DE GRUYTER MOUTON
DOI 10.1515/cog-2013-0017 —— Cognitive Linguistics 2013; 24(3): 437–456

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# What is a domain? Dimensional structures versus meronomic relations

**Abstract:** Within cognitive linguistics, the notion of *domain* is central. In the literature, the notion of domain has been interpreted in an all-encompassing way, which has led to conceptual confusion. The article proposes to distinguish between a more psychologically oriented description of domains based on dimensional structures, on the one hand; and meronomic relations, on the other. It is shown how Langacker's notion of a configurational domain can be analyzed as higher-level dimensional structures. An added benefit of the distinction between dimensional domains and meronomic relations is that it generates a natural account of the difference between metaphors and metonymies.

**Keywords:** domain, dimension, meronomy, locational domain, configurational domain, feature analysis, integral dimensions, separable dimensions, metaphor, metonymy

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## 1 Introduction

Within cognitive linguistics, the notion of *domain* is central. A number of articles analyze the meaning of the notion: e.g., Croft (2002), Clausner and Croft (1999), Croft and Cruse (2004), Evans and Green (2006); but they all fall back, more or less, on Chapter 4 of Langacker (1987).

Following Langacker (1987), there is a strong tendency in the literature to interpret the notion of domain in an all-encompassing way. For example, Clausner and Croft (1999: 1) write: "although the basic constructs of 'concept', 'domain', 'construal', and 'category structure' go by different names, they are essentially the same among researchers in cognitive linguistics."[1] One reason for this is that

1 This allows them to claim that an "image schema is a subtype of domain" (Clausner and Croft 1999: 4).

a key distinction in the early cognitive semantics is that between "figure" and "ground" that was borrowed from Gestalt psychology. A basic idea is then that the semantic structure for a word (or a construction) consists of both the concept (the figure) and its presupposed frame structure (ground).[2] In our opinion, the figure/ground distinction is not appropriate in all situations and using it as a universal principle leads to unnecessary confusion. Our aim is to clear up some of this conceptual complexity.

In Sections 2 and 3, we critically discuss attempts to specify what is meant by the notion of domain. We argue that Langacker's concept of domain conflates several components that are invoked in the analysis of lexical meanings. In particular, we believe that his distinction between locational and configurational domains is misleading. His configurational domains are better seen as *meronomic* information concerning the relation between parts and whole, rather than something pertaining to domains.

Accordingly, in Section 4, we make a distinction between a more psychologically oriented description of domains based on dimensional structures, on the one hand; and one based on meronomic relations, on the other. Meronomic relations, we argue, should not be included in the description of domains. We show that, by adopting a dimensional approach to domains, several of the problems with the view of Langacker and his followers can be avoided. In particular, configurational domains (Section 5) can be analyzed as higher-level dimensional structures. In cognitive linguistics, metaphors have been characterized as a mapping across domains and metonymies as involving relations within a domain. However, the broad use of the notion of a domain has made it difficult to apply this distinction. An added benefit of the distinction between dimensional domains and meronomic relations (Section 6) is that it generates a natural account of the difference between metaphors and metonymies.

## 2 Basic and abstract domains

Langacker (1987) wants to show that meaning is based on conceptualization; his motivation for introducing the notion of domain is part of this program. He says that domains "are necessarily cognitive entities: mental experiences, representational spaces, concepts or conceptual complexes" (1987: 147). He describes a domain as a "context for the characterization of a semantic unit" (1987: 147). This is in accordance with viewing a domain as a ground in the Gestalt sense.

2 We are grateful to William Croft for pointing this out to us.

The first distinction Langacker discusses concerning domains is *basic* vs. *abstract* domains. He notes that the concept *knuckle* "presupposes" *finger*; which, in turn, depends on *hand, arm, body*, and, finally, *space* (Langacker 1987: 147–148). However, *space* cannot be defined relative to some other, more fundamental, concept. This characterizes a *basic domain*. Langacker (1986) summarizes:

> It is however necessary to posit a number of 'basic domains,' that is, cognitively irreducible representational spaces or fields of conceptual potential. Among these basic domains are the experience of time and our capacity for dealing with two- and three-dimensional spatial configurations. There are basic domains associated with various senses: color space (an array of possible color sensations), coordinated with the extension of the visual field; the pitch scale; a range of possible temperature sensations (coordinated with positions on the body); and so on. Emotive domains must also be assumed. It is possible that certain linguistic predications are characterized solely in relation to one or more basic domains, for example time for (BEFORE), color space for (RED), or time and the pitch scale for (BEEP). However, most expressions pertain to higher levels of conceptual organization and presuppose nonbasic domains for their semantic characterization. (Langacker 1986: 5)

Evans and Green (2006: 234) add that basic domains are directly tied to pre-conceptual embodied experience: they provide "a 'range of conceptual potential' in terms of which other concepts and domains can be understood."

Given basic domains, an *abstract domain* is then defined as ". . . any nonbasic domain, i.e. any concept or conceptual complex that functions as a domain for the definition of a higher-order concept" (Langacker 1987: 150). In a footnote he adds: "an abstract domain is essentially equivalent to what Lakoff . . . terms an . . . idealized cognitive model . . . and what others have variously called a frame, scene, schema or even script . . . ."

The problem with this general characterization, which is repeated in most later discussions, is that it is too inclusive: it offers no criterion for what is *not* a domain. We see this as a consequence of using the figure-ground dichotomy as a basis for the notion of a domain. Taylor (1989: 84) writes that ". . . in principle, any conceptualization or knowledge configuration, no matter how simple or complex, can serve as the cognitive domain for the characterization of meanings." The all-embracing description of domains makes the concept too vague and rather useless. We shall argue that it is necessary to separate meaning relations that are based on *similarity judgments* from other types of relations. We suggest a narrower characterization of domain based on dimensionality and argue that many other aspects of meaning that have been sorted under the notion rather concern part-whole and other meronomic relations.

## 3 Locational and configurational domains

One of the central, but also more problematic, distinctions in Langacker's (1987) theory is between *locational* and *configurational* domains. This distinction has been copied by several other researchers: Clausner and Croft (1999: 7–13), Evans and Green (2006: 236), Croft and Cruse (2004: 21).

Langacker's description is ambiguous. First he writes that a *concept* "can be characterized as a location or a configuration in a domain (or in each of a set of domains)". A color is locational since it can be identified with a *region* of color space, while a *circle* is configurational since it can be described as a configuration of points in the domain of two-dimensional space (Langacker 1987: 149).

Then, he extends the terminology to *domains*. "A predicate specifies a location or a configuration in a domain (or in each domain of a complex matrix). Accordingly we can speak of a domain being either locational or configurational" (Langacker 1987: 152). In the following paragraph he writes: "the distinction between locational and configurational domains is elusive. ... A location presupposes some frame of reference making it possible to distinguish one location from another, whereas a configuration may be independent of any specific position within a coordinate system". An example of a configuration is a *triangle* that "is recognized as such regardless of its position and orientation within the visual field": i.e., he regards the visual field (physical space) as a configurational domain. On the other hand, *color space* is locational, since "changing the specification of color sensation ... results in a different color sensation" (Langacker 1987: 153).

Langacker discusses possible criteria for determining whether a domain is locational or configurational. He settles on the following: "what makes a domain configurational ... is our capacity to accommodate a number of distinct values as part of a single gestalt" (1987: 153). Using this criterion, he concludes that space, time, and pitch are configurational domains, while color is locational.

Clausner and Croft (1999, Section 2.2) criticize this distinction, showing that the domains Langacker calls configurational can support both locational and configurational concepts:[3] space supports locational *here* and configurational *circle*; time supports locational *now* and configurational *week*; and pitch supports locational *middle-C* and configurational *minor chord*.

Clausner and Croft take a step in the right direction when they recognize that "locationality vs. configurationality is a property of concepts, not domains"

3 Langacker (personal communication) says that he does not intend the distinction between locational and configurational domains to be exclusive.

(1999: 13). We want to go further: in Section 5, we argue that, by considering "higher-level" domains, one sees that concepts described as configurational in one domain can be seen as locational in another. This means that, once a hierarchy of domains is introduced, the distinction loses much of its relevance.

# 4 Dimensionality

## 4.1 Dimensional vs. meronomic structures

As a third theme in his presentation of domains, Langacker (1987: 150–152) observes that many domains – basic and abstract – are *dimensional*; but he does not formulate this property as a criterion of a domain. The examples Langacker and others give of domains can be grouped into two categories: (i) *dimensional* and (ii) *meronomic* (i.e., relating to part-whole relations). Langacker's first example – *finger* as the domain for *knuckle*, *hand* as the domain for *finger*, etc. – is a clear case of meronomic structure. Similarly, when he claims that no *hypotenuse* exists without a *right-angled triangle* (Langacker 1987: 183), this is a statement about a meronomic relation. We interpret Langacker's (1987) proposal to distinguish between locational and configurational domains as his attempt to characterize the two types of domains. Thus formulated, the distinction is misleading.

Clausner and Croft (1999: 6) go so far as saying that "... the concept-domain semantic relationship is essentially a part-whole (i.e. meronomic) relationship". This may only be true in a different sense for dimensional domains: as we shall argue later, concepts correspond to *regions* of dimensional domains. This is not normally what is meant by "a part-whole relationship".

Another distinction is subtler. When Langacker writes that one concept *presupposes* another, this can mean two different things. Even though a finger presupposes a hand, the meronomic structure makes it possible to replace one finger with another, with the result still being a hand. Or, the engine of a car can be replaced with another and the object still remains a car. In a dimensional domain like color – in contrast – *orange* might be said to presuppose the color domain; but orange cannot be replaced by another color while keeping the content of the domain the same. Therefore, the color domain does not have a meronomic structure. It forms an integrated whole where the *relations* between the elements are central for determining the content of the domain: Orange must be a color *between* yellow and red, otherwise it is no longer the color domain. In economic terms: the parts in a meronomic structure are *fungible*; regions of dimensional domains are not.

Meronomic relations do not occur only in the shape domain. They can be found in many other domains: a chord consists of three tones or more; a family, of parent(s) and child(ren); a limerick, of five lines; etc.

When Langacker (1987: 183) talks about the concept *arc* being "profiled" against the "base" *circle*, he also uses the term *domain* for the base. He emphasizes the distinction between profile and base in many situations. However, all his profile/base examples involve meronomic relations. Croft (2002: 166) explicitly relies on the profile/base distinction in defining a domain as "a *semantic structure that functions as the base for at least one concept profile*." We propose to go the other direction and define domains in terms of dimensions.

The dimensional domains have different *semantic roles* than do the meronomic structures. The examples given for meronomic structures are of concepts expressed by nouns; thus, they refer to objects and parts of objects. Characteristically, objects have multiple attributes, while a dimensional domain only represents a single attribute.

## 4.2 Domains in psychology

We now turn to a brief description of dimensions and domains as used in cognitive psychology.[4] Our aim is to make the psychological notion of domain a plausibly suitable tool for the aims of cognitive linguistics. Thus, we propose to unify the two areas.

Psychology has a long tradition of analyzing the dimensionality of perceptual structures. Shepard (1987) argues that, as soon as perception relating to a particular domain can be graded by similarity, mathematical techniques – such as multidimensional scaling (Kruskal 1964) or principal component analysis – can be used to extract a low-dimensional space representing the similarity judgments. The more similar two objects are judged to be, the closer the points representing the objects will be within the space. A large number of perceptual spaces have been identified in this way: see e.g. (Shepard 1987: 1318).[5]

We submit that everything Langacker calls a basic domain can be given a dimensional description. The claim must, however, be qualified: some dimensions are binary (e.g., gender); some are ordered structures (e.g., kinship relations); some have a full metric structure.

4 Clausner and Croft (1999: 5) remark that "Langacker's notion of a domain appears to differ in some respects from the term *domain* used by most psychologists dealing with concepts."

5 Nosofsky (1992) gives an excellent survey of different mathematical models in this area.

As a potential counterexample, Langacker (1987: 151) says that emotions cannot be characterized "in terms of a small number of essentially linear dimensions."[6] However, one finds several dimensional analyses of emotions in the psychological literature. Most of these (e.g., Osgood et al. 1957; Russell 1980) contain two basic dimensions: a *value* dimension, on a scale from positive to negative aspects of emotions; and an *arousal* dimension, on a scale from calm to excited emotional states.[7] Even though there is no one final theory of the dimensional structure of emotions, we do not view the emotion domain as a counterexample to our thesis.

## 4.3 Integral and separable dimensions

We next turn to the connection between dimensions and domains. Certain quality dimensions are *integral*: one cannot assign an object a value on one dimension without giving it a value on the other(s) (Garner 1974; Maddox 1992; Melara 1992). An object cannot be given a hue without also giving it a brightness; a sound pitch always goes with a certain loudness. Dimensions that are not integral are *separable*: e.g., the size and hue dimensions. Melara (1992) presents the distinction as follows:

> What is the difference psychologically, then, between interacting [integral] and separable dimensions? In my view, these dimensions differ in their similarity relations. Specifically, interacting and separable dimensions differ in their degree of *cross-dimensional similarity*, a construct defined as the phenomenal similarity of one dimension of experience with another. I propose that interacting dimensions are higher in cross-dimensional similarity than separable dimensions. (Melara 1992: 274)

Using this distinction, we propose that a *domain* be defined as a set of integral dimensions separable from all other dimensions. The three color dimensions constitute a prime example of a domain in this sense: hue, chromaticness, and brightness are integral dimensions separable from all other quality dimensions. Another example is the *tone* domain, with the basic dimensions pitch and loudness. Of course, ordinary space is also a domain, consisting of the integral dimensions width, depth, and height. The most fundamental reason for decomposing a cognitive structure into domains is that the properties of an object can be described *independently* of other properties. That an object has the weight of one kilo is independent of its temperature or color.

6 Langacker's position is repeated by Green and Evans (2006: 236).

7 Langacker (1987: 151) presents these two dimensions, too, but he does not seem to regard them as exhaustive.

## 4.4 Empirical criteria for integrality

Several empirical tests have been proposed to decide whether two perceptual dimensions are separable or integral (see Maddox 1992). One is called *speeded classification*. The stimuli consist of four combinations of two levels of two dimensions: $x$ and $y$ (e.g., *size* and *hue*). If the $x$-levels are $x_1$ and $x_2$ (e.g., *large* and *small*) and the $y$-values are $y_1$ and $y_2$ (e.g., *green* and *yellow*), one can denote the four stimuli $(x_1, y_1)$, $(x_1, y_2)$, $(x_2, y_1)$, and $(x_2, y_2)$. In the control condition, subjects are asked to categorize as quickly as possible the level of one dimension – say $x$ – while the other is held constant: i.e., they are presented with either the stimulus $(x_1, y_1)$ or $(x_2, y_1)$, or either the stimulus $(x_1, y_2)$ or $(x_2, y_2)$. In the filtering condition, the same subjects are asked to categorize the level of the same dimension while the other varies independently. If the mean reaction time in the filtering condition is longer than in the control condition, then the irrelevant dimension – in this case $y$ – is said to interfere with the test dimension $x$, and the two dimensions are classified as integral. The assumption is that two separable dimensions can be attended selectively, while this is difficult for two integral dimensions. Given separable dimensions, subjects can "filter out" the irrelevant information from the relevant.

Another test is the *redundancy task* (Garner 1974). The stimuli and the control condition remain the same as in the previous test; while in the redundancy condition, only two of the four stimuli are used: either $(x_1, y_1)$ and $(x_2, y_2)$, or $(x_1, y_2)$ and $(x_2, y_1)$. The values of the two dimensions are thus correlated, so that the value of one allows subjects to predict the value of the other. Subjects are presented with one of the two stimuli and asked to categorize, as quickly as possible, the value of one dimension: e.g., $x$. If the mean reaction time is shorter than in the control condition, the subjects are said to exhibit a *redundancy gain*, and the two dimensions are classified as integral.[8]

## 4.5 Comparison with feature analysis

In the philosophical tradition of semantics, it has been assumed that the meaning of a word can be decomposed into a finite set of conditions that are jointly necessary and sufficient to describe the reference of the word. The semantic analysis based on *distinctive features* goes one step further and also assumes that the

8 Gärdenfors (2000: 25) presents a third test: the so-called *direct dissimilarity scaling*.

necessary and sufficient conditions can be formulated in terms of a finite number of semantic primitives (cf. Jackendoff 1983: 112; Goddard and Wierzbicka 1994). In linguistics and cognitive science, these assumptions have been expressed most prominently by Katz (1966), Schank (1975) and Miller and Johnson-Laird (1976) (although the latter express some reservations).

Could it not be that the dimensions of a conceptual space can be generated from such a set of distinguishing features? There exist, however, a number of experimental findings that speak in favor of dimensional representations based on similarities in contrast to feature representations. The prototype theory of Rosch (1978) and her followers builds on data showing that objects can be more of less typical examples of a category and that there is graded membership in a category. These findings are difficult to explain in a theory of distinguishing features. Furthermore, Smith and Medin (1981: 121–123) present three types of results that speak against feature analysis: (i) People can make fine discriminations about, for example, the size of objects, which implies that they have access to dimensionalised knowledge about the corresponding concepts; (ii) multidimensional scaling analyses consistently reveal dimensional properties; and (iii) in perceptual categorizations, like in Labov's (1973) experiment with container-like objects, subjects distinguish, for example, diameter-to-height ratios that are used in their categorizations. Such ratios presume dimensional representations.

Also Langacker (1987: 54) criticizes feature analysis. He argues that "a cognitive domain is an integrated conceptualization in its own right, not a feature bundle". Similarly Jackendoff (1983: 112–122) expresses criticism. One of his examples is the concept *red*. *Red* must include the feature *color*, "[b]ut once the marker COLOR is removed from the reading of 'red', what is left to decompose further? How can one make sense of redness minus coloration?" (1983: 113). Thus, Jackendoff, like Langacker, ends up proposing irreducible integrated cognitive domains as a basis for semantics.

Most accounts of distinctive features assume that features are binary classifiers (or have a finite number of values). If the analysis is extended to features that have a dimensional structure, the position gets closer to the theory of *frames* and to the theory presented here. However, the theory of dimensional spaces still contains stronger assumptions about the underlying geometric structure, in particular on the integration and separability of dimensions and on the emphasis on concepts being *convex regions* (Gärdenfors 2000).

In this section, we have shown how results from cognitive psychology support the thesis that basic domains are dimensional. We next want to show that what have been called configurational domains can likewise be given a dimensional analysis, as "higher-level" domains.

# 5 Configurations are higher-level domains

## 5.1 Properties vs. concepts

Following Gärdenfors (2000), we will define a *conceptual space* as a set of dimensions that are sorted into domains of integral dimensions. The dimensions represent perceived similarity: the closer two points are within a space, the more similar they are judged to be.

This general description can be used to distinguish between *properties* and *concepts*. The following criterion was proposed in Gärdenfors (1990, 2000), whereby the geometrical characteristics of the quality dimensions are used to introduce a spatial structure to properties:

*A property is a convex region in some domain.*[9]

The motivation for this criterion is that, if two objects – located at *x* and *y* in relation to certain quality dimension(s) – are both examples of a concept, then any object that is located *between x* and *y* with respect to the same quality dimension(s) will also be an example of that concept.

As defined here, properties form a special case of *concepts*. While a property is based on a single domain, a concept is based on one *or more* domains (Gärdenfors 2000). Both linguistic and philosophical accounts have obliterated this distinction: for example, both properties and concepts are represented by predicates in first-order logic and in λ-calculus.

An example of a concept that is represented in several domains is *bird* (cf. Clausner and Croft 1999: 7). A bird has a shape, a size, a color, a weight, a distinctive sound, an ecological habitat, etc. Langacker (1987: 152) calls the set of domains used to characterize a concept the *domain matrix*. The set of domains for a concept need not be closed, but rather can be expanded as more knowledge is accrued. This is part of what Langacker (1987: 154) calls the *encyclopedic* conception of linguistic semantics.

Whenever several domains are involved in a representation, one must assume some principle for how the different domains are to be weighed together. In addition to the domains in a concept's domain matrix, one must include information

9 That a region *R* is convex means that, for any two points *x* and *y* in *R*, all points *between x* and *y* are also in *R*. We assume that the notion of betweenness is defined for all domains in a conceptual space, even though not all the domains may have a metric. This makes it possible to apply the criterion.

about the *prominence* of each domain. Langacker (1987: 165) calls a domain that is highly ranked a *primary domain*. He illustrates what he means by considering the difference in meaning between *roe* and *caviar*. The two concepts refer to the same entity: masses of fish eggs. However, with *roe*, the zoological domain of fish is prominent; while for *caviar*, the food domain is most prominent.[10] Note that the relative weight of domains depends on the context in which a concept is used. If you are eating an apple, its taste will be more salient than if you are using the same apple as a ball while playing with an infant – in which case, the shape domain is most prominent.

## 5.2 Higher-level domains[11]

Next, we want to show that configurational concepts can also be analyzed in terms of dimensional domains. Certain properties can be described as more general patterns arising from relations between points in a conceptual space. In an ordinary two-dimensional space ($R^2$) with standard Euclidean metric, one can, of course, define regions as subsets of the space. One can also introduce a new space of "shapes" that are patterns of points in the space. Consider the concept *rectangle*: a typical configurational concept, according to Langacker. It can be defined using the set of all quadruples $<a, b, c, d>$ of points in $R^2$ satisfying the condition that the lines *ab*, *bc*, *cd*, and *ad* form a convex polygon, with $ax - bx = cx - dx$ and $ay - cy = by - dy$ (i.e., the sides are pairwise equally long) and $|ad| = |bc|$, where $|ad|$ and $|bc|$ denote the length of the diagonals (i.e., the diagonals are equally long). One can partition this set of quadruples into equivalence classes by saying that two rectangles $<a, b, c, d>$ and $<e, f, g, h>$ are identical if $|ab| = |ef|$ and $|ac| = |eg|$. In this way, one identifies a rectangle by the length of its sides, independent of its position in $R^2$.[12] Now, let $E$ be the set of all such equivalence classes.[13] This amounts to mapping the rectangle $<a, b, c, d>$ to the point $(|ab|, |ac|)$ in $R^2$ (see Figure 1). The space $E$ of rectangles is therefore isomorphic to $(R+)^2$, with the width and the length of the rectangles as the generating dimensions.

Within $E$, one can now identify regions that correspond to certain properties. For example, a *square* is any point $<|ab|, |cd|>$ in $E$ such that $|ab| = |ac|$. It is easy

10 Croft and Cruse (2004: 18) discuss a similar example concerning the difference between *land* and *ground*.

11 This section builds on (Gärdenfors 2000), Section 3.10.

12 The rectangles have the same *shape* if $|ab|/|ac| = |ef|/|eg|$: i.e., if the quotients of the lengths of the sides are the same.

13 On E, one can define a metric $d$, by $d(<a, b, c, d>, <e, f, g, h>) = \sqrt{([|ab| - |ef|]^2 + [|ac| - |eg|]^2)}$.

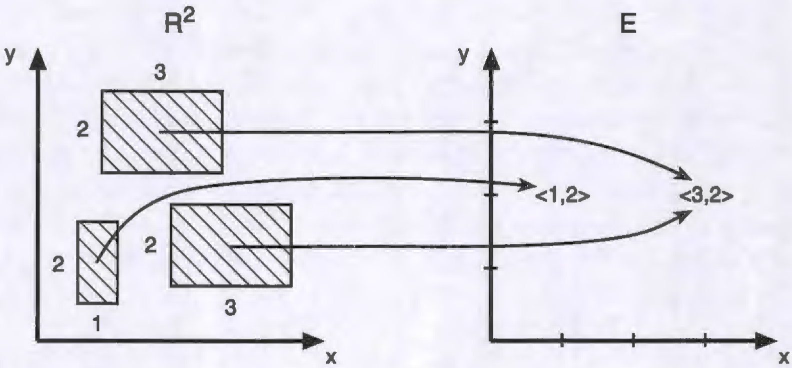


**Fig. 1:** The configurational space E of rectangles.

to show that this region is a convex subset of $E$, since that subset corresponds in $E$ to the line $x = y$, and a line is a convex set. On the right side of the line – i.e., where $y > x$ – one finds the set of all rectangles taller than they are wide: e.g., the rectangle <1, 2> in Figure 2. This set is also convex.

This analysis of the concept of rectangle is an elementary example how configurations (patterns) can be defined as higher-order correlations in an underlying space.

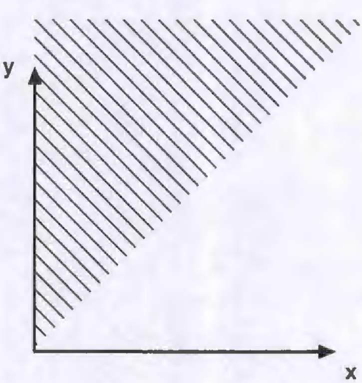


**Fig. 2:** The space of "vertically" extended rectangles.

## 5.3 Shapes and other configurations

Next, we discuss further examples of configurational concepts. Our arguments concerning the concept of rectangle can, in principle, be generalized to other shape concepts – though the technicalities may be intricate.

If something like Marr and Nishihara's (1978) analysis is adopted, one begins to see how such a space might appear. Their scheme for describing biological shapes uses cylinder-like modeling primitives. Each cylinder can be described by two coordinates: length and width. If one wants, one can add further dimensions describing the spatial orientation of the cylinder: e.g., horizontal or vertical.[14] The details are not important in the present context. It is worth noting that – following Marr and Nishihara's model – an object can be described by a comparatively small number of coordinates, based on lengths and angles. In this way, an object can be represented as a pattern (vector) in a high-dimensional space; and the shape space is *supervenient* on the spatial and angular dimensions, just like rectangles are supervenient on the length and width dimensions. The supervenience relation introduces a partial hierarchy of domains that should be considered in any lexical analysis of concepts.

Take an example from another type of domain: Clausner and Croft (1999: 9) argue that *intervals* and *chords* – on the pitch dimension – are configurational concepts. A similar analysis to that of the rectangles above can easily be developed for *interval* and *chord*. However, we will not pursue the details here.

Another example is the domain of *kinship relations*, generated by combining links of the type "*x* is a child of *y*", "*x* is a parent of *y*", "*x* is married to *y*", "*x* is a sister or brother of *y*" to generate a genealogical tree structure. The partitioning of that tree generated by kinship words varies widely between languages: e.g., many cultures make no distinction between *mother* and (maternal) *aunt*.

A genealogical tree is not the only way to represent kinship relations. Zwarts (2008) proposes a two-dimensional representation of kinship relations. One dimension is the number of steps backwards through the genealogy – represented by the horizontal dimension in Figure 3; the other is the number of steps forwards – represented by the vertical dimension.

| | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| 0 | I | mother | grandmother | great-grandmother |
| 1 | daughter | sister | aunt | (grand)aunt |
| 2 | granddaughter | niece | cousin | cousin |
| 3 | great-granddaughter | grandniece | cousin | cousin |

**Fig. 3:** Diagram based on Zwarts' two-dimensional space of kinship relations (only one gender represented).

**14** Cylinders are combined by determining the angle between the dominating cylinder and the added one, as well as the position of the added cylinder relative to the dominating one.

Note that – in accordance with the property criterion – this representation makes *cousin* correspond to a convex region, unlike what happens if one represents the concept in a genealogical tree. In this way, one sees that, depending on which representation is used, concepts are differently related.

Gärdenfors (2007) and Gärdenfors and Warglien (To appear) extend the dimensional analysis to representation of *actions*. When one perceives an action, one does not just see the movement, but also the *forces* that control the different kinds of motion. Clearly, the force domain can be given a dimensional description. By adding forces representing actions, one obtains the basic tools for analyzing the dynamic properties of actions. For many actions, such as moving and lifting, a single force vector is sufficient; some, such as walking and swimming, involve a complex of forces. Therefore, we define an action more generally as a *configuration of forces*, since several force vectors interact.

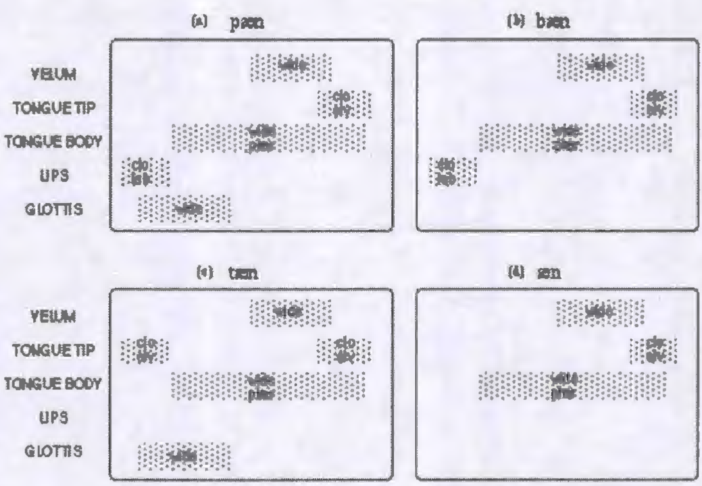


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**Fig. 4:** Utterances of the four words 'pæn', 'bæn', 'tæn' and 'æn' as sequences of force vectors applied to five vocal organs. The horizontal axis in each diagram represents the time dimension (from http://www.haskins.yale.edu/research/gestural.html [Accessed May 2011]).

An example of this approach to actions comes from phonetics. Browman and Goldstein (1990) describe the act of uttering a word as a "score of gestures" where the gestures are performed, not by the hands, but by the five vocal organs of velum, tongue tip, tongue body, lips, and glottis (see figure 4 for some examples). They then describe the utterance of a word as a temporal sequence – a score – of activation of these organs. Each activation is meant to be one of a limited number of types. Such a score can be re-described as a temporal pattern of force vectors. Browman and Goldstein's description of the patterns as "vocal gestures" underlines this analogy.

Another example comes from analyses of the force patterns involved in different kinds of *walking* (e.g. Giese and Lappe 2002; Wang et al. 2004). By mapping the forces exerted by the parts of the leg during different kinds of walking, the similarities between the types of walking can be measured. The configuration of forces determines how the walking is categorized. The fact that the meaning of *walk* is more similar to that of *jog* than that of *jump* can be explained by the fact that the force patterns representing walking are more similar to those for jogging than those for jumping. The similarities of action patterns also explain how *sub-categorization* is generated. For example, the force patterns corresponding to *march, stride, strut, saunter, tread*, etc., can all be seen as sub-regions of the force patterns that describe *walk* (for an example of patterns involved in different gaits, see Wang et al. 2004). In brief, the similarities of the configurational patterns predict many aspects of categorization of actions. Without the dimensional structures of actions and the model of concepts as regions in spaces, these aspects are difficult to explain.

The upshot is that many higher-level domains can be given a dimensional analysis. An even stronger claim would be that this holds for all domains: basic and higher-level. However, such a claim can only be taken as programmatic: for many higher-level domains, such as shape space, it may be difficult to identify the relevant dimensional structure.

We conclude that the distinction between configurational and non-configurational uses of a domain is not needed for semantic analysis – let alone for making a distinction between configurational and non-configurational domains *per se*. Instead, we propose, (1) to distinguish between dimensional structures and meronomic configurations, and (2) to restrict the notion of domain to the dimensional structures. We believe that the distinction made by (1) will bring much more order to analyses in cognitive semantics.

## 6 Metaphors and metonymies in light of the dimensional/meronomic distinction

In this section, we show that the distinction between dimensional domains and meronomic relations generates a simple and natural way of understanding the difference between metaphors and metonymies.

## 6.1 Characterizing metaphors and metonymies

On the basis of dimensional analysis, it is natural to say that a metaphor expresses an identity in structure between different domains. A word representing a particular pattern in one domain can be used as a metaphor to express the same pattern in another domain. In his *invariance principle*, Lakoff (1993: 215) expresses a closely related position: "metaphorical mappings preserve the cognitive topology (that is, the image-schema structure) of the source domain, in a way consistent with the inherent structure of the target domain". In this way, one can account for how a metaphor transfers information from one conceptual domain to another.

Metonymy's role is primarily referential. By picking out one specific aspect of an entity, it focuses attention on something salient to the situation, thereby helping one's understanding of it. Classical types of metonymy include *pars pro toto*, where the focus is on a part of an object instead of the whole; and *totum pro pars*, where the focus is on something that contains an object as one part. The relevant parts and wholes need not just be spatial, but can be temporal as well. More abstract meronomic relations of functional or causal nature also generate metonymies: e.g., in "Proust is tough to read", the author stands for the book he wrote; while in "Napoleon attacked Russia", the highlight is Napoleon's function as leader of the army. (For an extensive list of different types of metonymies, see Peirsman and Geerarts 2006, Section 2.)

Metonymic concepts allow one to conceptualize something by its relation to something else to which it is connected. In contrast to metaphor, metonymy is based not on the similarity between two domains but on meronomic relations within the same domain. Here we agree with Lakoff and Turner (1989: 103), who argue that – unlike metaphor – metonymy "involves only one conceptual domain. A metonymic mapping occurs within a single domain, not across domains". (See also Peirsman and Geeraerts 2006: 271.)

In summary, our thesis is:

*Metaphors refer to mappings between domains, metonymies to meronomic relations within domains.*

This thesis is, at large, compatible with much work on metaphors and metonymies in cognitive linguistics. One theory that comes close to ours – in content if not in terminology – is Croft's (2002). He starts out from the broad notion of domain in the Langacker tradition; but then, following (Langacker 1987: 152), he introduces a distinction between (base) domain and domain matrix. He writes: "the combination of domains simultaneously presupposed by a concept such as

[HUMAN BEING] [is] called a *domain matrix*" (2003: 168). In line with our proposal, he describes metaphors as domain mappings (2003: 177). He then argues that metonymy is based on (what he calls) *domain highlighting*, involving a shift from the foregrounding or highlighting of something in the primary domain of a concept, to the foregrounding or highlighting of it in a secondary domain within the same domain matrix (Croft 2002: 179). On the surface, this characterization differs from our notion of metonymy; but the result of Croft's analysis is basically the same as ours. That said, we believe that the contrast between dimensional domain mappings and meronomic relations makes the difference between the functions of metaphors and metonymies clearer.

## 6.2 The contiguity theory of metonymy

There are, however, accounts of metonymies that are based on a different tradition. One issue is whether all types of metonymy can be explained by a single cognitive mechanism: Peirsman and Geeraerts (2006) argue the implausibility of any unitary theory being able to do so. Before cognitive linguistics introduced the notions of *domain* and *domain matrix*, contiguity was the standard explanation for metonymy. Peirsman and Geeraerts consider whether contiguity might serve as an alternative to the *mapping theory* of cognitive linguistics. Given that contiguity suffers from the same vagueness as the notion of domain, they make an important addition to its traditional definition, arguing that any theory of contiguity be *prototype* based. Their definition of contiguity is conceptual in nature; they regard metonymy as something that is not objectively given, but rather the result of different construal operations.

Peirsman and Geeraerts (2006) define spatial part/whole contiguity as the prototype for the category. Of course, this is the most typical meronomic relation; thus far, their proposal agrees with ours. They argue that, on the next level of typicality, one finds container/contained relations such as "Oscar drank a glass too many" and "the milk tipped over". Next are location/located relations such as "the whole house woke up" or the use of "billiards" for "a room where billiards is played." The people who wake up are *not* parts of the house; rather, their locations are parts of the house's location. In this weaker sense, container/contained and location/located relations can be seen as meronomic relations – again, in accordance with our thesis. According to Peirsman and Geeraerts, the least typical form of spatial metonymy is adjacency: e.g., the use of "old wig" to mean "old person."

Peirsman and Geeraerts extend this prototypicality analysis to other domains, including (i) temporal domains; (ii) events, processes, and actions; and

(iii) assemblies and collections: e.g., temporal part/whole relations correspond to spatial part/whole relations and constitute the prototypical core of metonymical relations in the temporal domain. Meanwhile, rather than being predominantly temporal or spatial in nature, assemblies are structured entities with different functional parts. Peirsman and Geeraerts argue that, for all of these domains, the core can be extended – both along the *strength of contact* dimension and what they call the *boundedness* dimension.

In summary, Peirsman and Geeraerts (2006) propose that metonymy be explained by a prototype-based notion of contiguity. With the possible exception of adjacency, all of the cases of contiguity they analyze can be considered to be meronomic relations.[15] One finds little conflict between their approach and ours. The main difference is their focus on how metonymies can be more or less prototypical.

# 7 Conclusion

As it has been used in cognitive linguistics, the concept of domain seems to cover several distinct phenomena. Our aim has been to clear up that usage by distinguishing dimensional structures from meronomic relations. We believe this distinction provides useful tools for analysis of lexical semantics.

Apart from the obvious relevance for lexical semantics, these two types of information structure are important for work on the Semantic Web (Berners-Lee et al. 2001). The dream of the Semantic Web is to develop a knowledge formalism covering everything that exists on the Web. That said, the "ontologies" that have been developed and expressed so far in various formal languages, such as OWL, mainly provide mereological information ("has a" relations) and logical notation for concept hierarchies ("is a" relations). Gärdenfors (2004) argues that what is needed to make the Semantic Web more *semantic* is to include information about the similarity of concepts. We believe this is best done by including in the knowledge formalisms information about the domains and their underlying dimensions. One such attempt is the Conceptual Space Markup Language (CSML) proposed by Adams and Raubal (2009). In summary, by combining the domain and image-schema analysis of cognitive semantics with more logically oriented representations, the Semantic Web project will have a better chance to achieve a result that is truly semantic in nature.

15 Their examples of spatial adjacency – such as "old wig" – could possibly be analyzed as meronomic relations within a functional or other domain.

## Acknowledgements

We want to thank the Swedish Research Council for their support to the Linneaus environment Thinking in Time: Cognition, Communication and Learning. This article is written with generous support from that environment.

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