Polysemy and Lexical Representation: The Case of Three English Prepositions

Sally A. Rice
Dept. of Linguistics
University of Alberta
Edmonton, Alberta T6G 2E7 Canada
userrice@mts.ucs.ualberta.ca

Abstract

This paper is a preliminary analysis from a cognitive linguistics perspective of the meaning of three very high frequency prepositions in English, *at*, *on*, and *in*, which are argued to be inherently polysemous. Although these so-called grammatical morphemes are usually defined in terms of topological relations, the majority of their usages are far too abstract or non-geometric for such spatially-oriented characterizations. Because they seem to sustain a variety of meanings which often overlap, they are exemplary lexical items for testing theories of lexical representation.

Arguments against monosemous accounts center on their inability to formulate schemas which include all appropriate usages while excluding usages of other prepositions. Many of the usages differ only on the basis of variable speaker perspective and construal. A polysemic account is currently being developed and tested experimentally in a series of studies involving how native and non-native speakers of English evaluate and categorize various usages of the different prepositions. Initial results indicate that these naive categorizations reflect a gradient of deviation from a canonical spatial sense. Furthermore, deviant usages tend to form fairly robust clusters consonant with a constrained polysemic analysis.

Monosemy, Polysemy, or Homonymy?

Lexical representations play a central role in theoretical and computational linguistics, as well as in psycholinguistics, in mediating between linguistic and conceptual knowledge (Schreuder & Flores d'Arcais, 1989). The most commonly proposed and thoroughly discussed type of lexical representational system in the cognitive science literature has been the semantic network, a radially or hierarchically structured entity consisting of interconnected nodes representing various facets of meaning from inter-word relations to bundles of semantic features (in the case of lexical decomposition). Many of these network models directly exploit connectionist architecture and are often praised or damned in the same breath as connectionism. Leaving processing issues aside, arguments for and against semantic networks (cf. Johnson-Laird et al., 1984; Evens, 1988) have centered on models built around single lexical items or items selected from a restricted, and often very concrete, semantic field. Rarely have actual lexical entries or semantic networks been worked out in detail, nor have the models been subjected to native speaker validation for what is actually one of the most basic types of human categorization--actual word use. This empirical neglect casts doubt on many theories of lexical meaning, three of which concern us here.

Monosemy is a hypothesis that maintains that the majority of lexical items have a single, highly schematic meaning that extends to all usages of that item. Monosemy is primarily contrasted with two other hypotheses, namely **polysemy** and **homonymy**, each of which allows for the possibility that multiple meanings may be associated with a single lexical form. Polysemy assumes that the multiple meanings constitute a family of related senses and is therefore distinguished from homonymy, in which different meanings are not presumed to have any apparent connection. Given the relative rarity in English of true homonyms, such as *plant* ('vegetative organism' vs. 'factory') or *seal* ('aquatic mammal' vs. 'wax signet'), and our familiarity with multiple but similar dictionary definitions in listings for lexical items, polysemy appears to be the more intuitively plausible alternative to monosemy and will be our focus here.

The monosemy/polysemy debate [cf. Macnamara, 1971; Ruhl, 1989] may be seen as the manifestation at the lexical level of a more generalized issue which subsumes many theoretical controversies in linguistics, that is, whether human language is modular or interactional in nature. This semantic dispute polarizes those who maintain a single meaning for each linguistic form and those that allow for the possibility of multiple

but associated meanings. That is, it sets the "meaning minimalists" against the "meaning maximalists," as Ruhl, 1989, and others have called them. Generative approaches, perhaps guided by the exigencies of their computational foundation, have championed the idea that lexical items have stable, if not singular, meanings and syntactic behaviors. In formal terms, this amounts to treating the meanings of lexical items as exclusive disjunctives and defining the items themselves in terms of semantic primitives.

On the other hand, more functionally- or cognitively-oriented frameworks, which place matters of usage before matters of universality and strict parsimony requirements, explicitly recognize the role that convention, pragmatic context, language-specific conceptualization patterns, and speaker construal play in assigning variable meaning and acceptability to particular expressions. As a cognitive linguist, my sympathies tend to fall with the polysemists. As an empirically-minded one, I am committed to justifying each related meaning posited for a single lexical item as well as establishing the nature of the links between them. I contend that, for most lexical items, even for so-called grammatical morphemes like prepositions, polysemy is the norm, but it is also very systematic and more constrained than most monosemists would have us believe.

I argue here that *at*, *on*, and *in*, three very high frequency "contact" prepositions in English, are inherently polysemous. Many researchers in linguistics and AI (cf. Lindkvist, 1978; Hawkins, 1984; Wesche, 1986/87; Herskovits, 1986) have defined these prepositions in terms of highly schematic topological relations (such as the coincidence of a figured entity and a **zero-** or **one-** (in the case of *at*), **two-** (*on*), or **three-** (*in*) **dimensional ground**) or more broadly as predicating relations of **contiguity** (*at*), **support** (*on*), or **containment** (*in*). They have been able to maintain these schemas because they confined the scope of their studies to the prepositions' spatial usages. However, the majority of their usages are far too abstract, non-geometric, or simply non-spatial to sustain such simplistic characterizations. Furthermore, in many cases, the individual meanings of the prepositions overlap, creating a lexical nightmare for anyone trying to represent prepositional meaning on the basis of semantic contrast and a syntactic nightmare for anyone trying to characterize their occurrence on the basis of lexical meaning or grammatical category alone. Given this state of affairs, the English prepositions are exemplary lexical items for testing theories of lexical representation (cf. Lindner, 1981; Brugman, 1981; and, for a similar treatment of the French prepositions, Vandeloise, 1991). As grammatical theories and computational models increasingly rely on lexical knowledge as the impetus for linguistic form and behavior, knowledge about how the lexicon is structured necessarily has profound implications for theories about the mental representation of language.

Why Monosemy Doesn't Work

Basic Usages of the Prepositions

In order to highlight problems facing a monosemic analysis, I present below a small but not unrepresentative sampling of some of the constructions in which these prepositions occur. The analysis is based on an extensive spoken and written database compiled by the author. *In*, *on*, and *at* are three of the earliest and most frequently occurring lexical items in the English language. Some cross-linguistic child language studies suggest that they are among the first five prepositions acquired (notably, Johnston & Slobin, 1979), but Bowerman, 1991 argues that there is no reason to expect all languages to carve up their spatial and conceptual world equivalently or for developmental patterns to be universal. Carroll, Davies, & Richman, 1978 put them among the 20 most frequent morphemes of English.

As prepositions, they are both commonly and technically thought of as having a **spatial or locative function**, serving to place a figured entity or event in relation to one of several variously configured backgrounds such as a 0-D point, a 1-D line, a 2-D surface, or a 3-D container:

(1) *They put the books {**at** the end of the shelf (0 or 1), **on** top of each other (1 or 2), **in** the center of the pile of papers (0 or 2), **in** a row (1), **on** the table (2), **in** the box (3)}.*

Note here that each preposition appears to be compatible with multiply-configured grounds. Or, stated conversely, it appears that zero-dimensionality can be predicated with *at* or *in*; one-dimensionality with *at*, *on*, or *in*; two-dimensionality with *on* or *in*; while three-dimensionality strongly favors *in* alone.

These prepositions also have a **temporal function**, which is not too surprising since time and other abstract domains are regularly conceived of in spatial terms (cf. Lakoff & Johnson, 1980) and time, like space, is routinely segmented into various-sized episodes. Used temporally, *at*, *on*, and *in* serve to situate an event relative to a brief point, short period, or vast expanse of time:

(2) *He died {**at** 6:01, **at** dawn, **at** 6 **on** the dot, **on** Sunday, **on** the 12th, **in** May, **in** summer, **in** 1897, **in** the 19th century}.*

One would be hard-pressed to sustain these geometric notions or even notions of **contiguity**, **support**, or **containment** for the apparent locative usages in (3a) or the event-like usages in (3b):

(3) a. *She met him {**at** UCLA, **on** Guam, **in** Singapore}.*
b. *She met him {**at** the conference, **on** a trip, **in** college}.*

If we maintain, for example, that ***at*** requires a point-like ground, then we need a way of interpreting *UCLA* in (3a) and *the conference* in (3b) in a point-like fashion.

It is easy to concoct data featuring fairly basic usages which further compromise a monosemic analysis. Consider these usages of *on*:

(4) a. *The cat is **on** the mat.*
b. *The handle **on** that mug is chipped.*
c. *What a cruel look **on** his face!*
d. *He turned the light out **on** me.*

What schema or set of abstract features could possibly unite all these senses while excluding the other prepositions? Features that suggest themselves include **contact** and **pressure**, or more abstractly, **support**. But in (4b), a handle is part of a mug, and so not really in contact with it nor does it exert pressure (although the mug does support the handle in a sense). In (4c), a look is an expression that temporarily distorts a face but does not really exert pressure on it (although, the face temporarily supports it). And in (d), the pressure, if there is any, could only be interpreted metaphorically as an act of annoyance. A strictly monosemic analysis is rejected on the grounds that no semantic features are common and exclusive to all usages, even when allowing for context effects. If the meaning assigned to *on* is too schematic, then it will never rule out a usage like **the bottom **on** the jar* or **he stuck his tongue out **on** me*, based on examples like (4b) and (4d). A strictly homonymic analysis is also rejected because native speakers do intuit certain correspondences between these usages. If different usages are treated as instances of homonymy, then how many different lexical *on*'s do English speakers have? Any decision will be arbitrary and will ignore clear commonalities, tenuous though they might first appear to be.

Extended Usages of the Prepositions

By examining a wider assortment of data, we find that these prepositions support a vast array of semantic and syntactic patterns. These extended usages may be far removed from the idealized characterizations given above. In short, the topological relations are, in a sense, too specific to characterize the full range of their linguistic functions adequately. These same relations, if interpreted schematically, would require a serious examination of the real and conceived world knowledge that a speaker brings to bear on the task of determining semantic meaning. No adequate model of the lexicon has the luxury of ignoring the fact that speakers can construe a concept or a lexical item in a variety of ways in order to achieve different semantic effects.

To her credit, Herskovits (1986) tries to provide a formal representation of what speakers know about physical properties of objects in order to model the differential use of *at*, *on*, and *in*, and account for "sense shifts" that allow us to say, for example, both *the water **in** the vase* and *the bird **in** the tree*. She lists criteria such as shape, size, typical physical context and orientation, gravitational properties, conceived geometry and function, characteristic interaction patterns, and most salient subparts. Unfortunately, these attributes are of little help in determining the appropriateness of uses involving subjectively construed or non-spatial relations between abstract entities and events. Even in their purely spatial senses, these prepositions have a **deictic function**, and predicate meanings that are wholly dependent on subjective aspects or expectations of the speaker (e.g., in the proximity or distance of the speaker from the scene) and not on objective properties of the event. In (5), we find contrasts involving minimal pairs that boil down to whether or not the speaker is taking a remote or close-up point of view as in (a) and (b) or a more external or internal point of view as in (c):

(5) a. *He's {**at** the store (distal), **in** the store (proximate)}.*
b. *She's {**at** the beach (distal), **on** the beach (proximate)}.*
c. *I'm still {**at**/**on** Chap. 2 (external) **in** Chap. 2 (internal)} of the book.*

In (6) a similar contrast results from varying degrees of closeness between figure (*tools*) and ground (*hand*):

(6) *When working, it's best to keep all necessary tools {**at** hand (distal), **on** hand, **in** hand (proximate)}.*

Very likely, the proximate/distal contrast is elated to a type of ground canonically but not exclusively associated with each of these prepositions. *At* frequently takes a point-like ground that possibly contrasts with other potential points. *On* often situates a figure with respect to

a surface-like ground and *in* to a medium of some sort. In a physical sense, the farther one is from a scene, the more reduced in scope and scale and the more pointlike the scene appears. Conversely, the closer one is, the larger and more enveloping it appears. This experientially-based difference in specificity might motivate usages in which indirect or immediate perspective matters, as in (7):

(7) a. *I was horrified by what happened **at** Tiananmen Square.*
b. *Eyewitnesses said tanks ran over people **on** the square.*
c. *No one died **in** Tiananmen Square, reported the government.*

Some contrasts between the prepositions underscore a difference in degree of involvement between figure and ground, which has little to do with spatial coincidence but perhaps a lot to do with cognitive perspective. Take, for example, their **institutional association function**:

(8) *She's {**in** the Physics Department, **on** the faculty, **at** MIT}.*

In (8), *in* seems to predicate the most direct, relevant, or local association, while *at* predicates the most generic or global.

Some usages of these prepositions predicate a **cognitive association** between figure and ground. *At* and *on* often appear in two-word verbal expressions where a more superficial **perceptual focus** is involved, as in (9):

(9) a. *They looked **at** the map.*
b. *He frowned **at** her.*
c. *He focused **on** the TV.*
d. *Let's eavesdrop **on** their conversation.*
e. *He can speak **on** any subject.*

while *in* is more likely to be found in similar verbal expressions where a deeper **conceptual focus** is at issue, as in (10):

(10) a. *She's lost **in** thought.*
b. *I believe **in** equal pay for equal work.*
c. *We take pride **in** our work.*
d. *He has tremendous faith **in** her.*
e. *He spoke **in** great detail.*

Of course, these characterizations are not sustainable for all usages. Once the relevant background domain becomes abstract as in the following predications of **cognitive ability**, differences between the prepositions become more a matter of convention and acceptability is ultimately a matter of degree:

(11) a. *He's good {**at** math, **in** math, ***on** math}.*
b. *He's having trouble {**in** math, ?**at** math, ***on** math}.*
c. *He did well {**on** his math test, ?**at** his math test, ***in** his math test}.*

Indeed, if the domain becomes too abstract, as in the following usages with deverbal nominalizations which tend to assume a **pragmatic, summarizing function**, each of the prepositions is acceptable, although subtle semantic differences remain:

(12) a. *{**In** hearing that, **On** hearing that, **At** hearing that}, she turned and ran out.*
b. *She became quite despondent {**in** seeing him again, **on** seeing him again, **at** (the idea of) seeing him again}.*

Finally, all three prepositions figure in a host of bare nominal usages that predicate the **state** or **condition** an entity is in or the **manner** in which an activity is carried out. I would maintain that *at*, *on*, and *in* are still meaningful, though perhaps schematically so, in expressions like those in (13), which might convey abstract notions of **contrast**, **foundation**, or **medium**, respectively:

(13) a. *The countries are **at** war.*
b. *The countries are **on** a war footing.*
c. *The countries are **in** a state of war.*

Although we could link these notions to more spatial notions like **point**, **surface**, and **container**, the extensions are indirect and non-unique. As the sentences in (14) demonstrate, some usages are more affected by convention than conceptualization, and, consequently, their specific motivation may be more a matter of historical development than contemporary semantics in the minds of the speaker and the linguist:

(14) a. *The man is {**at** risk, **at** peace, **at** ease}.*
b. *The man is {**on** drugs, **on** good behavior, **on** duty}.*
c. *The man is {**in** trouble, **in** custody, **in** pain}.*

The discussion so far has downplayed the particular and specialized functions of these prepositions. I have not characterized the precise nature of the necessary semantic extensions so much as argued that these words support a range of meanings that are more or less preserved as they get used in more and more abstract predications. My central claim is that the basic spatial relations that many researchers have posited as their primary meaning do not apply in all circumstances. Highly schematic relations, on the other hand, would also fail to characterize what is

unique to each of these prepositions spatially. The examination of these data alone points to the need for both central and peripheral and specific and schematic meanings to be posited for each preposition, while allowing for a certain degree of overlap between usages of different prepositions.

A Constrained Polysemy

It could be argued that, at the very least, these prepositions support **spatial, temporal**, and a variety of **abstract** associations between a figured entity or event and a variably-dimensioned ground (the so-called object of the preposition). Most native speakers of English informally queried about the semantic function of these prepositions tend to concur with this rather modest and seemingly obvious claim. However, there are two lexical hypotheses that, in their extreme versions, do not agree with this claim. We might call them the strong monosemy and the strong polysemy views, respectively, although they are effectively equivalent in terms of the degree to which they attribute meaning to the individual prepositions.

A rigidly monosemic analysis assigns a single, indeterminate, and perhaps invariant meaning to each preposition, allowing context to modulate or fill in the remaining information specific to each usage. The preposition is thus like a prism that requires available light in order to transmit semantic color. The infinite polysemic account, on the other hand, like a homonymic account, may attribute a specific meaning to each usage. Such overspecificity and inconstancy essentially strip the lexical item of its peculiar semantic integrity. The preposition is like a chameleon, changing its hue to suit each semantic backdrop. Whether the semantic flexibility is extrinsic or intrinsic is immaterial; the effect is that context supplies or changes the preposition's meaning.

I am proposing, by contrast, a more constrained polysemic account in which each preposition is attributed with a small set of canonical meanings which over time can engender additional meanings that may be either highly schematic or specific in character. Thus, each preposition is represented by a constellation of related senses, some of which are very close and similar while others are rather tenuous and distant. The claim is that these extensions can, for the most part, be motivated, not on the basis of context necessarily, but on the basis of what we know about the plasticity of conceptual perspective and the pervasiveness of metaphor and reasoning by image schemas (cf. Lakoff & Johnson, 1980; Johnson, 1987).

I have only been able to highlight in this limited space the more salient aspects of prepositional meaning not amenable to the purported monosemic characterizations given in the first section. I have also suggested that polysemy is not unbridled and that different lexical items within a semantic field may share the same sorts of extended senses. The conceptual analysis sketched here has been based on certain leading assumptions of cognitive approaches in linguistics (cf. Lakoff, 1987; Langacker, 1987, 1991a and b): i.e., that all lexical items are meaningful in each application; that no single concept necessarily underlies every usage of a lexical item; that there may be schematic concepts that subsume other less central concepts; that the extension from concept to concept is gradual; that there may be multiple motivations for different extended senses; and that the role of convention and speaker construal is very great in assigning meaning to lexical items.

Since the majority of usages of these ubiquitous prepositions are non-spatial, they provide the greatest challenge for a complete semantic analysis. But one needn't sacrifice coherence when one abandons a monosemic solution. A unified account doesn't necessarily depend on finding an overarching schema that sanctions all usages of a polysemous morpheme, but rather on motivating most of the usages as relatively modest extensions from one of several core meanings. I would argue that a constrained polysemic account is thus far the best working hypothesis of lexical meaning for items like the English prepositions. While it is well beyond the scope of this paper to map out all the core and extended senses for even a single preposition, such detailed analysis is being undertaken and will be forthcoming.

Empirical Evidence for Polysemy

The extreme views face other more serious empirical challenges that I hope to address in future work. If a monosemic account is to be sustainable, then we need to ask where the highly abstract schemas come from. How are they built up developmentally from specific instances that seem quite unrelated? I am currently investigating the order of acquisition of the usages of these prepositions by infants and second language learners in order to track lexical extension and schematicization. On the other hand, if an infinite polysemic or homonymic account is to be maintained, then we need to ask why native speakers can group different usages together and even rank order different items within clusters.

A series of experiments is now under way which have been designed to reveal native speaker intuitions about the syntax and semantics of these prepositions. One preliminary study elicited similarity ratings between usages of a single preposition in different sentences. In this study,

60 token sentences containing different usages of a preposition were presented in pairs on a computer screen to 30 native speakers of English who were then asked to rate the similarity between the pairs according to usage. Each rating was indicated by manipulating a cursor via a mouse on an anchored but uncalibrated on-screen scale, whose ends were labelled *completely different* and *absolutely identical*. In each case, subjects rated sentences against the same highly spatial usage. Results show that subjects were able to attend to differences between the sentence pairs such that non-spatial or abstract usages judged a priori to be similar were systematically given similar ratings by subjects. That is, subjects were sensitive to relative deviations from a highly spatial usage and could rate them accordingly. Ratings for like similarities and like deviations tended to form clusters. These clusters were fairly robust within and across subjects and were consonant with a polysemic analysis. The groundwork has now been laid for additional studies using similar methodologies that will focus on fine-tuning the conceptual distance between usages within these small clusters and testing the robustness of the ratings for multiple tokens of a similar usage.

Thus far, I cannot sketch out in greater detail the exact nature of a polysemic account for prepositional meaning that holds across speakers. While I suspect that an integrated network organized around a small number of canonical usages is the best model of prepositional meaning, I do not yet have the independent empirical evidence needed to propose usages which best exemplify the core meanings. Furthermore, I do not reject highly schematic senses out of hand, for I believe that they form part of a well-integrated and mature prepositional network. Although low-level prototypes play the greatest role in motivating productive extension to novel uses, the existence of various higher and intermediate level schemas allows us to recognize graded distinctions between usages. Langacker's (1991b:266-272) approach to lexical networks specifically allows for the coexistence of prototypic and schematic senses. In fact, one might argue that a successful cognitive analysis which is able to demonstrate extensive semantic relatedness between usages would eventually vindicate a monosemic hypothesis of lexical representation, albeit a more relaxed version than is usually conceived, and thus achieve the ultimate in semantic unity.

Acknowledgments

I thank Terry Nearey for help in experimental design and analysis. Mary Hare and John Newman graciously commented on an earlier draft.

References

Bowerman, M. 1991. The origins of children's spatial semantic categories: Cognitive vs. linguistic determinants. Ms.

Brugman, C. 1981. The story of **over**. MA thesis, Dept. of Linguistics, UC Berkeley.

Carroll, J, Davies, P, & Richman, B. 1971. *Word Frequency Book*. Boston: Houghton Mifflin.

Evens, M.W. (ed.). 1988. *Relational Models of the Lexicon: Representing Knowledge in Semantic Networks*. Cambridge: CUP.

Hawkins, B. 1984. The semantics of English spatial prepositions. PhD diss., Dept. of Linguistics, UCSD.

Herskovits, A. 1986. *Language and Spatial Cognition: An Interdisciplinary Study of the Prepositions in English*. Cambridge: CUP.

Johnson, M. 1987. *The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason*. Chicago: Univ. of Chicago Press.

Johnson-Laird, P., Hermann, D., and Chaffin, R. 1984. Only connections: A critique of semantic networks. *Psychological Bulletin* 96:292-315.

Johnston, J.R. & Slobin, D.I. 1979. The development of locative expressions in English, Italian, Serbo-Croatian and Turkish. *Journal of Child Language* 6:529-545.

Lakoff, G. 1987. *Women, Fire, & Dangerous Things*. Chicago: Univ. of Chicago Press.

Lakoff, G. & Johnson, M. 1980. *Metaphors We Live By*. Chicago: Univ. of Chicago Press.

Langacker, R. 1987/1991a. *Foundations of Cognitive Grammar*, Vols. I and II. Stanford: Stanford University Press.

-----. 1991b. *Concept, Image, and Symbol: The Cognitive Basis of Grammar*. Berlin: Mouton de Gruyter.

Lindkvist, K.G. 1978a. *At versus On, In, By*. Acta Universitatis Stockholmiensis (Stockholm Studies in English) 49.

Lindner, S. 1981. A lexico-semantic analysis of verb-particle constructions with "up" and "out." PhD diss., Dept. of Linguistics, UCSD.

Macnamara, J. 1971. Parsimony & the lexicon. *Language* 47:359-374.

Ruhl, C. 1989. *On Monosemy: A Study in Linguistic Semantics*. Albany: SUNY Press.

Schreuder, R. & Flores d'Arcais, G. 1989. Psycho-linguistic issues in the lexical representation of meaning. In *Lexical Representation and Process*, W. Marslen-Wilson (ed), 409-436. Cambridge, MA: MIT Press.

Vandeloise, C. 1991. *Spatial Prepositions: A Case Study from French*. Chicago: Univ. of Chicago Press.

Wesche, B. 1986/87. At ease with "at". *Journal of Semantics* 5:385-398.