A cognitivist semantics of gradation[*]

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Abstract Scalar approaches to the semantics of gradation are generally based on the conception of degrees as either points or intervals. In this paper, I will review two prominent approaches which use intervals differently for modelling the polarity of adjectives. For a relevant subset of gradation phenomena, I will discuss several problems of these approaches and will develop a new proposal which is characterized by the assumption that for an attention-based, cognitivist semantics of gradation, both conceptions of degree are needed for a satisfactory solution of the problems.

1 Introduction

Gradation can be informally described as the characterization of an object's dimensional measure involving some sort of *comparison*. It is most prominently expressed by gradable adjectives and the constructions in which they appear (e.g., *10 centimeters long, more pretty than, much less than forty degrees celsius warm*).[1]

How gradation and the corresponding semantics of its expressions is to be formally represented is a matter of ongoing dispute. I will adhere to a recent view according to which it involves *scales* as abstract representations of measurement (for a review of arguments favoring this view see Kennedy 1999), where a scale is typically conceived as a structure $\langle D, \succeq, \delta \rangle$, where D is a set of ordered objects (*degrees*), '$\succeq$' is an ordering relation, and δ is a dimension corresponding to the domain of ordering.

The semantics of gradation is then systematically based on mapping gradation expressions on degrees and their relation on a pertinent scale. Within scalar approaches, there is disagreement as to whether degrees are conceived as *points* (corresponding to the real numbers, cf. Klein 1991) or *intervals*, and whether there is a relevant distinction between positive and negative intervals (Kennedy 1999) or not (Bierwisch 1989).

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1 In the following, I will restrict discussion to spatial adjectives and their corresponding dimensions.

The conception of degree-as-interval is based on the need to cope with polarity[2] phenomena of gradable adjectives. For example, only +pol positive adjectives can be used with measure phrases ([1a]) although this does not hold for comparative forms ([1b]). In comparison constructions, certain combinations of polarities ([1c]) are not acceptable.

(1)   a.   *The iPad is 10cms wide/*10 cms narrow.*
         b.   *The pen is 2mms thicker/thinner than the iPad.*
         c.   **The pen is longer than the iPad is narrow.*

It will be shown in this paper, however, that the implementations of this conception do not fully account for all of these (and other) linguistic phenomena and that there are separate reasons to question their ontological assumptions. Cases in point will be, among others, the so-called *cross-polar anomaly* (exemplified in [1c], cf. Kennedy 1999) and data like (2a) (from Bierwisch & Lang 1989b) and (2b) (from Carstensen 1992), which show unexpected and as yet unexplained polarity phenomena.

(2)   a.   *The plastic ball jumps *lower/less high and *nearer/less far than the rubber ball.*
         b.   *far/*near away/above, *far/near by*

The semantics of gradation has received a boost of interest in the past years, and it is impossible to do justice to the breadth of the field. I am therefore quite selective with regard to the phenomena and theories discussed. I will first give a synopsis of two main ("standard") interval-based scalar approaches (Bierwisch 1989, Kennedy 1999)[3] and then discuss some of their problems and unconsidered phenomena. By introducing general aspects of "cognitivist" semantics, I will show that from a cognitive point of view, both existing conceptions of degree – even the seminal cognitive linguistic one of Bierwisch (1989) – are insufficient. After that, I will develop a cognitivist approach to gradation that is characterized by respecting certain aspects of cognitive representation and processing. I will show that it is beneficial and even essential to consider data with adjective-preposition combinations, and that the resulting Cognitivist Semantics of Gradation (henceforth referred to as *CSG*) is more complex, but better suited to explaining basic gradation phenomena.

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2 Gradable adjectives usually come in (antonymous) pairs, the one often being called *positive* (e.g., *long*), the other *negative* (*short*). These terms, reflecting the *polarity* 'αpol' of an adjective partially conflict with *adjective form* terms (positive vs. comparative). I will therefore call *long* a +pol positive adjective, and *short* a −pol positive adjective (*longer* and *shorter* being αpol comparatives).

3 Naming the authors always includes their co-authors, of course. Regarding other (interval-based) approaches to the semantics of gradation and comparison (cf., e.g., Beck 2011), the chosen two seem to be sufficiently prominent and distinctive to justify that selection.

2 Scalar Approaches to the semantics of gradation

2.1 General aspects and selected phenomena

Gradation as a cognitive phenomenon includes a mapping of some objective extent *ext* along some dimension δ (hence *ext*$_\delta$) to its extent *ext*$_{Scale_\delta}$ on the corresponding scale *Scale*$_\delta$, with *ext*$_{Scale_\delta}$ being the degree-as-interval. The terminological nit-picking here serves to emphasize the fact that this mapping is non-trivial with regard to the following aspects.

First, an object may provide more than one *ext* to be measured as *ext*$_\delta$. An example is shown in figure 1, where "length" could, depending on object category and/or context, refer to different extents (depicted as dotted lines): to the object-internal maximal extent (e.g., of a bent tube), to the object's functional length (e.g., of a spearhead) or to the global maximal extent (e.g., for reaching something).

Second, three-dimensional objects are described wrt. a varying number of dimensions (from one to five): A ball can only be thick (or have a certain diameter), a brick-like object can, depending on context, be long, wide, deep, thick and high.[4] Therefore, a single *ext* may be categorized as more than one *ext*$_\delta$ for different δs.

Third, objects can be compared wrt. different dimensions (e.g., *longer than wide*). That is, adjectives like *long* and *wide* are *commensurable* as the corresponding *ext*$_\delta$s can be mapped onto the *same scale Scale*$_{LIN}$ of spatial linear extension.
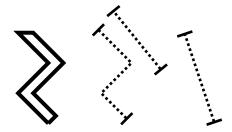

Figure 1:   Multiple length extents

As has already been mentioned, only +pol positive adjectives can combine with measure phrases. Expressions like *31 cms long* (vs. **31 cms short*) state that the length of an object is (at least) 31 cms, without entailment of this object being "long" (i.e., longer than most objects in some comparison class). Here, the adjective only names the dimension (Bierwisch calls this the 'nominative' use of an adjective).

Gradable adjectives are often analyzed as expressions denoting a relation between individuals and degrees as in (3) (m_δ^α being the *measure function*[5] of some adjective

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4 Cf. Lang et al. (1991) for the intricacies of dimensional designation.
5 This is usually the function that realizes the mapping from *ext*$_\delta$ to *ext*$_{Scale_\delta}$.

φ, with α representing *polarity*(φ) and δ representing *dimension*(φ)[6]), where $m_\delta^\alpha(x)$ denotes the 'reference degree' and d the 'standard degree'.

(3) $[\![$ *gradable* φ *(positive)* $]\!] = \lambda d \lambda x \, [m_\delta^\alpha(x) \succeq d]$[7]

If an adjective occurs in certain constructions without measure phrases as in *X is (too) long/short*, the expression states that the length of X is longer/shorter than ('contrasts with') some standard, which in turn is derived either from the category of X (i.e., a corresponding *norm* like the 'typical length of pens'), from some contextual comparison set (e.g., the pens on the table), or from the function X has in some context (hence the term 'contrastive' for this use of an adjective by Bierwisch).[8]

Comparative constructions are much more difficult to analyze. For example, measure phrases (*5 cms longer*) do not fit in as clearly as in positive form constructions. They are regarded as denoting *differential degrees* (the degree of difference between the compared degrees) and are integrated into the adjective's semantic form by a concatenation operation (the '•' in [4]), both for +pol and −pol comparatives.[9] As to the adjectives, *synthetic* forms (*shorter*) must be systematically distinguished from *analytic* constructions (*less long than*).

(4) $[\![$ *X is 5 cms longer than Y* $]\!] = m_{MAX}^+([\![X]\!]) \succeq [\![Y]\!] \bullet d_{5cms}$

An important other source of difficulty lies in the task to model our intuitions about the compatibility of the compared constituents (which also holds for equatives). First of all, one has to ensure commensurability (**hotter than wide*). In scalar approaches, this is realized as a condition on ordering relations to be defined only for degrees of the same scale. But then there are also incompatibilities depending on the polarity of the adjectives (see [5]).

(5)   a.   *The iPad is wider than the pen is long.*   (POS-POS)
       b.   *The iPad is narrower than the pen is long.*   (NEG-POS)
       c.   *The iPad is narrower than the pen is short.*   (NEG-NEG)
       d.   *The iPad is wider than the pen is short.*   (POS-NEG)

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6 For example, VERT and MAX as values for δ select the vertical and maximal objective extents, respectively (Lang et al. 1991). Please do not mistake MAX for the maximality operator used in some theories. It is not used in this sense here.

7 For ease of presentation, I have adjusted the different notations to a common scheme of semantic representation, glossing over the differences in detail to be discussed.

8 I am asked by a reviewer to point to the fact that usually only adjectives in this contrastive use are called *positives*. I side with Bierwisch in referring to the *form* of the adjective, however.

9 In this paper, I will not discuss issues deriving from the differing syntactic complexity of Y in (4), for example *longer than (Peter thought) the iPad (is (wide))*, where the semantic information of the comparative complement has to be systematically constructed even in case of missing syntactic information, e.g., about the polarity of the standard and its dimension.

While there is across-the-board unanimity about the judgment of (5a) (fully acceptable) and (5d) (fully inacceptable), acceptability judgments differ wrt. (5b) and (5c). Some claim that sentences involving same polarities are always acceptable and that sentences involving different polarities are always inacceptable (the latter is called *cross-polar anomaly* by Kennedy). Others regard (5b)-type sentences as fine (so-called *cross-polar nomaly* in Büring 2007) and/or (5c)-type sentences bad. Doetjes et al. (2011) investigate the acceptability of such sentences. They report a continuum of judgments (from [5a]- to [5d]-type sentences) in a survey of English and Dutch speakers, but find two clusters (many [5a,b]-type sentences vs. few [5c,d]-type sentences) in Google-search results. Doetjes therefore concludes that "[t]he discussion of these cases in the literature shows that there is no clear consensus about what data should be explained" (Doetjes 2009: 13). Whatever the theoretical outcome of this controversy is, the phenomenon of cross-polar anomaly has led some to the belief that adequate scalar models cannot be based on degrees as *points* on a scale. This is one of the reasons why *intervals* are currently used widely in scalar theories of gradation.[10]

Finally, there are sentences which involve seemingly incompatible constructions but are nevertheless acceptable, for example (6). They can be interpreted as a comparison of differences (of the degrees to their norms, so-called *comparison of deviation*), here roughly as 'The width of the iPad exceeds its norm as much as the length of the pen falls below its norm'.

(6)   *The iPad is as wide as the pen is short.*

2.2 Bierwisch

Bierwisch's approach (Bierwisch 1989) is characterized by a highly condensed lexical representation of various aspects of gradation, which is different from most other proposals. Although his semantic core of gradable adjective forms comprises degree relations representing *comparison*, it always involves three [sic] elements: the dimensional measure of *x*, a comparison value *v*, and a difference value d_c, all of which denote intervals as degrees. Here, the standard of the comparison is not the degree complement *d* of the adjective as in (3), but is composed of *v* and d_c (see the abstract +pol entry in [7]).[11]

(7) $[\![\ gradable\ \varphi\ (\text{+}pol\ positive)\ ]\!] = (\lambda d_c)\lambda x\ [m_\delta(x) \succeq [v+d_c]]$ (Bierwisch)

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10 For other reasons for interval-based models cf., e.g., Bierwisch (1989: 111ff.) and Schwarzschild & Wilkinson (2002). Note also that some approaches define intervals as sets of points or directly work with sets of points (cf. Heim 2008).

11 While d_c is an optional argument of the adjective, *v* is not linked to a syntactic element. Bierwisch specifies conditions for the proper instantiation of these variables.

There are interesting aspects of this (ultimately very complex) analysis: First, it generalizes over the positive and comparative forms of an adjective (roughly, v corresponds to the complement of the comparative, and d_c corresponds to the differential degree of the comparative). It therefore allows for structural alignment of positives and comparatives due to the same treatment of the degree complement (see [8a,b]).

Second, it provides a single representation for the nominative and contrastive uses of positives. Bierwisch uses semantic constraints to guarantee that measure phrases are only possible in nominative use (v is always 0), but not in contrastive use (v is instantiated by a norm, compare [8c] with [8a]).

Third, Bierwisch ontologically assumes only one domain of *positive* degrees as *intervals/extents* and models polarity as a phenomenon resulting from the interval composition of v and d_c: for +pol adjectives, the comparison value is '$v + d_c$' whose interpretation is the interval concatenation '•' of both degrees; for −pol adjectives, the comparison value is '$v - d_c$', the interpretation of which involves an additional inversion operation '*Inv*' applied to d_c (compare [8d] and [8c]). In this way, his analysis captures the *markedness* distinction of polar adjectives. +pol adjectives are the unmarked element of the pair and are assumed to be less complex (production/understanding typically shows shorter reaction times in psycholinguistic experiments, cf. Schriefers 1985) than the marked −pol ones.

It is important to note that in Bierwisch's approach, the antonymy of positive adjectives is reflected in their contrastive use, which again is characterized primarily by norm-relatedness (i.e., N_C instantiates v in [8c] and [8d]).[12] In addition to that, it is reflected in the use of the converse degree relations '$\succeq$' and '$\preceq$'. Antonymous comparatives are distinguished by the different orderings of degrees and the interpretation of '$v \pm d_c$', without any reference to norms (compare [8b] and [8e]).

(8) a. $[\![X \text{ is 5 cms long}]\!] =$ $\qquad m_{MAX}([\![X]\!]) \succeq d_0 \bullet d_{5cms}$
     b. $[\![X \text{ is 5 cms longer than } Y]\!] = m_{MAX}([\![X]\!]) \succeq [\![Y]\!] \bullet d_{5cms}$
     c. $[\![X \text{ is long}]\!] =$ $\qquad \exists d_c \, [m_{MAX}([\![X]\!]) \succeq d_{N_C} \bullet d_c]$
     d. $[\![X \text{ is short}]\!] =$ $\qquad \exists d_c \, [m_{MAX}([\![X]\!]) \preceq d_{N_C} \bullet Inv(d_c)]$
     e. $[\![X \text{ is 5 cms shorter than } Y]\!] = m_{MAX}([\![X]\!]) \preceq [\![Y]\!] \bullet Inv(d_{5cms})$

As to cross-polar (a)nomaly, the critical NEG-POS constellation of (5), *The iPad is narrower than the pen is long*, comes out as perfect in his analysis (compare [8e]). It is less clear, however, whether and how the full pattern of acceptability judgments wrt. (5) is accounted for in his approach.

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12 N_C is the "norm with regard to [the contextually determined comparison class] C" (Bierwisch 1989: 80), for example the average length value of pencils for *long pencil*. Therefore, even a short pencil can be referred to by *long object* in a context of needles and pins.

2.3 Kennedy

Kennedy's scalar analysis of gradation (e.g., Kennedy 1999, 2001) is strikingly dissimilar to Bierwisch's. Most importantly, the semantics of positive adjective forms is different: nominal, or "bare", positives (i.e., the core of the adjectives) are semantically treated as measure functions $m_\delta^\alpha(x)$ that map an object x onto the scale corresponding to the dimension δ and the polarity α of the adjective φ (see [9]).

(9) $[\![\, \varphi \ (positive, \ nominal) \,]\!] = \lambda x \, [m_\delta^\alpha(x)]$ (Kennedy)

As a consequence, all gradation expressions (i.e., *long; 5cms long; less long than; as long as* etc.) involve semantic composition of the dimensional measure function with some (possibly non-overt) degree morpheme and a standard, where semantic composition proceeds along the (hypothesized) syntactic structure of gradable expressions. According to this proposal, which is shown in (10), the relational meaning R of a degree morpheme first combines with the external object's measure function G of the bare positive and then with the standard degree d (Kennedy 1999: 99).

(10) $[\![\, degree \ morpheme \,]\!] = \lambda G \lambda d \lambda x \, [R(G(x))(d)]$

The following aspects correspond to those discussed above wrt. Bierwisch's account. First, Kennedy treats the bare positives and the comparatives differently, the former being a measure function of objects. It is only through semantic composition that the same relational structure of positives and comparatives gets constructed (compare [12a,b]).

Second, he distinguishes nominative and contrastive uses of the positive by assuming the non-overt elements *Meas* and *pos* (cf. Svenonius & Kennedy 2006). *Meas* (see [11a]) establishes the relation between reference degrees $G(x)$ and their specific standard degree d (given by a measure phrase argument), and *pos* (see [11b]) establishes the relation between reference degrees $G(x)$ and their corresponding, contextually determined standard degree $d_{standard(G)(c)}$ (see [12a,c], respectively).

(11)   a. $[\![_{Deg} Meas]\!] = \lambda G \lambda d \lambda x \, [G(x) \succeq d]$
         b. $[\![_{Deg} pos]\!]^c = \ \lambda G \lambda x \, [G(x) \succ d_{standard(G)(c)}]$

Third, although his account is based on degrees as points, he uses *extents* (intervals defined as sets of points) to model the characteristic distinction of $+$pol and $-$pol adjectives. For him, polarity therefore is a *sortal* distinction: each $+$pol adjective maps to a positive extent (a set of points defined by $\{p \in Scale_\delta | p \leq d_\delta(x)\}$), and $-$pol adjectives map to negative extents (a set of points defined by $\{p \in Scale_\delta | d_\delta(x) \leq p\}$). In these definitions, $d_\delta(x)$ is a degree function that determines the degree as *point* for some dimension δ of object x (cf. Kennedy 1999: 192f.).

The positive and negative extents on a scale are complementary, and are regarded by Kennedy as different *perspectives* on the corresponding degree-as-point. Based on these assumptions, he explains cross-polar anomaly by reference to a sortal mismatch (incompatibility) of compared extents, which leads to a good rating of the NEG-NEG constellation in (5). Antonymous comparatives, like *pos*, are modelled only by a single degree relation '$\succ$' (compare [12c,e]). Correspondingly, they always have a "more than bare positive" reading (cf. Büring 2007 for a critique of this account).[13]

(12)   a. $[\![X \text{ is 5 cms long}]\!] = \qquad m^+_{MAX}([\![X]\!]) \succeq d_{5cms}$
         b. $[\![X \text{ is 5 cms longer than } Y]\!] = m^+_{MAX}([\![X]\!]) \succ [\![Y]\!] \bullet d_{5cms}$
         c. $[\![X \text{ is long}]\!]^c = \qquad m^+_{MAX}([\![X]\!]) \succ d_{standard(length)(c)}$
         d. $[\![X \text{ is short}]\!]^c = \qquad m^-_{MAX}([\![X]\!]) \succ d_{standard(shortness)(c)}$
         e. $[\![X \text{ is 5 cms shorter than } Y]\!] = m^-_{MAX}([\![X]\!]) \succ [\![Y]\!] \bullet d_{5cms}$

2.4   Short comparison of Bierwisch's and Kennedy's approaches

The main difference of both approaches can be demonstrated most clearly if their formal inventories are depicted in comparison. Figure 2 shows that Bierwisch analyzes antonymy exclusively by recourse to the involved ext_{Scale_δ}s as positive degrees (formalized as intervals, drawn here as differently shaded rectangles) and their difference d_c. Most of his immensely complex conceptual and formal apparatus is used to ensure that the analysis of gradation structures can be reduced to relating these three elements.

Kennedy likewise uses positive degrees as intervals ("positive extents") for the analysis of +pol-adjectives, but analyzes −pol-adjectives by recourse to *the complements* of the ext_{Scale_δ}s as *negative extents* (drawn as dashed rectangles of corresponding shading).

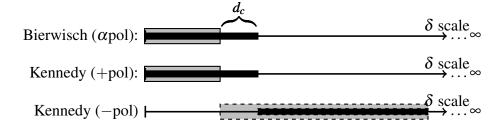Figure 2:   Different conceptions of interval-based degrees

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13 Note that the concatenation of differential degrees leads to problems in compositionality with measure phrases, see (12b) and (12e), where '$\succ$' should appear as '$\succeq$'.

3 Problems

Both proposals face problems some of which will be discussed in this section and which will be given an alternative account in *CSG* afterwards.

3.1 Compatibility and comparability

Basically, the pattern of analysis of dimensional expressions is as follows: the value of an adjective's measure function of an object is related to some standard degree/extent on a corresponding scale. The measure functions therefore seem to take responsibility for matters of compatibility, i.e., which adjective can combine with which object (**long sphere, *deep needle* etc.). They somehow determine whether the object provides an objective extent ext_δ that can be measured accordingly. Then they map an adequate ext_δ onto its corresponding scale extent ext_{Scale_δ}.

According to this analysis, a pair of polar measure functions (at least in Kennedy's theory) and no incompatibility should be expected if the object provides the ext_δ corresponding to some gradable adjective φ_δ (even if some conceptual reinterpretation is needed, cf. Lang et al. 1991 for such contextual variations of dimensional designation).

This hypothesis seems to be corroborated by dimensional expressions for the most part. For the adjective *deep* (and its corresponding expression in other languages, cf. Lang 2001), however, there appears to be what has been called an *antonym gap*: contrary to expectations, there is no −pol adjective (and corresponding negative measure function) generally applicable for small objective depth extents (of, say, drilling holes or crevices).[14]

Further counterevidence to a simple ext_δ-to-ext_{Scale_δ} mapping appears if one considers *distance expressions*, where the spatial (relation) expression that is modified provides the ext_δ for distance measure functions (cf. Carstensen 1992 for a first review of this topic). With projective prepositions as spatial relation terms, the use of +pol adjectives as in (13a) is good, while the use of the corresponding −pol adjectives leads to at least bad, if not unacceptable, expressions (see [13b]). This pattern of incompatibilities is reversed with proximal prepositions as spatial relation terms. Here, the use of some −pol adjective as in (13c) is good again, while the use of the corresponding +pol adjective leads to unacceptable expressions (see [13d]).

(13) a. *high above, far behind, far away, deep below*
　　 b. *?low above, ?close behind, ??close away, *shallow below*
　　 c. *near by, close to*
　　 d. **some meters (far) by, *far to*

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14 Note that general applicability does not hold for *shallow*.

The overall pattern of (in)compatibilities in distance expressions is reminiscent of the cross-polar (a)nomaly examples in (5) and the discussion of the variation of acceptability judgments. Let us assume for a moment that projective prepositions are +pol and that proximal prepositions are −pol, as has been proposed in Carstensen (2002, 2007). Then we have a clear picture of acceptability judgments with POS-POS as in (13a) perfectly good, POS-NEG (see [13d]) perfectly bad, NEG-NEG (see [13c]) again very good, and NEG-POS as in (13b) at least quite questionable.

This shows that the {POS,NEG}-patterns reflect aspects of (in)compatibility and not aspects of (in)comparability as in cross-polar (a)nomaly, which calls for a different analysis of the latter.

3.2 Proximal degree relations

Consider the modifiers *nearly* and *almost* as in *nearly 5cms long* or *almost as long as*. It might be supposed that they express proximality in the sense that the difference of the reference degree and the standard degree (as intervals) is small, or that the reference degree is proximal to the standard degree (both as points). This is not the case, however. Instead, these expressions denote "directed proximality" in the sense that the reference degree may be slightly smaller, but *not slightly larger* for *long*.

This situation is depicted in figure 3, which shows schematic constellations of degrees as points for relevant linguistic expressions. Assume that all degree constellations are proximal and assume that both *ref* and *std* are actually short in 3b and 3c. Figure 3a and 3c, and 3b and 3d, respectively, are supposed to represent the same objective situation. To my knowledge, the inacceptability of the expressions in 3c and 3d is not explained in standard gradation theories (but see Penka 2006; Pozzan & Schweitzer 2008; Rotstein & Winter 2004).

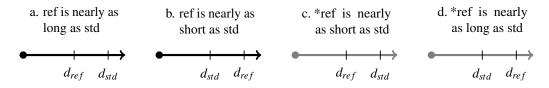Figure 3: Applicability of proximal degree expressions

3.3 Complex gradation

Complex gradation comprises the range of phenomena that are involved in the analysis of sequences of degree expressions (e.g., *very much more than 5cms wider than*). This is extensively discussed by Bierwisch, whose approach is capable of coping with these phenomena, as any modifying structure can be incorporated via

the d_c-value in his three-element semantic representation of degree expressions, see (7). This makes it straightforward to formalize expressions like *very* and *much* in this scheme, as shown in (14) (Bierwisch 1989: 175-177).

(14)   a. $[\![very]\!] = [\varepsilon x [\exists d_c [m_Q(x) \succeq [v + d_c]]]]^{15}$ (Bierwisch)
        b. $[\![much]\!] = \lambda d_c [\alpha x [[m_Q(x) \succeq [v + d_c]]]]$ (Bierwisch)

However, as *all* of these expressions have to have this structure, he is forced to make heavy use of αx-operators (meaning 'any *x* such that') and εx-operators (meaning 'an *x* such that') in order to provide a semantic element of the required type (cf. Bierwisch 1989: 174), or to bind the d_c-variables existentially. This is demonstrated by one of his examples shown in (15) (Bierwisch 1989: 198; A,B,C,D are shorthands for the ext_{Scale_δ}s of the persons).

(15) $[\![Adam\ is\ as\ much\ taller\ than\ Bert\ as\ Chris\ is\ shorter\ than\ Dora]\!] =$
        $[A \succeq [[\alpha c_i[B \succeq [0 + c_i]]] + [\alpha x[m_Q(x) \succeq$
        $[0 + [\alpha y[m_Q(y) \succeq [0 + [\alpha c_j[C \preceq [[\alpha c_k[D = c_k]] - c_j]]]]]]]]]]]]$ (Bierwisch)

According to Kennedy & McNally (2005a), complex gradation with *very* and *much* involves the corresponding denotations in (16).

(16)   a. $[\![very]\!]^c =$ (Kennedy)
        $\lambda G \lambda x. \exists d[standard(d)(G)(\lambda y. [\![pos(G)(y)]\!]^c) \wedge G(d)(x)]^{16}$
        b. $[\![much]\!] = \lambda G \lambda x. \exists d[d \succ!!min(S_G) \wedge G(d)(x)]^{17}$ (Kennedy)

Both approaches have difficulties in doing justice to the modifier/complement-status of degree constructions. As just described, Bierwisch's scheme always expects a d_c-variable as argument; Bierwisch is therefore forced to make stipulations in case no measure phrase complement appears. Kennedy faces the problem mentioned in footnote 13, which essentially is about the modification of comparatives (with measure phrases or more complex constructions like *much more than 5cms wider*). Bierwisch, on the other hand, seems to run into the converse problem: Apparently, his interval relation '$\supset$' may have an improper reading ("The relation $\supset$ is to be read: 'The scale segment d_i contains (improperly) the scale segment d_j'", Bierwisch 1989: 116). In this case, he would not be able to adequately represent the "more

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15 Read: some amount whose measure value is greater than some norm value (which gets instantiated for *v*) on some abstract quantity scale (Bierwisch's examples here are slightly simplified).

16 Read: "Thus *very A* is true of an object if the degree to which it is *A* exceeds a norm or average on the *A*-scale for a comparison class based on those objects that have the property *pos A* in the context of utterance." (Kennedy & McNally 2005a: 370)

17 "[W]here '$\succ$!!' is a context-dependent relation that means 'greater than by a large amount'" (Kennedy & McNally 2005a: 373)

than"-reading of the bare comparative. In general, both approaches have difficulties in explaining the data in (17).

(17)   a.   *How long / 5cms long / *How much long / very long*
        b.   **How longer / 5cms longer / How much longer / *very longer*

Some of the problems with handling examples like these can be traced back to the use of degree-as-interval concatenation in the semantics of (complex) gradation expressions. This corresponds to the fact that there is no recursivity in complex gradation in the sense that systematic measuring of differential extents is provided for. The alternative would be to allow for measurement of degree relations and to do without a concatenation operation in the semantics of gradation (which will be proposed below).

4   Cognitivism

4.1   General aspects

In Carstensen (2011), cognitivism is presented as an approach to representation and semantics that is placed between realist and conceptualist stances in the broad context of cognitive science. In this section, I will elaborate on its role in the context of linguistics, as "cognitive" itself is understood very differently: it may be used in a range of approaches, from those which are aware of the fact that language is a cognitive phenomenon (which is often not considered to be relevant for theory building, however) to the various brands of cognitive linguistics (cf. Jackendoff 1983; Bierwisch & Lang 1989a; Croft & Cruse 2004) where aspects of cognition are included in theoretical models to some (differing) extent.

As to cognitive semantics, there is a single criterion that distinguishes strong from weak interpretations of "cognitive": The assumption that semantics relates linguistic expressions to *cognitive* representations of the world (as argued for in Jackendoff 1983 and Carstensen 2011) – as opposed to (*some* representation of) the world itself. In addition to that, "cognitive" may then also mean that aspects of linguistic expressions (e.g., differences in acceptability) are not only explained on the basis of static representational models but also wrt. aspects of cognitive *processing* (a stance that can be traced back to Miller & Johnson-Laird 1976; cf. also Lang & Maienborn 2011 for a recent review, and Löbner 2011 for a procedural approach to explaining the pattern of dual oppositions in language).

Within cognitive semantics, there is variance as to whether and how results from cognitive disciplines are taken into account. Historically, main insights from cognitive science have found their way into some linguistic theories, among them the observation that there are other codes than propositions relevant for cognition

(e.g., imagery: a main influence on Lakoff/Langacker/Talmy-type approaches) and that there are various (neuro-)representational aspects (e.g., the "what"-/"where"-distinction, see Landau & Jackendoff 1993) which might be relevant for the explanation of certain semantic phenomena.

The cognitivist semantics as presented in this paper goes beyond these approaches by respecting the newly acknowledged important role of *selective attention* within the cognitive system as an interface between imagistic and propositional formats (cf. Kosslyn 1994; Campbell 1997; Scholl 2001; Carstensen 2011), by identifying representational aspects of selective attention as constraints for semantic models, and by relating aspects of certain linguistic expressions to these attentional representations and their processing. In doing so, it tries to connect results from formal semantics with these new insights, and respects issues of compositionality.

4.2 Cognitivist semantics

There is a set of characteristics which can be used to describe the present cognitivist approach to semantics in more detail. They are listed in (18) and explained subsequently (this list is not intended to motivate cognitive semantics in general, of course).

(18)   Characteristics of Cognitivist semantics

      A.   (Reference to) complex representational systems
      B.   Conceptual representations
      C.   Attention-based implicit/explicit-distinction
      D.   Features
      E.   Reification

Cognitivist semantics assumes that an adequate account of linguistic phenomena requires more elaborate representational structures (i.e., more elaborate than the above proposal for scale representations), even *complex representational systems*. Let me illustrate this on the basis of spatial relation expressions. Their formalization could be based on modelling spatial relations in terms of spatial points, regions, or vectors (cf. Zwarts & Winter 2000). The distinction of *above* and *over* could then be captured by a condition stating that *above*-relations are less restricted wrt. the extension of vertical regions/vectors than *over*-relations, compare [19a] and [19b].

(19)   a.   *the cloud above/over the mountain*
        b.   *the stars above/?over the mountain*
        c.   *one color coat *above/over the other one* [both on a wall]
        d.   *amputate the leg above/*over the knee* [patient lying]

(19c,d) show, however, that actual verticality is not a necessary condition for the acceptability of prepositional use, and that further representational assumptions are required for the explanation of the (complementary) distribution of *over* and *above*. The examples can be interpreted (cf. Carstensen 2007) as demonstrating that the prepositions denote relations in different cognitive representational systems: A visual representational system that codes verticality without reference to the gravitational axis (over), and a spatial representational system which does so exclusively (above).

They furthermore demonstrate that cognitivist semantics involves aspects of *conceptual representations*: horizontally positioned legs have an *inherent* verticality due to conceptual coding of a leg's *typical* vertical orientation. This can be illustrated with another example (discussed in Carstensen 2003): Although a certain blade of grass may be vertically oriented (blades of grass are even typically in upright position, objectively) we would not describe it as "high".[18] Aspects of conceptual structure therefore restrict the denotations of expressions by representing how we *perceive/conceive* the world, which is in accord with the two-level approach of Bierwisch & Lang (1989a), Lang & Maienborn (2011).

A further aspect of cognitivist semantics is the *distinction of implicit and explicit representations*. A well-known example (Kosslyn 1994; cf. Olson & Bialystok 1983 for a similar one) concerns the fact that even small children are easily able to recognize a human face (with one eye being left/right to the other) although they have not yet acquired an understanding of left and right. That is, they represent eye relations implicitly, but not explicitly. The relevance of this distinction is even more clearly demonstrated by some neuropsychological defects: Although patients with so-called *object-based neglect* can "see" (i.e., their visual system is provably intact) a spatial relation of two objects (e.g., the circle and the square in figure 4), they may be aware of only one object (and neither the other, nor the relation between them, cf. Behrmann & Tipper 1994). This is analyzed as a failure of the attentional system to move selective attention from one to the other object (which then can be identified as a necessary condition for spatial relation semantics, cf. Logan 1995). Phrased differently, these results show that representational systems have a component (usually called *working memory*) in which information is present ("implicit") that can only be made explicit by attentional engagement.

Figure 4:   Explicit spatial relations wrt. implicitly related objects

18 Likewise, it cannot be described as "tall", in contrast to, for example, people. In both cases, anyway, the antonym is "short".

As figure 4 shows, there are two possible attention-based explicit relations (depicted as arrows) resulting from different sequences of attentional engagement. They correspond to two possibilities for imposing a *perspective* on the implicit representation. For this reason, and as a shorthand for "explicit, attentional spatial relations", I have called them *micro-perspectives*. They can be conceived of as instances of a binary relation defined in the set of explicitly represented objects in some representational system.

Another aspect of cognitivist semantics is the appearance of *features* in the denotations of linguistic expressions. They categorize informational elements wrt. the (functional) role they play according to conceptual structure (cf. Carlson & van der Zee 2004). A case in point would be that the elongation axis of the leg in (19d) is marked as inherently vertical (although it is in fact oriented horizontally).

The final aspect of cognitivism is *reification*. This is a term used widely (at least) in natural language processing for the "thingification" of relational predicates where *referential arguments* "stand for" the predicate in question. In linguistic semantics, it is known by the (neo-)Davidsonian approach to the treatment of events and their adverbial modification (and therefore used quite restrictively, cf. Maienborn 2011 for an overview). A non-restrictive use of this principle is put forward by Hobbs:

> But virtually every predication that can be made in natural language can be specified as to time and place, be modified adverbially, function as a cause or effect of something else, be the object of a propositional attitude, be nominalized, and be referred to by a pronoun. It is therefore convenient to extend Davidson's approach to all predications. That is, corresponding to any predication that can he made in natural language, we will say there is an event, or state, or condition, or situation or 'eventuality', or whatever, in the world that it refers to. This approach might be called 'ontological promiscuity'. One abandons all ontological scruples.
>
> Thus we would like to have in our logical notation the possibility of an extra argument in each predication referring to the 'condition' that exists when that predication is true. (Hobbs 1985: 62)

I will assume such a treatment also for spatial predicates, for example, that they may be represented by a referential variable r. This is necessary if we want to represent the fact that a spatial relation "is vertically aligned", "has a certain amount of distance" etc. Formally, these aspects can be *predicated* to the referent of the relation. Reification then allows to model the compatibility phenomena of relational expressions and their modifiers, for example those in (13). This treatment will also play a role in formalizing complex gradation expressions.

4.3   Features of micro-perspectives

As they will appear also in the cognitivist semantics of gradation, I will elaborate on some features relevant for the semantics of spatial relation expressions as shown in Carstensen (2007).

It is a basic result of spatial cognition that specific representational elements are made meaningful by categorizing them wrt. conceptually salient reference elements. For example, any micro-perspective that gets verbalized as *above* or *below* must have been categorized as being aligned to the gravitational vertical, a directed reference axis. This vertical can be regarded as the value of the first relevant feature here: 'δdim', a multi-valued feature coding the dimension a micro-perspective is aligned with. The distinction between the prepositions can then be captured by a feature 'βdir' which represents co-directionality ($+$dir for *above*) or opposite direction ($-$dir for *below*).

Linguistically, the two elements of a micro-perspective get assigned different theta-roles: located object (or trajector) and reference object (or landmark).[19] Obviously, there are two possible assignments. They can be distinguished as to whether the source of the micro-perspective is the reference object or not. Correspondingly, I have called this option *reference polarity* 'γrpol', which is $+$rpol for that condition and $-$rpol otherwise. As has been shown in Carstensen (2002, 2007), reference polarity can be regarded as the feature underlying the distinction between projective prepositions like *above, below, behind, left of* ($+$rpol) and topological prepositions like *at, on, by* ($-$rpol). Interestingly, the diagnostic criterion for these two classes of prepositions is their combinatorics with distance adjectives as presented in (13).

A fourth feature relevant here concerns the specificity of the reference object of a spatial relation, that is, whether there is a clearly identifiable object which gets verbalized appropriately. Such a specificity has an influence on whether measure phrases can be used in distance designation: While the expression in (20a) is fully acceptable in German with a given reference object, distance specification without it leads to inacceptability in (20b). (20c) shows that this is neither a syntactic defect (the missing NP) nor a defect of measurability (in that case, use of adjectives should not be possible at all).

(20)   a.   *Es ist 10 Zentimeter über der Tür.*
             It is 10 cms   above the door

        b. **Es ist 10 Zentimeter oben.*
             It is 10 cms   above

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19 Unfortunately, located object and reference object correspond to reference degree and standard degree in gradation theories, respectively, which might be a source of confusion here.

    c.   *Es ist (weit) oben.*
        It is (far) above

This observation is modelled by a feature 'ɛrspec' which is positive if the reference object is specified and negative else. This feature will be also used in gradation when a modifier requires that a certain degree relation is reference specific or not.

In summary, some of these features probably belong to those "idiosyncratic features, which correspond to biologically determined conditions of perception, motor control, or emotion" (Bierwisch 2011: 352) which Bierwisch includes in his set of relevant semantic features.

5 Cognitivist semantics of gradation (*CSG*)

5.1 Compatibility or: What is measured?

In the approaches to gradation considered in this paper, degrees typically correspond to measurements of objects, where "object" mostly means 'physical object'. I have already pointed out that this should at least be specified to "measurements of dimensional extents of objects". By taking distance aspects into consideration (which very few approaches do) one has to add "or distance extents between objects". Unfortunately, this is still incorrect. If it was just the extents that were measured, no incompatibilities should be expected. As becomes clear from the data in (13), however, such incompatibilities actually appear with distance extents (and see also the unexpected antonymy gaps for dimensional extents, most of all for *deep*).
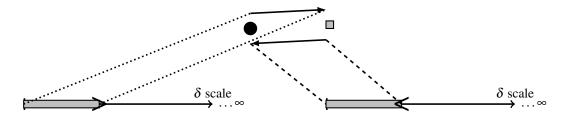

Figure 5:   Mapping micro-perspectives on a scale

A solution to this puzzle emerges if not bare extents, but *perspectivations of extents* are the entities to be measured. This leads to more complex scale representations, which is schematically illustrated with figure 5. Assume that the circle is the reference object of the relation (signified by black coloring), corresponding to examples like *the square is a few mms away from the circle* (+rpol) or *the square is close to the circle* (−rpol). Scales then consist of a set EXT_{Scale_δ} of ext_{Scale_δ}s (implicit

extents as intervals in the sense of Bierwisch) which retain $\gamma rpol$ (signified by the variation of '>'/'<' at ext_{Scale_δ}s boundary) and $\varepsilon rspec$ of the micro-perspectives.

(21) defines m as a mapping from the set of micro-perspectives Π to EXT_{Scale_δ}, where the argument and the value of m have identical values for the features $rpol$, dir, dim and $rspec$ (as indicated by the superscripted feature structures).

(21) $m : \Pi \longrightarrow EXT_{Scale_\delta},$
    $x^{[\gamma rpol, \beta dir, \delta dim, \varepsilon rspec]} \mapsto m(x)^{[\gamma rpol, \beta dir, \delta dim, \varepsilon rspec]}$

Although annotated with featural information, ext_{Scale_δ}s correspond to the degrees-as-intervals ordered by '$\succeq$' in standard theories of gradation.

5.2 Degrees and explicit degree relations

It has long been known that the perception of spatial ext_δs for the processing of dimensional adjectives (cf. Clark et al. 1973) – or visual tasks in general (cf. the *visual routines* of Ullman 1984) – involves attentional scanning. In the following I will propose (as has already been done in Carstensen 1998) that the perception of degree relations is analogous to the perception of spatial relations.

Correspondingly, degrees (and their relations) are regarded as being only *implicitly* represented by the ext_{Scale_δ}s on the dimensional scale and must be distinguished from some explicit counterparts. This situation is depicted in figure 6a showing the implicit relation of the two ext_{Scale_δ}s.[20]

Figure 6:   Attention-based explicit degree relations

Following the above cognitivist assumptions, implicit degrees and their relations are instantiated in the working memory of a specific scalar representational system. Conceiving scales as abstract spatial representations has rarely been done explicitly yet (but compare the vector-based approaches in Winter 2005 and Flieger 2009). Assuming cognitive reality of scales with associated spatial properties is in line with Clark et al. (1973) or Frazier et al. (2008) whose results suggest that "semantically

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20 This corresponds to Bierwisch's approach (cf. figure 2).

introduced scales are part of the obligatory computation of the meaning of the sentence" (Frazier et al. 2008: 31). Such a view is also corroborated by the fact that degree relations can be expressed with spatial relation terms, as in *He is over/under 10 feet tall* (cf. also Nouwen 2010).

If the depiction of the scalar representational system is adequate at all (it might actually be less "pictorial"), it makes little sense talking of attentional engagement "moving from" one implicit degree-as-interval to the other, however. Instead of that, it is the *boundaries* of the ext_{Scale_δ}s which attract attention as salient entities (see figure 6b). Correspondingly, it is attentional engagement to these boundaries that defines *explicit* degrees as points (cf. Carstensen 2011 for attentionally defined cognitivist ontologies).

Recall that neither Bierwisch nor Kennedy model degrees as points on a scale. Kennedy uses the measure of an object a as point $d(a)$ only to define positive and negative extents (where his positive extent actually is ext_{Scale_δ}, and his negative extent actually is the complement of ext_{Scale_δ} on $Scale_\delta$) and regards these extents as different (implicit) *perspectives* on an object a, to be precise: on $d(a)$.

In the *CSG* proposal made here, explicit degrees as points are reintroduced into gradation theory. That is, the function d is regarded as a mapping from the set of implicit-degrees-as-intervals EXT_ς (using ς here as a variable for scales) to the set of explicit-degrees-as-points D_ς reflecting attentional engagement to the boundary of an ext_ς, as shown in figure 6b. The definition of d in (22) ensures identical feature values for direction, dimension and reference specificity in d's argument and value, and furthermore models the fact that the inherited *reference polarity* value γ of the micro-perspective is identical to the *polarity* value of the explicit degree (and hence, the corresponding adjective). The latter is the formal basis for adequately modelling the incompatibility phenomena in (13).

(22) $d : EXT_\varsigma \longrightarrow D_\varsigma,$
    $x^{[\gamma rpol, \beta dir, \delta dim, \varepsilon rspec]} \mapsto d(x)^{[\gamma pol, \beta dir, \delta dim, \varepsilon rspec]}$

Negative extents, on the other hand, are removed from the ontology (which from a cognitivist point of view is even more justified if one acknowledges the fact that negative extents are infinitely large entities on open scales).

Contra Bierwisch, explicit degrees-as-points are assumed to be polar according to the reference polarity of the micro-perspective r taken on the ext_δ (see figure 5, and [22]). The mapping from some perspectivized ext_δ to its explicit αpol degree then is a functional composition $(d \circ m)(r)$ which passes relevant features of its argument on to its value.

Explicit degree relations are established through attentional changes from one explicit degree to the other (figure 6c), analogously to the establishment of explicit spatial relations as depicted in figure 4 and 5.

As to differential degrees/extents, they result from mapping explicit degree relations on their own scale if the degree relation is measured.[21] Measuring degree relations is therefore analogous to measuring spatial relations as shown in figure 5, which is the basis for recursivity in gradation.

5.3   Representing explicit relations

I will use the iconic symbol '$\rightleftarrows$' reminiscent of figure 4 and 5 for the representation of micro-perspectives as explicit relations. Somewhat unorthodox, its referential variable will be indexed here to the relation symbol, resulting in the predicate '$x \rightleftarrows_r y$'.[22] The features introduced above will be relevant for gradation, too. Again I will use a feature structure (with βdir, $\gamma rpol$, δdim and $\varepsilon rspec$) annotated to the relational predicate in question. This is schematically shown in (23) as logical representation of figure 6c and will reappear in the semantic forms of relational gradation expressions. It denotes the set of pairs of attended objects modelling attentional change, where each pair has a unique identifier r. Furthermore, this set is restricted by the four features such that each pair of the relation is in the subset licensed by some instantiation of the feature structure.

(23)   EXPLICIT RELATION : $std \rightleftarrows_r^{[\beta dir, \gamma rpol, \delta dim, \varepsilon rspec]} ref$

5.4   Adjective semantics

The semantics of gradable distance adjectives in their nominal positive form (e.g., *high* as in *10 kms / less high above the clouds*) will be construed roughly according to Kennedy's proposal, but as in (24), rather than as in (9). The functional composition of d and m reflects the fact that a micro-perspective r is measured and that an explicit degree results from attentional engagement to the boundary of $m(r)$.

(24)   ⟦ *distance* φ_δ^α *(positive, nominal)* ⟧ $= \lambda r^{[\alpha rpol, \beta dir, \delta dim, \varepsilon rspec]} [d(m(r))]$

As has been shown with (21) and (22), the polarity, direction, dimension and reference specificity of this explicit degree are dependent on the measured micro-perspective. Because of this, an argument expression has to provide feature values that are compatible with those of the adjective. (24) is therefore the *CSG* proposal for modelling the (in)compatibilities in (13) via selectional restrictions imposed on r, and therefore via feature matching of functor and argument: α(r)pol (*far from / close*

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21 A similar proposal has been made by Bierwisch (1989: 115) (as so-called *scale-stacking*).

22 Alternatives could have been prefix notation ('$\rightleftarrows' (r, x, y)$') or Bierwisch's use of the instantiation operator INST ('$[r\ INST\ [x\ '\rightleftarrows'\ y]]$', cf. Bierwisch 1997), or even the standard notation with role predicates ('$\rightleftarrows' (r)\ \&\ arg1(r) = x\ \&\ arg2(r) = y$').

to vs. **far by / close from*), βdir (*high above* vs **high below*), δdim (*high above* vs. **high behind*) and εrspec (*10 meters above the house* vs. **10 meters above*).

Formalizing δ-*dimensional* adjectives (e.g., *long* in *long pencil*) is less straight-forward. First of all, objects do not lexically code micro-perspectives. Therefore, the dimensional micro-perspective between two *boundaries* of the object in question along δ has to be conceptually provided and identified. (25) shows the corresponding proposal along the lines of Bierwisch and Lang (cf. Bierwisch & Lang 1989a) where this condition is incorporated into the denotation of the adjective. Here "$\pi^{[\alpha rpol, \beta dir, \delta dim, \varepsilon rspec]}$", which represents a certain perspectivation of x, corresponds to their parameter of dimensional identification.

(25) $[\![$ *dimensional* φ_δ^α *(positive, nominal)* $]\!] =$
        $\lambda x \; [d(m(\pi^{[\alpha rpol, \beta dir, \delta dim, \varepsilon rspec]}(x)))]$

Furthermore, objects lack the reference polarity characteristic of spatial relations. Correspondingly, there is only a single default perspectivation of ext_δ possible. In *CSG*, this is regarded as the determinant of the markedness distinction in dimensional adjectives, more specifically, of the unmarkedness of the $+$pol instances (*high, wide* etc.). Markedness effects (cf. Schriefers 1985) arise because the dimensional extent has to be *re-perspectivized* in order to match a $-pol$-adjective (*low, narrow* etc.).

Before turning to comparatives, it is instructive to take a look at the generic semantic structure of relational degree elements shown in (26) which is conceived along the lines of Kennedy's proposal given in (10). It displays the fact that in *CSG*, relational degree morphemes are interpreted as micro-perspectives between explicit degrees, where one degree is provided as a function of the external object and the other is directly incorporated as an argument. *r* appears as referential argument in the argument structure in order to allow modification (in the sense of a modifier being predicated to the referential argument of the head, cf. Bierwisch 1989: 77). Of course, the argument structures of the elements vary (as indicated by the round brackets) due to different syntactic types of the morphemes. δ' (short for $\delta' dim$) indicates that it is not necessarily the specific dimensional scale of the reference degree on which both degrees are related (in fact, δ' must be the most specific common dimension of both degrees; I will neglect this issue in the following, however).

(26) $[\![$ *relational degree element* $]\!] =$
        $(\lambda G)(\lambda y)\lambda x \lambda r \, [y \rightleftarrows_r^{[\delta']} G(x)^{[\alpha pol, \beta dir, \delta dim, \varepsilon rspec]}]$

Synthetic comparatives are characterized by the fact that they are $+$dir (this corresponds to a "more"-interpretation, and in contrast to the semantics of *less*), $+$rpol (can be modified with measure phases) and $+$rspec (there is a specific standard

degree incorporated as argument). (27) and (28) show the denotations of two comparative morphemes corresponding to the uses in *The plane flies higher than the balloon*[23] and *The house is lower than the tree*, respectively. Note that no featural restrictions are imposed on *y*, which is relevant for the discussion of cross-polar (a)nomaly.

(27) $[\![\, higher \text{ (distance) }]\!] =$
$$\lambda y \lambda x^{[+rpol,+dir,VERT,+rspec]} \lambda r \, [y \rightleftarrows_r^{[+dir,+rpol,\delta',+rspec]} d(m(x))]$$

(28) $[\![\, lower \text{ (dimensional) }]\!] =$
$$\lambda y \lambda x \lambda r \, [y \rightleftarrows_r^{[+dir,+rpol,\delta',+rspec]} \\ d(m(\pi^{[-rpol,+dir,VERT,+rspec]}(x)))]$$

(29) shows that the analytic comparative *less* incorporates the degree function of its complement (as in *less long, less short*) and that it has negative directionality. The truth conditions for comparative representations are given in (30) where they are specified with respect to the truth values of the implicit ordering of degrees '$\prec$'.

(29) $[\![\, less \,]\!] = \quad \lambda G \lambda y \lambda x \lambda r \, [y \rightleftarrows_r^{[-dir,+rpol,+rspec]} G(x)]$

(30) a. $[\![std \rightleftarrows_r^{[+dir,+rpol]} ref^{[\alpha pol]}]\!] = \quad \begin{cases} [\![std \prec ref]\!] & if \, \alpha = + \\ [\![ref \prec std]\!] & if \, \alpha = - \end{cases}$

   b. $[\![std \rightleftarrows_r^{[-dir,+rpol]} ref^{[\alpha pol]}]\!] = \quad \begin{cases} [\![ref \prec std]\!] & if \, \alpha = + \\ [\![std \prec ref]\!] & if \, \alpha = - \end{cases}$

5.5 Other relational degree morphemes

An important aspect of the semantics of gradation concerns the fact how *contrastive* readings of gradable adjectives are established and how the fact is formalized that the use of measure phrases always has a non-contrastive (nominative) interpretation. I will take up the proposal made by Svenonius & Kennedy (2006) that is based on a complementary distribution of two non-overt relational degree morphemes, *pos* and

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23 Sentences like these were discussed for the first time in Carstensen (1992). The distance adjective *higher* was proposed to be analyzed as heading an AP modifying a (in this case implicit) P-bar (something like *above the ground*, as in *The plane flies higher above the sea than the balloon*), using a referential argument of the spatial relation. This is not sufficiently worked out, of course (for example, it requires existential binding of the referential argument at some point). However, it is backed by Hobbs' proposal of ontological promiscuity, and it seems to be a plausible outline to secure compatibility (the only reasonable to me, I must add) that might be followed or refuted.

Meas.[24]

The denotation of *pos* given in (31) is characterized by the negative reference specificity of the standard degree (the unspecific norm d_{N_C}) in the semantic representation. Furthermore, the polarity values and the dimension of the involved degrees are required to match, and the resulting relational element can be modified (+rpol), but only by expressions sensitive to negative reference specificity (like *very*). (32) shows the denotation of the distance adjective *high* interpreted contrastively.

(31) $[\![_{Deg}\ pos]\!] =$
$\lambda G \lambda x \lambda r\ \exists d_{N_C}^{[\alpha pol,\delta,-rspec]}\ [d_{N_C} \underset{r}{\rightleftarrows}^{[+dir,+rpol,\delta,-rspec]}\ G(x)^{[\alpha pol,\delta]}]$

(32) $[\![_{DegP}\ high]\!]$ (distance, contrastive) $=$
$\lambda x^{[+dir,+rpol,V(ERT)]} \lambda r\ \exists d_{N_C}^{[+pol,V,-rspec]}\ [d_{N_C} \underset{r}{\rightleftarrows}^{[+dir,+rpol,V,-rspec]}\ d(m(x))]$

As to the representation of *Meas*, there is general agreement in standard gradation theories about '$\succeq$' as the default degree relation between the reference degree and +rspec standard degrees introduced by measure phrases (*x is 5 cms long*) or equatives (*x is as long as y*).[25]

From a cognitive point of view, this is implausible, however: It would mean that a perceived equality somehow has to be turned into an "at least", i.e., a potential inequality. Therefore, it is proposed here that the alternative to attentional shifts between degrees as explicit relations is the *lack of a shift* corresponding to indistinguishability of the degrees on some level of granularity at some point of time.

This is formalized as '$\approx$' in (33) (with its definition given in [34]) which constitutes the explicit counterpart to the implicit '$\sim$' equivalence relation (cf. Klein 1991). The identical value for polarity excludes expressions like **10cms short* (assuming that measure phrases denote positive degrees). The identical value for reference specificity models the observation that *The pen is as long as the iPad is wide* is ambiguous between the +rspec reading (e.g., "namely 10 cms") and the −rspec reading (e.g., "namely very"), but cannot be interpreted as, for example, "the one is 10 cms long and the other is very wide"). For expressions like *The pen is as short as the iPad is wide*, (33) ensures that they can only be interpreted as 'comparison of deviation', where both degrees have negative reference specificity.

(33) $[\![_{Deg}\ Meas]\!]$ $= \lambda G \lambda d^{[\alpha pol,\delta',\varepsilon rspec]} \lambda x\ [d \approx G(x)^{[\alpha pol,\delta,\varepsilon rspec]}]$

(34) $std \approx ref$ iff $\neg\,(ref \rightleftarrows std \vee std \rightleftarrows ref)$

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24 A crucial point here is that I do not expect comparatives to combine with either of these. Instead, I will follow the final idea in Svenonius & Kennedy (2006) that an intervening element "much" is required (see below).

25 Although there are some who argue against such a solution (e.g., Geurts & Nouwen 2007) and insist on a systematic ambiguity of these constructions between an 'exact' and 'at least' reading.

As to the question why '$\succeq$' is usually chosen as default degree relation, the answer lies in the *directionality* of the possible continuations of positives with measure phrases (see [35], taken from Kennedy 1999). Measure phrase constructions like *5 feet tall* are therefore not analyzed as denoting an equivalence of degrees (instead, this interpretation is assumed to derive from a scalar implicature).

(35)   A. *You have to be at least 5 feet tall to be an astronaut.*
         B. *I'm 5 feet tall: in fact, I'm over[/*under] 5 feet tall.*

However, there are contexts in which this directionality is reversed and where some reasonable continuation (that is not just a precisification) does not satisfy the ordering assumed to be denoted by its antecedent construction (see [36]), which seems to be in conflict with the standard view.

(36)   *I didn't want to spend much money on a new car. So I bought a used Audi that cost 10000 dollars. In fact, it cost*

    a.   *less than 10000 dollars, because of 10 percent discount.*
    b.   ?*more than 10000 dollars, because of 10 percent interest.* [clarifying]
    c.   *more than 10000 dollars, because of 10 percent interest.* [admitting]

The *CSG* account therefore reverses the standard argumentation: *Meas* represents indistinguishability of two degrees, and continuation phenomena are treated as a separate issue. It is assumed that the latter involves a certain perspective on the reference degree. This perspective may coincide with the polarity of the reference degree, so that +dir qualifications are acceptable for some reason (e.g., *short, even shorter / *longer / *less short; long, even longer / *shorter / *less long*). But not necessarily so, as is exemplified in (36), where the perspective is determined by the negative polarity of the context sentence. Here, an "incrementing" continuation is only fully acceptable in a repairing, admitting sense (see [36c]).

It has already been mentioned above that proximal degree relation expressions like *almost* and *nearly* have been largely ignored in gradation theories. They cannot be modified (**10cms almost / *much almost / *very almost* etc.) and they represent "unidirectional proximality" in equative constructions (*almost as long as*) or with measure phrases (*nearly 10 cms long*). The latter property is once again shown in figure 7. In addition to simply depicting the position of the (explicit) degrees, their polarity (+pol: '>|', −pol: '|<'), the degree relation (directed arrow), and the reference polarity of the degree relation ('●' for reference object) are also present. These variations can be represented straightforwardly in *CSG* with the given features. At least descriptively, the inacceptability of the expression in figure 7d can be accounted for by requiring proximal degree relations to be −rpol but +dir. The corresponding denotation for *almost*(/*nearly*) is given in (37), (38) presents its truth
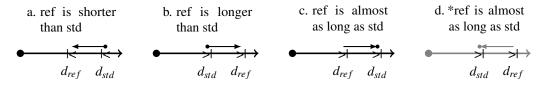
a. ref is shorter than std	b. ref is longer than std	c. ref is almost as long as std	d. *ref is almost as long as std
d_{ref} d_{std}	d_{std} d_{ref}	d_{ref} d_{std}	d_{std} d_{ref}

Figure 7: γrpol-degree relations

conditions, again with respect to the implicit constellations.[26]

(37) $[\![\,almost\,]\!] = \quad \lambda G \lambda y \lambda x \lambda r\, [y \rightleftarrows_r^{[+dir,-rpol,\delta',+rspec]} G(x)^{[\delta,+rspec]}]$

(38) $[\![std \rightleftarrows_r^{[+dir,-rpol]} ref^{[\alpha pol]}]\!] = \begin{cases} [\![ref \prec std]\!] & \text{if } \alpha = + \\ [\![std \prec ref]\!] & \text{if } \alpha = - \end{cases}$

Finally, one has to capture the characteristic differences between *almost as wide as* and *almost 10 cms wide*, *less wide than* and *less than 10 cms wide* and so on. A straightforward analysis of that is to assume separate semantic entries for the elements which take measure phrase complements (cf. also Bierwisch 1989: 179). However, I am sympathetic to any approach that derives both uses of the relational degree element from a single lexical entry.

5.6 Recursive gradation

For the formalization of complex gradation expressions like the above *Adam is as much taller than Bert as Chris is shorter than Dora*, we have seen that different accounts are possible (see also the explicit discussion of recursion in gradation in Neeleman et al. 2004). Bierwisch uses nested structures that are essentially based on the same comparison pattern, as shown in (15). The proposal of Svenonius & Kennedy (2006) is based on a differentiation of measure phrases and positives as degree valued expressions and *Meas*, *pos* and comparatives as relational expressions (in Kennedy & McNally 2005b, there are also "intensifiers" like *very*); interestingly, they also assume a non-overt element "much" (overt in Norwegian and in questions like *how much longer*, compare *10 cms longer, *how longer*) for the combination of degree elements and comparatives.

Based on the foregoing discussions, this is generalized in *CSG* as follows: Gradation is regarded as a phenomenon in which measured micro-perspectives of ext_δs are mapped on explicit degrees which in turn are related to other degrees. Accordingly, there are only two general types of gradation elements: "degree elements"

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26 A reviewer asks how this captures the proximal aspects of *almost*. I have given a detailed procedural account of proximality in Carstensen (2002).

(measure phrases, bare positives, including "much") and "degree relation elements" (*Meas*, *pos*, comparatives, others like proximal expressions and *very*).

The *CSG* denotations for *very* and *much* are given in (39) and (40). *very* is seen here as a relational expression that can be modified (*very very*), *much* as a bare gradable adjective denoting a measure function, the latter receiving no separate treatment as proposed in (16). As explained above, their denotations differ especially in their reference specificity.

(39) $[\![very]\!] =$
$\lambda r^{[\alpha rpol,\delta,-rspec]} \lambda v \, \exists d_{N_r}^{[\alpha pol,\delta,-rspec]} \, [d_{N_r} \rightleftarrows_v^{[+dir,+rpol,\delta,-rspec]} d(m(r))]$

(40) $[\![much]\!] = \lambda r^{[+rpol,+rspec]} \, [d(m(r))]$

There is an interesting cross-linguistic difference, also noted by a reviewer, in the distribution of English *very* and *much*, and German *sehr* and *viel*, see (41). Within *CSG*, this can be explained by assuming that German *sehr* rather has the semantic entry of (40) than (39), albeit with a $-$rspec-feature specification.[27]

(41)   a.   *I like you very *(much).*   (English)
               *Ich mag dich sehr (*viel).* (German)
    b.   *How much/*very do you like me?* (English)
               *Wie *viel/sehr magst du mich?* (German)

Compositionality then determines the acceptability of a gradation construction (**very longer, much longer, *very almost, *much almost, *5cms very, *5cms almost*). This may include *Meas* and *pos*, as is visible in the equalities in (42) (where these non-overt elements are underlined).[28]

CSG does not explain all the data in (17), especially not why elements sometimes can be non-overt (e.g., the *Meas* in *5 cms longer*) or must not be (e.g., *much* in the case of **How longer ...*) – there are proposals who try to account for these aspects syntactically (cf. Neeleman et al. 2004; Solt 2009). Yet it gives a clearer picture of complementation and modification, and how acceptability may result from (in)compatibility of functor and argument.

(42)   a. $[\![\textit{5cms longer}]\!] =$ $[\![\textit{5cms \underline{Meas} \underline{much} longer}]\!]$
    b. $[\![\textit{very much longer}]\!] =$ $[\![\textit{very \underline{pos} much longer}]\!]$

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27 Compare also the difference in the use of measure phrases, e.g., German *100 Tonnen schwer* vs. English **100 tons heavy*, cf. Schwarzschild (2005), Krasikova (2009), Beck (2011).

28 Consider also constructions with *too*, which are not discussed in depth in this paper: **How too long*, *How much too long*, *5cms too long*, **very too long*, *(very) much (more than 5cms) too long*, *almost as much too long as*. It has to be analyzed similarly to *pos*, but with a +rspec contextual (functional) threshold value as standard degree (cf. Bierwisch 1989: 193).

The corresponding denotations are shown in (43) and (44), respectively. While (43) only involves the bare *much* (nominative use), (44) includes also the interpretation of *pos* (contrastive use).

(43) $[\![5cms\ longer]\!] =$

$$\lambda y \lambda x\ \exists l[[\ y \overbrace{\rightleftarrows_l^{[+dir,+rpol,\delta',+rspec]}\ d(m(\pi^{[+rpol,+dir,MAX,+rspec]}(x)))}^{longer}]$$

$$\wedge [\ \overbrace{d_{5cms}^{[+pol,MAX,+rspec]} \approx d(m(l))^{[+pol,\delta',+rspec]}}^{5cms\ (Meas\ much)}]]$$

(44) $[\![very\ much\ longer]\!] =$

$$\lambda y \lambda x\ \exists l[[\ y \overbrace{\rightleftarrows_l^{[+dir,+rpol,\delta',+rspec]}\ d(m(\pi^{[+rpol,+dir,MAX,+rspec]}(x)))}^{longer}]$$

$$\wedge \exists dl[[d_{N_l}^{[+pol,+dir,\delta',-rspec]} \overbrace{\rightleftarrows_{dl}^{[+dir,+rpol,\delta',-rspec]}\ d(m(l))^{[+pol,+dir,\delta',+rspec]}}^{(pos)\ much}]$$

$$\wedge \exists dll[[d_{N_{dl}}^{[+pol,+dir,\delta',-rspec]} \overbrace{\rightleftarrows_{dll}^{[+dir,+rpol,\delta',-rspec]}}^{very}]\ ]]$$
$$d(m(dl))^{[+pol,+dir,\delta',-rspec]}$$

(45) shows a *CSG* analysis of Bierwisch's example for complex gradation. Note that the sentence must again be analyzed as containing an implicit *much* (*... as Chris is much shorter ...*).

(45) $[\![Adam\ is\ as\ much\ taller\ than\ Bert\ as\ Chris\ is\ shorter\ than\ Dora]\!] =$

$$\exists t1[[d(m(\pi^{[+rpol,+dir,V(ERT),+rspec]}(B))) \overbrace{\rightleftarrows_{t1}^{[+dir,+rpol,V,+rspec]}}^{A\ taller\ B}$$
$$d(m(\pi^{[+rpol,+dir,V,+rspec]}(A)))]$$

$$\wedge \exists t2[[d(m(\pi^{[\alpha rpol,+dir,M(AX),+rspec]}(D))) \overbrace{\rightleftarrows_{t2}^{[+dir,+rpol,M,+rspec]}}^{C\ shorter\ D}$$
$$d(m(\pi^{[-rpol,+dir,M,+rspec]}(C)))]$$

$$\wedge [[d(m(t2))^{[+pol,+dir,M,+rspec]} \overbrace{\approx d(m(t1)))^{[+pol,+dir,V,+rspec]}}^{as\ much\ as\ (much)}]]]]$$

(45) is one of the possible interpretations regarding reference specificity. Because of its positive values, the sentence can be continued by, for example, *namely 5cms*. In case of negative values, it could be continued by *namely enormously!*. However, the semantic representation would be more complex in that case. To see this, consider

(43), and compare it to (44).

A central aspect of the *CSG* analysis is the fact that with referential arguments for relations, gradation structures can be *recursive* (as they are in the examples of this subsection): Measure functions are applied to entities which in turn involve measure functions, due to the fact that different kinds of relations (spatial relations and degree relations) can be measured.

5.7 Analytic vs. synthetic comparatives

Up to this point we have not yet accounted for the observation (central to Bierwisch's approach) that $-$pol positive adjectives are always contrastive (norm-related). For example, it can be inferred from *The pen is as short as the iPad* that both objects are short. The question is, however, whether this condition is part of the denotation of the adjective.

In this respect, it might be interesting to first discuss a different question: In a situation (with some pen and some iPad) which can be described as *less long than* or *shorter than*[29] – what are the conditions for their use? I want to argue that one has to consider the necessary *processing steps* involved in the construction of gradation structures. Figure 8 is a more detailed (still schematic) picture of what happens in such cases.
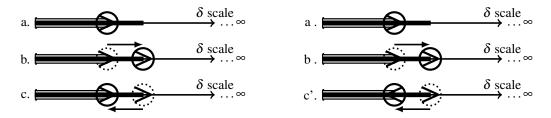

Figure 8:   Distinguishing analytic and synthetic comparatives

We start with the state of having mapped the default positive perspective on the scale and having established the explicit degree (figure 8a). Now the iPad's length extent

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29 Heim (2008) shows that there are linguistic contexts in which the uses of a comparative and its analytic equivalent are not substitutable by each other. Wrt. the German translation (i) of (i'), she argues that this is due to scopal differences of negative elements licensing *brauchen*.

(i) *Polly braucht *langsamer / weniger schnell zu fahren als Larry.*

(i') *Polly needs to drive less fast than Larry needs to drive.*

Non-synonymity does not only occur in modal contexts and/or result from scopal differences, however. Bierwisch & Lang (1989b) already pointed to examples like (ii) and (iii) which led to the *CSG* approach in the first place (cf. Carstensen 1992).

(ii) *The pole is high / *low / not high (for a pole in upright position).*

(iii) *The plastic ball jumps *lower / less high and *nearer / less far than the rubber ball.*

is noticed, which attracts attention to its boundary (establishing the second explicit degree). This change of attention in figure 8b from a positive reference degree to a positive standard degree (coding a −rpol micro-perspective) could be categorized as a proximal degree relation (pen is almost as long as iPad). If this does not happen, attention has to be turned back to the pen's degree (figure 8c). This +pol, +rpol, −dir micro-perspective corresponds to the description "pen is less long than iPad".

Now, we know from (28) that negative comparatives require their reference degree to be −pol. On the way to constructing this representation via figure 8a-b-c', there must be a processing step (between b and c') turning the reference degree to −pol. This obviously involves *re-perspectivation* of the pen's implicit extent. As ext_{Scale_δ} is part of the scale (with the origin as reference point), it is inherently asymmetric. −rpol re-perspectivation therefore results in the negative explicit degree shown in figure 8c' which then can be expressed as *shorter than*.

This proposal solves the problem of specifying the semantics of −pol dimensional adjectives mentioned above. As to bare positives φ, it is minimally required that for some object x there exists a micro-perspective with reference polarity γ which is ultimately mapped on the corresponding explicit degree having polarity(φ), see (25). While this is the default perspective for +pol adjectives (unmarked case), it is the result of re-perspectivation for −pol ones (and it is this additional cognitive effort of this operation which leads to the characteristic semantic markedness effects).

According to that analysis, the influence of norms as probable cause for re-perspectivation is acknowledged for −pol adjectives. However, it is assumed that they are coded explicitly only by *pos*, expressing contrastive use. This also nicely explains the observation that −pol *comparatives* are not necessarily used contrastively (i.e., *x shorter than y* does not assert that both x and y are short).

This analysis therefore diverges from Bierwisch who assumes that contrastiveness is lexically coded in −pol positives (even in questions and equatives like *How short is x?* or *x is as short as y*, the variable v of the adjective is instantiated by N_C). In *CSG*, αpol adjectives are represented uniformly, which is corroborated by the identical behaviour of positive and negative degrees as arguments of −rpol degree relations (cf. *almost as long/short as*). As further evidence, consider the hypothetical remark in an editors' conference in (46a). According to my intuition, the continuation in (46b) is reasonable (but would lead to contradiction in the Bierwisch model). This shows that −pol positives are not necessarily norm-related but only involve a certain perspective on the measured extent (although the perspective may usually be motivated by noticing below-normness, of course).

(46)   a.   *Paper A is very short. Paper B is fortunately less short than the first.*
       b.   *Actually, it [i.e., paper B] is even quite long.*

According to figure 8c', it is evidently the polarity *of the reference degree* (i.e., irrespective of the standard degree) which determines the polarity of the adjective. This is important for the discussion of cross-polar (a)nomalies, as it does not necessarily require that both degrees of some relation have the same polarity.

5.8   Cross-polar (a)nomalies

The established opinion about the cross-polar (a)nomalies in (5) seems to be that they should be treated semantically. This has been most rigidly carried out by Kennedy, where sortal mismatches are blamed as cause for the acceptability pattern (for extensions cf. Büring 2007, 2009, Heim 2008) – which has not led to satisfactory unanimous results. According to the *CSG* analysis, on the contrary, the differing acceptability judgments are not caused by semantic mismatches, as is the case, for example, in (13) for the most part. Instead, they are assumed to be the effect of the differing cognitive effort invested in the description of the objective situation. As has been shown in figure 8, this involves in particular the number of steps in attentional processing. Reconsider the examples in (5), here repeated and annotated in (47).

(47)   a.   *The iPad is wider than the pen is long.*   (POS-POS)
               two default perspectives involved
         b.   *The iPad is narrower than the pen is long.*   (NEG-POS)
               + re-perspectivation of reference extent
         c.   *The iPad is narrower than the pen is short.*   (NEG-NEG)
               + re-perspectivation of standard extent
         d.   *The iPad is wider than the pen is short.*   (POS-NEG)
               + re-perspectivation of reference extent

(47a) is perfect because it relates the degrees of two default perspectives. (47b), which corresponds to figure 8c', adds re-perspectivation of the reference extent. It is a quite natural description of some scene (for other real-world examples see Büring 2007) despite the fact that different dimensions are involved. Compare this to (47c) which gets worse acceptability grades although it has a parallel structure of negative polarities. Here the standard extent has been additionally re-perspectivized to match the semantic form of *short*. Finally, (47d) gets even worse judgments as its underlying processing necessarily involves a third change of perspective (back to the default perspective of the iPad's extent).

Compared to Kennedy's proposal, the *CSG* analysis therefore correctly captures the grouping/ordering of "good" and "bad" sentences and furthermore explains different gradings within and across the groups. It also extends to the equatives in (48). Here, same-polarity comparisons (see [48a,b]) are acceptable, where the indistinguishability condition requires both degrees to have the same polarity. At least in

my intuition, the sentences with mixed polarities in (48c) cannot be differentiated but are acceptable, too, as both have to be analyzed as comparisons of deviation (i.e., they mean 'The iPad's width is as much under some norm as the pen's length is above some norm' and vice versa). Their differential degrees both have positive polarity on their abstract scale.

(48)   a.   *The iPad is as wide as the pen is long.*   (POS-POS)
        b.   *The iPad is as narrow as the pen is short.*   (NEG-NEG)
        c.   *The iPad is as narrow as the pen is long.*   (NEG-POS)
           The iPad is as wide as the pen is short.   (POS-NEG)

6   Taking stock

The *CSG* approach to the semantics of gradation goes beyond standard scalar approaches in various respects, most important of which is the distinction of implicit and explicit representations. First, it considers distance adjectives and their *compatibility* phenomena with spatial relation expressions (which are different from the *comparability* phenomena known as cross-polar (a)nomalies).

Second, it identifies *attentional perspectivation of extents* as pivotal in the semantics of spatial gradation, with micro-perspectives as the elements to be measured. The reference polarity of micro-perspectives is regarded as the source of the polarity of gradable adjectives,[30] and their reference specificity is argued to restrict compositionality in recursive gradation.

Third, degree relations are not modelled as implicit relations on degrees/extents, but as explicit micro-perspectives between degrees as points in an abstract linear spatial domain. This leads to the distinction of positive and negative reference polar degree relations. The latter are denoted by expressions like *almost* or *nearly* which correspond to proximal spatial relation expressions that have been analyzed as negatively reference polar in Carstensen (2002, 2007). +rpol-degree relations match the directionality given by the polarity (+dir) or not (−dir) and, as an empirical principle, −rpol-degree relations must be +dir.

Fourth, the *CSG* approach makes use of reification in the semantics of relational expressions in line with Hobbs (1985). According to that proposal, the denotation of these expressions comprises an additional semantic argument which provides a variable for modification and thus makes it possible to model recursive gradation.

Fifth, recursive gradation allows to do without concatenation of degrees in the semantics of comparatives whose application for the integration of differential degrees has always been problematic wrt. compositionality.

Sixth, cross-polar (a)nomaly is not treated as a semantic phenomenon (sortal

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30 Compare this to the assumption of negative extents (Kennedy) or interval reversal (Bierwisch).

incompatibility of extents). Instead of that, varying judgments of acceptability are regarded as resulting from differential cognitive effort (e.g., mental changes of perspectivation) underlying the processing of gradation structures.

In a sense, the *CSG* approach to the semantics of gradation is a cognitivist synthesis of Bierwisch's and Kennedy's proposals, as illustrated by table 1. It differs from both approaches with respect to recursive gradation, concatenation of degrees and the default relation.

	Bierwisch	Kennedy	*CSG*
degree as point	-	(+)	+
degree as extent	+	+	(+)
single ext_{Scale_δ}(degree)	+	-	+
positive and negative degrees	-	+	+
antonymy as reversal	+	-	+
antonymy as different perspective	-	+	+
non-lexicalist approach	-	+	+
non-semantic analysis of cross-polar (a)nomaly	+	-	+
recursive gradation	-	-	+
concatenation of (differential) degrees	+	+	-
'$\succeq$' as default relation	+	+	-

Table 1:   Comparison of approaches

To recap, while cross-polar (a)nomaly has been reconstructed as a phenomenon of (in)comparability, the data in (2) (here repeated as [49], with non-overt information underlined) can be explained as (in)compatibilities.

(49) a. *The plastic ball jumps to a place *lower / less high above the ground and *nearer / less far away from some origin than the rubber ball.*
      b. *far/*near away/above, *far/near by*

7   Conclusion

Based on the discussion of two standard scalar approaches and associated problems, this paper has developed *CSG*, an alternative cognitivist scalar approach to the semantics of gradation. It has been shown that with some additional, but separately motivated assumptions, *CSG* can provide a solution to the discussed problems. Central to *CSG* is a level of explicit attentional perspectivation that allows to distinguish between explicit degrees-as-points and implicit degrees-as-intervals, and

provides additional features for a systematic treatment of various phenomena. Micro-perspectives as explicit attentional relations are identified as the pivotal elements in the semantics of gradation: They not only interface the semantics of distance adjectives and prepositions, which helps to explain the observable compatibility phenomena, but also allow for a systematic treatment of recursive gradation. On this ground, the notorious cross-polar (a)nomaly can be analyzed non-semantically as a set of judgments reflecting the differential underlying cognitive processing effort for some expression wrt. a given objective situation. It has thus been shown that respecting both cognitive and formal aspects can be beneficial for the development of semantic theories.

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