

Asymmetries in Spatial Semantics*

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1 Introduction

Spatial objects are central to our grasping the outer world, both in its literal and its abstract sense. This simple fact marks the importance of Ewald Lang's cognitive linguistic work on the semantics of spatial adjectives (*long, wide, high* etc.) or *spatial dimension terms* (Lang 2001). His treatment of the *dimensional designation of spatial objects* (Lang 1987, 1989) includes assumptions about the conceptual representation of spatial objects which are empirically grounded and theoretically well motivated from the linguist's point of view, and furthermore have far reaching consequences for the conceptual modelling of (spatial object) knowledge within Cognitive Science, as has been shown in Lang, Carstensen & Simmons (1991). The following discussion of asymmetries in spatial semantics is deeply rooted in this work. I will therefore start with a short description of the essence of his approach.

With his lucid theory of dimensional designation, Ewald Lang has increased our awareness for further problems to be solved and facts to be explained, which otherwise would have been blurred by the vast amounts of linguistic observations and their corresponding possible explanations. I will report on some of these problems, which, interestingly, have to do with *asymmetries* in various senses. Based on recent evidence about the interrelation of language, space, and attention (see Carstensen 2001) I will show that it is necessary to extend the semantics of dimensional designation and of gradation (cf. Bierwisch 1989) to including systematic reference to a level of *attentional perspectivation* of spatial representations.

Ewald Lang has argued convincingly that language can be legitimately regarded as a "window to cognition" (a view that is now widely accepted in Cognitive Science). While he has repeatedly miniaturized the role of (spatial) linguistics for Cognitive Science to a "peep hole", however,¹ I will try to show that it should rather be magnified: As language might not only reflect structural aspects of spatial representation but also snapshots of their (attentional) processing, language may even provide us with a panoramic view on (aspects of) spatial cognition.

2 Dimensional designation of spatial objects

The theory of the dimensional designation of spatial objects (henceforth D₂SO) is one of the theoretical pillars of the work documented in Bierwisch & Lang (1987a, 1989a). It is concerned with a small group of spatial adjectives (*lang/kurz* (*long/short*), *breit/schmal* (*wide, broad/narrow*), *dick/dünn* (*thick/thin*), *hoch/niedrig* (*high/low*), *tief/flach* (*deep/*

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¹ :-)

flat, shallow), *weit/eng* (*wide, broad/narrow, tight*), *weit/nah* (*far/near, close*), *groß/klein* (*big, tall, large/small, short, little*)² which are characterized as being *gradable* (cf. *How long is X?, smaller, more than 2 ms wide* etc.), marking the difference to other spatial adjectives like *round, pointed* etc.³ It is therefore embedded in the *Semantics of Gradation* (henceforth SoG) as developed in Bierwisch (1989).

The joint proposal for a generic semantic entry for dimensional adjectives is given in (1). It reflects the well known asymmetry of *polarity* I will come back to in the next section (that is, *long, broad, thick* etc. are +Pol-adjectives, and *short, narrow, thin* etc. are –Pol-adjectives). For now, we will be concerned with the centerpiece of D₂SO, the conceptual interpretation of ‘DIM x’⁴.

- (1) a. +Pol-adjectives: $\lambda c [\lambda x [[\text{QUANT DIM } x] \subseteq [v + c]]]$
 b. –Pol-adjectives: $\lambda c [\lambda x [[\text{QUANT DIM } x] \supseteq [v - c]]]$

This treatment of adjective semantics has become the classic example for the more general approach to lexical semantics known as “two-level semantics”. In the classical semantic treatment of dimensional adjectives in Bierwisch (1967), the semantics of adjectives, spatial nouns, and their combination (see (2)-(4)) were specified in terms of semantic markers, that is, at one level of description only.

- (2) *hoch* ‘high’:
 (+ Pol) [(+ Main) [* [(–Inherent) [(+ Vert)]]]]
- (3) *Stange* ‘pole’:
 [(PhysObj) [(3 Space) [(+ Main) [(+ Max) [(–Second)]]]]]
- (4) Combination of *hoch* and *Stange*:
 [(PhysObj) [(3 Space) [(+ Main) [(+ Pol)[(–Inherent) [(+Vert) [(+ Max) [(–Second)]]]]]]]]]

Leaving aside general objections to this type of semantics (e.g., the well known “marke-rese” objection), featural descriptions are not only unhandy in this domain but also inadequate on the whole. For example, as was observed by Lang, the inherent relativity underlying the adjective *breit* cannot be captured with such a featural description.

In order to cope with this problem and to meet the demands of the cognitive science community, semantics must instead be construed as the systematic interaction of the linguistic system with the non-linguistic conceptual system (see Bierwisch 1983). In the two-level approach, semantic interpretation of – in this case dimensional – linguistic expressions therefore is understood as a mapping from the *semantic level* (determined by the former) to the *conceptual level* (determined by the latter) in the form of parameter instantiation. In D₂SO and its extension in Lang, Carstensen & Simmons (1991), Lang gives a precise account of how this has to be spelled out for ‘DIM x’. He proposes

² Note that the distance adjectives *weit/nah* are included here in the classical version of his theory.

³ Here, Ewald would certainly not have hesitated to point out that this linguistic classification corresponds to the distinction of expressing *gestalt* and *form* properties of objects, respectively.

⁴ where ‘DIM’ is a variable for the Dimensional Assignment Parameter (DAP) of an antonymic pair of adjectives. For example, MAX is the DAP for *lang/kurz* and identifies the maximal dimension of an object.

Object Schemata (OS) as representations of spatial object knowledge which merge *gestalt* and position properties of spatial objects as categorized by the so-called *Inherent Proportion Schema (IPS)* and *Primary Perceptual Space (PPS)*, respectively (see also Lang 1990).

The IPS provides information about an object's dimensionable extents, namely the set of axes determined by principles of object delimitation, symmetry, and axial disintegration.⁵ These axes are ordered wrt. their relative prominence and so constitute the "skeleton" of an OS, supplemented by further information qualifying each axis.

The PPS provides information about the three axes defining our internal model of external space (the Vertical, the Observer axis, and the Horizontal axis). By noting the conceptualized alignment of object and environmental axes as qualitative information in the OS, an object's orientation and/or perspectivization is represented.

Being conceptual structures, OS primarily code *typical* information, as opposed to actual or contextually induced information. In D₂SO, a corresponding distinction between *canonical* and *contextually induced* orientation/perspectivization was drawn. This marks the difference between representing, for example, a flagpole (as being canonically oriented) and a pole simply put upright (which means a contextually induced orientation). In Lang, Carstensen & Simmons (1991), we have added information about *inherent* orientation/perspectivization (e.g., for a picture having a height irrespective of its position) and *fixed* orientation/perspectivization (e.g., for a valley having only one position).

The "flesh" of an OS then consists of conceptual constants coding qualitative information about the axes of an OS. They are called *Dimensional Assignment Values (DAVs)* and serve as possible instantiators of some DAP. Table 1 shows a simplified list of DAVs with their corresponding description.

IPS-related DAVs	max, i-max	The maximal extent of an object (<i>lang/kurz</i>)
	sub (MIN in Lang 2001)	The minimal extent of an object, categorized as "substance" (<i>dick/dünn</i>)
	dist	An inner distance of a hollow object (<i>weit/eng</i>)
	∅	An object extent, unspecified in IPS but landing site for a PPS-DAV
PPS-related DAVs	vert, i-vert, f-vert	An extent aligned to the Vertical and therefore oriented (<i>hoch/niedrig</i>)
	obs, i-obs	An extent aligned to the Observer axis and therefore perspectivized (<i>tief</i>)
	across	An extent conceptualized as orthogonal to another salient axis (<i>breit/schmal</i>)

Table 1

Two-level semantic interpretation in dimensional designation is therefore basically a process of identifying suitable DAVs for DAPs, which boils down to finding corresponding lower-case DAV-variants for an upper-case DAP (e.g., vert, i-vert, f-vert can

⁵ I apologize that I can only give a sketch of the theory here and must leave out most of the details. The reader is referred to the cited references of Ewald's work for more elaborate descriptions.

be DAVs for VERT). This is not always possible, of course, as contextual specification or de-specification might have happened. In this case, various operations for updating an OS are applied which reflect inferences about positional specifications or changes of the object in question. For example, a pole can only be said to be *hoch* (*high*) if it has been set upright, and a tower can only be said to be *lang* (*long*) if it has lost its canonical orientation (by tilting). I refrain from bothering the reader here with further examples, like all possible contextual specifications of a brick (which shows at least two ‘ø’-DAVs in its OS) or all possible different orientations/perspectivizations of a desk (caused by tilting and turning).⁶ It works. Ask OSKAR.

Thus, the conceptual interpretation of ‘DIM x’ is the extent of x as identified by DIM in x’s OS. This is what the gradation part of a dimensional adjective’s semantics seemingly has to cope with. We’ll see.

3 Asymmetry in dimensional adjectives⁷

Probably the most well known asymmetry to be observed with dimensional adjectives is reflected in their *polarity*: almost all of them come in antonymic pairs (e.g., *long/short*) where one adjective (*long*) figures as the *unmarked* element with *positive* polarity (+Pol), the other (*short*) being *marked* and *negative* polar (–Pol). It is only the unmarked adjective that can occur with a measure phrase (*Im long*) without any commitment of the speaker as to the object’s length relative to some categorial or contextual comparison value.⁸ In Bierwisch’s terms, it can be used both *nominatively* and *contrastively*, while the marked adjective can only be used contrastively.

For an explanation of this difference in SoG, one has to look at the semantic forms of dimensional adjectives given in (1) again. It shows that the value of QUANT (the mapping of an object extent on some scale) is compared to a complex value consisting of the comparison value *v* and the grade complement *c*. A set of conditions in SoG ensures that if *c* is a measure phrase then *v* is 0 (nominative use) and that if *c* is not a measure phrase then *v* is some norm value N_c (contrastive use).

Aside from the differences in their usage, the asymmetry of dimensional adjectives results from the interval operations in $[v\pm c]$: it is assumed that $[v-c]$ involves a scale inversion ($[v+(-c)]$) which makes (–Pol)-adjectives semantically more complex. This is corroborated by psycholinguistic experiments which show that marked adjectives indeed take longer to be processed in a linguistic reaction task. It could further be shown (cf. Schriefers 1985) that this effect is linguistic (or better, semantic) inasmuch as it does not appear in a non-linguistic reaction task (hence its name: *semantic markedness effect*).

As (5) shows, there is a further asymmetry in the semantics of dimensional adjectives: subsequent specification of dimensional designation must always be allowed,

⁶ These were our favourite examples for testing when developing OSKAR (“(Ein Programm, das) ObjektSchemata für die Konzeptuelle Analyse Räumlicher Objekte (verwendet)” (a program that uses object schemata for the conceptual analysis of spatial objects)). It’s not important, it’s just nostalgia.

⁷ Detailed considerations on this topic can be found in Bierwisch & Lang (1987b: 678ff). I will confine myself to presenting the tips of the theoretical icebergs here in order to stay on my road of argumentation.

⁸ This is different to *Im short* which implies the speaker’s judgment of the object as being SHORT.

which not only rules out equality in modelling gradation phenomena but also shows that different “directions of comparison” according to polarity must be represented. This aspect is apparent in the relators (\subseteq , \supseteq) in (1) which guarantee the correct inclusion relation of the scale intervals.

- (5) a. It is long. It is even *quite short /very long
 b. It is short. It is even *quite long /very short

This seemingly stable pattern of antonymy-by-polarity-as-interval-arithmetics does not apply to all dimensional adjectives, however. There are at least two well-known exceptions which must be mentioned.

The first is the English adjective *tall* as an expression of MAX VERT. Although *short* must be regarded as its antonym *prima facie* (as everyone knows what, e.g., a *short person* is), it might better be called a *quasi-antonym*. The reason for this is that *short* is the regular antonym to *long* and would therefore give rise to what has been called an “antonymy gable” (Lang 1987: 357). Using *short* as the counterpart of *tall* at all, however, seems to be more a (if conventionalized) way out of a missing-antonym situation. This is corroborated by the fact that *short* or its German counterpart *kurz* appear in other constellations for the expression of ‘smallness of dimensional extent’, most obvious in cases of contextually induced orientation like the ‘poles that are put upright’. Here, the use of *niedrig* is not possible, and it seems that the description of the maximal extent is “reduced” from within the PPS to within the IPS (that is, to *kurz*). Similar cases in point are uses of *kurz* in, for example, *kurzsichtig*, *kurz vor Bern* and *kurzer Weg* (where it is the (–Pol) term of *weit*).

The second exception is the adjective *tief* (*deep*): “Contrary to widely held views, *tief* does not have a lexical antonym [...]. *flach* is not the antonym of *tief*.” (Lang, Carstensen & Simmons 1991: 27). Just try to rephrase *Das Bohrloch ist nicht tief* (*The drilling hole is not deep*) using a (–Pol) dimensional adjective. There is none. Why should there be such an *antonymy gap* (Lang 1987: 361f)?

We are thus faced with a slightly confusing picture of the semantics of dimensional adjectives. On the one hand, comparison of scale intervals is the conceptually well motivated core of their semantic forms, with polarity asymmetry being explained by the different interval operations in $[v\pm c]$, which are assumed to reside on a distinct semantic level. On the other hand, there exist systematic exceptions to this scheme that lead to the following conclusion: “The SF and CS proposed so far are not suited for the solution of this problem” (Bierwisch & Lang 1989b: 688). Therefore, the following two questions cannot be avoided.

Firstly, how can there possibly be a solution to this problem as long as gradation is conceived of as a relation of *intervals* (based in part on mappings of (object) extents on-to scales)? One would not expect subtle differences to appear on this level of representation. Secondly, what is a possible alternative to such an interval-based approach? But before trying to find an answer to these questions let us turn to an even more intriguing asymmetry first.

4 Asymmetry in distance designation

Distance adjectives and their semantics have received only scarce interest in the literature. In D₂SO, too, distance designation was somehow marginal as it did not fit into the overall picture of adjectives designating object extents wrt. object schemata. The proposal for the semantic forms of (α Pol) distance adjectives made there (Lang 1987: 361) is shown in (6).

- (6) a. *weit* ‘far’: $\lambda c [\lambda y [\lambda x [[\text{QUANT DIST}' x y] \subseteq [v + c]]]]]$
 b. *nah* ‘near’: $\lambda c [\lambda y [\lambda x [[\text{QUANT DIST}' x y] \supseteq [v - c]]]]]$

Note that according to (6), distance designation requires a further argument (and even a different parameter, DIST', different from DIST). This captures the intuition that there are always two objects involved which act as boundaries of the distance extent. Thus, expressions like *nahe A*, *nahe bei B*, *weit von C*, *weit vor D* etc. can be handled by a subcategorization requirement of ‘y’ to be a PP in (6a) and a PP or NP in (6b).⁹

Wunderlich & Kaufmann (1990), while adopting the foregoing approach for their treatment of spatial verbs and prepositions, explicitly deny that ‘y’ has argument status in the semantic form of distance adjectives and take it as a free parameter instead (“[y] ist ein freier Parameter, der kontextuell bzw. konzeptuell zu ergänzen ist”, Wunderlich & Kaufmann 1990: 241).

This modification does not go far enough, however. As has been first pointed out in Carstensen (1992), the underlying assumption still is that a distance phrase expresses a property of an object *to be in a certain distance wrt. another object*, and that a distance expression modifies a local expression (following the pattern “AP modifies PP”). According to this analysis, for example, *hoch über dem Haus* would be represented as (7), which shows that distance modification would amount to simple conjunction of distance and location predicate, along with unification of the external arguments (both referring to the spatial object x).¹⁰

- (7) $\lambda x [\text{ABOVE}(x, \text{HAUS})]^{11}: [[\text{QUANT VERT DIST}' x y] \subseteq [N_c + c]]]$

Unfortunately, this analysis does not explain why syntactic configurations like (8) are ill-formed in spite of the compatibility of the given spatial relations and distance designations. It is somehow too tolerant with respect to the “scope of modification” of the distance expression as it allows a “loose coupling” of the location and distance predicate. Because of that, modification of this type must be excluded from modelling com-

⁹ It may be appropriate to mention here that this semantic treatment of distance adjectives, marginal as it may seem, simply marks the starting point of my own interest in the semantics of distance adjectives which led to a new and different approach to the semantics of spatial expressions (cf. Carstensen 2001).

¹⁰ I use the ‘:’-connector here reflecting the asymmetry of conjunction in modification (cf. Bierwisch 1988). Note that the referent for ‘y’ would have to be identified as the one for ‘HAUS’ on the conceptual level, as proposed by Wunderlich & Kaufmann.

¹¹ Usually, the spatial predicate would be written as “LOC (x, ABOVE*(HAUS))” meaning ‘part of x is included in the ABOVE-region of the house’ (this is what I call the “localization as region inclusion view” of linguistic spatial relations).

binations of distance and local expressions. Or, to put it in other words, an AP does *not* modify a PP.

- (8) * $[_{PP} [_{AP} 100 \text{ m hoch}] [_{PP} [_{AP} 100 \text{ m tief}] [_{PP} \text{ über dem Haus unter den Wolken}]]]$

Intuitively, one would expect distance APs to be more closely tied to the (projections of) prepositions they modify. This could be ensured if they would be semantically modelled as properties of an object *to have a certain distance*. The data in (9) show that this is indeed the right analysis.

- (9) a. der weite Weg
the far way
b. Der Bahnhof ist nicht weit (weg/entfernt) von hier
The railway station is not far (away/distant) from here
c. weit werfen (, weit reisen..)
throwing far (, travelling far...)

In (9a), the distance adjective clearly resembles a dimensional adjective in every aspect: the *Weg* naturally provides a distance extent that is designated and quantified. In (9b), it becomes obvious that the PP *von hier* is not an argument of the distance adjective but of an intervening element which is modified by the adjective. (9c) cannot be interpreted as “x is thrown such that x is FAR FROM some y in some consequent state”: it is the distance extent associated with the throwing event that is directly addressed by the adjective. Thus, we can stick to a modification analysis, yet we need a different one.

Indeed a plausible alternative for (6) can be found in (10), which fits into the general pattern of dimensional designation again. This solution requires the external argument of a distance adjective to be an object that – on the conceptual level – provides a distance extent which can be designated and quantified. In case of modification by a distance AP, this object will instantiate the ‘x’ in (10) and apart from that will characterize the bounding elements of the extent on its own (cp. *Der Weg von hier nach da*).

- (10) a. +Pol-Dist-Adjectives: $\lambda c [\lambda x [[\text{QUANT DIST}' x] \subseteq [v + c]]]$
b. –Pol-Dist-Adjectives: $\lambda c [\lambda x [[\text{QUANT DIST}' x] \supseteq [v - c]]]$

Following this line of argumentation, spatial prepositions are expected to provide a (referential) argument in their semantic form serving as attachment point for modification (we will later see that this assumption is justified for independent reasons). Analogous to the event variables in verb semantics I therefore add a variable in the semantic forms of spatial prepositions which reifies the spatial relation at hand.¹² On this account, *hoch über dem Haus* will be represented as (11) in which r instantiates the external argument of the distance AP. Accordingly, structures like the ones in (8) will be excluded by demanding modification constellations of this type to be of the pattern $[_{PP} AP P']$ while still allowing modifications of the type $[_{PP} PP PP]$.

¹² This of course requires a semantic analysis of spatial prepositions that is quite different from current mainstream (cf. Carstensen 1995, 2000). There are others who depart from the “region inclusion view”, however (cf., e.g., Zwarts 1995).

(11) λx [ABOVE(r , x , HAUS): [[QUANT VERT DIST' r] \subseteq [$N_c + c$]]]

A closer look at adjective-preposition constellations reveals a puzzling asymmetry in distance designation, however. As shown in (12), the distance adjective antonyms *weit* and *nahe* each co-occur with different prepositions.

- (12) a. *weit* *an/*bei/weg/vor/hinter...
 far *by/*at/away/in front of/behind...
 b. *nahe* an/bei/*weg/?vor/?hinter...¹³
 near by/*away/?in front of/?behind...

One would neither expect these data on the basis of the standard approaches to spatial semantics or of SoG, nor by intuition: if, for example, *bei dem Haus* expresses proximity, why should it not be possible to further specify this characterization with a distance expression (*Im (weit) beim Haus*)? Note that this inacceptability cannot be explained by a lack of distance extent (or spatial dimension) to be designated as suggested by Wunderlich & Kaufmann: “Eine Präposition wie *bei* weist keine derartige Dimension auf; daher ist *Im beim Haus stehen* nur schwer zu akzeptieren” (Wunderlich & Kaufmann 1990: 247). As *nahe beim Haus* is perfect, this argument is simply not valid!

The data also run counter to the core of SoG. How can it possibly be that antonymic adjectives apparently take arguments of *different type*? Finally, the selectional peculiarities revealed in (12) corroborate our assumption that we need to find an alternative to the canonic view of linguistic spatial relations. Or else, how could *region inclusion* (see footnote 11) possibly provide a linear extent to be available for distance designation?

In order to get answers to our questions it seems appropriate to take a closer look at spatial relations. It will become clear that the new analysis provides the solution for these questions and that even a well-motivated conceptual basis for the hypothesized variable r can be found.

5 Spatial relations

Both D₂SO and SoG have successfully shown the value of a cognitive linguistic approach to dimensional adjectives and gradation expressions, by bridging the gap between linguistic data and cognitive principles of gestalt perception and mental comparison. Until recently, a similar approach to spatial prepositions had been lacking. Their semantics had mostly been specified in merely descriptive terms, generally as a localization relation of a spatial object and a spatial region, which is insufficient for explaining the incompatibility phenomena in (12).

In Carstensen (2001), I have made a different proposal that is based on work on spatial relations drawn from different disciplines within cognitive science. In this approach, a distinction is made between implicitly represented spatial relations (*implicit*

¹³ Personally, I would replace the ‘?’ by a ‘*’ (remember *kurz vor* above). Speakers’ judgements seem to differ on this point, however. For example, the sentence *Sie steht nahe vor dem Haus* is used as a fully accepted example in Wunderlich & Kaufmann (1990).

spatial relations) and explicitly represented spatial relations (*explicit spatial relations*). The former are described in the following citation:

For example, a representation of a face by necessity includes implicit information about the locations of the parts and the distances among them. However, such spatial representations are embedded in the pattern itself; they cannot be used in any other context.

Kosslyn (1994: 421)

In other words, implicit spatial relations are simply *not available* for the conceptual (and hence also for the linguistic) system. The reason for this is the following:

The visual system cannot fully process all of its input. There is not enough room in the skull for all of the neural hardware that would be required to perform all visual functions at all locations in the visual field at the same time [...]

Wolfe (1994: 202)

For example, in viewing a pattern like Figure (1a), it is necessary for us to have the implicit relations between its elements represented in our visual system. This does *not* imply that we are aware of (i.e., that we have explicitly represented) the spatial relations between any of the elements (for example, the one between the elements shown in Figure (1b)). Logically, this means that there must be a mechanism which *constructs* explicit spatial relations, in the sense of making implicitly represented relations explicit.

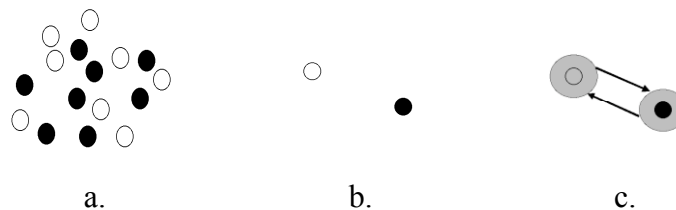


Figure 1: *Implicit and explicit spatial relations*

Overwhelming evidence from attention theory suggests that this mechanism can be identified as the working of focused attention (cf., e.g., Theeuwes 1993) acting as a selective device on visuo-spatial representations. Salient entities in the so-called “visual buffer” are sequentially attended, which brings processing of these entities for object recognition with it. It follows that in order to establish an explicit spatial relation, attention focus must move from one of its elements to the other. This becomes evident most dramatically in cases of so-called object-based neglect, where patients (in spite of having intact visual areas) would not be able to see even the spatial relation in Figure (1b). They would report only the existence of one object as their attention would be “stuck” to it (Behrmann & Tipper 1994).

Shifts of attention are therefore necessary for establishing explicit spatial relations (“Computing relations requires directing attention”, Logan 1995: 163). This is important, because it marks a characteristic difference to approaches within cognitive linguistics based solely on (only implicitly spatial) image schemata, inclusion of local regions etc.

Another aspect of attention-based relations is shown in Figure (1c). As there are two possibilities of attention shifts between the objects of an implicit relation, the shifts have the effect of imposing a certain perspective (which I have called “microperspective” in order to distinguish it from viewer-centered perspectivization) on it. These asymmetric

microperspectives themselves – the shifts of the attentional “window” (cf. Kosslyn 1994, Talmy 1995) – constitute the core of explicit spatial relations that get verbalized as prepositions.

Conceptually, an important further asymmetry is imposed on an explicit spatial relation if it is expressed by a preposition. Each of its arguments either functions as the *theme* (or *trajector* or *located object*) or *relatum* (or *landmark* or *reference object*) of the relation (answering an underlying *quaestio* “Where is X?”, cf. Klein & von Stutterheim 1987). This asymmetry can be modelled by a feature which I have correspondingly called *reference polarity* (as defined in (13)).

- (13) a. +refpol: relatum is source of a microperspective
 b. –refpol: relatum is goal of a microperspective

In principle this gives rise to two distinct general classes of explicit spatial relations. In fact, such a subclassification can indeed be found in the linguistic data, as is exemplified by the constructions in (14).

- (14) a. X steht weiter weg von/*zu Y als von/*zu Z
 X stands further away from/*to Y than from/*to Z
 b. X steht näher zu/*von Y als zu/*von Z
 X stands closer to/*from Y than to/*from Z

Observe that the directionality of the microperspectives is overtly reflected in the directional prepositions *von* and *zu*.¹⁴ This co-occurrence pattern of the distance adjectives (which by the way has not been given a satisfactory account until now) then points back to the examples in (12), in which the adjectives can be used as an indicator of which of the two classes a preposition belongs to.

6 Processing aspects

Especially in the field of language generation/production the question becomes relevant at some point how and when the decision for the choice of a specific preposition is made. The region inclusion view provides no clue whatsoever in this respect (for example, the criteria for the distinction of *Im weit weg von* and *nahe bei*). If one takes into account that a speaker has to build up a mental presentation¹⁵ of a spatial relation prior to linguistic categorization and communication (a view that has been called “localization as mental presentation” in Carstensen (2001)) then these questions can be answered by looking at the explicit relation at hand within a certain window of processing for lexical access.

Consider the problem: The speaker has been given the *quaestio* (“Where is X?”). Logically, she must *first* locate X, *and then* provide a suitable reference object Y. From

¹⁴ Or, to be more precise: Note that we can now explain the use of directional prepositions with distance adjectives by reference to the directionality of microperspectives.

¹⁵ I deliberately use “mental presentation” here in order to avoid speaking of instantiated spatial representations in, e.g., “mental models” or “mental images”.

a cognitive point of view, she necessarily first has to attend to the mentally present(ed) referent of X and then has to directly shift attention to the referent of Y which is selected as the most salient entity from the mental presentation. This fits quite nicely with the more general concept of ‘noticing’ as proposed by Glenberg & Langston (although different in detail):

We propose that whenever a mental model is updated (by adding, deleting or moving a representational element), attention is focussed on that element. Following the ‘spotlight’ metaphor of attention, we propose that other representational elements in the spatial vicinity of the updated elements are noticed. When this occurs, the relationship between the updated element and those noticed is encoded and stored [...].

Glenberg & Langston (1992: 131)

If this happens within the time frame for preposition categorization, then a (rather unspecific) –RefPol microperspective will be expressed.¹⁶ If, however, this linguistic categorization is unsuccessful or discarded by the monitoring component of high level cognitive processing (cf. Levelt 1989), attention is evidently focussed first on the reference object and must then be shifted back to the referent of X in order to establish a spatial relation for the fulfillment of the communicative goal. This directly codes a +RefPol preposition. In case the spatial relation is not further specified, an under-specified preposition like *weg von* will be expressed. Otherwise, if the +RefPol-microperspective is conceptually categorized with respect to some reference frame centering on the reference object (in other words, wrt. some PPS axis), grammatical coding leads to the expression of more specific linguistic spatial relations *vor*, *über*, *unter* etc.

Note that it falls out quite naturally from this explanation that the topological prepositions *an* and *bei* are rather unspecific, without stipulating “proximal regions” whose properties are notoriously unclear (likewise, “distal regions”, which are in conflict with examples like *10cm weit weg von*, need not be introduced).

Let me emphasize the importance of the point made here: Aspects of cognitive *processing* are relevant for (spatial) semantics, and they are, however indirect, sometimes reflected in language. With this remark, let’s turn back to distance adjectives.

7 Adjectives again

The lesson to be learnt from the previous discussion is that we have to distinguish spatial extents as implicitly represented entities from microperspectives as explicit spatial relations. From the data in (12) we can infer that it is the latter which are semantically relevant (that is, which are arguments of QUANT); otherwise there should be no compatibility problem. Yet what this means is that we have to assume different types of scales on which microperspectives are projected, depending on reference polarity (else there could not exist a compatibility problem). Thus there are +RefPol and –RefPol scales, with the starting point of a scale coinciding with the source or the goal of QUANTed microperspectives, respectively. Apparently, then, distance is different. Do these new insights have repercussions on dimensional gradation?

¹⁶ I have proposed elsewhere (e.g., Carstensen 2000) that the –RefPol prepositions *bei* and *an* can be distinguished by the requirement that Y’s mental referent represents it *as a whole* or by its *boundary*, respectively, depending on aspects of mental presentation. I will not elaborate on that here.

Considering the distinction between implicit and explicit spatial representations, the logic behind microperspectivizing distance extents also applies to dimensional extents. These do not “pop out” of a visual display (i.e., are available at once) but must be “scanned” by an attentional mechanism. In an experiment reported in Clark et al. (1973) where subjects had to decide which of two simultaneously presented lines was the shorter or the longer one, reaction times were dependent on the length of the *shorter*! With respect to this result, the authors write:

this model postulates that people scan a dimension outwards from the primary reference point of that dimension [the starting point of the scale] to locate the proximal object
Clark et al. (1973: 341)

Another reason why scanning is necessary is shown in Figure (2). Here, one can distinguish three different “length extents” of the object (a: wrt. the object reference system; b: wrt. a functionally determined reference system; c: wrt. the surrounding space).

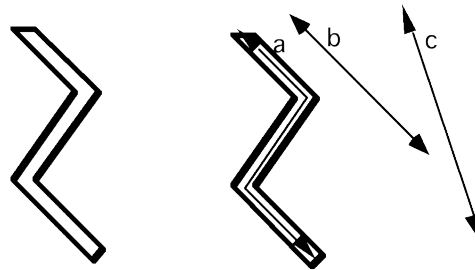


Figure 2: *Different length extents*

Some mechanism evidently has to determine these length extents. In an experiment reported in Ullman (1984), subjects were given a display with two curves and two ‘X’ and had to decide whether the ‘X’s lay on one or on different curves¹⁷. The results are described as follows:

the time to detect that the two X’s lay on the same curve increased monotonically, and roughly linearly, with the separation along the curve. This result suggests the use of a tracing operation [...].
Ullman (1984: 569)

Ullman places particular emphasis on the fact that the task was performed without any subjective effort. The subject reported to “just see” the ‘X’s on a curve (or not), and no one mentioned “scanning” along a curve.

In other words, even the processing of simple dimensional extents requires attentional scanning. We therefore have to do away with intervals in the semantics of gradation as they are only implicitly represented. Instead, it is the boundaries of the microperspectives which determine the grades on a scale. Besides that, it is microperspectives between grades on a scale that underlie further aspects of gradation (e.g., concerning the abstract comparatives *weniger* und *mehr*). See Figure (3) for an illustration of the proposed difference between approaches based on intervals and microperspectives, respectively (for an elaborate discussion see Carstensen 1998, 2001).

¹⁷ Note that the “one curve case” is functionally equivalent to recognizing the length extent in Fig. 2a.

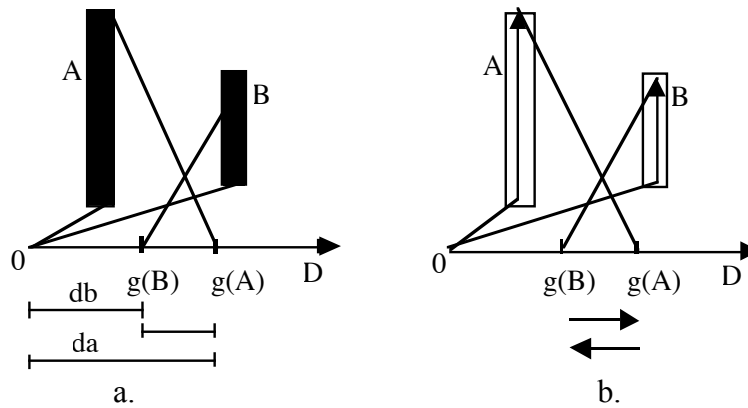


Figure 3: Interval-based vs. microperspective-based gradation

As to reference polarity (which is of vital importance for distance designation), there is no such asymmetry in dimensional designation, as long as dimensional extents are categorized wrt. to IPS only. It seems as if the scales underlying the antonyms *lang-kurz* and *dick-dünn* constitute a type of mental presentation that makes shifting attention (and changing the direction of scanning) easy. Thus, although it is *possible* to dissociate grade determination and abstract comparison with suppletive subtractive constructions (e.g., *weniger lang als (less long than)*), it is *not necessary* (see *kürzer (shorter)*) as opposed to the case of *weniger tief als, weniger hoch/*niedriger springen*¹⁸, *weniger weit/*näher laufen*.

With respect to PPS-related extents, things might be different. Bierwisch & Lang tentatively explain the defect of **Die Stange ist niedrig (*The pole is low)* by the supposed fact that “here the scaling inadmissibly covers orientation at the same time, so that ‘pole’ is recategorized, so to speak, as if ‘pole’ had a canonical orientation” (Bierwisch & Lang 1989b: 506). In other words, only the *primary*, non-contextual entries in an object’s OS determine scale projection.

- (15) a. Das Bild ist *niedrig/50cm hoch
The picture is *low/50 cm high
b. Der Granitklotz ist niedriger als der Betonklotz
The granite block is lower than the block made of concrete
c. ?Der Grashalm ist niedriger als das Gänseblümchen
?The blade of grass is lower than the daisy

This proposal is surprising, as it undermines the heretofore modular interaction of the QUANT and DIM components. Besides that, Bierwisch & Lang have to introduce an extra principle to allow contextual specification at all. As shown in (15a), the requirement of canonical orientation does not capture cases of *inherent orientation* which also do not allow –Pol-adjectives. It does neither explain the acceptability of (15b) when uttered in an adequate situational context, nor the intuition that *weniger hoch als* or *nicht so hoch wie* would be better than *niedriger* in (15c) in spite of both

¹⁸ While I am writing this, Marcel Reich-Ranicki utters the following sentence in his last “Literary Quartet”: “Er springt niedriger als er springen könnte (*He jumps lower than he could*)”. This reminds us (including him) to be cautious (with judgments of acceptability) when using dimensional adjectives.

objects' canonical orientation. Thus this "structural" account of explaining antonymy gaps is to be deprecated.

Banks et al. (1975) report an experiment that directs us to a possible solution of the antonymy problems. In this experiment, subjects were presented the displays shown in Figure (4a). Note that the small black balls have the same height but are connected with a string either to the ground (A) or to the ceiling (B) of the corresponding display. The subjects were asked which one of the two objects in a displays (called "balloon" in A, and "jo-jo" in B) was the higher or lower one, and they had to give a push button response. In addition to that, subjects were asked which of the *strings* was longer or shorter in each display.

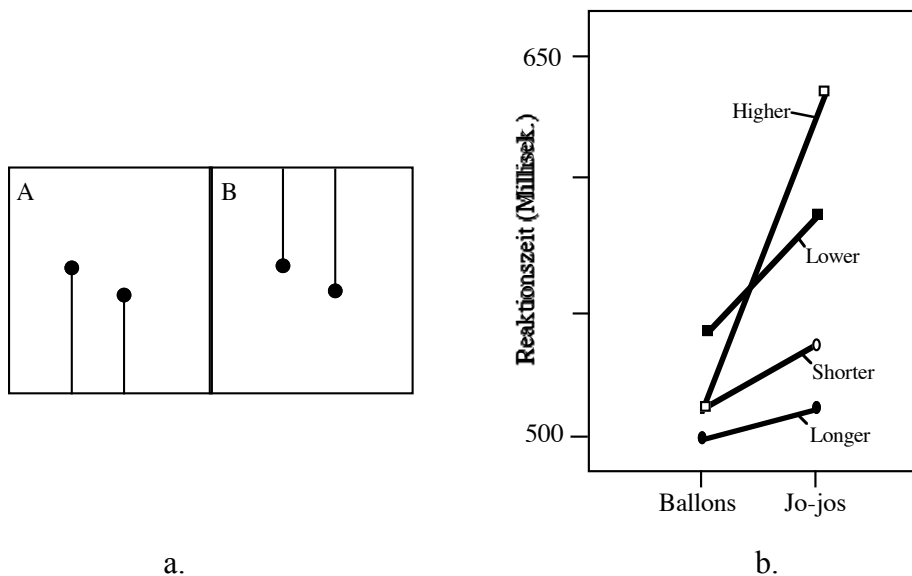


Figure 4: Experiments by Banks et al. (1975)

The results are shown in Figure (4b): In accordance with the markedness effect observed in other experiments, –Pol-adjectives generally take longer response times. A noteworthy exception to this is the response time for *higher* in B (which leads to a significant *crossover* of *higher/lower* reaction times). Banks et al. (1975: 43) present the following explanation for this result: "[...] it may be that subjects have visual scanning strategies or expectations that favor the balloons".

This confirms our previous assumption that semantic phenomena of comparison and gradation must not be modelled as operations on intervals that somehow "pop out" as quantities of dimensional extents (in which case no crossover effect would be expected to appear). Instead of this, dimensional processing is "situated" in different reference systems in the sense that it is influenced by its representational context. Thus it should not come as a great surprise any more that we find variations in reaction times and acceptability measures, and with differences in lexical semantic structure, in the domain of dimensional expressions.

By combining the representational distinction of IPS and PPS with aspects of attentional processing we can now offer tentative solutions for the aforementioned problems of dimensional asymmetry.

First and foremost, processing IPS-related extents requires less effort than processing PPS-related extents as can easily be seen in Figure (4b). If we assume a relation between ease of processing conceptual material and time-constrained lexical access, then difficulties can be expected to occur with respect to PPS-related extents for the most part.

Second, and in agreement with SoG, +Pol- and –Pol-adjectives involve different directions of processing wrt. some scale. Due to our result that it is not implicit intervals but explicit microperspectives which underlie scale projection, further qualitative distinctions have to be made, however. For IPS-related extents, there is a base direction reflected in a +Pol-adjective and a change of direction reflected in a –Pol-adjective on *one* scale. For distance extents, the opposing directions exist on *different* scales, due to the influence of reference polarity. For PPS-related dimensional extents, there may be different directions on one scale but the change of direction is evidently constrained. At present there are no clearcut results as to whether reference polarity – leading to different scales – is at work here, too.

Third, attentional processing of PPS-related extents is apparently constrained by its “situatedness”. It is influenced both by the directedness of PPS-axes and by the “stability” of the reference frame wrt. which processing takes place.

The first factor is revealed by the fact that +Pol-adjectives – reflecting a direction that is congruent with the corresponding axis’ direction – are unproblematic in general, while –Pol-adjectives are either problematic (cf. *niedrig*) or even missing (antonymy gap wrt. *tief*).

The influence of the second factor can be derived from the variation of acceptability in the use of *niedrig*. For objects with fixed orientation (e.g., mountains) or canonical orientation (e.g., towers) acceptability is high because perceiving/conceptualizing¹⁹ these objects implies a stable reference frame as a background for the situated gradation aspects to be processed. Thus, they satisfy a requirement for PPS related gradation (e.g., for successful direction change wrt. PPS axes) which I will shortly call “PPS stability condition” (see (16)). Correspondingly, the effort to establish or maintain this condition for situated gradation is regarded as the main source for less-than-perfect gradings of acceptability here.

(16) PPS STABILITY CONDITION

Objects are “ceived” as being aligned to VERT/OBS only wrt. a vertical/observer reference frame (that is, including the *ground/origin*).

This explains why even objects only having a contextually specified orientation but meeting this stability condition (e.g., blocks being large enough, see (15b)) lead to sufficient acceptability measures. On the contrary, use of *niedrig* is bad with objects having inherent orientation (e.g., pictures) or with moving/movable objects (in spite of having canonical orientation like human beings or bottles). The fact that objects with canonical orientation (even if fixed to the ground, like blades of grass and small flowers) are also disapproved for use with *niedrig*, clearly shows that there can be no structural explana-

¹⁹ Let us use Talmy’s notion of “ception” (motivated in Talmy 2000: 139ff) for a generalization of perception and conceptualization.

tion for these data and that the processing-oriented PPS stability condition is responsible instead.²⁰

A failure to establish or maintain this condition then means reverting to the corresponding IPS axis. This is obvious in those cases where *kurz* is the chosen –Pol-adjective designating a MAXimal dimension (see above). In all other cases, subtractive (*weniger* [+Pol-adjective] *als*) or negative (*nicht so* [+Pol-adjective] *wie*) descriptions must suffice.

We conclude our discussion of spatial asymmetries by simply noting that the antonymy gap for *tief* must be explained by the fact that maintaining the stability condition is not possible when changing direction during situated perspectivization. This is certainly not the last word on depth in language and cognition. For the time being, I'll leave it to Ewald: "Let's go into depth more deeply" (Lang 2001: 1273).

8 Conclusion

In this paper I have shown that a structural account of spatial semantics based on merely implicit aspects of spatial representations is insufficient for dealing with important problems in this field, especially with those of spatial asymmetry in dimensional designation and gradation. As an alternative, a processing-oriented approach has been proposed in which attentional microperspectivization of implicitly represented space plays a crucial role.

According to this view, attentional processing is necessary for building explicit spatial relations expressed by prepositions, and it leads to reference polarity, an interesting conceptual asymmetry that is also relevant for the semantics of distance adjectives. Problems of spatial asymmetry with dimensional adjectives can be explained by the fact that dimensional processing of PPS-related extents is "situated" (that is, involves constructing and maintaining a corresponding reference frame) and therefore constrained by the so-called "PPS stability condition" whose violation leads to the observed phenomena (especially the gradual differences in acceptability of adjective use).

Having emphasized these processing-oriented extensions of D₂SO, we should keep in mind that they are based on the significant structural distinction of IPS and PPS made by Ewald Lang.

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²⁰ That is, we seem to ceive these objects only wrt. to IPS.

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