

# SCALE STRUCTURE AND THE SEMANTIC TYPOLOGY OF GRADABLE PREDICATES

Christopher Kennedy      Louise McNally  
*Northwestern University      Universitat Pompeu Fabra*

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In this paper we develop a semantic typology of gradable predicates, with special emphasis on deverbal adjectives. We argue for the linguistic relevance of this typology by demonstrating that the distribution and interpretation of degree modifiers is sensitive to its two major classificatory parameters: (1) whether a gradable predicate is associated with what we call an OPEN or CLOSED scale and (2) whether the standard of comparison for the applicability of the predicate is ABSOLUTE or RELATIVE to a context. We further show that the classification of adjectives within the typology is largely predictable. Specifically, the scale structure of a deverbal gradable adjective correlates either with the algebraic part structure of the event denoted by its source verb or with the part structure of the entities to which the adjective applies. These correlations underscore the fact that gradability is characteristic not only of adjectives but also of verbs and nouns, and that scalar properties are shared by categorially distinct but derivationally-related expressions.\*

**1. DEGREE MODIFICATION IN DEVERBAL GRADABLE ADJECTIVES** Among the many observations made in Bolinger's (1972) classic study of degree expressions in English, two stand out. First, degree modifiers in English have distributions which cannot be given a purely syntactic explanation. This fact is illustrated by the case of *well*, *much* and *very*. At a superficial level, these three modifiers appear to have very similar syntactic and semantic properties: they all apply to deverbal gradable adjectives, and they all 'boost' the degree to which the deverbal adjective holds of its subject. In (1), for example, the addition of the degree modifiers increases the degree to which the properties are claimed to hold of their respective subjects in roughly the same way.

- (1)    a.    Beck was (well) acquainted with the facts of the case.  
      b.    Their vacation was (much) needed.

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- c. Al was (very) surprised by the results of the election.

Despite these similarities, however, these modifiers differ in terms of their acceptability with different adjectival participles. In fact, as shown by the following examples, their distributions are largely complementary (see Knowles 1974 for discussion of the complementarity of *very* and *much*):

- (2) a. Martin Beck is well/??very/??much acquainted with the facts of the case.  
 b. This is a well/??very/??much known problem.  
 c. The facts are well/??very/??much understood.  
 d. The concert seemed well/??very/??much publicized.  
 e. The well/??very/?much documented abuse of public funds continued during subsequent administrations.
- (3) a. Department chair is a much/??well/??very desired position.  
 b. She took a much/??well/??very needed rest.  
 c. That film was much/??well/??very praised.  
 d. This novel seems to be much/??well/??very talked about in the trade journals.
- (4) a. A very/??well/??much surprised face peered out of the window.  
 b. Kim was very/??well/??much pleased by the reviewers report.  
 c. People should very/??well/??much concerned by the changes in global weather patterns.

These judgments are mirrored by distributional asymmetries in corpus data, as illustrated by the numbers in Table 1. These counts are from the first edition of the British National Corpus (<http://info.ox.ac.uk/bnc>), and reflect the number of hits in a search of approximately 100 million words.

One possible explanation for these facts, or at least for the impossibility of *very* in (2)-(3), is that these participles are either not adjectives or are not gradable. As shown by the examples in (5) and (6), *very* is restricted to modifying expressions that are both adjectives and gradable. The modifier *much* also requires its argument to be gradable (Doetjes 1997), though it does not show the same sorts of categorial restrictions.

- (5) a. ??He is very a boy/a very boy. (cp. He is very much of a boy.)  
 b. ??That candidate is very to the left of the center. (cp. That candidate is very far/well to the left of the center.)
- (6) a. ??That bomb is *very atomic*.  
 b. ??Richard Nixon, a *very former* president, resigned before he was impeached.

Table 1: Distribution of degree modifiers in the British National Corpus

	<i>well</i>	<i>very</i>	<i>much</i>
protected	62	2	0
educated	78	3	0
defined	146	2	0
needed	2	0	211
appreciated	12	0	134
prized	0	1	16
surprised	0	154	5
worried	0	192	1
frightened	0	92	0

This hypothesis cannot be correct, however. First, the facts in (7) show that the participles that disallow modification by *very* allow negative *un*-prefixation, a property of adjectives (and not verbs, for instance).

- (7)
- a. Beck is *unacquainted* with the facts of the case.
  - b. For in a world as yet *unacquainted* with the horrors of the mushroom cloud, poison gas was still regarded as the ultimate in hideous weapons. [Brown Corpus F02]
  - c. The singer's *unpublicized* appearance caused a commotion at the restaurant.
  - d. These claims are *undocumented*, and therefore not admissible in court.
  - e. *uneducated, undefined, unprotected*
  - f. *unneeded, undesired, unpraised, unappreciated*

Second, they can appear as complements to copular verbs such as *seem*, *remain* or *become*, yet another adjectival property.

- (8)
- a. Beck seemed *acquainted* with the facts of the case.
  - b. The phenomenon remains poorly *understood*.
  - c. The scandal became *publicized* after a leak to the press.
  - d. The case remained *documented* on file.

Finally, the fact that these participles are gradable is shown by their appearance in comparative constructions, a property that holds only of gradable predicates. This is illustrated by the corpus data in (9).

- (9)
- a. But as I became *more acquainted* with this set and stopped rushing from impossible passage to impossible passage, hoping against hope

that at some point he would lose his balance and tumble like a second-rate trapeze artist off his swing, I was unwittingly dragged in to a more sinister, melancholic side to his playing. [*CD Review*, 1992. (BNC)]

- b. The causes of weakness in adhesion are rather *less understood* at present than they are in cohesion but no doubt they are rather similar in character. [J. Gordon, *The New Science of Strong Materials*. 1991. (BNC)]
- c. This was certainly more dramatic than the *more publicized* event that finished off the dinosaurs. [Antony Milne, *The Fate of the Dinosaurs: New Perspectives in Evolution*. 1971. (BNC)]
- d. He was *more talked about* than if he had been open and obvious. [Jean Bow, *Jane's Journey*, 1991. (BNC)]
- e. ...virginity was *more prized*, promiscuity was frowned upon. [W.F.R. Stewart, *Sexual Aspects of Social Work*, 1979. (BNC)]

We therefore conclude that the facts in (2)-(4) can be explained neither in terms of a category mismatch nor in terms of the non-gradability of the predicate: these deverbal expressions are gradable adjectives (see Borer 1998, pp. 92–93, for the same conclusion).

Bolinger's second important observation, which echoes an earlier point made by Sapir (1944), is the obvious but mostly neglected fact is that gradability is a property not just of adjectives, but of nouns, verbs, adverbs, and prepositions as well (though see Doetjes 1997; Kennedy and McNally 1999; Hay, Kennedy, and Levin 1999; Tsujimura 2001; Vanden Wyngaerd 2001; Paradis 2001; Wechsler 2002 for examples of recent work exploring these connections). Given the fact that the adjectival expressions we are interested in here are derived from (or related to) verbs, we should ask whether there is some regular correspondence between aspects of verb meaning and aspects of adjective meaning, in particular: are there underlying similarities in the kind of gradability they manifest? Put another way, it accidental that the various participles in (2)-(4) show the behavior that they do, or does some property of the source verb determine the behavior of the adjectival form with respect to degree modification?

The purpose of this paper is twofold. First, we use the distribution of degree modifiers as a starting point for developing a semantic analysis of gradable predicates that supports a typology parameterized along two core features. The first is the structure of the scale that a gradable property uses as a basis for ordering the objects in its domain, in particular, whether the scale is fully closed (has a minimum and maximum value), partly closed (has only a minimum or maximum value, but not both), or fully open (has no minimum or maximum value). The second feature is the nature of the standard of comparison with respect to which a particular use of a gradable property is evaluated: put roughly, whether it is fixed contextually (as with an adjective like *tall*, which may be true of an object in one context and false in another), or whether it is determined without reference to context (as in the case

of *empty*, which simply requires its argument to be devoid of contents). The fact that degree modifiers are sensitive to these features argues for encoding them in the lexical semantics of gradable expressions.<sup>1</sup>

Our second goal in this paper is to demonstrate that the scalar properties of gradable expressions are largely predictable from properties of the events and individuals which they denote or to which they apply and, moreover, that scale structure is shared by derivationally-related lexical items — for example, deverbal adjectives and source verbs (cf. Yumoto 1991). This result reinforces the larger claim advanced by Bolinger and Sapir: gradability is a fundamentally important grammatical property, whose influence extends beyond adjectives to other lexical categories. The generality of scale structure, its importance for a wide range of linguistic phenomena, and the relative simplicity of the typology of scales that we will develop thus justify a prominent place for scale structure in natural language semantics.

**2. THE SEMANTIC TYPE OF GRADABLE PREDICATES** We begin by laying out our basic assumptions about the semantic analysis of gradable adjectives. A well known property of gradable adjectives like *tall* and *expensive* is that their interpretations are context dependent: what counts as tall or expensive may vary from context to context. One way to account for this variation is to characterize the truth conditions of a sentence containing a gradable adjective in terms of a contextually defined STANDARD OF COMPARISON, as in (10) (see e.g., Sapir 1944; McConnell-Ginet 1973; Bartsch and Vennemann 1973; Kamp 1975; Lewis 1979; Klein 1980, 1991; Bierwisch 1989; Ludlow 1989; Kennedy 1999b; Graff 2000 and many others)

- (10) a. Michael Jordan is tall.  
 b. The Mars Pathfinder mission was expensive.
- (11) a. Michael Jordan's height is at least as great as a standard of tallness.  
 b. The cost of the Mars Pathfinder mission was at least as great as a standard of expensiveness.

The standard of comparison is itself determined relative to a COMPARISON CLASS of objects that are similar in some way to whatever is being discussed (see Klein 1980 for discussion); the result is that the truth conditions of sentences like those in (10) may vary. For example, in a conversation about the cost of various missions to outer space, the comparison class for *expensive* might include many things that are quite a bit more expensive than the Mars Pathfinder mission. (One of the successes of the Pathfinder mission was that its cost was relatively low.) If the standard of comparison is set correspondingly high, then (10b) will work out to be false. In

<sup>1</sup>Paradis (2001) also provides a number of empirical arguments that the distribution of degree modifiers correlates with the scalar properties of gradable adjectives, though she does not develop a semantic analysis of modifiers or a formal characterization of adjectival scale structure to account for these facts.

contrast, in a discussion about things with the name ‘Pathfinder’, the comparison class might include compasses, mountain bikes, and sport utility vehicles, as well as missions to Mars. The standard of comparison should therefore be quite a bit lower, and (10b) may work out to be true.

There are different ways in which this basic analysis can be implemented. The approach that we assume here is one in which gradable adjectives map their arguments onto abstract representations of measurement, or DEGREES, which are formalized as points or intervals totally ordered along some DIMENSION (e.g., height, cost, etc.; we provide a more formal discussion of these issues below). The set of ordered degrees corresponds to a SCALE, and propositions constructed out of gradable adjectives define relations between degrees on a scale with truth conditions analogous to the paraphrases in (11). (See Kennedy 1999a,b for an overview of scalar analyses of gradable adjectives and for arguments that a scalar approach is empirically superior to analyses that do not make use of scales or degrees).

For the semantic type of gradable adjectives, we follow a well-established tradition and analyze them as relations between individuals and degrees (see Seuren 1973; Cresswell 1977; Hellan 1981; von Stechow 1984a; Heim 1985; Bierwisch 1989; Klein 1991; Kennedy 1999b and others). Specifically, a gradable adjective like *expensive* has the denotation in (12), where **expensive** is a measure function that maps its argument onto the scale associated with the adjective, in this case a scale of cost.<sup>2</sup>

$$(12) \quad \llbracket [A \text{ expensive}] \rrbracket = \lambda d \lambda x. \mathbf{expensive}(x) \succeq d$$

The adjective *expensive* thus denotes a relation between objects  $x$  and degrees of cost  $d$  such that the cost of  $x$  is at least as great as  $d$ .

In this type of approach, the value of the degree argument is determined by degree morphology — in English, comparatives, degree modifiers, and measure phrases. Comparative morphemes, for example, are analyzed as quantifiers over degrees (see e.g. Heim 2000); degree modifiers are discussed in detail below. For predicates formed out of unmodified gradable adjectives, such as those in (10), we will assume that the degree argument is bound by a default existential quantifier

<sup>2</sup>Kennedy (1999a,b) argues for a decompositional analysis in which the measure function is actually the denotation of the adjective itself, rather than a subpart of the adjective meaning (see also Bartsch and Vennemann 1973). Properties of individuals are built on top of measure functions through the addition of (possibly phonologically null) degree morphemes, which contribute an ordering relation and a standard degree to the adjectival predicate. Particular degree morphemes, which in English include comparative morphemes and degree modifiers, differ in the type of ordering relation they impose and in the properties of the standard degree that they introduce, but the end result of combining degree morphology with a gradable adjective is a property of individuals that is characterized as a relation between two degrees — i.e., an expression of the same semantic type as an adjectival predicate on the traditional analysis. Since the proposals we make in this paper do not crucially rely on one of these two analyses, we adopt the more standard relational analysis of gradable adjectives.

with an unspecified restriction  $\mathbf{C}$ , as shown in (13); We assume that this quantifier is introduced by whatever mechanisms handle implicit arguments in general.<sup>3</sup>

$$(13) \quad \llbracket [\text{AP expensive}] \rrbracket = \lambda x. \exists d [\mathbf{C}(d) \wedge \mathbf{expensive}(x) \succeq d]$$

The domain restriction variable  $\mathbf{C}$  determines the standard of comparison (in this case, the ‘cutoff point’ for things that are definitely *expensive*) by defining an appropriate property of degrees, e.g. the property of being significantly greater than some norm for some comparison class (cf. Bierwisch 1989; Graff 2000), or the property of being greater than average for some comparison class (cf. Cresswell 1977; Klein 1991), and so forth. Assuming that the value of  $\mathbf{C}$  is fixed contextually, like other implicit quantifier domain restrictions (see von Stechow 1994; Stanley 2000, 2002), the standard of comparison is allowed to vary across different contexts of use. The result is that sentences like those in (10) may be true in some situations and false in others, which is exactly what we want.<sup>4</sup>

**3. SCALE STRUCTURE AND STANDARD OF COMPARISON** A question that naturally arises from this sort of approach to grading is whether scales and degrees are merely convenient formal tools for representing the meanings of gradable adjectives, or whether they have linguistic and cognitive significance. One of the goals of this paper is argue for the latter conclusion. In this section, we will show that certain structural properties of scales — in particular, whether they have minimal and maximal elements (whether they are open or closed) — correlate to a large de-

<sup>3</sup> Alternatively we could follow von Stechow (1984a), who posits a null degree morpheme *pos* with the semantics in (ia) instead of a default existential quantifier (see also Cresswell 1977). Composition of *pos* and *expensive* (which he treats as denoting a measure function) gives (ib), which is essentially the same as (13).

- (i) a.  $\llbracket pos \rrbracket = \lambda G \lambda x. \exists d [d \text{ is greater than average} \wedge G(d)(x)]$   
 b.  $\llbracket [\text{AP } pos \text{ expensive}] \rrbracket = \lambda x. \exists d [d \text{ is greater than average} \wedge \mathbf{expensive}(x) \succeq d]$

Our analysis differs from von Stechow’s in assuming a contextual domain restriction on the degree quantifier, but is otherwise completely comparable (and we will assume interpretations of degree modifiers below that are completely analogous to (ia)). Ultimately, the choice of default quantifier or null morpheme boils down to one’s assumptions about the interpretation of null arguments, which is an issue that goes beyond the scope of this paper.

<sup>4</sup> A common alternative to the approach described here is to analyze the standard of comparison as a designated free variable  $d_c$ , as shown in (i), whose value is set to the relevant standard of comparison for the context of utterance by a DELINEATION FUNCTION provided by the model (see Lewis 1979; Barker 2002).

- (i)  $\llbracket [\text{AP expensive}] \rrbracket = \lambda x. \mathbf{expensive}(x) \succeq d_c$

We adopt the ‘domain restriction’ analysis of the standard of comparison in (13) primarily because it connects quite naturally with the lexical semantic analysis of gradable adjectives that we present in the appendix to this paper, but the choice between this approach and the ‘free variable analysis’ in (i) is not crucial. See Kennedy 2002 for further discussion of this issue.

gree the most important semantic property of gradable predicates discussed above: whether they invoke a context-dependent standard of comparison or not. In section 4, we will show that this feature also plays a crucial role in the analysis of the degree modifiers *very*, *much* and *well*. We present arguments that such an analysis must include an articulated theory of scale structure, and we show that scale structure has an impact on the grammatical properties of gradable adjectives.

**3.1. A BASIC TYPOLOGY OF SCALE STRUCTURES** Formally, a scale is a pair  $\langle S, \succeq_\delta \rangle$  consisting of a set of objects and an asymmetric ordering relation along some dimension  $\delta$ . Scales may be distinguished either by properties of the set of objects or by properties of the ordering relation. In the case of gradable adjectives, both points of variation are linguistically significant. The nature of the ordering relation invoked by a particular gradable adjective is precisely what distinguishes one gradable adjective from another: *tall* and *flexible* both express orderings, but the first involves an ordering with respect to height (or possibly something more abstract, like ‘linear extent’) and the second an ordering with respect to flexibility.

An empirical reflex of this distinction is the phenomenon of INCOMMENSURABILITY (see Klein 1991; Kennedy 1999b). As shown by the examples in (14), it is possible to construct (possibly quite complex) comparisons out of distinct gradable adjectives as long as they map their arguments onto scales that share the same ordering relation. Thus *wide* and *tall* in (14a) both involve orderings along a dimension of linear extent, and *long* and *old* in (14b) both involve orderings with respect to temporal extent. (The pairs of adjectives still denote different functions corresponding to different perspectives on the property they measure, though (e.g., *wide* corresponds to a horizontal perspective on linear extent, and *tall* to a vertical one), and so impose different orderings on their domains.)

- (14) a. They call him ‘The Bus’ because he’s kind of as wide as he is tall. (National Public Radio broadcast, 1/26/02)  
 b. [This comparison] is unfair both to him and the quarterbacks like Dan Marino and John Elway who excelled for almost as long as [Peyton] Manning is old. (*Chicago Tribune*, 11/2/00)

In contrast, comparatives formed out of adjectives that do not use the same ordering relation are anomalous:

- (15) a. ??They call him ‘The Bus’ because he’s kind of as wide as he is punctual.  
 b. ??These quarterbacks excelled for almost as long as Peyton Manning is talented.

Assuming that orderings along different dimensions entail different scales, and that comparative morphemes presuppose that the degrees they order come from the

same scale (see Kennedy 2001b), the examples in (15) are correctly predicted to be anomalous.

The structure imposed on the set ordered set of degrees — the scale — is also important, however, and it is this issue that we are most concerned with here. In principle, several different properties of the scale could be linguistically significant, including whether it is finite or infinite, whether it is dense or discrete, whether it contains minimal or maximal elements or not, and so forth. Determining the full range of structural variation in scales that natural languages are sensitive to requires an empirical investigation that goes beyond the scope of this paper; instead, we focus here on demonstrating that one of these parameters is particularly significant and must be captured in an adequate lexical semantic analysis of gradable adjectives: whether a scale is OPEN (does not have minimal/maximal elements) or CLOSED (has minimal/maximal elements).

At the level of intuitions about meaning, the open/closed distinction looks exactly right for characterizing the difference between the adjectives in (16a) and those in (16b): the former appear to involve properties that can have maximal and minimal values, but the latter do not.

- (16) a. empty, full, open, closed  
 b. long, short, interesting, inexpensive

This intuition is supported by linguistic data involving PROPORTIONAL MODIFIERS like *completely*, *partially*, and *half*, which are acceptable with some gradable adjectives and unacceptable with others. This is illustrated by the contrasts in (16b) and (16a) (see Lehrer 1985; Cruse 1986; Hay 1998; Kennedy and McNally 1999; Paradis 2001).<sup>5</sup>

- (17) *Closed scale adjectives*  
 a. completely {empty, full, open, closed}  
 b. partially {empty, full, open, closed}  
 c. half {empty, full, open, closed}
- (18) *Open scale adjectives*  
 a. ??completely {long, short, interesting, inexpensive}  
 b. ??partially {long, short, interesting, inexpensive}

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<sup>5</sup> Note that proportional modifiers of maximality like *completely* and *totally* have both an endpoint-oriented use and a use that is roughly synonymous with *very*; these two uses are distinguished by their entailments. A proportional use entails that the end of a scale has been reached, as shown by the fact that (ia) is a contradiction; a non-proportional use carries no such entailment, thus the contingency of (ib).

- (i) a. #The line is completely straight, though you can make it straighter.  
 b. I'm completely uninterested in finances, and Kim is even less interested than I am.

c. *half* {long, short, interesting, inexpensive}

These contrasts can be explained in terms of the semantic requirements imposed by proportional modifiers. Assuming the modifiers *completely*, *half* and *partially* have interpretations along the lines of those in (19), where  $S_G$  denotes the scale associated with a gradable adjective  $G$ , they are compatible only with adjectives that map their arguments onto scales with maximal or minimal elements. (The DIFF function returns the difference between two degrees; see Kennedy 2001b.)

- (19) a.  $\llbracket \text{completely} \rrbracket = \lambda G \lambda x. \exists d [d = \max(S_G) \wedge G(d)(x)]$   
 b.  $\llbracket \text{half} \rrbracket = \lambda G \lambda x. \exists d [\text{DIFF}(\max(S_G), d) = \text{DIFF}(d, \min(S_G)) \wedge G(d)(x)]$   
 c.  $\llbracket \text{partially} \rrbracket = \lambda G \lambda x. \exists d [d \succ \min(S_G) \wedge G(d)(x)]$

This sort of analysis immediately raises two questions, however: what precisely are the parameters of variation in scale structure, and how are these parameters encoded in the meanings of individual gradable adjectives in such a way that scalar information is compositionally accessible to terms like proportional modifiers? The details of the answer to the second question will vary depending on the particular theoretical framework used to characterize lexical meaning; in this paper we focus on the more general theoretical question about the parameters of scalar variation. (See McNally and Kennedy 2002 for an analysis of the lexical representation of gradability formulated in the Generative Lexicon framework (Pustejovsky 1995), and see Koenig 1992 for a similar approach.)

Starting from the simplest assumption about possible scale structures — scales may or may not have maximal and minimal elements — there are four logically possible variations to consider: a scale may have neither a minimal nor maximal element, it may have a minimal but no maximal element, it may have a maximal but no minimal element, or it may have both maximal and minimal elements. The first and fourth options correspond to totally open and closed scales, respectively; the second and third options are lower closed and upper closed respectively. To make things precise, let us assume that scales consist of sets of points that are isomorphic to the real numbers, and represent these four possible scale structures as in (20).<sup>6</sup>

- (20) *A typology of scale structures*
- |    |  |              |
|----|--|--------------|
| a. | $\langle S_{(0,\infty)}, \preceq_\delta \rangle$ | OPEN         |
| b. | $\langle S_{[0,\infty)}, \preceq_\delta \rangle$ | LOWER CLOSED |
| c. | $\langle S_{(0,1]}, \preceq_\delta \rangle$      | UPPER CLOSED |
| d. | $\langle S_{[0,1]}, \preceq_\delta \rangle$      | CLOSED       |

<sup>6</sup>Note that we do not need to assume that scales are actually constructed out of numbers (i.e., that gradable adjectives actually map their arguments onto numerical values), though this is one way of formalizing them (see Klein 1991 for discussion). What is important is that whatever the ontological status of scales and degrees — whether they correspond to numbers, equivalence classes of objects in a model (Cresswell 1977), mental constructs (Bierwisch 1989), or something else — they can vary with respect to the structural properties discussed here.

The question we need to address is whether all of these options are actually attested. Assuming the semantic analyses of proportional modifiers in (19) is essentially correct, these terms provide an empirical tool for probing scale structure. However, in order to get full use out of this tool, we need to take adjectival polarity into account.

At a basic level, the crucial semantic difference between polar antonyms like *tall/short*, *empty/full*, *wet/dry*, *expensive/inexpensive*, *accurate/inaccurate*, *pure/impure* and so forth is a scalar one: both members of an antonymous pair map their arguments onto the same scale (e.g., both *tall* and *short* map their arguments onto a scale of height), but they make use of inverse ordering relations. This fact is illustrated by tautologies like (21).

- (21) The Sears Tower is taller than the Empire State Building if and only if the Empire State Building is shorter than the Sears Tower.

In terms of the assumptions laid out here, we can assume that positive and negative pairs of adjectives make use of the same set of degrees and an ordering along the same dimension, but the orderings are the inverse of each other (see e.g. Rullmann 1995).<sup>7</sup> The antonyms *tall* and *short*, on this view, include the measure functions in (22a) and (22b), respectively, where the domain  $D$  is the set of objects with some height value.

- (22) a.  $\llbracket \mathbf{tall} \rrbracket = f : D \rightarrow \langle S_{(0,\infty)}, \preceq_{height} \rangle$   
 b.  $\llbracket \mathbf{short} \rrbracket = f : D \rightarrow \langle S_{(0,\infty)}, \succeq_{height} \rangle$

The feature of polarity that we are concerned with here is the following: if the positive member of an antonym pair has a maximal degree, then this corresponds to the minimal degree for the negative adjective, and vice-versa. This is most clearly illustrated by a pair like *full/empty*: if a cup is maximally full, then it is minimally empty (not empty at all); likewise, if it is maximally empty, then it is minimally full (not full at all).

Taking polarity into account, then, we see that proportional modifiers give us a tool for determining whether all four scale types listed in (20) are attested. Specifically, given the assumptions about polarity outlined above, we predict that modifiers that pick out maximal degrees should be acceptable with positive adjectives only if

<sup>7</sup>Kennedy (2001b) argues that this account of adjectival polarity is actually empirically inadequate, as it makes incorrect predictions about the acceptability and interpretation of comparatives constructed out of antonymous pairs of adjectives. Kennedy instead advocates an alternative approach to polarity in which degrees are characterized as intervals on a scale, rather than points, and polar adjectives map their arguments onto complementary regions of the same scale (see also Seuren 1978; von Stechow 1984b). In addition to resolving the empirical problems for the analysis of polarity outlined here, this approach has the advantage of deriving the inverse ordering relation between positive and negative adjectives (Kennedy 2001a). For the purposes of the current paper, however, the two approaches are equivalent, but it is worth pointing out that if the Seuren/von Stechow/Kennedy approach to polarity is correct, then it provides further arguments that structural properties of scales — in this case, the structure of degrees — are linguistically significant.

they use a scale with a *maximal* element, and with negative adjectives only if they use a scale with a *minimal* element. In other words, the four scale types should give rise to the pattern of acceptability in (23) for the indicated degree modifier/polar adjective collocations (where ?? denotes semantic anomaly).

(23)		OPEN	L-CLOSED	U-CLOSED	CLOSED
	[Deg <sub>max</sub> A <sub>pos</sub> ]	??	??	✓	✓
	[Deg <sub>max</sub> A <sub>neg</sub> ]	??	✓	??	✓

The maximizing modifier *absolutely* provides particularly clear judgments in this test (cf. Unger 1975), since it does not admit of a *very*-like interpretation (see note 5).<sup>8</sup> As shown by the following examples, the expected pattern does in fact emerge:

- (24) *Open scales*  
 a. ??absolutely {tall, deep, expensive, likely}  
 b. ??absolutely {short, shallow, inexpensive, unlikely}
- (25) *Lower closed scales*  
 a. ??absolutely {possible, bent, bumpy, wet}  
 b. absolutely {impossible, straight, flat, dry}
- (26) *Upper closed scales*  
 a. absolutely {certain, safe, pure, accurate}  
 b. ??absolutely {uncertain, dangerous, impure, inaccurate}
- (27) *Closed scales*  
 a. absolutely {full, open, necessary}  
 b. absolutely {empty, closed, unnecessary}

We can therefore conclude that at least the four basic scale types in (20) are attested, and that this is a possible point of variation for different gradable adjectives. In the next section, we will see that whether an adjective uses a totally open scale or one of the three scales with maximal/minimal values has further important effects on its interpretation.

**3.2. THE CONTEXT (IN)DEPENDENCE OF THE STANDARD** The distribution of proportional modifiers is not the only area in which we see the linguistic significance of scale structure. Scale structure also influences a crucial feature of the interpretation of gradable adjectives in context: the determination of the standard of comparison.<sup>9</sup>

<sup>8</sup>*Absolutely* does permit a higher-order interpretation of the form *it is absolutely true that p*, however this reading is sufficiently distinct from the ‘maximal degree’ reading that it does not confuse things.

<sup>9</sup>A number of recent works have uncovered other empirical consequences of the open/closed scale distinction in several different empirical domains. For example, Vanden Wyngaerd (2001)

An expectation of the approach to gradable adjective meaning outlined in section 2, the general structure of which is shared by all scalar analyses, is that all predicates headed by (unmodified) gradable adjectives should give rise to the sort of vagueness observed with *tall* and *expensive*. This is not the case, however: there are adjectives that are demonstrably gradable but whose standards are not context-dependent in the way discussed above. For example, the adjectives in (28) simply require their arguments to possess some *minimal* degree of the gradable property they introduce, not that the degree to which the arguments possess this property is greater than some contextually determined standard. Thus under normal usage, (28a) does not mean that the degree to which the baby is awake surpasses some standard (for babies), but rather simply means that the baby has a non-zero level of awakesness. Likewise, (28b) is true as long as there is some amount of water on the table, (28c) just requires some minimal positive aperture of the door, and (28d) is true of a rod that is minimally bent.

- (28) *Minimum standards*
- a. The baby is awake.
  - b. The table is wet.
  - c. The door is open.
  - d. The rod is bent.

The adjectives in (29) are similar, except that their arguments are required to possess a *maximal* degree of the property in question. (29a) typically means that the glass is completely full, not that its contents fall above some standard of fullness, (29b) is an assertion that the road has no bumps, (29c) requires the door to be completely closed, and (29d) requires a completely straight rod.

- (29) *Maximum standards*
- a. The glass is full.
  - b. The road is flat.
  - c. The door is closed.
  - d. The rod is straight.

Following Unger (1975), we will refer to adjectives like those in (28) and (29) as ABSOLUTE LIMIT (gradable) adjectives, and ‘ordinary’ gradable adjectives with context-dependent standards as RELATIVE (gradable) adjectives. Other than Unger’s work, there has been little discussion in the semantics literature of absolute limit adjectives. (Unger focuses specifically on the behavior of the gradable adjective *flat*, as well as the predicates *certain* and *know*, as part of a broader philo-

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argues that the open/closed scale distinction is relevant to the licensing of resultative predicates in Dutch, Wechsler (2002) makes similar claims for English, and Rotstein and Winter (2001) argue that this aspect of scale structure is the basis for the ‘total’ vs. ‘partial’ predicate distinction identified by Yoon (1996).

sophical argument for a skeptical epistemology.) This may stem from a strong initial intuition that our characterization of the facts is both too strong and too weak: that the adjectives in (28) actually require something significantly more than a minimum standard, and that those in (29) actually allow something less than a maximum standard. These intuitions are supported by examples like those in (30).

- (30) a. I'm not awake yet.  
 b. The gas tank is full, but you can still top it off. It's not completely full yet.  
 c. The theater is empty tonight.

(30a) can be felicitously uttered by someone who is not talking in his sleep. Likewise, most speakers we have consulted feel that *full* only requires its arguments to fall *near* the maximal value on the scale, pointing to examples like (30b), which does not sound contradictory (but cf. the examples discussed below in (45)). Similarly, (30c) can be used to describe a situation in which only a very few people show up to a film in a very large movie theater.

On the whole, it is fairly easy to come up with other 'imprecise' uses of absolute limit adjectives, calling into question our claim that these adjectives represent a semantic class distinct from relative gradable adjectives. While it is arguably true that in some cases imprecise uses reflect a semantic shift away from a 'default' absolute limit meaning towards a purely relative one (a point to which we return below), we nevertheless contend that there are both coherent theoretical reasons and compelling empirical arguments for maintaining our (and Unger's) claim that absolute limit adjectives need to be semantically distinguished from relative adjectives, and that context-(in)dependence of the standard of comparison is a property that is largely determined by linguistically-encoded properties of gradable adjectives (in particular, lexical semantic ones), and not by non-linguistic properties of the context of utterance.

First, from a purely theoretical perspective, it is fairly straightforward to account for imprecise uses of absolute limit adjectives such as (30) while still maintaining the claim that they have maximum or minimum standards. The simplest strategy would be to claim that the propositions conveyed by sentences like these are strictly speaking *false*, and explain their felicity and informativity in terms of general pragmatic principles governing the interpretation of 'loose talk' (this is essentially Unger's position). Formally, we could implement this approach in terms of Lasersohn's (1999) theory of PRAGMATIC HALOS, which provides a framework for determining how much deviation from what is actually true still counts as 'close enough to the truth' in any context to be an acceptable amount of deviation. Lasersohn proposes that the pragmatic context can associate with any expression of the language a set of denotations of the same type as its actual denotation which differ only in some respect that is pragmatically ignorable in the context; this is its pragmatic halo. Any value in the pragmatic halo of an expression  $\alpha$  counts as an

acceptable and informative approximation of  $\alpha$  even if this leads to a proposition that is strictly speaking false. In the case of (30c), for example, we can maintain our claim that the actual denotation of the predicate headed by *empty* is a property that is true only of objects that are completely empty, but that its pragmatic halo includes properties that are true of objects that are just a little bit less than empty. How much less is determined by context; in this case by non-linguistic factors such as the size of the theater, expectations about attendance, and so forth.<sup>10</sup>

Regardless of how we account for imprecise uses of absolute limit adjectives, if our claim that their meanings involve endpoint-oriented standards is correct, we should be able to find empirical evidence that distinguishes them from relative gradable adjectives. In particular, we predict that they should show a significantly smaller degree of variation in the position of the standard than relative adjectives (since any variation would be governed by the principles of ‘loose talk’, rather than allowed by the meaning of the term), and we expect to find evidence that the standards used by absolute adjectives involve minimal and maximal degrees. In the following sections, we will present data that supports both of these conclusions.

**3.2.1. FOR-PPS** The first piece of evidence that distinguishes absolute limit adjectives from relative ones comes from the distribution of *for*-PPs. As shown by (31), such expressions can be used to introduce the comparison class with respect to which a context-dependent standard is determined.

- (31) a. The baby is {tall, short, fast, talkative} for a two year old.  
 b. That table is {small, sturdy, unusual} for a dining room table.  
 c. That glass is {expensive, clean, dirty} for a wine glass.  
 d. The door is {strong, big, wide} for an office door.

This type of *for*-PP is infelicitous with adjectives like those in (28) and (29), however, which follows if the interpretation of these adjectives does not involve reference to a context-dependent standard: the *for*-PPs in (32) contribute nothing to the assertion.

- (32) a. ??The baby is awake for a kid who hasn’t napped all morning.

<sup>10</sup>There are alternative approaches to the problem of getting ‘close enough to the truth’ that we could also adopt; see Lasersohn 1999 for a survey. A somewhat different strategy for dealing with imprecise uses of absolute limit adjectives would be to weaken our notion of ‘maximum’ and ‘minimum’ so that these predicates pick out regions on a scale that are (in some appropriately vague sense) close to the actual maxima/minima. (See Schwarzchild and Wilkinson 1999 for discussion of the role of scalar regions in the semantics of gradable adjectives.) While this approach may sound very much like introducing a context dependent standard, there is an important difference: the ‘region of maximality/minimality’ would necessarily be connected to the actual maximum or minimum, rather than located at arbitrary point on the scale, so we would predict absolute limit adjectives to show a very small degree of flexibility in where the standard can be. As the data discussed below indicate, this is exactly right.

- b. ??That table is wet for a dining room table.
- c. ??That glass is full for a wine glass.
- d. ??The door is closed for an office door.

Note that these facts do not indicate that these adjectives are not gradable. As shown by (33), they are perfectly felicitous in comparatives, in contrast to what we find with true nongradable adjectives such as those in (34).

- (33) a. The baby is more awake now than it was a few minutes ago.
- b. The table is wetter than the floor.
- c. My glass is fuller than your glass.
- d. The door is more closed than it needs to be.
- (34) a. ??The energy we use these days is more nuclear than it was before they built that plant down the road.
- b. ??Dinosaurs are more extinct than spotted owls.

**3.2.2. SHIFTING STANDARDS** Two similar arguments illustrate the impossibility of shifting the standards of absolute limit adjectives in contexts in which the standards of relative adjectives can be easily shifted. The first comes from antonyms. As shown by the examples in (35), it is possible to sequentially describe an object in terms of both members of a relative antonym pair in a single context, since the standard for the second member of the pair can be appropriately shifted up or down to be consistent with that introduced by the first.

- (35) a. Mercury is a small planet, but it's still quite large.
- b. The Mars Pathfinder mission was expensive, but it was inexpensive compared to other missions to outer space.

In contrast, antonyms with context independent standards cannot be felicitously predicated of the same object in the same context:

- (36) a. ??This is a full theater, though it's still quite empty.
- b. ??The students are awake, but they're asleep for kids who are supposed to be paying attention.

The second argument of this type comes from the use of gradable adjectives in definite descriptions. Relative gradable adjectives can be used to distinguish one object from another, even when the degree to which that object possess the relevant is less than the contextually determined standard (Kyburg and Morreau 2000; Sedivy, Tanenhaus, Chambers, and Carlson 1999). Consider, for example, a context in which one farmer is negotiating with another farmer over two pigs (adapting an example from Kyburg and Morreau). One of the pigs is a runt, the other is bigger, but neither truly qualifies as fat for a pig. It is nevertheless the case that a definite description like *the fat pig* can be quite naturally used to identify the

fatter of the two pigs, since the standard for *fat* can be shifted just for the purpose of differentiating one pig from another. Thus (37a) could be both felicitous and true in this context, while (37b) would be false.

- (37) a. The fat pig can talk to spiders.  
b. The pig that can talk to spiders is fat (for a pig).

Absolute limit adjectives do not permit this sort of use, however. Consider a context in which two glasses of beer are on the table, one of which is half full and one of which is  $2/3$  full. Referring to the latter with the definite description *the full glass*, as in (38a), is infelicitous; instead, it is necessary to use the comparative form of the adjective as in (38b). (The comparative form is of course also possible with relative adjectives when a distinction is being made between two objects, but it is not required.)

- (38) a. #The full glass of beer is mine.  
b. The fuller (of the two) glass(es) of beer is mine.

Minimal standard absolute adjectives behave the same. If two people A and B are standing in front of two partially open doors, one that is barely open and one that most of the way open, A cannot felicitously direct B towards the more open of the two doors by saying (39a); A must say (39b).

- (39) a. #You should go through the open door.  
b. You should go through the more open (of the two) door(s).

These facts follow if the standards for *full* and *open* are fixed at the maximum and minimum values of the respective scales (modulo imprecision). Since the standards cannot be shifted, the existence and uniqueness presuppositions associated with the definite descriptions in these examples (that there is a full glass of beer/open door) are not satisfied, and the (a) sentences are anomalous.

**3.2.3. PRETTY** The degree modifier *pretty* also distinguishes between relative and absolute limit gradable adjectives. When it modifies adjectives of the former type, it has a meaning very similar to *very*, in that it ‘boosts’ the value of whatever degree the context selects as a standard (though perhaps not to quite the same degree). As a result, (40a) entails (40b).

- (40) a. The rod is pretty long.  
b. The rod is long.

The same interpretation is observed with absolute limit adjectives that make use of minimal standards, such as *bent*: (41a) entails (41b), and describes a rod that has a high degree of bend relative to the (minimum) standard.

- (41) a. The rod is pretty bent.  
b. The rod is bent.

In contrast, when *pretty* modifies an absolute limit adjective with a maximal standard, its interpretation is different, as pointed out by Unger (1975). (42a) means that the rod is nearly or almost straight, and entails the negation in (42b).

- (42) a. The rod is pretty straight.  
b. The rod is not straight.

If the basic meaning of *pretty* is that of a standard booster (like *very*, a point to which we return below), then it is not surprising that this meaning disappears with maximum standard adjectives like *straight*: if the standard is already the maximum degree on the scale, it cannot be boosted. Following Unger, we may assume that in such cases, an implicit *close to* or *nearly* is inserted into the semantic representation as a kind of repair strategy, and *pretty* modifies this (i.e., (42a) really means something like *The rod is pretty nearly/close to straight*).

**3.2.4. ENTAILMENT PATTERNS** Entailment patterns provide a fourth piece of evidence for distinguishing relative from absolute limit adjectives. If the standards associated with the latter involve endpoints, as we have claimed, then the denotations of the predicates they head can be characterized as in (43).

- (43) a.  $\llbracket [\text{AP } \text{adj}_{\text{min}}] \rrbracket = \lambda x. \exists d [d \succ \text{min}(S_{\text{adj}}) \wedge \text{adj}(x) \succeq d]$  *min stnd*  
b.  $\llbracket [\text{AP } \text{adj}_{\text{max}}] \rrbracket = \lambda x. \exists d [d = \text{max}(S_{\text{adj}}) \wedge \text{adj}(x) \succeq d]$  *max stnd*

These truth conditions are just like what we posited above in (13), except that the restrictions on the standard are explicit, rather than context-dependent: (44a) requires it to be a minimum degree and (44b) a maximum degree. For the purposes of this paper, we will assume that the domain restriction variable **C** is obligatorily set to the values in (43a) or (43b) for absolute adjectives, though exactly how this is accomplished is an issue that should be resolved in future work (see Kennedy 2002 for discussion).

These truth conditions make clear predictions about entailment patterns. First, (43a) predicts that a denial *a is not adj<sub>min</sub>* should entail that *a* possesses no amount *adj*-ness at all (assuming that the minimal degree on a closed scale represents a zero amount of the relevant property). The contradictory statements in (44) illustrate that this prediction is borne out.

- (44) a. #My hands are not wet, but there is some moisture on them.  
b. #The door isn't open, but it is ajar.

Second, (44b) predicts that an assertion of *a is adj<sub>max</sub>* should entail that *a* has a maximal amount of '*adj*-ness', i.e., that nothing can be more *adj* than *a*. This sort

of entailment is difficult to test, since maximum standard adjectives readily allow imprecise uses (see the discussion of (30) above), but the examples in (45) involve cases in which an imprecise interpretation is highly unlikely (though see Unger (1975) for arguments that it is possible to force a precise interpretation by adding focal stress to the adjective). B's response in (45a) is readily understood as a joke, but note that the joke wouldn't be possible if A's assertion didn't, strictly speaking, entail that B's glass was 100% empty. And according to our intuitions, *dead*, unlike e.g. *full*, is rarely if ever used imprecisely, hence the outright oddness of (45b).<sup>11</sup>

- (45) a. A: Your glass is empty; let me get you another beer.  
       B: No it's not – there are still a few drops left in it.  
       b. #The plant is dead, though one part of it still appears to be alive.

Since the truth conditions for a relative adjective entail only that its argument falls above a contextually determined standard of comparison, neither of these entailments should hold. This is correct:

- (46) a. That film is interesting, but it could be more interesting.  
       b. Sam is not tall, but his height is normal for his age.

A related argument involving entailments is discussed in Cruse 1986 (see also Rotstein and Winter 2001). As shown by the examples in (47), there exist pairs of antonyms such that negation of one form entails the assertion of the other:

- (47) a. The door is not open.  $\models$  The door is closed.  
       b. The table is not wet.  $\models$  The table is dry.  
       c. The baby is not awake.  $\models$  The baby is asleep.

The explanation for this is straightforward: both members of the pairs in (47) are absolute limit adjectives, but the positive adjectives impose minimum standards while the negative adjectives impose maximum standards. Since a minimal positive degree corresponds to a maximal negative degree on the same scale, the entailment relations in (47) follow from the truth conditions in (43) (see the discussion of polarity in section 3.1).

Relative antonyms do not show the same entailment relations, as illustrated by (48).

- (48) a. The door is not large.  $\not\models$  The door is small.  
       b. The table is not expensive.  $\not\models$  The table is inexpensive.  
       c. The baby is not energetic.  $\not\models$  The baby is lethargic.

<sup>11</sup> Although *dead* is sometimes taken as a paradigmatic case of an ungradable adjective, the felicity of expressions such as *half dead* indicate that it is, in fact, gradable, associated with a bounded scale and an upper endpoint standard (see below).

Again, this follows from the fact that the standards for both positive and negative relative gradable adjectives are contextually identified, and crucially need not be endpoints (in fact, cannot be endpoints if the scales are open). Since a context dependent standard is determined for particular uses of particular adjectives, it need not be the case that the standard for e.g. *large* be the same as that of its antonym *small* (this point was illustrated above by (35a)), and we allow for the possibility of a ‘grey area’ between the standards onto which fall objects that are neither large nor small (Sapir’s (1944) ZONE OF INDIFFERENCE; Klein’s (1980) EXTENSION GAP). Indeed, the possibility of such ‘borderline cases’ is one of the defining properties of vague predicates; see Williamson 1994 for general discussion.

Finally, a version of the same entailment test can be used to determine whether the standard corresponds to the upper or lower end of a scale. (This test presupposes that the adjectives being tested have context-insensitive standards, however; cf. Knowles 1974, pp. 23-24). If the standard is a maximal degree, then an affirmation such as *x is half/partially adj* entails that *x is not adj*, as shown by (49a-b).

- (49) a. The plant is half dead.  $\models$  The plant is not dead.  
 b. The glass is partially full.  $\models$  The glass is not full.

If the standard corresponds to the lower endpoint, however, then such an affirmation entails that *x is adj*. This is illustrated by the examples in (50).

- (50) a. The door is half open.  $\models$  The door is open.  
 b. The table is partially wet.  $\models$  The table is wet.

The conclusion to be drawn from the preceding array of facts is that there is a semantic distinction between gradable adjectives with absolute limit and relative standards. Even though the former have imprecise uses that sometimes make them appear superficially similar to relative adjectives, the data discussed above show that the absolute/relative distinction — whether a gradable adjective has a context-sensitive or context-insensitive standard — is in fact grammatically significant.

**3.3. RELATING SCALES AND STANDARDS** We now have a new question: is there a principled relationship between an adjective’s scale structure and its standard value? The data discussed so far suggest the following generalization: gradable adjectives associated with totally open scales have relative standards; gradable adjectives that use totally or partially closed scales have absolute standards. The first of these two generalizations is exceptionless: since open scales lack endpoints, it is impossible for open scale adjectives to have endpoint standards. While we will see below that the second of these two generalizations is not exceptionless, it does appear that the standards for closed-scale adjectives default to an endpoint of the scale: the minimum in some cases (e.g., *awake* and *open*); the maximum in others (e.g., *asleep* and *straight*). There are at least two, mutually compatible, ex-

planations for such a default. The first is functional: The endpoints of a totally or partially closed scale provide a fixed, obvious, and thus useful value as a potential standard. The second, and probably more important, one has to do with the way in which adjectival properties come to hold of entities. In many cases, an adjectival property comes to be true of an entity in virtue of that entity having participated in some kind of event or state. As will be explained in detail in section 5, there is a strong correlation between the structure of such an event, the role played by the relevant entity in it, and the satisfaction conditions (including the nature of the scales structure) for the adjectival predication whose truth is supported as a result of the event or state transpiring. The result, as we will see below, is a maximal or minimal absolute limit standard, depending on the relation of the argument to the event.

Nevertheless, there isn't a logically necessary reason why adjectives with closed scales should have absolute limit standards. As we have seen, many closed-scale, absolute limit adjectives have imprecise uses, and it also seems clear that there are closed-scale adjectives with true relative standards. In particular, we have observed a tendency for adjectives with closed scales to undergo semantic changes or extensions in which their standards change from absolute to relative. One such example is *educated*, which admits proportional modifiers (*completely/partially/half educated*) and *well*-modification, which we will argue in section 4 to be a property of closed-scale adjectives. Its principle definition in the *Oxford English Dictionary*, which was written on historical principles, is given in (51a); in contrast, the *Collins Cobuild English Dictionary*, which is based on corpus of English of the 1980s, classifies the word as a (relative, in our terms) gradable adjective and defines it as in (51b).

- (51) a. That has received education, mental or physical; instructed, trained, etc; see the vb. Often with an adverb prefixed, as *half-*, *over-*, *well-*.  
 b. Someone who is educated has a high standard of learning.

Although we must leave a complete exploration of this matter for future research (though see the discussion of *dry* in section 4.2 below for some initial thoughts), it seems clear that such changes require something like the existence of a prototypical set of properties which can be extrapolated from a set of individuals to which the adjective applies and which can constitute a basis for a relative standard of comparison.

**4. DEGREE MODIFICATION** The central conclusion of section 3 is that scale structure (open vs. closed) and standard value (relative vs. absolute) are grammatically significant properties of individual gradable adjectives. We now return to the issue we started this paper with — the distribution of the modifiers *very*, *much* and *well* in adjectival participles — and we show that the facts can be explained in terms of these two semantic features of gradable adjectives.

**4.1. THE SEMANTICS OF DEGREE MODIFICATION** Recall from the discussion in section 2 that we are assuming that gradable adjectives denote relations between individuals and degrees with interpretations along the lines of (52), where  $\mathbf{m}$  is a function from objects to degrees on the scale associated with *GrAdj*.

$$(52) \quad \llbracket \text{GrAdj} \rrbracket = \lambda d \lambda x. \mathbf{m}(x) \succeq d$$

We further assume that degree morphemes denote functions from (gradable) adjective meanings to properties of individuals, whose semantic function is to restrict the value of the degree argument of the adjective in some way. In other words, all degree modifiers have interpretations that match the template in (53), where  $\mathbf{R}$  is a property of degrees.<sup>12</sup>

$$(53) \quad \llbracket \text{Deg} \rrbracket = \lambda G \lambda x. \exists d [\mathbf{R}(d) \wedge G(d)(x)]$$

What distinguishes different degree modifiers from each other is the specific value of  $\mathbf{R}$ , i.e., the way in which they restrict the adjective's degree argument. For example, the comparative degree modifiers *more*, *less* and *as* are placed into the template in (53) by substituting the values for  $\mathbf{R}$  specified in (54), where  $d_c$  is the degree denoted by the comparative (*as* or *than*) clause (we ignore here the question of how this value is compositionally derived; see Gazdar 1981; Hellan 1981; von Stechow 1984a; Heim 1985; Bierwisch 1989; Rullmann 1995; Hendriks 1995; Kennedy 1999b, to appear for different approaches).

$$(54) \quad \begin{array}{l} \text{a. more: } \mathbf{R} = \lambda d. d \succ d_c \\ \text{b. less: } \mathbf{R} = \lambda d. d \prec d_c \\ \text{c. as: } \mathbf{R} = \lambda d. d \succeq d_c \end{array}$$

Note that these restrictions on the degree argument place only a single, general requirement on the expression modified by comparative morphemes: that it be a gradable adjective (i.e., that it has a degree argument in the first place). It is possible, however, that other degree modifiers may place further restrictions on the degree argument that limit the range of gradable adjectives with which they may felicitously combine.

Proportional modifiers, which as noted above restrict the standard based on specific features of the modified adjective's scale, are a case in point. Assuming the truth conditions for proportional modifiers discussed above in (19), the different values of  $\mathbf{R}$  for *completely*, *half* and *partially* are shown in (55) (where  $S_G$  is the scale associated with  $G$ , as above).

$$(55) \quad \begin{array}{l} \text{a. completely: } \mathbf{R} = \lambda d. d = \max(S_G) \\ \text{b. half: } \mathbf{R} = \lambda d. \text{DIFF}(\max(S_G), d) = \text{DIFF}(d, \min(S_G)) \end{array}$$

<sup>12</sup>Note that the null degree morpheme *pos* posited by von Stechow (1984a) (see note 3) is an instance of (53).

- c. partially:  $\mathbf{R} = \lambda d.d \succ \min(S_G)$

Assuming that the *max* and *min* functions are defined only for scales with the relevant endpoints, these modifiers require the adjectives they modify to have appropriately closed scales.

Given the observations in section 3, we might also expect to find degree modifiers that are sensitive to the nature of a gradable adjective's standard value — the relative/absolute distinction — in addition to modifiers that are sensitive to scale structure, like proportional modifiers. As we will show in the following sections, the 'standard boosting' degree modifiers *very* and *much* are examples of this class of expressions, while *well* is sensitive to scale structure rather than standard type.

**4.2. VERY** We begin with *very*. Roughly speaking, the difference between e.g. *expensive* and *very expensive* is that the latter denotes a property whose meaning is just like the former, except that the relative standard is boosted by some amount. This is most clearly illustrated by pairs like the one in (56), which shows that the standard boosting effect of *very* (in terms of absolute increase of degree) depends on how high the initial standard is determined to be.

- (56) a. The international space station is very expensive. (for space projects; *large increase in the standard*)  
 b. The coffee at the airport is very expensive. (for coffee; *smaller increase in the standard*)

This suggests a lexical entry for *very* along the lines of (57), where **high** is a context-dependent property of degrees of the form 'greater than the standard by a large degree'. Clearly, this is a vague restriction on degrees, but the examples in (56) show that this is exactly what we want.

$$(57) \quad \llbracket \textit{very} \rrbracket = \lambda G \lambda x. \exists d [\mathbf{high}(d) \wedge G(d)(x)]$$

The connection between *very* and the relative standard is even stronger than these examples suggest, however: in normal usage, adjectives associated with *absolute* standards reject modification by *very*:

- (58) a. ??They were very able to solve their own problems.  
 b. ??The door is very open.  
 c. ??That drug is currently very available.

The adjective *dry* provides a particularly clear illustration of this restriction on *very* modification, since it has both relative and absolute uses. When *dry* is used to describe a (more or less) permanent, stable property such as the average degree of moisture in the atmosphere, as in (59a), it can be modified by *very*. As shown by (59b), this use of *dry* accepts *for*-PPs, indicating that it receives a relative interpre-

tation.

- (59) a. This region of the country is very dry.  
b. This region of the country is dry for a temperate zone.

However, if it is used to describe a more transient sort of property like the amount of liquid on a surface, as in (60b), modification by *very* is impossible, and *for*-PPs are infelicitous, indicating an absolute interpretation.

- (60) a. ??This part of the countertop is very dry.  
b. ??This part of the countertop is dry for a cutting surface.

In examples in which the object being described does not promote one reading of *dry* over another, we can actually detect an ambiguity. (61a) can be understood either as a claim that my hands have a certain skin quality, or as a claim about the amount of some liquid on them. (61b) is consistent only with the former interpretation, however, while (61c) forces the latter.

- (61) a. My hands are dry.  
b. My hands are very dry.  
c. My hands are partially dry.

These facts reflect Bolinger's observation that the adjective modified by *very* must express an 'essential' rather than 'accidental' property (Bolinger 1972, p. 38-39). In most cases, adjectives with absolute scales are simply incompatible with *very*, though *very* modification is acceptable to the extent that the adjective can have a relative-like, 'essential' interpretation, as illustrated by the examples in (62).<sup>13</sup>

- (62) a. What we need is a man who is very able, very cheerful, and a good mixer. (Bolinger 1972, p. 39)  
b. The department chair is very open to suggestions as to how to revamp the doctoral program.  
c. She's is a very available person considering her busy schedule.  
d. The baby is very awake. ( $\neq$  wide awake)

Alternatively, for absolute adjectives with maximum standards, *very* may satisfy the constraint that it modify a predicate with a relative standard in a way comparable to what we saw with *pretty* in section 3.2.3: it may be construed as modifying an

<sup>13</sup>For the time being, we remain neutral as to exactly how this interpretation comes about. There are various, not entirely mutually exclusive, possibilities: the adjective might be vague with respect to the type of standard used to evaluate its applicability, with context serving to resolve the vagueness; the adjective might have become truly polysemous over time, with the degree modifier serving to disambiguate; or it may be that, faced with an ostensible conflict between the standard required by *very* and that associated with the adjective, speakers are able to reinterpret the adjective in such a way as to eliminate the conflict. What is important for our purposes is that the degree modifier clearly manifests some kind of sensitivity to the standard value.

implicit *nearly*, so that *very A* means *very nearly A* (and so entails *not A*).

As an illustration of this, consider a context involving a bar in which all the glasses are marked to indicate the level to which they are supposed to be filled with beer. In a situation where an inattentive bartender accidentally fills a glass past this ‘full mark’, it would be infelicitous for his accuracy-obsessed boss to object by saying (63a). Likewise, the lucky recipient of the overfull glass of beer cannot felicitously describe this situation with (63b).

- (63) a. Hey! That glass is very full! Pour out some of that beer.  
 b. Wow! My glass is very full for a change!

We can account for these facts by revising the interpretation for *very* given above in (57) to constraint the domain of the modifier to the set of relative adjectives, as shown in (64).

$$(64) \quad [\textit{very}] = \lambda G : G \in A_{rel} \lambda x. \exists d [\mathbf{high}(d) \wedge G(d)(x)]$$

Clearly, this analysis assumes that the set of relative and absolute adjectives is distinguished in the lexicon in some way. Although we have not proposed here a specific means of representing this distinction in the lexicon, since the details depend on particular theoretical assumptions about the representation of lexical information, the empirical data discussed in section 3.2 clearly show that such a distinction must in fact be encoded in some form or other, and so accessible to degree modifiers. (See McNally and Kennedy 2002 for a specific proposal about the lexical representation of scalar meaning; see also Koenig 1992 for a related approach.)

If our semantic analysis is correct, then we expect the class of deverbal gradable adjectives that accept modification by *very* to show properties of relative adjectives. For example, they should accept *for*-PPs that identify a comparison class, and they should show the entailment patterns observed with other relative adjectives (see section 3.2.4). The following examples confirm these predictions.

- (65) a. Klaus was very pleased for someone with his generally dreary outlook on life.  
 b. Mike appeared very frightened for a supposedly invincible boxer.  
 c. For someone who had just been accused of embezzlement, Gil seemed very relaxed.
- (66) a. Klaus wasn't pleased by the report, though he did find a few positive aspects to it.  
 b. Klaus was pleased by the report, though he could have been happier with it.
- (67) a. Mike wasn't frightened when he entered the ring, though he did feel a bit of apprehension.  
 b. Mike was frightened when he entered the ring, though he wasn't pet-

rified.

- (68) a. Gil wasn't relaxed, though he wasn't very nervous, either.  
 b. Gil felt relaxed, though he could have been more so.

**4.3. MUCH** Turning to *much*, we claim that it has the same sort of meaning as *very*, with one crucial difference: *much* is constrained to modify only absolute adjectives, as made explicit in (69).

$$(69) \quad \llbracket much \rrbracket = \lambda G : G \in A_{abs} \lambda x. \exists d [\mathbf{high}(d) \wedge G(d)(x)]$$

This analysis is most clearly supported by the distributional properties of *much* as a modifier of deverbal gradable adjectives (we address the acceptability of *much* with lexical adjectives below).

First, since **high** takes the basic standard and boosts it, (69) predicts that *much* is compatible only with absolute gradable predicates that make use of minimum standards: maximum standards cannot be boosted, so modification of a maximum standard adjective by *much* should be either undefined or vacuous. The entailment test for minimum standards (*x is not A* entails *x has no amount of A-ness at all*; see section 3.2.4) confirms that adjectival participles that accept modification by *much* (see (3) and Table 1) do in fact have minimum standards: all of the examples in (70) are contradictory.

- (70) a. #The war was not desired, but certain parties hoped that a conflict would break out.  
 b. #Your financial support is not needed, but it is necessary that we get small contribution from you.  
 c. #The film was not praised, but one critic said good things about it.  
 d. #The problem was not talked about, though Frank mentioned it to his mother.

Deverbal adjectives with maximum standards do not accept modification by *much*:

- (71) a. ??The meat is much done. (cp. partly done  $\neq$  done)  
 b. ??The book is much written. (cp. half written  $\neq$  written)  
 c. ??The glass is much filled. (cp. partially filled  $\neq$  filled)

Nor do adjectives with relative standards, as seen in the incompatibility of *much* modification with a *for*-PP that indicates comparison class:

- (72) a. ??Klaus was much pleased for someone with his generally dreary outlook on life.  
 b. ??Mike appeared much frightened for a supposedly invincible boxer.  
 c. ??For someone who had just been accused of embezzlement, Gil seemed much relaxed.

Second, although the adjectives modified by *much* must have lower closed scales, since a minimum standard corresponds to a lower endpoint, (69) places no restrictions on the upper end of the adjectives' scales. This predicts that *much* should in principle be compatible both with totally closed and partially closed scale adjectives. This prediction is at least partly borne out: *much* is clearly compatible with adjectives whose scales are open on the upper end, as shown by the examples in (73), where the adjective is unacceptable with proportional modifiers of maximality:

- (73) a. ??a completely needed expense  
 b. ??a completely desired result  
 c. ??a completely discussed issue

It is less clear to what extent *much* is compatible with adjectives with totally closed scales. To date, we have found very few examples of this kind, though the following is ostensibly one:

- (74) ...a much-deserved rest (cf. fully deserved) [Commissioner Gordon, at the end of *Batman* episode 'Surf's Up/Joker's Under']

Although the reason for this apparent gap in the data remains to be explained, it may be a kind of 'elsewhere effect', given that the modifier *well* is restricted to predicates with totally closed scales (though not necessarily with absolute standards!), as we will argue in the next section. Alternatively, it may ultimately be necessary to adjust the semantics for *much* to make reference to scale type in addition to the nature of the standard value.

Before we move to our analysis of *well*, it should be acknowledged that *much* also differs from *very* in that it is more often than not infelicitous with underived adjectives, even if they satisfy the absolute adjective/minimum standard requirement (cf. Bolinger 1972):

- (75) a. \*much {wet, open, dirty}  
 b. \*much {aware of the difficulties, able to cope, available}

It is unclear whether this is a purely morpho-syntactic constraint or is indicative of a deeper semantic difference between derived and underived adjectives—interestingly, there is significant overlap in the few underived adjectives that permit *much* and those that permit *well*; see below.<sup>14</sup> However, what is important for our purposes

<sup>14</sup>An important exception to this generalization involves comparative forms (as well as the comparative-like expressions *the same*, *different*, and *preferable*), which are compatible with *much*-modification independent of the relative/absolute distinction:

- (i) a. much {wetter, more open, dirtier, etc.}  
 b. much {drier, more closed, cleaner, etc.}  
 c. much {taller, happier, more expensive, etc.}

is that both *much* and *very* can modify *derived* gradable adjectives; therefore it is in this domain we can clearly see the effects of the purely semantic restriction on absolute vs. relative adjectives that we have argued for here.

**4.4. WELL** We now turn to a rather different kind of degree modification. In contrast to *very*, *well* combines felicitously with adjectives that have totally closed scales, but not with adjectives that have open scales:

- (76) a. We are well aware of the difficulties.  
 b. They are well able to solve their own problems.  
 c. The bud was well open. (Bolinger 1972, p. 43)
- (77) a. We are partially/half/completely aware of the difficulties.  
 b. They are partially/half/completely able to solve their own problems.  
 c. The bud was partially/half/completely open.

Under at least one plausible analysis of comparatives the fact that *much* can modify comparative forms follows directly from the semantics we have proposed in (69). Unlike non-comparative degree morphology, *more* and the other comparative morphemes select for not only an adjective but also a degree argument, which may be made explicit by a comparative clause. Let us suppose that the denotation of e.g. *more* is something like (ii); here we assume that surface word order reflects order of composition, i.e., that the first argument of *more* is the adjective (as in e.g., Klein 1980), rather than the comparative clause (as in e.g. Heim 2000).

$$(ii) \quad \llbracket \text{more} \rrbracket = \lambda G \lambda d \lambda x. \exists d' [d' \succ d \wedge G(d')(x)]$$

On this analysis, the interpretation of e.g. *more expensive* is as shown in (iii), which is an expression of the same semantic type as an ordinary gradable adjective, and so could in principle combine with *much*.

$$(iii) \quad \llbracket \text{more expensive} \rrbracket = \lambda d \lambda x. \exists d' [d' \succ d \wedge \mathbf{expensive}(x) \succeq d']$$

If we make the further assumption that comparatives are members of the class of absolute adjectives (or a related class of adjective phrases) — an assumption justifiable when we consider the behavior of comparative forms with respect to the tests for absolute vs. relative standards in 3.2 — then *more expensive* also satisfies the selectional restrictions of *much*, giving us (iv) as the interpretation of *much more expensive*.

$$(iv) \quad \llbracket \text{much more expensive} \rrbracket = \lambda x. \exists d'' [\mathbf{high}(d'') \wedge \exists d' [d' \succ d'' \wedge \mathbf{expensive}(x) \succeq d']]$$

In prose: *much more expensive* is true of an object iff there is a degree  $d''$  that is appropriately higher than the standard for *more expensive* (the degree introduced by the comparative clause) and a degree  $d'$  that exceeds  $d''$ , and the degree to which object is expensive is at least as great as  $d'$ .

As it stands, however, this analysis leaves unresolved how exactly the comparative clause is compositionally incorporated into the interpretation of the adjective phrase as a whole, suggesting that an alternative proposal should be considered on which *much* modifies *more* alone. Note, though, that this alternative would also require, perhaps problematically, that *much* also be able to modify the *-er* morphology alone. We leave a resolution of this complex issue for future work.

Not all nonderived adjectives with totally closed scales permit modification by *well*, however, which may be due to an independent morphosyntactic preference for *well* to modify participles.<sup>15</sup> Focusing on participles that accept modification by *well*, we see from the acceptability of proportional modifiers that they have closed scales.

- (78) a. well {acquainted, documented, understood, publicized, written, etc.}  
 b. partially/half/completely {acquainted, documented, understood, publicized, written, etc.}

An important difference between *well* on the one hand and *very* and *much* on the other is that the output of *well*-modification can be the input to a full range of further degree modification:

- (79) a. Sam is more well able to cope with the situation than is his brother.  
 b. They remained very/quite/only too/hardly well aware of the difficulties that might arise from their analysis.  
 c. Martin Beck is very well acquainted with the facts of the case.  
 d. The facts are hardly well understood.  
 e. The concert was quite well publicized.

Although in many cases it may be difficult to determine whether the degree modifier or comparative has combined with just *well* or with the *well A* constituent, comparatives show that the latter type of combination is indeed possible: (79a) entails that Sam is well able to cope, whereas (80), in which the use of a suppletive form clearly shows that the comparative combines first (and exclusively) with *well*, only entails that Sam is able to cope to some degree. (See also Bolinger 1972, p. 268ff for related comments on the difficulty of determining what degree modifiers in fact modify.)

- (80) Sam is better able to cope with the situation than is his brother.

These facts strongly indicate that *well* is not of the same syntactic or semantic category as *very* and *much*, even though its semantic effects are similar. Instead, the facts in (79) indicate that *well* denotes a function from (gradable) adjective meanings to adjective meanings. But what kind of function?

Four facts are relevant to answering this question. First, the fact that the output of *well* modification supports degree modification by *very* shows that the resulting complex expression must be a relative gradable predicate. Second, although a *well A* construction can be further modified by a range of degree morphemes, there is a

<sup>15</sup>Alternatively, this restriction may be due to a semantic requirement that *well* have access to an event variable in the fine-grained lexical semantics of the modified expression, as proposed below. Something similar may be going on with *much* (cf. the discussion above), though it does seem that *well* is somewhat more permissive than *much* when it comes to modification of underived adjectives; see Bolinger 1972, pp. 38ff, 44.

systematic exception: proportional modification is infelicitous, as shown by (81), indicating that the *well A* complex uses an open scale.

- (81) a. ??Martin Beck is partially/half/completely well acquainted with the facts.  
 b. ??The concert was partially/half/completely well publicized.  
 c. ??The facts are partially/half/completely well understood.

Third, as illustrated by the examples in (82), an utterance of *x is well A* presupposes that *x is A*: each of (82a)-(82c) require it to be the case that (82d) is true.

- (82) a. Martin Beck is well acquainted with the facts.  
 b. Is Martin Beck well acquainted with the facts?  
 c. Martin Beck is not well acquainted with the facts.  
 d. Martin Beck is acquainted with the facts.

Finally, there is a clear semantic relation between the degree modifier use of *well* and its adverbial use, as illustrated by the examples in (83).

- (83) a. We acquainted Beck well with the facts.  
 b. Beck is someone well acquainted with the facts.

If a person is well acquainted with a set of facts, then it is also true that that person has been acquainted well with those facts.

With these considerations in mind, we will propose an interpretation of *well* in terms of the meaning of the open scale, relative adjective *good*, which we assume underlies *well*. Specifically, we propose that *well* takes a closed scale gradable predicate *G* as input and returns a relation between an object *x* in the positive extension of *G* (an object that is *G*) and a degree *d* such that there is an event related to *G* with participant *x* and the degree to which the event is good is at least as great as *d*. An initial formalization of this hypothesis is provided in (84), where  $G^v$  is an abbreviation for an event description related to *G*, which we take to be specified in *G*'s fine-grained lexical representation.

- (84)  $[[\text{well}]] = \lambda G : S_G \text{ is closed.} \lambda d \lambda x : x \text{ is } G. \exists e [G^v(x)(e) \wedge \mathbf{good}(e) \succeq d]$

For example, a sentence like *Beck is well acquainted with the facts* presupposes that Beck is acquainted with the facts (and has therefore been the acquaintancee in an acquainting event), and is true if this event qualifies as good, perhaps because it was very thoroughly carried out.

Obviously, more needs to be said about the relation between *well* and the event introduced by the gradable predicate, an issue that we investigate in detail in McNally and Kennedy 2002.<sup>16</sup> However, for the purposes of this paper, it is enough

<sup>16</sup>In that work, we develop a more articulated analysis of the semantics of *well* which shares its basic claims about meaning with the analysis presented here, but which is formalized within the Generative Lexicon framework (Pustejovsky 1995), allowing for a specific characterization of how

to observe that (84) has the desired consequence of turning a closed scale adjective into an open scale one, since the degree argument of *well A* is a degree on the scale associated with *well* — the ‘goodness’ scale — rather than a degree on the scale associated with the modified adjective.

In addition to deriving the facts discussed above, this aspect of (84) also makes a new prediction: since there are various ways in which an eventuality might count as good, we should see a certain amount of polysemy in *well* modification. In fact, expressions of the form *well A* typically have two interpretations, as pointed out in Kennedy and McNally 1999. In addition to the ‘high degree’ reading that we have been focusing on here, *well* has a ‘manner’ reading that means something like ‘in a good way’. The following titles of articles from the world wide web illustrate this apparent polysemy.

- (85) a. Well-documented, yet little known facts about dams and reservoirs  
(<http://www.sandelman.ottawa.on.ca/dams/readme.html>)  
b. Well documented patterns reduce future labour  
(<http://www.expressitpeople.com/20011119/management3.htm>)

The point of the first article is that there is a large volume of information about the harmful effects of large dam and reservoir projects outside of the narrow domain of engineering literature (which is typically ignored); *well* is clearly being used here to indicate a high degree of documentation. The second article is a discussion of pattern-oriented methodologies in software development. It argues that such a methodology will be successful only if the relevant patterns are carefully documented; here *well* has a manner interpretation. See McNally and Kennedy 2002 for an explanation of the the degree vs. manner interpretations of *well* in terms of the role played by the object in the event.

**4.5. SUMMARY** Although our discussion of the semantics of these degree modifiers has been necessarily brief, it should at least be clear that they each show a slightly different kind of sensitivity to aspects of the scalar features of the adjectives they select for: in the case of *very* and *much*, reference to the nature of the standard value is necessary; in the case of *well* (and perhaps *much* as well), scale type is crucial.

**5. THE ORIGINS OF SCALES AND STANDARDS** The conclusion to be drawn from our analysis of degree modification, plus the other facts discussed in section 3, is that the two semantic properties of gradable predicates that we have focused on

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*well* accesses an event variable introduced by its adjectival argument. In particular, we show how it is possible to capture the relationship between the manner adverb and degree modifier uses of *well* by guaranteeing in the semantics that the scale structure of an adjective phrase of the form *well A* is inherited from the scale structure of *well* in its manner adverb use.

in this paper — scale structure and the relative/absolute distinction in the standard of comparison — are linguistically significant features. We have further argued that these properties are linked: in general, gradable predicates with open scales have relative standards, and gradable predicates with (possibly partially) closed scales have absolute standards. These results raise an important new question: how is the scale structure of a gradable predicate determined? In the case of underived adjectives, we may assume that this information is encoded in the lexical entry, but in the case of derived adjectives, something more needs to be said. Is it possible to predict whether a particular derived adjective will be associated with an open or closed scale, and to predict what sort of standard value will it use? We argue that the answer to this question is ‘yes’, that the scale structure of a derived adjective can be predicted based on the event structure associated of the source verb or the boundedness of its argument (cf. Paradis 2001). We further show that the orientation of an absolute standard — whether it is maximum or minimum — also depends on properties of the aspectual and argument structure of the source verb.

## 5.1. PREDICTING THE SCALE STRUCTURE OF DERIVED ADJECTIVES

**5.1.1. EVENT STRUCTURE AND SCALE STRUCTURE** Taking as a starting point the class of deverbal gradable adjectives with totally closed scales (those that are acceptable with degree modification by *well*), the data that we have observed indicate that this class corresponds very closely to the class of verbs that introduce incremental arguments. As pointed out by Krifka (1989, 1992) (see also Dowty 1991; Tenny 1995; Jackendoff 1996; Ramchand 1997), what is unique about this class of verbs is that it is possible to establish a homomorphic relationship between the events they denote and their incremental arguments. This homomorphism is captured formally by Krifka in terms of his notion of **MAPPING TO OBJECTS**, defined as a characteristic of thematic roles  $R$  as follows (Krifka 1989, p. 92):

$$(86) \quad \forall R[\mathbf{MAP-O}(R) \leftrightarrow \forall e \forall e' \forall x [R(e, x) \wedge e' \subseteq_E e \rightarrow \exists x' [x' \subseteq_O x \wedge R(e', x')]]]$$

In prose, **MAP-O** guarantees that all subevents  $e'$  of a given event  $e$  with participant  $x$  in role  $R$  (what Dowty 1991 refers to as the ‘incremental theme’) involve a part  $x'$  of  $x$ . A typical incremental theme is the object of the verb *eat*: for all subevents of a given event of eating an orange, for example, we can identify unique parts of that orange which were eaten during each of those subevents. Conversely, we know how much of the eating-an-orange event has been completed by examining how much of the orange has disappeared; the homomorphism in this direction is captured by Krifka’s analogous notion of **MAPPING TO EVENTS** (see Krifka 1989, p. 92).

As pointed out by Ramchand (1997), however (see also Jackendoff 1996 and in particular Hay et al. 1999 and Kennedy and Levin 2002), there are at least two additional types of incremental arguments: what she calls  $\text{Pat}(\text{ient})_{+/-}$  and  $\text{Pat}_{\text{LOC}}$ .

Pat<sub>+/-</sub> arguments are those which undergo an incremental change of state, such as the subject of the verb *cool* in a sentence like *The soup cooled*. Those verbs for which a homomorphism can be established between the progress of the event and the location of one of its participants have Pat<sub>LOC</sub> arguments. For example, the verb *descend* in *Max descended the staircase* entails incremental movement of the subject along a path defined by the direct object.<sup>17</sup>

We claim that it is precisely the homomorphic relation between the incremental theme argument and the corresponding event that is responsible for the scalar properties of adjectives derived from this class of verbs. Specifically, since such adjectival participles measure the degree to which their arguments have participated in the event described by the source verb, their scales should have minimal and maximal values defined as follows. The minimal degree on the scale represents participation in a minimal (sub)event of the appropriate sort by (a minimal part of) the incremental theme (or a minimal degree of the relevant measurable property for Ramchand's Pat<sub>+/-</sub> arguments, or a minimal movement along the relevant path for Ramchand's Pat<sub>LOC</sub> arguments); the maximal degree on the scale represents participation in the maximal event involving (all of) the incremental theme/property/path.

As an example, consider *loaded*, as in (87).

(87) The truck is loaded with hay.

Let us assume, generalizing Dowty's (1991) analysis of *spray/load* verbs, that the truck is the incremental theme in the loading event described in (87). We can define a mapping between the progress of the event of loading and a property of the truck, namely, the volume of the material that it holds; the degree to which the truck can be said to be loaded corresponds to the degree to which it has progressed through a loading event. Since we can define a beginning point and endpoint for this event (corresponding to when the truck is unloaded and loaded, respectively), we can identify minimal and maximal values for the scale of 'loadedness' of the truck.

Note that it is important to distinguish the *derived* measure function expressed by an adjective derived from an incremental verb, which measures the degree to which an object has participated in the event described by the verb, from any adjectival component of the lexical semantics of the verb itself. A number of researchers have argued that incremental verbs crucially contain an adjectival component to their meanings, specifically a measure function of some sort, which play an important role in determining their aspectual properties as a function of the sort of arguments they compose with (see Krifka 1989, 1992 and in particular Kennedy

<sup>17</sup>Whether the three types of incremental roles posited by Ramchand are theoretically justified, or whether these different classes of incremental verbs can be subsumed under a single, general semantic analysis, as argued by Kennedy and Levin 2002, is not a question that we will address here. What is important for us is that all of these verbs are similar in the incremental relation between (different aspects of) their arguments and the described events, and that this relation forms the basis for building a closed scale for the adjectival form, as argued below.

and Levin 2002).<sup>18</sup>

The meaning of the verb *load*, for example, includes a function that measures the degree to which the incremental argument has been filled with stuff, i.e., an adjectival component whose meaning is very similar to *full*; this measure is distinct from that expressed by the adjectival participle *loaded*, however. This is illustrated by the differences in meaning between the sentences in (88) and (89).

- (88) a. Kim's truck is partially loaded.  
 b. Kim's truck is half loaded.  
 c. Kim's truck is 80% loaded.  
 d. Kim's truck is completely loaded.
- (89) a. Kim's truck is partially full.  
 b. Kim's truck is half full.  
 c. Kim's truck is 80% full.  
 d. Kim's truck is completely full.

The truth values of the examples in (88) are intimately connected to the progress of corresponding loading events (a half loaded truck is one which has gone halfway through a loading event, a fully loaded truck is one which has gone entirely through a loading event, etc.). However, although participation in a loading event affects the truth of the sentences in (89), the degree to which any particular truck is loaded need not be identical to the degree to which it is full. (88d), for example, does not entail (89d), as shown by (90).

- (90) Kim's truck is completely loaded (with the hay), but it is not full.

The following examples support the generality of the claim that if an adjective is derived from a verb with an incremental argument, that adjective will have a closed scale, as such adjectives are compatible with proportional degree modifiers.<sup>19</sup>

- (91) "*Classic*" incremental theme arguments
- a. half eaten cookies  
 b. a partially written novel  
 c. a fully paid bill  
 d. a half prepared talk

<sup>18</sup>Indeed the general hypothesis that verbs that express changes of state have adjectival components to their meanings is commonplace in lexical semantics, showing up in e.g. Jackendoff's (1972) complex lexical representations, Dowty's (1979) verb decompositions, Kratzer's (2000) neo-Davidsonian analysis of derived statives in German, and many other works.

<sup>19</sup>We will not explicitly demonstrate that these and the remaining participles discussed in this paper are adjectives. However, the reader can confirm for him/herself that the majority of them accept *un-*prefixation, and those which do not (like *hated*) occur readily as the complement to predicates like *seem*. See e.g. Levin and Rappaport 1986 on the question of which participles in English can be adjectival.

- e. a completely severed connection
- (92) *Pat*<sub>+/-</sub> *arguments*
- a. partially documented allegations
  - b. an individual fully acquainted with the facts
  - c. fully straightened teeth
  - d. partially frozen liquid
  - e. a completely covered terrace
- (93) *Pat*<sub>LOC</sub> *arguments*
- a. a partially crossed desert
  - b. a half descended staircase
  - c. fully raised blinds
  - d. a completely traversed distance

As expected, all of these participles accept modification by *well*, though many of them allow only the ‘manner’ interpretation discussed in section 4.4 (which can be difficult though not impossible to place into an appropriate context, especially for the verbs in (93)), not a degree interpretation.

Now let us consider the implication that, if a participial adjective has a totally closed scale, it is derived from a verb with an incremental argument. If this implication is correct, then those adjectives derived from verbs *lacking* such arguments should *not* have closed scales, and it should be impossible to combine them with proportional modifiers. And indeed, the examples we have found, such as those illustrated in (94), systematically bear out this prediction. Note that these participles are derived from atelic verbs (whether stative or nonstative, (94a)-(94d)) or from verbs which are telic but in which the theme or experiencer argument is affected wholistically (94f) or experiences a change in property which is necessarily mapped onto an open scale (94g).

- (94)
- a. ??a completely hated/loved/envied/admired neighbor
  - b. ??a fully needed/wanted rest
  - c. ??a partially regretted action
  - d. ??a completely looked for reaction
  - e. ??a completely watched suspect
  - f. ??a partially kissed/met/punched young man
  - g. ??a fully worried/surprised mother

If telic verbs with incremental arguments map onto totally closed scales, what should we expect from adjectives derived from atelic verbs such as *needed* or *looked for*? If the same sort of homomorphic relation exists between the event structures of atelic verbs and the scale structures of the corresponding adjectives, then such adjectives should have *partially* closed scales. The minimal (sub)event or state which supports the truthful application of the adjectival property to its argument will

map onto the lower endpoint of the scale. Progressively larger subevents will map onto progressively higher points on the scale. However, since atelic verbs describe situations with no natural endpoint, there will be no obvious *maximal* event or state which could correspond to an upper endpoint of the corresponding adjectival scale. The scale should thus be open on the upper end.

Consider for example *needed*. If the Mediterranean coast needs even just a tiny bit of rain (for example, because it's rained just slightly less than normal for the season), it will be entailed that rain is needed. If the drought continues, the degree to which the rain is needed will increase. But just as it makes no sense to talk about the *culmination* of this need relation (as opposed to its *end*), it makes no sense to talk about the rain being “completely needed”.

However, since the degree modifier *much*, unlike the proportional modifiers, is compatible with adjectives with scales which are closed on the lower end and open on the top end, we predict that it should combine felicitously with the vast majority of adjectives derived from atelic verbs. The examples in (95) bear out this prediction.

- (95) *Adjectives derived from atelic verbs*
- a. a much admired statesman
  - b. much needed rain
  - c. a much regretted action
  - d. a much praised piece of work
  - e. a much looked for treasure
  - f. a much talked about program

Observe that the ordering of entities (or events, since they can be needed too) on the “neededness” scale as described above was determined by the temporal duration of the need relation that supports the truthful ascription of the adjective. And similarly, most of the examples in (95) can be paraphrased as “A’d for a long time.”

However, this is not the only kind of reading they permit, a fact which indicates that the scale structure associated with an adjective can stand in homomorphic relations to other aspects of the events which support their truthful ascription. For example, arguably the most natural reading of *much admired* is paraphrasable as *admired by many people*, without necessarily entailing that the admiration has been long lasting.<sup>20</sup> On the other hand, *a much talked about program* might well be one

<sup>20</sup>Adjectives denoting the property of being the object of an emotion, such as *admired*, *loved*, or *hated*, or the experiencer of an emotion, such as *worried*, also permit readings on which the scalar dimension along which they are measured is one of intensity. For example, a much despised neighbor might be despised by only one individual, but with a passion. What these facts show is that the derived measure function expressed by the deverbal adjective is indeterminate, able to measure the degree to which an object possesses some property (e.g., the property of being admired) from different perspectives. See McConnell-Ginet 1973; Kamp 1975; Kennedy 1999b for discussions of indeterminacy.

which has been talked about many times, though not necessarily by many different people or for a particularly long time on any given occasion. In both cases, however, a scale for the adjective can be constructed by mapping from a set of potentially complex events which can be ordered in an algebraic structure as proposed in e.g. Link (1983), Landman (1989), or Lasersohn (1995). Such algebraic structures are formed by summing together larger events out of smaller ones—for instance, various “atomic” events in which the same statesman is the object of admiration, possibly by a different person each time, or in which the same program is talked about. These events are ordered by increasing size (and complexity), and this ordering, in turn, can map onto a scale which is bounded on the lower end but not on the upper end, since there is in principle no limit to the number of individuals that can admire someone, nor to the number of times an event such as talking about something can be iterated.

The hypothesis that event structure correlates with scale structure makes an additional prediction: no deverbal adjective should, in principle, be associated with a scale which is open on the *lower* end, whether or not it is bounded on the upper end. The reason is that there should always be a minimal event which supports the truth of the adjectival predication and which is homomorphically related to the lower bound on the scale. Evidence that this prediction is correct comes from the fact that, to the best of our knowledge, all deverbal adjectives prefixed with *un-*, which reverses the polarity of the adjective scale, accept modification by endpoint-oriented modifiers such as *absolutely* (see 3.1, above).

**5.1.2. BOUNDED ARGUMENTS, BOUNDED SCALES** Although the generalizations described in the previous section are quite robust, one also finds some *prima facie* counterexamples. One is *known*. The verb *know* is stative, and thus atelic, in English. Given what was said in the previous section, we would predict that *known* would be associated with a scale that is bounded on the lower end but open on the upper end. Nevertheless, examples such as (96), in which the adjective cooccurs with an (upper) endpoint-oriented modifier, are felicitous:

(96) The effects of that drug are not fully known.

How does *know* come to be associated with a closed scale? More specifically, what might provide the basis for a homomorphic mapping to that closed scale?

There are two possible answers to this question. One is that the scale structure of adjectival participles like *known* is based on an implicit event of ‘coming to know’, which has as its culmination the state described by the verb. A second possibility is that it is actually the extension of the adjective’s argument that provides the basis for building a closed scale for such adjectives. If, for example, an object *x* is partially known, then one or more individuals stand in a knowing relation to at least some part of *x*; if *x* is fully known, then one or more individuals stand in a knowing relation to all parts of *x*; and so on. In general, those adjectives which can be

applied not only to the whole of an entity but also to its parts can also be associated with a scale based on the part structure of that entity.

Evidence that the second analysis is correct comes from at least two sources. First, we find that not only participles but also non-deverbal adjectives typically associated with unbounded scales come to be associated with bounded scales when combined with the right kind of argument. Consider the adjective *hot* for example. Although it rejects modification by an endpoint-oriented adjective when its argument is not easily considered bounded, as in (97a), such modification becomes possible when the adjective is applied to something clearly bounded, as in (97b), which is paraphrasable as “All of the baby’s face is hot.”

- (97) a. ??Outside it’s completely hot.  
b. The baby’s face is completely hot.

(98) makes the same point: A mass noun such as *milk*, even when understood generically, does not identify a bounded entity whose physical extension could form the basis for a mapping to a closed scale; consequently, the use of *completely* in (98a) sounds odd. In contrast, when the adjective is predicated of a bounded argument such as in (98b), the degree modifier becomes acceptable and the sentence entails that the entirety of the suit was white.

- (98) a. ??Milk is completely white.  
b. His suit was completely white.

The second source of evidence comes from the vagueness observable in (99), in which we find the modifier *half*, which, like *completely*, requires an adjective with a closed scale:

- (99) a. The meat is half cooked.  
b. The crops are partially frozen.

(99a) can be understood as entailing that all of the meat is half cooked, but it also can be true in situations in which half of the meat is entirely cooked. In other words, in addition to the scale made available by the event structure of *cook* — the scale relevant for the first construal of the sentence — *cooked* can also be associated with a closed scale made available by the part structure of the meat, which is relevant for the second construal of the sentence.

Though we must leave for future research a full analysis of the effects of event structure and the boundedness of the adjective’s argument on the determination of scale type, the above examples are sufficient to demonstrate that the scale type of adjectives is often predictable, and that regularities can be established not only between the algebraic part structure of events and scale structure, but also — in a parallel fashion — between the algebraic part structure of individuals and scale structure.

**5.2. PREDICTING THE ORIENTATION OF ABSOLUTE STANDARDS** We close this section with one final example of the tight relationship between event structure and scale structure: the role that the former plays in allowing us to predict whether an absolute limit adjective defaults to a minimum or maximum standard.

The data show that in the case of deverbal adjectives, the orientation of the standard depends on the role of the adjective's argument in the event associated with the corresponding verb. Adjectives whose arguments satisfy Mapping to Objects (see (86), above), such as *cut* and *written*, systematically have upper endpoints as standards, while those whose arguments do not, such as *acquainted* and *documented*, have lower endpoints as standards. This correlation is exemplified in (100) and (101). The fact that (100a) and (100b) are mutually entailing supports the claim that the argument of *cut* satisfies Mapping to Objects. The fact that (100a) does *not* entail (100c) shows that the standard for *cut* is the maximum value on the scale (cf. the discussion of in 3.2.4).

- (100) a. The grass is half cut.  
 b. Half of the grass is cut.  
 c. The grass is cut.

A different pattern appears in (101). Here we see that (101a) and (101b) are *not* mutually entailing; rather, (101a) entails (101c). This indicates that the (external) argument of *acquainted* does not satisfy Mapping to Objects. And again in contrast to what happens with *cut*, (101a) entails (101d), as expected if the adjective has a minimum standard.

- (101) a. Beck is partially acquainted with the facts.  
 b. ??Part of Beck is acquainted with the facts.  
 c. Beck is acquainted with part of the facts.  
 d. Beck is acquainted with the facts.

The explanation for these correlations can be traced to the relationship between the truth conditions for the adjective and those for the related verbal predication. Consider first the case of the argument satisfying Mapping to Objects. Because it cannot be asserted that the eventuality corresponding to the participle is completed until the argument has been totally affected (in the relevant way), it follows that an adjectival participle truthfully applies to such an argument only if that argument possesses a maximal amount of the relevant (deverbal) property. The result is a maximum standard.

The situation is different in the case of other types of arguments. Since the completion of the eventuality corresponding to the participle does not depend on affecting all of the relevant argument (or affecting that argument in its entirety), it may be asserted that the eventuality is completed even when that argument has been minimally affected. As a result, the adjectival participle may be truthfully applied

to such an argument as long as the argument possesses a minimal degree of the relevant property. This derives a minimum standard.

**6. CONCLUSION** We have argued on the basis of facts involving the felicity of use of gradable adjectives in different contexts, entailment patterns, and in particular the distribution and interpretation of degree modifiers for the linguistic relevance of a scalar typology parameterized along two dimensions — the (un)boundedness of the scale and the nature of the standard value — and we have presented a semantics for the degree modifiers *very*, *much* and *well* which makes crucial use of this typology. In addition, we have shown that an adjective's scale structure is not always arbitrary, but rather there are strong correlations between the structure of the scale and the nature of the standard value, between the event structure of the verb from which a participial adjective is derived and the scale structure of that adjective, and between the part structure of an adjective's argument and the scale structure of that adjective.

This paper clearly leaves many things to be explored. One question is to what extent the orientation of the standard can be predicted in cases of adjectives not obviously related to events. In addition, there are also many more degree modifiers which merit investigation, and it remains to generalize the semantics provided here for *much* and *well* to uses as degree modifiers of other syntactic categories. One of the most important issues, however, is how scale structure should be encoded in the lexical semantic representations of members of different grammatical categories. At the very least, lexical entries should be structured to allow us to explain the influence that (both linguistic and extralinguistic) context can have on the scale with respect to which an adjective is evaluated, and they should also make clear how the scale structures of derivationally-related expressions (verbs and deverbal adjectives, for instance) are related. The facts we have discussed here clearly reinforce the hypotheses put forward by Bolinger and Sapir that gradability is a feature of grammatical categories other than adjectives; future research should be directed towards increasing our understanding of how exactly this central semantic property is encoded in lexical representations.

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**Kennedy**

Department of Linguistics  
Northwestern University  
2016 Sheridan Rd.  
Evanston, IL 60208 USA  
*kennedy@northwestern.edu*

**McNally**

Departament de Traducció i Filologia  
Universitat Pompeu Fabra  
La Rambla, 30-32  
08002 Barcelona SPAIN  
*mcnally@upf.es*