s' \sqsubseteq w$ & $P(s')(x)$

Plugging the individual-situation relation *climb a d-high mountain* into the P-slot in (33) yields (34).

(34) $\lambda x_e\lambda s_s$. $\forall w$ if w conforms to what x needs in s, then $\exists s'$ $s' \sqsubseteq w$ & x climbs$_{s'}$ a d-high mountain

If replace the string *x needs to climb a d-high mountain* in all its occurrences in the tree in (32a) with what follows the period in (34), we get the denotation represented in (35) for (32a), corresponding to the formula at the top node of (32b) with the relevant adjustments. For perspicuity's sake I list the main components of the formula on separate lines in (35).

For (32a) to be true, the degree set in (35b) must be a proper superset of the degree set in (35d) in some need situation of Kyle's s.

(35) a. $\exists s$
b. $\{d \mid \max(\lambda d' \ . \ \forall w$ if w conforms to what Kyle needs in s, then $\exists s'' \ s'' \sqsubseteq w$ & Kyle climbs$_{s''}$ a d'-high mountain$)\leq d\}$
c. $\supset$
d. $\{d \mid \exists x' \neq Kyle \ \exists s' \neq s \ \max(\lambda d'. \ \forall w$ if w conforms to what x needs in s', then $\exists s''$ $s'' \sqsubseteq w$ & x' climbs$_{s''}$ a d'-high mountain$)\leq d\}$

Recall that Kyle needs to climb a 1000m mountain and a 2500m mountain. Therefore, in all the worlds that conform what what Kyle needs in s, there is a situation in that world in which she climbs an (at least) 1000m mountain and a situation in which she climbs an (at least) 2500m mountain. Therefore, the maximum degree such that in all her need worlds, there is some situation in which she climbs a mountain that high, is 2500. Then, the degrees greater than or equal to the maximum degree such that in all worlds conforming to Kyle's needs, there is a situation in which she climbed a mountain that high, constitute the set (2500, ∞). This set does not contain the corresponding sets for the alternatives to Kyle, since everyone else needs to climb a mountain less high than the 2500m mountain that Kyle needs to climb. If the situation theoretic implementation of the DP-internal analysis of the superlative is correct, then something else is missing from this analysis.

In fact, observations independent of the behavior of the superlative suggest that needs are more differentiated than the definition in (33) captures. I turn to this evidence below, after presenting a concrete amendment to the definition fo *need* in (33). Specifically, I propose that *need* requires there to be a situation in every world compatible with the need situation s that is the unique fulfilment of that need in that world. 'Fulfilment' is the relation between a situation of having a modal relation to a proposition (a need, a requirement, an obligation, or in existential contexts a possibility) and a situation in virtue of which the need, requirement, etc. is met in that world, or the possibility manifested. The definition in (36) for *need* is that in (33) with the additional criterion that the situation s' fulfils the need situation s and

further that no other situation in w fulfils s. In this manner, need situations are paired with possible situations that fulfil those needs.

(36) $\lambda P_{\langle e,\langle s,t\rangle\rangle}\lambda x_e\lambda s_s$. $\forall w$ if w conforms to what x needs in s, then $\exists s'$ $s' \sqsubseteq w$ & fulfil(s', s) & $P(s')(x)$ & $\forall s'' \sqsubseteq w$ fulfil$(s'', s) \rightarrow s'' = s'$

Additing this criterion to the truth condition in (35) yields (37).

(37) a. $\exists s$
b. $\{d \mid \max(\lambda d'$. $\forall w$ if w conforms to what Kyle needs in s, then $\exists s''$ $s'' \sqsubseteq w$ & fulfil(s'', s) & Kyle climbs$_{s''}$ a d'-high mountain & $\forall s''' \sqsubseteq w$ fulfil$(s''', s) \rightarrow s''' = s'') \leq d\}$
c. $\supset$
d. $\{d \mid \exists x' \neq Kyle\ \exists s' \neq s \max(\lambda d'$. $\forall w$ if w conforms to what x' needs in s', then $\exists s''$ $s'' \sqsubseteq w$ & fulfil(s'', s') & x' climbs$_{s''}$ a d'-high mountain & $\forall s''' \sqsubseteq w$ fulfil(s''', s') $\rightarrow s''' = s') \leq d\}$

Recall that Kyle has a need to climb a 1000m mountain in the sandwich scenario in addition to her need to climb a 2500m mountain. There is therefore a situation—namely the one in which she needs to climb a 1000m mountain—in which the maximum degree d such that in all worlds compatible with that need, she climbs a d-high mountain in the unique fulfilment of that need in that world, is '1000'. The set of degrees greater than or equal to 1000 is (1000, ∞), which property contains the degree sets that this formula associates with her counterparts in the sandwich scenario, correctly predicting the truth of (32a) in that context.[3]

The notion that needs are differentiated in the way described above is corroborated by

[3]The unique fulfilment of the need could be one that exceeds the need. A possible situation in which Kyle climbs a 1500m mountain is one that could fulfil her need to climb a 1000m mountain. Crucially, she does not climb a 1500m mountain in *all* the situations that fulfil that need, but she does climb an at least 1000m mountain in all the situations that fulfil that need. Additionally, the fact that there is a unique fulfilment of a need situation in every world compatible with the that need does not mean there is only one situation meeting the underlying description in each of those worlds. If Kyle needs to climb a 1000m mountain, a world in which she climbs a 1000m mountain, a 1500m mountain and a 2000m mountain is compatible with her need, but according to (36) only one of these mountain climbing situations may count as a fulfilment of the need in that world. We would not normally be forced to take a pick, knowing that any would do. Non-linguistic criteria might guide the choice if necessary. In the case of eventive predicates like climbing mountains, temporal precedence seems to play a role. If Kyle, who needs to climb a 1000m mountain, first climbed a 1000m mountain and then went on to climb a 1500 mountain, I would be reluctant to say that she met her need by climbing the 1500m mountain, since that need had already been met by climbing the 1000m mountain.

the following consideration. The fact that (38) is felicitous is at first somewhat surprising, since the semantic context of the first clause entails that of the second. Given the first clause, the second does not add anything new. But intuitively, the second clause of (38) describes a new need distinct from the first. The definition in (36) makes it possible to capture this intuition, since it attributes a situation argument to *need* and to the two need situations in (38) different conditions on their fulfill]ment.

(38) Kyle needs to climb a 2500m mountain. She also needs to climb a 1000m mountain.

In its treatment of *need*, the analysis proposed here displays an abstract similarity to an aspect of Sharvit and Stateva's (2002) DP-internal analysis of superlatives in upstairs de dicto contexts that I describe here, and take the opportunity to compare the two analyses in more detail. Sharvit and Stateva propose that in interpreting superlative *least* in the upstairs de dicto reading of sentences like (32a), the modal verb *need* ranges only over possible worlds in which everyone climbs the lowest mountain that fulfils their needs, and there are no other mountains. Then, having the greatest (or least) 'need' is tantamount to climbing the highest (or lowest) mountain in each of these worlds.

Specifically, Sharvit and Stateva derive the upstairs de dicto reading of sentences like (32a), repeated in (39a) below, from the LF in (39b), where *least* occurs at the NP edge and the covert operator IDENT′-W* applies to the whole NP. The numerals are abstraction indices (they discuss a parallel example with *est* on pp. 479-481; I have modified their example slightly to be directly pertinent to the sandwich scenario described above).

(39) a. Kyle needs to climb the least high mountain.
b. Kyle needs [1 [PRO to climb-w_1 [the-$\mathscr{J}$ [IDENT′-W* [2 [least [high mountain-w_2]]]]]-w_1]]

The constituent beginning with the index '2' in (39b) denotes an intensionalized property, a relation between worlds and the property of being the least high mountain in that world. IDENT′-W* combines with such a property P and derives the set of intensionalized properties that have the same extension as P in every world in the contextually supplied set of worlds

W*. The worlds relevant to the interpretation of (39a) are worlds that minimally satisfy everyone's needs. If as before Kyle needs to climb a 1000m mountain and a 2500m mountain, Parker a 1500m mountain and Alex a 2000m mountain, then W* contains all the worlds in which Kyle climbs one mountain that is exactly 1000m high and another that is exactly 2500m, Parker climbs an exactly 1500m mountain and Alex an exactly 2000m mountain, and there are no other mountains. The constituent [IDENT′-W* [2 [least [high mountain-w_2]]]] in (39b) then denotes the set of properties extensionally equivalent to the property of being the least high mountain in every world in W*, in this case, the set containing the property *be a 1000m mountain*. The definite article then applies to this constituent, denoting in this case not its usual function from sets of individuals to individuals but a lifted function from sets of properties to properties. The article also carries a domain restriction $\mathscr{J}$ that, like W*, is contextually determined, denoting a set of properties made salient by the context. The article then maps a set of properties $\mathscr{P}$ (what its complement denotes) to the unique property that is in both that set $\mathscr{P}$ and in $\mathscr{J}$ as well. In the sandwich scenario, the value the context makes salient for $\mathscr{J}$ is the set of properties {*be a 1000m mountain, be a 1500m mountain, be a 2000m mountain, be a 2500m mountain*}. *The-*$\mathscr{J}$ then derives the unique property P which is a member of $\mathscr{J}$ and which in each world in W* has the same value as the property of being the least high mountain. This is the property *be a 1000m mountain*. This property is interpreted as a restriction on the internal argument of *climb*, so that (39a) is true just when Mary needs to climb a 1000m mountain, correctly predicting that (39a) is true in the sandwich scenario without movement of *est* out of the NP it is base generated in.

The role of W* in Sharvit and Stateva's analysis bears an abstract similarity to the notion of a 'fulfiling' situation in the analysis I have proposed here. By restricting our attention to W* in the evaluation of needs, we consider only the worlds in which everyone's minimal needs are met. Since these needs are fixed by the context, such worlds differ only in the mountains they contain, not in their heights; now we can (indirectly) pick out the lowest (or

highest) such mountain.

In the analysis I have proposed, the notion of fulfilment of a need plays the role of differentiating need situations, which makes it possible to single out the least (or greatest) need on the basis of mountain heights in examples like (39a). These fulfilling situations do not need to be 'minimal' in the sense required of W* (see footnote 3) but only the minimal requirement is met in all possible worlds compatible with the need. Examples like (38) seem to show that the relevant adjustment to the meaning of *need* (and by analogy other modal verbs) is one that is called for anyway. This analysis builds the differentiation necessary into the meaning of *need* itself in (36), rather than into a null operator at work only in upstairs de dicto contexts. The denotation for *need* in (36) works in concert with an analysis of *little* and superlative *est* that incorporates a situation argument, to generate the correct readings of superlatives in sandwich scenarios in the framework of a DP-external analysis of relative readings of the superlative. At the very least, this approach shows that a DP-external analysis of the superlative is not inherently afflicted with the sandwich problem, whatever other advantages or disadvantages it may have. In the following section, I claim that this analysis has one more advantage over a DP-internal analysis, when it comes to comparative constructions.

5 Comparatives in sandwich scenarios

Sharvit and Stateva (2002) attribute a more standard semantics to comparative *er* and *less* than they do superlative *est* and *least*, one in which we compare degree sets. According to them, *Parker climbed a less high mountain than Alex* is true if the set of degrees such that Parker climbed that high a mountain is a subset of the set of degrees such that Alex climbed that high a mountain. In principle, this definition invites the sandwich problem: if Alex climbed both a higher and a lower mountain than Parker, the higher mountain is cannot be ignored in the calculation of degrees such that Alex climbed that high a mountain.

This predicts that the sentence *Parker climbed a less high mountain than Alex* is true in the sandwich scenario.

Sharvit and Stateva claim that the judgments in such cases are not decisive, and so they do not hold comparative constructions accountable to the sandwich problem. Büring (2007a) disagrees on the basis of a scenario like the following. Suppose Mary knows one very cheap and one very expensive method for producing a certain product, and Bob knows a method intermediate in cost. Since I would normally want to know the cheapest way of producing the product, I would feel misinformed if you told me *Ask Bob, he knows a less expensive method than Mary* (40), since Mary knows a still less expensive method. But again, the standard degree-semantic characterization of *less* predicts that (40) is true in this sandwich scenario, since the method Bob knows is less expensive that the more expensive of the two methods that Mary knows.

(40) Bob knows a less expensive method than Mary.

Büring (2007a) considers applying a version of Sharvit and Stateva's analysis of superlatives to comparatives, where we compare not degree sets but sets of entities, and the *than*-clause *than Mary* denotes the set of methods that Mary knows. If (40) means that Bob knows a method which is less expensive than any entity in the set of methods that Mary knows, we correctly predict this assertion to be false in the sandwich scenario just described. But Büring shows that this approach makes the wrong predictions about modal contexts like (41), which is predicted to mean that you bought a house which is more expensive than any house I thought you would buy, parallel to the interpretation of (40) that asserts that Bob knows a method that is less expensive than any method Mary knows. But (41) does not require me have thought you would buy any particular houses. Büring ends with the conclusion that the Heim/Szabolcsi style DP-external approach has more generality than Sharvit and Stateva's system all told, but does not seem to be able to shake off the sandwich problem.x

(41) You bought a more expensive house than I thought you would.

The situation argument attributed to *little* in (16) plays a role both in its superlative derivative *least* and its comparative derivative *less*. Like the superlative *est*, comparative *er* must be defined in a way that is compatible with the situation argument that *little* brings with it, and if this situation argument resolves the sandwich problem in superlatives, it should have the same effect in comparatives. I claim that this is so, on the basis of the definition for comparative *er* in (42), which relates two degree descriptions (based on Heim 2006:p. 9) with situation arguments (based on the considerations above).

(42) $[\![\text{er}]\!] = \lambda P_{\langle d,\langle s,t\rangle\rangle}\lambda Q_{\langle d,\langle s,t\rangle\rangle}\lambda s_s.\{d \mid Q(d)(s)\} \supset \{d \mid \exists s\ P(d)(s)\}$

This definition corresponds to the 'clausal' or 'indirect' analysis of the comparative, according to which *er* relates two degree descriptions P and Q (with situation arguments), corresponding to the *than*-clause and the matrix clause respectively. The main clause is construed as a degree description by virtue of movement of the degree phrase headed by *er*. The *than*-clause is a full clause according to this approach, in which the phonological material that it shares with the main clause has been elided, and is construed as a degree description by virtue movement of a null operator (*Op* in (43a)).

The base structure of (40) looks like (43a) from this perspective, where the entire comparative phrase [er than Mary knows a [[Op-little]-expensive method]] sits in the degree argument slot of the quantity adjective *little*, which in turn sits in the degree argument slot of the quality adjective *expensive* that occurs in the main clause. Movement of *little* together with the comparative clause and insertion of the abstraction index 1 yields the structure in (43b).

(43) a. Bob knows a [[$_{\text{DegP}}$ er than Mary knows a [[Op-little]-expensive method]]-little]-expensive method

b. [[$_{\text{DegP}}$ er than Mary knows a [[Op-little]-expensive method]]-little] 1 Bob knows a t_1-expensive method

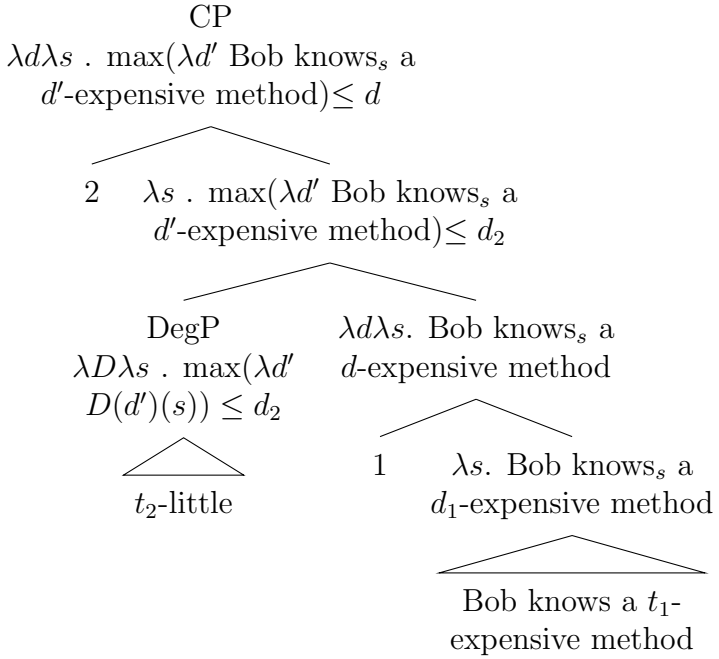
Subsequent movement of the comparative phrase with insertion of the abstraction index

2 yields the structure in (44).

(44) [$_{\text{DegP}}$er than Mary knows a [[Op-little]-expensive method]] [$_{\text{CP}}$ 2 [t_2-little] 1 Bob knows a t_1-expensive method]

The constituent labeled 'CP' in (44) has the semantic composition in (45)

(45)



Regarding the constituent labeled DegP in (44), here, too, the quantity adjective *little* moves together with the operator Op that later is responsible for abstraction over the degree argument of *little*, deriving (46).

(46) [$_{\text{DegP}}$ er than [Op-little] 3 Mary knows a [t_3-expensive method]] [$_{\text{CP}}$ 2 [t_2-little] 1 Bob knows a t_1-expensive method]

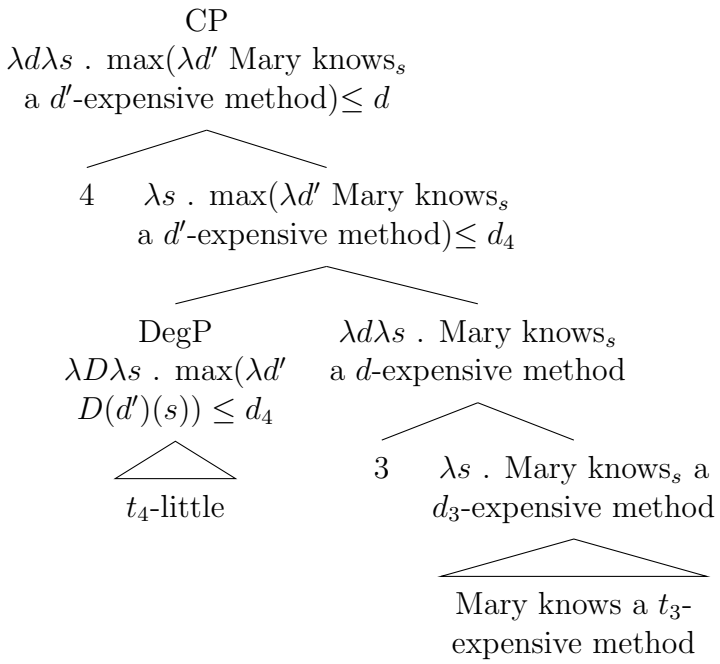
Lastly, the operator Op, itself vacuous, moves to a position where it triggers insertion of the abstraction operator 4. Op movement in DegP parallels DegP movement itself in the main clause.

(47) [$_{\text{DegP}}$ er than [$_{\text{CP}}$ Op 4 [t_4-little] 3 Mary knows a [t_3-expensive method]]] [$_{\text{CP}}$ 2 [t_2-little] 1 Bob knows a t_1-expensive method]

The CP within DegP in (47) has the semantic composition in (48), in which I omit Op,

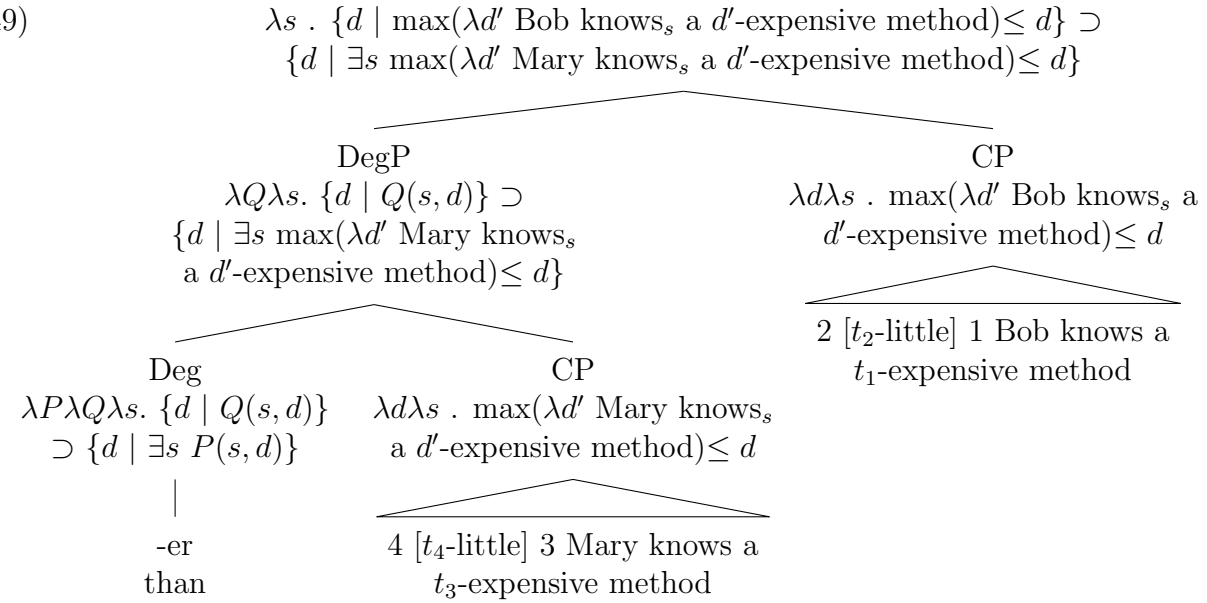
whose only role is to introduce abstraction index 4.

(48)



Treating *er than* as a single morpheme for perspicuity's sake, the comparative composes first with the tree in (48) and then with that in (45), deriving the structure in (49).

(49)



With existential closure over the situation argument of the denotation generated in (49), it asserts that there is a situation such that the set of degrees greater than or equal to the maximum degree such that Bob knows that expensive a method in that situation is a

superset of the set of degrees d such that there is a situation in which d is greater than or equal to the maximum degree such that Mary knows that expensive a method in that situation.

If the two methods Mary knows cost \$2 and \$10 respectively and Bob's costs \$5, then the first set is the set $(5,\infty)$. If, as before, a situation of knowing a certain method x is a distinct knowing-situation from the situation of knowing a certain method y distinct from x (since one could know one of these methods without knowing the other), then the second set starts at two, since two is a degree such that there is a situation (the situation in which she knows the less expensive of the two methods she knows) in which that degree (i.e., two) is greater than or equal to the maximum degree such that she knows a method that expensive in that situation (which is two). This set also includes three, four, etc. Since Bob's set $(5,\infty)$ is not a superset of Mary's set $(2,\infty)$, (40) is predicted to be false in the sandwich scenario, which accords with the sense that (40) is underinformative in the sandwich scenario, since one would normally be invested in finding the cheapest method. The situation theoretic analysis of the DP-external superlative therefore extends naturally to comparative constructions.

6 Conclusion

In this paper, I have claimed that taking the aspectual/situation argument of the underlying description into account in the interpretation of quantity adjectives like *little* and of comparatives and superlatives, gives rise to interpretations that do not fall victim to the sandwich problem. Existential quantification over that situation argument has scope over *little*. As a result, instantiations of degree are relativized to a particular situation. In this framework, the sandwich problem does not arise, even if the superlative and comparative degree quantifiers are interpreted at a distance from the degree variable they bind, as in the DP-external analysis of Heim (1985, 1999) and Szabolcsi (1986).

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