# The syntax and semantics of multiple degree modification in English

**Christopher Kennedy**
Department of Linguistics
University of Chicago
1010 E 59th Street
Chicago, IL 60637 USA
ckennedy@uchicago.edu

**Louise McNally**
Dept. Traducció i Filologia
Universitat Pompeu Fabra
La Rambla, 30-32
08002 Barcelona Spain
louise.mcnally@upf.edu

## 1 Multiple degree modification in English

In this paper we offer an integrated syntactic and semantic analysis of various cases of multiple degree modification in English, some examples of which appear in (1).

(1) a. a new tower 10 feet taller than the Empire State Building
b. an old department store a lot less taller than the city hall building than is the new company headquarters
c. a structural engineer very much more afraid of heights than the architect

To our knowledge, no such integrated proposal exists for this kind of modification in the HPSG literature. Pollard and Sag (1994) broadly sketch a syntactic analysis of multiple degree modification. However, because it lacks a semantics, their analysis does not make very specific predictions about the restrictions on various combinations of multiple degree modifiers. Although we show that some of these restrictions are matters of pragmatic or lexical semantic detail, others turn out to involve fundamental aspects of the syntax and semantics of degree modification. In contrast, Abeillé and Godard (2003) present a detailed syntax and semantics for French degree adverbs, but their analysis is situated more in the context of a general analysis of adverbial modification, rather than within the context of a complete treatment of degree modification. As a result, their analysis does not address multiple degree modification or differences in the distributions of different subclasses of degree expressions; on the other hand, nothing in our analysis will conflict in important ways with their proposal.

As the syntax of multiple degree modification is tightly bound up with the semantics of the expressions involved, we begin by presenting our semantic assumptions. We follow Kennedy (1999) in analyzing gradable adjectives and related experssions (such as the vague determiners *many* and *few*) as measure functions, which map individuals to degrees on a scale (type $\langle e, d\rangle$). Measure functions are converted to properties of individuals by degree morphology; in Kennedy's analysis, the category of degree expressions includes measure phrases (e.g. *10 feet*), comparative morphemes (e.g. *-er/more, less, as*), intensifiers (e.g. *very*), and the phonologically null positive degree morpheme *pos* (for the 'positive', unmarked form of a gradable adjective, e.g., *(is) tall*). Such expressions take a measure-function and return a property of individuals that is expressed as a relation between two degrees: one determined by applying the measure function to the argument of the predicate; the other introduced by the degree morpheme (the 'standard value').

For example, the comparative morpheme *more* has the denotation in (2) in Kennedy's analyis.

(2) $\llbracket more \rrbracket = \lambda g \in D_{\langle e,d\rangle} \lambda d \lambda x . g(x) \succ d$

The degree argument is expressed by the comparative clause (the constituent introduced by *than*), which denotes a maximal degree (von Stechow, 1984). A simple comparative predicate like (3a) is assigned the denotation in (3b): it is true of an object if it has a degree of height that exceeds the maximal

degree to which the Empire State Building is tall.[1]

(3) a. [[more tall] [than the Empire State Building ~~is tall~~]]
b. $\lambda x.\textbf{tall}(x) \succ max\{d' \mid \textbf{tall}(\textbf{the ESB}) \succeq d'\}$

A problem with this approach is that multiple degree modification facts such as those illustrated in (1) and other data strongly suggest that neither comparative morphemes nor intensifers really belong in the category of degree morphology as defined above. For example, (1b) shows that a comparative can modify another comparative, which is unexpected on Kennedy's analysis, since he treats degree morphemes as type-changing: he would be forced to hypothesize that e.g. *less* can combine not only with measure function-denoting expressions (when it takes a simple adjective) but also with property-denoting ones (when it combines with a comparative+adjective complex). This is not a typical case of type polymorphism.

Similar comments apply to intensifiers. Although it is sometimes claimed to the contrary, a number of combinations of multiple intensifiers are possible (as even a simple Google search will demonstrate):

(4) a. very much alone
b. rather very good
c. rather quite interesting

Again, Kennedy's treatment of intensifiers as type changing forces one to adopt a rather ad hoc type polymorphism to account for the fact that these expressions modify both adjectives and other intensifiers.

In contrast to the comparative morphemes and intensifiers stand a group of degree expressions that 'close off' the predicate they combine with; these include (at least) measure phrases, degree *this/that*, proportional modifiers like *completely* and *half*, and the *wh*-degree morpheme *how*. These expressions can combine with an unmodified adjective or with a comparative (provided a system of measurement is defined for the adjective in the case of measure phrases), as shown in (5) for the measure phrase *2 meters* and degree *that*.

(5) a. 2 meters/that tall
b. 2 meters/that {taller, less tall, too tall}

However, they do not accept further modification (6a), nor can they further modify an intensifier (6b) (we assume the *much* in (5b) is a dummy element; see (Corver, 1997)):

(6) a. *rather 2 meters/that long
b. *2 meters/that very long

## 2 Three classes of degree expressions and one lexical rule

In this paper, we develop an analyis in which degree expressions are divided into three subclasses: (true) DEGREE MORPHEMES, which map gradable adjectives into properties of individuals; INTENSIFIERS, which affect the computation of the standard of comparison for the positive form; and SCALE ADJUSTERS, which modify the measure function expressed by the adjective. In addition, we assume a lexical rule to handle the interpretation of the unmarked positive form.

### 2.1 The positive form

As noted above, Kennedy (1999) assumes that the positive form involvues a null degree morpheme *pos*, which maps a gradable adjective to a property of individuals that expresses a relation to a context-dependent standard of comparison (see also (Bartsch and Vennemann, 1972), (Cresswell, 1977), (Klein, 1980), (von Stechow, 1984), (Kennedy, 1999), (Kennedy and McNally, 2005)). The positive form of an adjective like *tall* is thus analyzed as the predicate [$_{\text{AP}}$ *pos* tall], which denotes the property of having a degree of length that exceeds a standard of length whose value is determined based on features of the context of utterance (what is being talked about, the interests/expectations of the participants in the discourse, etc.; see (Lewis, 1970), (Bogusławski, 1975), (Graff, 2000), (Barker, 2002), (Kennedy and McNally, 2005)). Here we take the (possibly universal) absence of overt morphology in the positive form at face value and instead assume a lexical rule that maps measure functions to

[1] We assume for simplicity here that the comparative clause is an ellipsis structure; this issue is orthogonal to the main concerns of this paper. See (Kennedy, 2002) for a compositional analysis. Likewise, we abstract away from the morphological alternation between *more* and *-er*.

properties of individuals in the absence of overt degree morphology. This rule (whose particular implementation is not crucial for our purposes) is stated in (7), where **stnd** is a context-dependent function from a measure function (a 'basic' gradable adjective meaning) to a degree in the range of the measure function (its scale) that represents an appropriate standard of comparison for the gradable property measured by the adjective in the context of utterance. (Compare Lewis' (1970) and Barker's (2002) DELINEATION FUNCTION.)

(7)
$$\begin{bmatrix} \text{cat} & \text{A} \\ \text{cont} \mid \text{rest} & \begin{bmatrix} \text{reln} & \boxed{1} g_{\langle e,d\rangle} \\ \text{arg1} & \boxed{2} x \end{bmatrix} \end{bmatrix} \Rightarrow$$
$$\begin{bmatrix} \text{cat} & \text{AP} \\ \text{cont} \mid \text{rest} & \begin{bmatrix} \text{reln} & \succ \\ \text{arg1} & \boxed{1} \\ \text{arg2} & \boxed{2} \\ \text{arg3} & \textbf{stnd}(\boxed{1}) \end{bmatrix} \end{bmatrix}$$

With this as our starting point, we now turn to the analysis of degree morphology.

### 2.2 True degree morphemes

This category contains expressions of type $\langle\langle e, d\rangle, \langle e, t\rangle\rangle$; in English: *how*, *that*, and measure phrases. These behave as in (Kennedy, 1999), mapping a measure function onto a property of individuals expressed as a relation between degrees: the degree derived by applying the measure function to the individual argument of the predicate, and a standard degree specified by the degree morpheme itself. For example, in the case of measure phrases, this is the correponding degree of measurement, as illustrated by our analysis of the measure phrase *2 meters* (8).

(8)
$$\begin{bmatrix} \textit{2 meters} & \\ \text{cat} & \text{Deg} \\ \text{cont} \mid \text{rest} & \begin{bmatrix} \text{reln} & \succeq \\ \text{arg1} & g \\ \text{arg2} & x \\ \text{arg3} & \textbf{2 meters} \end{bmatrix} \end{bmatrix}$$

### 2.3 Intensifiers

We analyze intensifiers as traditional predicate modifiers (type $\langle\langle e, t\rangle, \langle e, t\rangle\rangle$), which are restricted to apply only to gradable predicates in the positive form. We derive this restriction from their semantics, treating them as expressions that modify the **stnd** function introduced by the positive form rule in (7) (cf. (Wheeler, 1972), (Klein, 1980)). This proposal is based on two observations. First, the semantic effect of intensification is to 'adjust' the contextually determined standard of comparison. Second, the distribution of degree modifiers is highly sensitive to the type of standard of comparison associated with particular *pos*+adjective combinations (whether the standard is context dependent or lexically determined by the adjectival head; see Kennedy and McNally's (2005) analysis of *very* vs. *much*).

Consider for example the case of *very*. Both *tall* and *very tall* require an object to exceed a contextual standard of height, but the standard of comparison introduced by the latter is greater than that used by the former. Following Wheeler (1972) and (1980), we derive this result by assuming that *very* modifies the **stnd** function associated with its argument (an adjective to which the lexical rule in (7) has applied) so that it computes a standard of comparison based on just the heights of those objects that its argument is true of. That is, [$_{\text{AP}}$ *very tall*] is (syntactically and semantically) just like [$_{\text{AP}}$ *tall*], except that the standard of comparison for the former is computed by considering only those objects that count as tall in the context of utterance. General principles of informativity ensure that the modified **stnd** function will select a new standard of comparison partitions the domain of [$_{\text{AP}}$ *very tall*] into things it is true of and things it is false of, effectively boosting the base standard associated with [$_{\text{AP}}$ *tall*] (i.e., some tall objects will not count as very tall).

This proposal is made explicit in (10) (after the References section). For the puposes of illustration, we adopt Kasper's (1997) treatment of nonintersective modification, where the MOD feature is split up into information about the ARGument of the modifier (including its internal content) vs. the (External) CONTent of the resulting phrase.

Our analysis explains why measure phrases (or rather, measure phrase + adjective combinations)

cannot be intensifed, even though their semantic (and syntactic) type should in principle allow for it. The difference between [$_{\mathrm{AP}}$ MP A] (a type $\langle e,t\rangle$ predicate consisting of a measure phrase plus gradable adjective) and [$_{\mathrm{AP}}$ A] (a positive form gradable adjective to which the rule in (7) has applied) is that the latter is evaluated with respect to the **stnd** function but the former is not. As a result, there is no value for an intensifier to manipulate, so the addition of an intensifier has no semantic effect.

### 2.4 Scale adjusters

This category includes comparatives and *too/enough*, after they have been saturated by their internal (clausal) arguments; their semantic type is that of gradable adjective modifiers ($\langle\langle e,d\rangle,\langle e,d\rangle\rangle$). Specifically, we claim that these expressions modify the measure function they take as input by resetting the maximal or minimal value (depending on the morpheme) to the degree introduced by the comparative clause. For example, *more than CP* (where CP is the comparative clause) takes a measure function and assigns it a new scale whose minimal value is the degree denoted by CP. Thus if *tall* is a function that maps an individual onto whatever part of the height scale corresponds to its height, *taller than the Empire State Building* maps an individual onto whatever region of the height scale represents its 'taller-than-the-ESB-ness': an object whose height is less than or equal to the maximal degree of the Empire State Building's height is mapped onto the zero element of the derived scale, and all others are mapped onto their actual height value. This is made explicit in (11) (after References).

The result of this analysis is that expressions consisting of an adjective plus comparative morphology must ultimately either undergo the positive form rule in (7) or combine with a true degree morpheme (e.g. a measure phrase) in order to derive a property of individuals. Assuming that the positive form of an adjective that uses a scale with a minimal element is true of an object as long as it has a non-minimal degree of the relevant property (Kennedy and McNally, 2005), the result is that *taller than CP* is true of an object if its height exceeds the degree denoted by the CP (the minimal element of the derived scale). In other words, *taller than the Empire State Building* is true of an object just in case its height exceeds that of the Empire State Building, which is exactly what we want.

## 3 Predictions of the analysis

In our presentation, we go through the analysis of complex modification structures like those in (1) in detail; here we outline the predictions about possible combinations of degree expressions made by our proposals:

1. Iteration of comparative expressions and intensifiers should be possible.
2. Iteration of true degree morphemes should not be possible.
3. Measure phrases should be external to all comparative morphology.
4. Under the assumption that intensifiers and scale adjusters are not reanalyzable as intersective (unlike, e.g., what is the case with many adjectives or adverbs), iterations both of comparatives and of intensifiers must be interpreted in a nested right-branching fashion, rather than in a left branching fashion, as predicted on Pollard and Sag's Specifier analysis.

The data presented above illustrate 1-3; 4 is difficult to test because of the rarity of sequences of more than 2 intensifiers, but appears to be borne out by the fact that the interpretation of the string in (9a) corresponds on our intuitions to the bracketing in (9b) rather than that in (9c).

(9) a. Becca was rather very slightly drunk last night (www.elvislovers.fanspace.com/fsguestbook.html)
b. (rather (very (slightly)))
c. *((rather (very))(slightly))

## 4 Concluding remarks

Our HPSG implementation of degree modifiers combines intensifiers and scale adjusters with their semantic arguments in Head-Adjunct structures, while true degree morphemes combine with their arguments in a Head-Specifier structure. Our analysis

thus resembles Abeillé and Godard's insofar as they argue for a Head-Adjunct analysis of French degree adverbs. It refines their proposal in allowing (at least in English) for two types of degree Adjuncts: those that operate on 'bare adjectives' (measure functions), and those that operate on gradable APs (i.e., on the **stnd** function introduced by the positive form). Kennedy and McNally's (2005) comments concerning the semantics of the degree modifier *well* indicate that these two types are clearly justified.

Nonetheless, the analysis also preserves the essence of the insight behind Pollard and Sag's proposal, on which degree expressions are treated as specifiers of adjectives, adverbs or other gradable predicates in a Head-Specifier configuration. It simply reduces the class of expressions that have this specifying function, as a result of having refined the semantics of degree modification.

A question of broader theoretical interest is why the set of degree expressions should be divided up in the way we have proposed here. We claim that this is a natural result of our initial assumptions that gradable adjectives have basic meanings as measure functions, and 'derived' meanings (in the positive form) as context-dependent properties of individuals (where context dependence comes from the **stnd** function). If the basic semantic type of a gradable adjective is $\langle e, d\rangle$ (a measure function), then there should exist overt morphology (in addition to our positive form lexical rule) that converts a gradable adjective to a property of individuals: this is our class of true degree morphemes. Furthermore, if natural language quite generally allows expressions of type $\langle \tau, \tau\rangle$, there should also exist a class of modifiers of measure functions: these are our scale adjusters. By the same token, we also expect to find modifiers of the type $\langle e, t\rangle$ variant of a gradable adjective (the positive form): this is our class of intensifiers.

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(10)

$$\left[\begin{array}{ll} \textit{very} & \\ \text{cat} \mid \text{head} & \left[\begin{array}{ll} \text{mod} & \left[\begin{array}{ll} \text{arg} & \left[\begin{array}{ll} \text{cat} & \text{AP} \\ \text{cont} & \boxed{1}\left[\begin{array}{ll} \text{reln} & \succ \\ \text{arg1} & g \\ \text{arg2} & x \\ \boxed{2}\text{arg3} & \textbf{stnd}(g) \end{array}\right] \end{array}\right] \\ \text{econt} & \boxed{3}\left(\boxed{1}\right) \end{array}\right] \end{array}\right] \\ \text{cont} & \boxed{3}\left[\begin{array}{ll} \text{reln} & \textbf{recompute-stnd}_{very} \\ \text{arg1} & \boxed{1} \end{array}\right] \end{array}\right]$$

(11)

$$\left[\begin{array}{ll} \textit{more than} & \\ \text{cat} \mid \text{head} & \left[\begin{array}{ll} \text{mod} & \left[\begin{array}{ll} \text{arg} & \left[\text{cont} \left[\text{index} \quad \boxed{1}g\right]\right] \\ \text{econt} & \boxed{2}\left(\boxed{1},d\right) \end{array}\right] \\ \text{val} & \left[\text{comps} \quad \left\langle \text{CP}_d \right\rangle\right] \end{array}\right] \\ \boxed{2}\text{cont} & \left[\begin{array}{ll} \text{reln} & \textbf{more-than} \\ \text{arg1} & g \\ \text{arg2} & d \end{array}\right] \end{array}\right]$$