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Towards an empirical lexical semantics*

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1. Cognitive-linguistic approaches to lexical semantics

In cognitive linguistics language is considered to be a means of organising, processing, and conveying informational structures in the mind that reflect our interaction with the world. "Language, then, is seen as a repository of world knowledge, a structured collection of meaningful categories that help us deal with new experiences and store old ones" (Geeraerts 1995a: 112-113). Both lexical categories and grammatical constructs are considered to be meaningful units, i.e. repositories of conceptual information and world knowledge. For instance, the study of the semantic value of grammatical categories and constructions - e.g. transitivity, grammatical relations, voice, case - has found its best representatives in Langacker's Cognitive Grammar (Langacker 1982, 1987, 1991a, 1991b) and in Fillmore's and Goldberg's Construction Grammar (Fillmore 1988, 1990; Fillmoren & Kay & O'Connor 1988; Goldberg 1992, 1995).

The present paper will focus on lexical-semantic categories. In cognitive lexical semantics, research interests can be grouped under two general headings: (i) the internal structure of monosemous and polysemous lexical items taken separately: prototype structure, family-resemblance structure, lexical networks (Brugman 1981, Lakoff 1987, Taylor 1989, Geeraerts 1989a, 1989b, 1993) and (ii) larger conceptual structures: metaphor research (Lakoff & Johnson, 1980; Lakoff & Turner 1989), frame semantics (Fillmore 1982), idealised cognitive models (Lakoff 1987).

One of the major issues in cognitive lexical semantics over the past two decades has been the analysis of polysemous lexical items in terms of a family-resemblance network of multiple, interrelated senses or usage types. The different senses of a polysemous lexical item have been represented by different network models (see Sandra & Rice 1995): a radially structured network (Brugman 1981, Lakoff 1987), a schematic network (Langacker 1991b), or yet different network versions.[1] The links between the different senses in a lexical network are manifold (conceptual/semantic overlap, metaphor, metonymy, image-schema transformation) and are supposed to represent the cognitive principles behind the processes of meaning extension. This description of polysemous lexical items

owes a great deal to Rosch's psychological research in the mid-seventies into prototype effects in lexical categories (Rosch & Mervis 1975, Rosch 1978).[2] Later, it got a major impetus when Brugman and Lindner presented their seminal analyses of the polysemous structure of the preposition *over* (Brugman 1981) and the verbal particles *up* and *out* (Lindner 1981). It has been increasingly popular ever since (Cuyckens 1991, Goldberg 1992, Taylor 1992, Casad 1992, Schulze 1993, Tuggy 1993).

The cognitive-linguistic approach to (polysemous) lexical meaning is diametrically opposed to the classical (structuralist and generative) view, with its emphasis on economy of representation. Highly abstract or unitary senses have been replaced by networks of richly interconnected usage types,[3] with the separate usage types differing in rather minor ways, i.e. along a number of different very concrete dimensions. Prepositional networks especially, feature an abundance of fine-grained distinctions (for instance, the presence or absence of physical contact between landmark and trajector underlies the purported different usages of *over* in *The car drove over the bridge* and *The plane flew over the bridge*).

While these lexical network models may be welcomed as an improvement over classical approaches to polysemy (e.g. Caramazza & Grober 1976), they are not uncontroversial. First, cognitive linguists have often been vague on important aspects of these models. In particular, lexical network models show a lack of explicit criteria for distinguishing between usages. "Given this vagueness, different linguists are likely to make different distinctions between usage types and to propose different networks for the same preposition" (Sandra & Rice 1995: 92). Furthermore, the diversity of network models that are currently around leads to uncertainty about the correct model type for the phenomena under study. In general, then, "network models are especially dependent on the particular analytic skills or subjective aesthetic of the individual researcher" (Rice 1996a: 137f.). Finally, some linguists have presented network analyses with cognitive-psychological overtones, thus suggesting that the models reveal aspects of the language user's mind. However, it is far from clear how these analyses relate to mental structures. At any rate, at this point in time there is no reason for maintaining that lexical-semantic networks in cognitive linguistics are a blueprint of the conceptual territory associated with a lexical item in the mind of the speaker.

2. The need for empirical support

The assumption that linguistic analysis can shed light on aspects of the mind (i.e. that lexical-semantic networks reflect aspects of the language user's mental representation) probably results from the foundational assumption of the paradigm, i.e. the claim that language cannot be insulated from general cognition and that linguistic analysis should therefore be informed by cognitive principles. However, even if this general view of language may hold true, it does not automatically follow that a linguist's semantic analysis of a lexical item should map onto cognition in any direct way. Even if the general theory behind the analysis may be correct (i.e. that there is a relationship between language and cognition), cognitive linguists might lack the methodology for actually relating language to the very specific level of mental representation. As a matter of fact, the appropriate methods for studying the way language is represented in the mind are not linguistic but psycholinguistic ones. For that reason, cognitive-semantic network analyses are entirely neutral with respect to issues of mental representation unless the issues are studied with techniques of psycholinguistic experimentation.

When psychological aspects of lexical-semantic networks in cognitive linguistics are at stake, a number of research issues figure prominently. One set of issues pertains to prototypes (e.g. What are the prototypes around which particular lexical categories are organised? Are prepositional categories, for instance, organised around spatial prototypes? Are there multiple prototypes? Is the nature of the prototype a schema, a specific examplar, or an average over a cluster of exemplars?). Another set of research issues, one that we will mainly deal with in this paper, concerns the presence and/or degree of polysemy in the mental lexicon of the language user. A number of questions are involved here: (i) Do language users subsume the usage variability of a word under an abstract schematic sense (strong monosemy)? (ii) If not, do they tend do mentally represent a lexical item's different senses as interrelated (polysemy) or as unrelated (homonymy). (iii) If they have a preference for polysemy, how fine-grained are the distinctions they make? Do they correspond to relatively generalised senses like, for instance, spatial versus temporal - in this case, any further, minor distinctions would be instances of vagueness - or do they correspond to highly specific ones like, for instance, the different spatial senses of the preposition *over* in the examples given earlier. (iv) In contrast, if language users have a preference for a homonymous set of fairly generalised senses, do they view any further, fine-grained distinctions within each such sense as interrelated (yielding a polysemous mininetwork), or do they treat any further distinctions as instances of vagueness - in which case each sense can be viewed as monosemous? (v) What principles of semantic extension do language users appeal to and where do they play a role in actual language use (at the time of lexical acquisition, in processing individual senses)?

In our research over the past few years we have begun to investigate empirically some of these issues. In all cases we studied prepositional categories. We investigated (i) the initial acquisition/learning of prepositional usages (child language acquisition, foreign language learning) and (ii) the ultimate representation of such usages in the mind of the adult language user. Two types of experimental techniques were used: (i) off-line tasks, which invite subjects to perform a task where they can reflect on their performance (e.g. sorting, rating) and are assumed

to indirectly reflect aspects of the underlying representational structure (perception being mediated by memory structures), and (ii) on-line tasks, which have subjects perform a task - usually under time-pressure - that is contingent on the mental process/representation under study (e.g. speeded decision). Below we will present an overview of our results. We will use the experimental task as an ordering principle.

3. Psycholinguistic studies

First we will present research on how prepositional categories are acquired/learnt in child language acquisition (3.1.) and in foreign language learning (3.2. and 3.3.). Then we will discuss experiments investigating the way the internal semantic structure of prepositions is perceived (3.4. through 3.7.) and mentally represented (3.8.) by adult language users.

3.1.   *Child language acquisition*

One line of empirical enquiry into the lexical semantics of prepositions has examined the development of sense types for the prepositions *in, on, at, to, for, from, with, by,* and *of.* It is hoped that charting the progress of lexical acquisition (especially by children) might shed light on the way language users treat word meaning. For instance: Which usages appear first? Is there a pattern in the acquisition sequence? Cognitive linguistics lacks any explicit theory about the time-course, nature, and mechanics of language acquisition except for the rather minimalist claim by Langacker (1991b: 265):

> We know, for example, that speakers learn and manipulate specific expressions; but we do not know, in any direct way, precisely what degree of schematicization they achieve, i.e. how abstract and general the rules are that they manage to extract from more specific structures. I suspect that speakers differ somewhat in this regard, and do not invariably arrive at the highest-level schemas that the data would support. In any event, the omnipotence of high-level generalizations is not a matter of apriori necessity.

As is evident in the underspecificity of this quote, further investigation is required. In effect, the claim that grammar is meaning- and usage-based as well as experientially grounded, while obviously true, must be supported with empirical evidence. More flesh needs to be put on these statements if they are to carry any degree of descriptive let alone explanatory weight.

In a study being conducted by the third author, data from regularly sampled transcript files of four non-impaired children were taken from the CHILDES Archive (MacWhinney & Snow 1990). The sampling window covered a period of at least two years for each child from roughly the ages 2;2 to 4;6. Each usage of one of the targeted prepositions was coded for a wide variety of factors, including imitative usages, repetitions, spatial usages, temporal usages, usages in fixed expressions, grammatical usages, etc. Patterns observed for these children and for these prepositions suggest that onset and mastery of a particular sense type of a given item of this alleged lexical class is partly regular and partly idiosyncratic; is motivated by conceptual, linguistic, and pragmatic factors; can be rapid or slow; and that the successful acquisition of other parts of a child's lexicon plays a big role in the acquisition of individual prepositions. In short, not a lot of pattern was noted. Each child displayed rather distinctive styles and sequences of prepositional acquisition.

A few examples should suffice to illustrate. Although the first usages of *in* and *on* for all four children were spatial, the first usage to emerge for *at* did not seem to be spatial at all and only marginally prepositional (synchronically speaking). In all four children, its first emergence was in the collocation *look at* and in several of the children, this usage either dominated or persisted as the major usage throughout the sampling period. Although spatial usages quickly emerged, as did temporal ones, so did extremely abstract, semantically opaque usages such as *at all* or *at the same time,* thus suggesting that parental input is an important factor along with conceptual basicness (cf. Rice 1996b). For the preposition *by,* its use by one child was confined throughout the sampled files to use in the expression *by myself,* whereas another child first used it as a spatial locative, then rather unexpectedly as a marker of a passive agent, and only much later in productive *by -self* constructions. Likewise, benefactive usages of *for* emerged much earlier for all four children than did those same usages of *to,* suggesting that linguistic factors, rather than conceptual ones are partly responsible for extension within a lexical category.

Although such findings remain anecdotal, they certainly underscore one aspect of the Langacker quote given above: there may be considerable speaker variation with respect to the acquisition process itself and possibly with respect to the specific structures (schemas or extensions) that the language user arrives at. In effect, by studying trends or sequences in a child's development of a lexical category, we hope to relate empirical data to cognitive linguistic models of the lexicon. For instance, is there evidence to suggest that lexical extension processes like metaphor and other grammaticalisation mechanisms, which have been shown to operate diachronically, are recapitulated in the course of language acquisition? To give another example, what is the status, judged from a developmental perspective, of the claim that semantic extension is on the whole conceptually (rather than linguistically) motivated or proceeds outwards through image-schematic transformations applying to a basic sense type? In many cases, it seems that the emergence of a lexical item's initial or subsequent sense types is

motivated more by frequency of exposure or contrastive pressures exerted by other lexical items than by purely conceptual factors.

3.2.   Lexical learning process

Whereas child language acquisition data might reveal a natural course of acquisition (a hypothesis which is thus far not supported by the above data), the study of foreign language learning might show that semantic relationships between word usages are functional at the time of learning. We set out from the following hypothesis. If two usages of a preposition are interrelated in a semantic network, i.e. if one is a conceptually motivated extension of the other, it would seem that language learners will put this relationship to use for their benefit. More particularly, if a usage U2 is an extension of usage U1, it seems likely that knowledge of U1 will make it easier to learn U2. Frisson *et al.* (1996) tested this prediction in a set of learning experiments.

The task involved concept formation. Subjects (all native speakers of Dutch) were seated in front of a computer screen, on which individual English sentences appeared. In each sentence the same non-existing preposition *yeath* was used. The semantics of this item matched the meaning potential of the English preposition *beyond*, a word that the subjects did not master. Subjects were told that the unfamiliar form was a Scottish preposition, whose meaning they had to learn, and that the rest of the sentence was in English to make the task doable. Their task was to decide for each sentence whether the preposition had been used correctly or not (by pressing the appropriate response button). Initially, of course, subjects had to guess but gradually they were able to induce the meaning of the item by using the computer's feedback on the correctness of their responses.

As the basic question was whether learning U1 in the first trial block would make it easier to learn U2 in the second block, subjects learning U1-U2 were compared to control subjects learning U2 after a block of trials on a different preposition. The results showed no transfer effects from the spatial sense of *yeath/beyond* to its figurative sense of "exceeding" (e.g. *the temperature rose yeath* 'beyond' *35 degrees C*), whereas such transfer effects were found from the "exceeding" sense to the "out of reach" sense (e.g. *That goes yeath* 'beyond' *my imagination*).

This outcome suggests (i) that the spatial and "exceeding" meanings of the preposition were unrelated for our subjects, i.e. were homonyms, and (ii) that the two figurative meanings were related. A straightforward interpretation of these results is difficult. The first effect may result both from subjects' failure to perceive a semantic relationship between the spatial and figurative usages or, alternatively, from their assumption that trials in block 2 will instantiate the same meaning as those in block 1 (equal form = equal meaning). The second effect can

be explained by assuming a polysemous relationship between the "exceeding" and "out of reach" meanings or by considering these usages as vague instantiations of a more schematic usage type.

3.3.   Intermediate states in lexical learning

In Cornelis & Cuyckens (1996), the Dutch preposition *door* is regarded as a polysemous lexical item in that it displays a variety of interrelated readings within the spatial, the temporal and the causal domains. In particular, *door*'s semantics can be described as a family resemblance network in which, going from one end of the network to the other, the notion "causal participant" becomes increasingly important, while, at the same time, the notion "intermediary" becomes less important.[4]

Dutch *door* can be translated in English as *through* (for its spatial and temporal uses) and as *by* (for the passive agent and the causee in causative constructions). For Dutch learners of English, the choice between these two English prepositions seems at first sight not to be very difficult. This should come as no surprise if we assume - along with more traditional semantic descriptions of *door* - that there are two homonymous kinds of *door*, one with the meaning "intermediary" (*through*), and one which functions as a grammatical operator in passives (*by*). As such, the relative ease with which Dutch learners of English learn to choose between *through* and *by* seems to point at the need for positing homonymy, and hence, for rejecting a polysemy account of *door*.

In an experiment (reported in Cornelis & Cuyckens 1995), 148 Dutch-speaking students of English were asked to translate 15 instances of *door* covering the entire range of uses as exemplified in the family resemblance structure. The results of the experiment show that, for intermediate learners of English, the translation of *door* is not as easy as might be expected. Indeed, when learners translated *door* as if there were two kinds of *door*, they ran into interesting difficulties for those usages in which *door*'s landmark denotes an instrument (e.g. *Hij verpestte alles door zijn rare gedrag* 'He spoiled everything through/by his strange behaviour') rather than a spatial/temporal intermediary (e.g. *De trein reed door de tunnel* 'The train went through the tunnel') or a causal participant (*Mijn zus werd ontslagen door haar baas* 'My sister was fired by her boss') and which can be situated in the middle of the cline from spatial to causal usages. Often, subjects did not translate *door* by means of either *through* or *by*, but they resorted to other prepositions (e.g. *with, because of*), which are at best only approximate translations.

While this experiment does not bring conclusive proof in favour of the polysemous structure of *door*, at least it is evidence which is commensurate with such a structure. Precisely because subjects have difficulties translating the in-

termediate usages, one might assume that a representation in terms of two homonymic uses/senses is not satisfactory. Alternatively, one could also argue, of course, that the spatial/temporal intermediary and the causal participant are indeed two homonymous usages and that the insecurity in the translation of the other usages of *door* simply results from learners not having learned a third, unrelated sense of the preposition. It is quite difficult to disentangle these two possible accounts on the basis of the data.

In the experiments to be presented below we were interested in the internal semantic structure of a preposition in the mind of the adult language user, who has reached a relatively steady (final) state of semantic representation. Whereas one experiment (3.4.) is concerned with prototypes, all the others focus on aspects of the monosemy/polysemy/homonymy debate: the language user's perception of distinctions and relationships within a prepositional category (3.5. through 3.7.) and his mental representation of prepositional usages (3.8.).

3.4.   *Sentence generation task*

What are the prototypical usage types of a given preposition? Are they spatial in nature? There seems to be a tendency in cognitive linguistic work to consider the spatial domain as the most cognitively salient one and other domains as derived from it (for references see Rice *et al.* in press). The basic question in the present experiment was whether spatial usages of heavily grammaticalised prepositions like *in*, *on*, and *at* would still be the most prototypical.

Research on prototype effects and human categorisation suggests that the more prototypical members of a category should be the most cognitively salient. Defining, let alone explaining, cognitive salience is a tricky matter, but prototypicality has been successfully operationalised across a number of categories and tasks (cf. Rosch 1975, 1978; Lakoff 1987; MacLaury 1991). One index of prototypicality is ease of production. It has been found that prototypical class members are produced more frequently than non-prototypical class members (Rosch 1975).

The sentence generation task was based on the assumption that the most prototypical usages of a preposition should be remembered and produced most often across a number of speakers. We asked speakers in an off-line experiment to produce sentences containing these prepositions and then analysed the types of usages they came up with.[5]

Three hundred undergraduate students, all in the first weeks of an introductory linguistics course, were asked to compose ten sentences containing a given English preposition as quickly as possible. They were asked to write one sentence each on one of ten numbered and ordered index cards which they found inside an envelope, on the flap of which was written the target preposition. They were given no more than a few minutes to carry out the task. One hundred sample sentences were produced for the prepositions *in*, *on*, and *at* (singled out especially because they share the semantic property of contiguity between trajector and landmark) and sorted into very general categories by the third author and two of her research assistants. These categories were determined on the basis of the general background domain invoked by the usage (that is, SPATIAL, TEMPORAL, or ABSTRACT). The results are shown in Table 1 below.

	SPATIAL	TEMPORAL	ABSTRACT	TOTAL
at	57	21	22	100
on	57	9	34	100
in	60	7	33	100

Table 1. Frequency of response types for each preposition in sentence generation task

For each of the three prepositions, usages which were spatial in nature comprised nearly 60% of the responses. These findings suggest that spatial usages *are* somehow privileged for these prepositions. Taken together with other experimental findings (cf. Rice 1996a), they suggest that there are prototypical semantic values for the English prepositions *at*, *on*, and *in*, which are definitely spatial in meaning. Furthermore, the fact that temporal usages and/or abstract usages were also produced in sizeable percentages indicates that these usage types are also important members of the category. The present data do not pertain to the polysemy/homo-nymy discussion, as the experiment was not design to address this issue.

3.5.   *Similarity judgement task*

The extremely fine level of granularity that cognitive linguists apply to their analyses of purportedly polysemous lexical items has long been of particular interest. Most of these analyses have proposed a high degree of similarity within a single domain. Indeed, some analyses have described a multiplicity of distinctions within the spatial domain alone. By domain, we mean the broadly construed spheres of, for example, space, time, social interaction, causality, and so forth, against or within which we conceive of events as happening. One may wonder to what extent such analyses are artifactual, reflecting characteristics imposed on the data set by the analyst. In the absence of notable differences in the set of us-

ages under study, minor differences may have been magnified. We changed this standard procedure in two respects: (i) the data were gathered from a group of ordinary language users rather than a highly trained linguist[6] and (ii) the pattern of usages under study reflected a broader range of meaning and function, more particularly was not restricted to usages drawn from the spatial domain. We wondered whether intra-domain usage differences might not be reduced in the presence of inter-domain stimulus sets. Moreover, we wanted to know which intra- or cross-domain comparisons would be judged most similar or dissimilar.

Since semantic network analyses represent the set of similarities and dissimilarities in the linguist's perception, a similarity judgement task was used. By having subjects rate the similarity between two usages of a preposition we wanted to ascertain native speakers' perception of differences, if any, between usages of a purportedly polysemous lexical item (cf. Rice *et al.*, in press, for a more detailed presentation).

In order to arrive at a fairly unbiased set of response patterns, naive native speakers (paid undergraduates in an introductory linguistics course) rated usages of a target preposition embedded in two sentences appearing simultaneously on a computer screen. Twenty subjects made similarity judgements on pair of sentences containing spatial (S), temporal (T), and abstract (A) usages of 7 English prepositions. They were presented in every possible paired combination of 3 spatial, 3 temporal, and 3 abstract usages of the preposition.
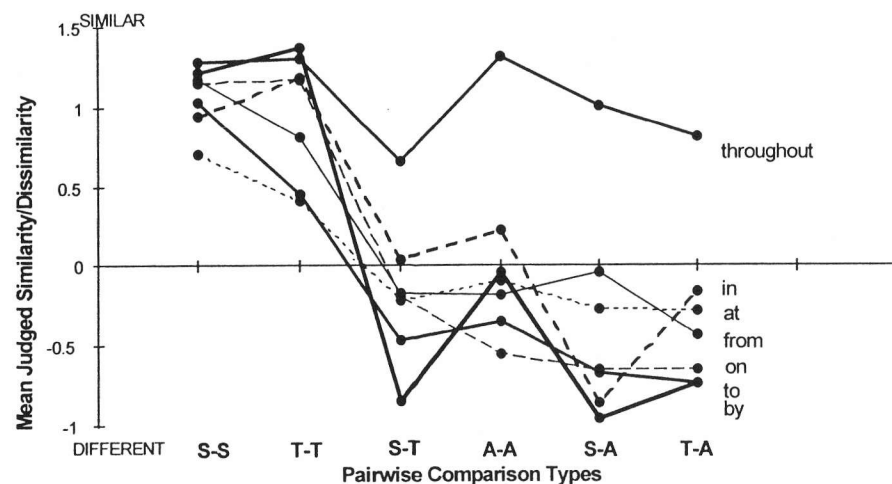

Figure 1.   Average ratings for all pairwise comparisons of sentences in similarity judgement task

The graph in Figure 1 shows that, although there was a parallelism between the prepositions (note the general downward curve), the individual prepositions behaved differently. Moreover, the response patterns for the six different usage type pairings varied significantly. As can be seen from this graph, only the intra-domain comparisons involving space and time (S-S and T-T pairings) were judged to be at all similar (except in the case of *throughout*). As far as the inter-domain comparisons are concerned, paired S-T usages were on average rated as dissimilar as the intra-domain comparisons between abstract usages and the other two types of cross-domain comparisons (S-A and T-A). This is remarkable, as in all cases the temporal usages of the preposition can be regarded as instantiations of the more general TIME IS SPACE metaphor (see Rice *et al.*, in press).

These findings suggest that background domain is of critical importance as an indicator of perceived dissimilarity. While this perceived dissimilarity between spatial, temporal, and abstract usages can be taken as evidence against the strong monosemy hypothesis, one cannot draw further conclusions for the inter-domain level. It could be the case that the perceived dissimilarity is truly relative and assumed to be embedded within an overall perception of similarity, in keeping with a polysemous analysis at this level. But it could also be the case that the perceived dissimilarity is absolute (i.e. subjects perceive spatial and temporal uses as unrelated), in keeping with a homonymous interpretation.

At the intra-domain level of purported minor distinctions, these experimental findings (i.e. the similarity in the S-S and T-T comparisons) - along with similar results from an earlier similarity judgement experiment (cf. Sandra & Rice, 1995: 111-117) - are compatible with intra-domain polysemy. At the same time, however, the perceived similarity in intra-domain pairings is not incongruent with viewing minor distinctions as instances of vagueness.

3.6.   *Sentence sorting task*

Linguists arrive at semantic network analyses by grouping or sorting individual usages into clusters and then relating these clusters to each other.[7] The purpose of the present experiment was to obtain a network-like structure by having many (non-linguist) language users sort a set of prepositional usages and then averaging over all these individual sortings. To what extent does the ensuing structure resemble the kind of analysis presented by cognitive linguists?

In a sorting task (cf. Sandra & Rice 1995, Rice 1996a, Rice *et al.*, in press, for a more detailed presentation), naive subjects were asked to sort 50 sentences containing different usages of the same preposition into groups based on how the preposition was being used in each sentence. Each set of 50 sentences contained exactly 10 temporal usages and at least 10 clearly spatial usages and 10 either

abstract or quite grammaticalised usages (the relative proportions varied across experimental conditions).

Statistical analysis indicated that (i) subjects were quite able to sort sentences in a non-random way since there were discernible patterns in each of the three sorts; (ii) a major division among the 50 sentences was brought about by the presence or absence of a spatial sense; (iii) within the non-spatial division, temporal usages were tightly clustered indicating a high degree of perceived similarity; (iv) both spatial and temporal usages were treated in a more unitary or congruent fashion than abstract usages, which did not tend to cluster at all (a result echoed in the similarity judgement task reported earlier).

These findings suggest that subjects perceive a profound difference between concrete and non-concrete experiential domains for the purpose of semantic classification, which, again, argues against the strong monosemy position. This perceived dissimilarity at the level of major, inter-domain distinctions is in keeping with a polysemy or homonomy hypothesis of lexical meaning.[8] However, it gives us cause to speculate about the degree of granularity that is minimally detectable in cases of purported polysemy. We argue that first and foremost shifts in background domain (as in the case of metaphor) rather than image-schematic transformations (affecting paths and landmark configurations along the lines of those proposed for *over* in Lakoff 1987: 418-430) induce a perception of appreciably distinct usage types for a given lexical item. Of course, this does not exclude that subjects also make intra-domain distinctions of a more fine-grained nature. The tight clustering of minor distinctions in the spatial and temporal domain do not allow firm conclusions on this issue. Sandra & Rice (1995) present the results as compatible with the fine-grained distinctions made by cognitive linguists, but the data are congruent with vagueness as well as with polysemy.

3.7. *Translation task*

The question whether the relationship between major usage types (such as the purported relation between space and time) is part of the language user's mental representation could not be conclusively answered in the previous experiments. The following experiment looks for further evidence in favour of the relationship between usage types in the conceptual system.

In many languages the conceptual domain of time is metaphorically conceived of in terms of the conceptual domain of space (*in the house/in the afternoon*). The pervasiveness of the TIME IS SPACE metaphor suggests that there is a natural tendency in the human conceptual system to relate these two domains. Given this, it would seem that language users can easily perceive the conceptual rela-

tionship between spatial and temporal word usages. Rice *et al.* (in press) designed a number of experiments in which this hypothesis was tested.

The experimental methodology was based on the assumption that, if language users are "aware" of the strong conceptual relationship between time and space, they will expect this metaphor to occur in other languages as well. Hence, the task was designed to tap subjects' intuitions on translation equivalents for the different usages of a single word. The typical experimental item consisted of two prepositional phrases: a probe, which exemplified the spatial use of an invented Turkish preposition *weh* (the equivalent of English *in* as in *in the box*), and a target, which exemplified another trajector/landmark configuration. The subjects' task was to decide whether the appropriate preposition for the target expression was *weh*, as in the probe, or a different preposition. All subjects were native speakers of Dutch with no knowledge of Turkish. It was pointed out to them that there were no right or wrong answers as we were only interested in what they thought would be the preferred choice of preposition in Turkish.

In order to make sure that a response tendency for the spatial probe/temporal target pairs would reflect subjects' perception of the semantic relationship, a number of control conditions were included: pairs of homonymic usages (where the *different* response should dominate), obvious cases of polysemy (*same* response expected), and pairs in which the same usage type appeared in both probe and target (*same* response expected). We found that the latter three types of semantic relationships gave rise to highly reliable response behaviour in the expected direction, which justifies the assumption that the task is sensitive to subjects' intuitions on the co-occurrence strength of semantic and formal relationships in the lexicon. In the case of homonymy the two meanings are accidentally expressed by the same form, which makes it unlikely that this meaning-form relationship will recur in a non-related language; in the case of clear polysemy the integrity of the meaning-form relationship makes it very likely that another language too will use a single lexical item for expressing these two meanings.

The major finding was that subjects reliably chose the *different-translation* response for the spatial probe/temporal target pairs (*in the box/in the afternoon*). If the rationale behind the experiment is correct, this would indicate that language users do not experience the TIME IS SPACE metaphor for the preposition *in* as a very natural one. Unfortunately, this interpretation is not based on firm ground, as a response effect may be involved. The presence of clear cases of polysemy and of items where the same usage appeared in probe and target may have caused subjects to set a very high criterion for making *same-translation* decisions. Indeed, in another experiment, in which these two item types were removed and where pairs of spatial/idiomatic usages were used (i.e. clearly unrelated), subjects did not reliably choose for either of the response options in the case of space/time pairs. This indicates that the responses in this type of experiment were sensitive to the composition of the stimulus list.

Even though the methodology seems to work well for cases that are situated at either end of the continuum ranging from vagueness to homonymy, it turns out to be less effective for other cases. The problem is that the task can conceptually be decomposed into two distinct stages: (i) determination of the semantic overlap between probe and target and (ii) determination of the response. Whereas degree of semantic overlap is a continuous variable, response type is a dichotomous one. Hence, subjects have to set a criterion at the semantic variable to be able to determine their response. Apart from the problem that this criterion is dependent on the composition of the stimulus list, there is the problem that a *different* response does not necessarily mean that subjects fail to experience a semantic relationship. The only conclusion that one can draw from a *different* response is that, comparatively speaking, the experienced semantic relationship is weaker than in cases where a *same-translation* response is given. As a result, no firm conclusions can be drawn on the experienced naturalness of the TIME IS SPACE metaphor.

3.8.   Primed semantic decision

Whereas some of the experimental techniques described above were used to find out whether ordinary language users *perceive* word usages in the same way as linguists do, the present experiment was designed to find out how language users actually store different word usages in their *mental lexicon*. Are word usages that are distinguished by cognitive linguists also distinguished in the mental lexicon? Are word usages that are related in cognitive linguistic analyses also structurally linked in the language user's representational system for word meaning?

In order to study mental representations one needs an on-line technique. Considering the fact that these representations must be accessed in real time, a favoured research tool in psycholinguistics is a reaction time experiment in which the response must follow access to the representation under study (such that the access time is reflected in the data). Sandra & Rice (1995) report one such experiment.

Subjects had to make speeded decisions on the semantic acceptability of prepositional phrases (acceptable versus non-acceptable). In all these so-called target phrases, the preposition was Dutch *in*. On each trial the target phrase was preceded by a so-called prime (to be read silently), which was either an instantiation of the spatial prototype or a neutral prime (a row of hash marks, #####). The neutral primes were needed in order to have a baseline against which the effect of the spatial primes could be measured. The rationale behind this priming technique is the following: if the prepositional usages in prime and target access the same mental representation, the second access event will be faster. This should be reflected in faster decisions relative to the neutral prime condition, where no

repeated access can take place. If, on the other hand, prime and target elicit different representations, the representation accessed by the prime may temporarily inhibit access to the representation of the target (as both representations are being accessed by the same lexical item, they are competitors in an activation process).

The most important outcome of the study was that a spatial usage in prime position preceding a temporal usage in target position caused a significant increase in errors. This suggests that these two usages have different representations in the semantic representational system, i.e. that the temporal usage accesses a different semantic representation than the prototypical spatial usage. Selection of the spatial usage inhibits access to the temporal usage, which leads to more erroneous decisions in conditions of time-pressure. This finding, then, seems to refute the strong monosemy hypothesis at the level of mental representation. The experimental results also revealed inhibition effects between certain spatial usages, indicating that subjects also make distinctions of a rather fine-grained nature. Probably, this is the best evidence so far that minor distinctions are not instances of vagueness. Again, these inhibition effects do not preclude that major, inter-domain distinctions or minor, intra-domain distinctions are related by polysemous links.

4.   Asking the right questions (the right way)

In the set of experiments reported above we focused on prepositions, lexical-semantic categories that are purportedly highly polysemous and primarily spatial in meaning. Two questions were central to the research: (i) what is the role of polysemous relationships in lexical acquisition/learning? and (ii) what is the internal structure of these lexical-semantic categories (prototypes, degree of polysemy)?

The data from child language acquisition and foreign language learning do not directly demonstrate the involvement of polysemous relationships in the process of adding novel usages/senses to the mental lexicon. However, a polysemy account is not refuted by the data either. In one experiment (L2 knowledge at intermediate level) subjects' reluctance to extend word meaning to unfamiliar usages is even predicted by the polysemy view.

The results which focus on the internal semantic structure of prepositions can be summarised as follows. First, even for highly grammaticalised prepositions such as English *in*, *on* and *at*, the spatial usages appear to be the most prototypical ones. Second, a number of experiments on the way language users perceive semantic relationships (similarity rating, sorting, intuitions on translation equivalents) have shown that coarse *distinctions* (like spatial versus temporal versus abstract) are readily made but have not indicated that subjects are aware of the *semantic relations* between these distinct usages (e.g. between spatial and

temporal usages). Effects of item context and task-specific effects may have played a role here. The data of these perception experiments do not allow us to distinguish the homonymy from the polysemy view, although the results are hardly compatible with a strong monosemy view. Finally, the on-line reaction time experiment corroborates the finding in the perception experiments that the distinction between spatial and temporal usages is a real one and extends this finding to the level of the mental lexicon. At the same time, the experimental outcome suggests that some fine-grained distinctions of the type made in cognitive semantic network models have psychological reality as well. The experiment sheds no light on the relationship between these usages, again leaving the homonymy/polysemy issue unresolved.

Even though these experiments have not yielded conclusive results or results that support concepts from cognitive linguistic theory, we believe that there is a need for the empirical approach they represent. If cognitive linguistics claims lexicogrammatical meaning and form to be products of human cognition and wants to be taken seriously as a form of theoretical psychology (which seems to be a shared intention of all post-structuralist frameworks in linguistics) it will have to develop a means and a will for formulating and testing explicit hypotheses. One of the most pressing hypotheses, of course, concerns the presence and/or degree of polysemy relevant for language representation and processing by actual speakers, the users of cognitive linguistics' usage-based approach. The main challenge will be to demonstrate that language users make more discriminations within the semantic usage potential (i.e. the set of all permissible usages) of a word than is logically necessary.

The empirical approach that needs to be developed is not necessarily restricted to experimental research but may cover a set of convergent methodologies. There are a number of empirical proving grounds available to cognitive linguists, each with its virtues and limitations. Diachronic studies allow scholars to propose explanatory mechanisms of linguistic change, lexical shift and expansion, and grammaticalisation. Thus observed patterns may be attributed to cognitive principles in the mind of the language user. However, as far as the particular language elements under (diachronic) study are concerned, these mechanisms do not necessarily have any psychological reality in the minds of contemporary speakers. Cross-linguistic verification of cognitive linguistic hypotheses is another way of gathering empirical data. Although few proposals in the theory are intended to have predictive power or universal scope (by virtue of being wedded to usage-based description), the same basic mechanisms must be in evidence in a broad range of linguistically diverse languages or the very cognitive basis of cognitive linguistics would be in doubt. Again, whereas cognitive principles may thus be identified, it is a hazardous undertaking to extrapolate from such data to the level of mental representation and processing. If one wants to take that step, controlled

psycholinguistic experimentation is the appropriate methodology. However, as has become clear in the above review of experiments, the psycholinguistic study of particulars of word meaning beyond obvious cases of homonymy (i.e. ambiguity resolution) presents a real challenge to the researcher. Considering the complexity of the study object, there certainly needs to be an intense communication between cognitive linguists and psycholinguists, so that the right questions can be asked (i.e. theoretically interesting ones) and can be formulated in a testable way.

Even though cognitive linguists may not necessarily intend their analyses to be exact renderings of the content of a language user's mind, they must surely commit themselves to at least some psycholinguistically relevant claims. Quite clearly, cognitive linguistics research calls for broad-based empirical investigation, heretofore lacking. Otherwise, the tension between formal and usage-based analyses can never be resolved except on purely aesthetic, that is, wholly theoretical grounds (e.g. by appeals to descriptive economy, naturalness, generality, and explanatory power), and it is that theoretic aesthetic that cognitive linguists have explicitly rejected from the beginning, opting for a view of grammar as an inventory of symbolic resources rather than as a constructive device. Be that as it may, the symbolic inventory is still the product of a human conceptual system that operates through mechanisms such as analogy, schematicisation, and re-perspectivis-ation for purposes of extending the linguistic inventory of form and meaning. No linguistic framework, least of all one calling itself cognitive, should feel comfortable hypothesising about that conceptual system in the absence of empirical evidence.

Notes

1. Another representational format is the overlapping sets model introduced by Geeraerts (1989b). This model, he argues, is a notational variant of the network models in that it exhibits the same representational potentialities (cf. Geeraerts 1995b).
2. "We viewed natural semantic categories as networks of overlapping attributes; the basic hypothesis was that members of a category come to be viewed as prototypical of the category to the extent to which they bear a family resemblance to (have attributes which overlap those of) other members of the category." (Rosch & Mervis, 1975: 575)
3. The terms "usage type" and "usage" reflect a more neutral position than the term "sense" in the debate on the status of lexical network nodes as either reified meanings or as contextualized variations of a single meaning or restricted set of meanings. For ease of exposition, we will continue to vacillate between the two terms.

4. *Door*'s reading in the spatial domain is probably the basic one: it indicates a spatial relation between two entities, i.e. a trajector and a landmark, whereby *door*'s landmark operates as an intermediary on the path occupied by *door*'s trajector. *Door*'s causal usages, now, cannot just be described as straightforward extensions from its spatial ones. Indeed, in *door*'s most proto-typical causal usages (i.e. in passive sentences), *door*'s landmark denotes a passive agent, the initiator of the causal event, and can thus hardly be seen as an intermediary.

5. The production of sample sentences containing a target lexical item (in this case, an English preposition) is no different from what many linguists working on their native language have traditionally done in the course of their research. It has not been uncommon for theoreticians to originate and analyse the product of their own mind, relying on their own intuition, all the while being guided by their own theoretical imperatives. Unfortunately, most analysts disregard the possibility that the data they compose do not reflect the full range of some particular linguistic phenomena, but rather a very narrow set of the most typical response patterns. Such a lack of generality has been a chronic problem in traditional generative approaches to language study. However, in the experimental task reported here (described in greater detail in Rice 1996a), the lack of broad data coverage was deliberately being exploited. Moreover, naive native speakers rather than trained linguists were asked to provide the data. It was anticipated that these speakers would produce on demand the most typical usages of a lexical item.

6. Judging the similarity or dissimilarity of two occurrences of a linguistic element in two different sentential contexts is, again, not unlike what many linguists have to do routinely in their work. Nevertheless, it is a task that is impossible for a linguist to carry out in a neutral fashion. For the linguist, there are always theoretical expectations that can potentially magnify or minimise the importance of certain common or distinctive features.

7. Rather than relying exclusively on language examples of their own devising, linguists are increasingly turning to text and conversational sources for their data.

8. As Sandra and Rice (1995: 110) point out, "it is unclear whether such sharp 'boundaries' result from the absence of a relationship between these usages in most subjects' mental lexicon or from a task-dependent response component, i.e. since discriminations are asked for, the first step may have been to keep the most obviously different usages apart, even if the relationship between them was appreciated."

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