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George Lakoff

Cognitive Semantics*

Two Views of Cognition

When cognitive science emerged as a field in the mid-1970's, a number of researchers rallied around a certain philosophical view of mind that they assumed would form the common ground for the research program of the new field. I will refer to that philosophical position as *objectivist cognition*. Its central claim was the following:

– Rational thought is the algorithmic manipulation of arbitrary abstract symbols that are meaningless in themselves but get their meaning by being associated with things in the world.

In objectivist cognition, the symbols and algorithmic operations of symbol-manipulation are seen as constituting a *language of thought*. The symbols function as *internal representations of external reality* and the rules that manipulate the symbols do not make use of what the symbols mean. There are two aspects to the objectivist theory:

– The algorithmic theory of mental processes: All mental processes are algorithmic in the mathematical sense, that is, they are formal manipulations of arbitrary symbols without regard to the internal structure of the symbols or to their meaning.

– The symbolic theory of meaning: Arbitrary symbols can be made meaningful in one and only one way: by being associated with things in the world (where "the world" is taken as having a structure independent of the mental processes of any beings).

If such a philosophical view of the mind had been scientifically established, it would indeed have been remarkable and interesting. But what happened within the ensuing decade is even more remarkable and interesting. Within one decade, enough researchers had investigated objectivist cognition in enough detail to show that such a theory of mind is fundamentally inadequate in many, many ways. That research points to a very different theory of mind, one that focuses on two things that were left out of the objectivist picture:

– The role of the body in characterizing meaningful concepts, and
– The human imaginative capacity for creating meaningful concepts and modes of rationality that go well beyond any mind-free, external reality.

* A much more detailed discussion of the issues raised here can be found in the author's book *Women, Fire, and Dangerous Things: What Categories Reveal About the Mind*, Chicago, University of Chicago Press, 1987. This research was supported in part by a grant from the Sloan Foundation to the University of California at Berkeley.

Objectivist cognition failed in large measure because of its conception of meaning. The objectivist view of meaning as the relationship between symbols and the world not only failed empirically, but was subject to a logical inconsistency. We will discuss some of those failures shortly. It also failed because of its assumption that all mental processes use *only* arbitrary symbols, symbols whose internal structure and whose meaning cannot be made use of by the processes operating on them. Research in cognitive linguistics, cognitive anthropology, and the philosophy of mind (cf. Langacker, Quinn, Lakoff, Talmy, Sweetser, Johnson, Lindner, Brugman, Casad, and Janda) indicates that rational mental process of the sort involved in using language and drawing inferences makes use of *image-schemas*, which are *nonfinitary meaningful symbols* of the sort excluded by the strict mathematical characterization of algorithmic manipulation. Image-schemas for containers, paths, links, force dynamics, etc. are made meaningful by human sensory-motor experience (see Johnson, 1987). Mental processes of a different sort – scanning, focusing, figure-ground reversal, superimposition, etc. – are needed for the processing of image-schematic symbols (see Langacker, 1987). What is needed to replace the objectivist view of meaning is an irreducibly cognitive semantics, one that accounts for what meaning is to human beings, rather than trying to replace humanly meaningful thought by reference to a metaphysical account of a reality external to human experience.

What I see as the most promising approach to cognitive semantics is what Johnson (Johnson, 1987) and I (Lakoff, 1987) have called *experientialist cognition*. “Experiential” is to be taken in the broad sense, including basic sensory-motor, emotional, social, and other experiences of a sort available to all normal human beings – and especially including *innate capacities* that shape such experience and make it possible. The term “experience” does not primarily refer to incidental experiences of a sort that individuals happen to have had by virtue of their unique histories. We are focusing rather on that aspect of experience that we have simply by virtue of being human and living on earth in a human society. “Experiential” should definitely NOT be taken in the empiricist sense as mere sense impressions that give form to the passive tabula rasa of the empiricists. We take experience as *active* functioning as part of a natural and social environment. We take common human experience – given our bodies and innate capacities and our way of functioning as part of a real world – as *motivating* what is meaningful in human thought. “Motivating” does not mean “determining”. We are not claiming that experience strictly determines human concepts or modes of reasoning; rather the structure inherent in our experience makes conceptual understanding possible and constrains – tightly in many cases – the range of possible conceptual and rational structures (see Johnson, 1987).

The theory of experientialist cognition posits:

– Concepts of two sorts that are meaningful because of their roles in bodily experience (especially movement and perception):

1. Basic-level concepts (to be discussed below).
2. Image-schemas (e.g., containers, paths, links, part-whole schemas, force-dynamic schemas, etc.). These have a nonfinitary internal structure.

– Imaginative processes for forming abstract cognitive models from these: Schematization, Metaphor, Metonymy and Categorization.

– Basic cognitive processes such as focusing, scanning, superimposition, figure-ground shifting, vantage-point shifting, etc.

– Mental spaces.

These views have been worked out and argued for in considerable detail in a number of books, including Lakoff and Johnson (1980), Fauconnier (1984), Lakoff (1986), Langacker (1986), Holland and Quinn (1986), Johnson (1987) and Sweetser (in press). The central claim of experientialist cognition is:

– Meaningful conceptual structures arise from two sources:

- (1) from the structured nature of bodily and social experience and
- (2) from our innate capacity to imaginatively project from certain well-structured aspects of bodily and interactional experience to abstract conceptual structures.

Rational thought is the application of very general cognitive processes – focusing, scanning, superimposition, figure-ground reversal, etc. – to such structures.

In the most general terms, the two theories contrast in the following ways:

– Where objectivist cognition views human thought as fundamentally disembodied, experientialist cognition sees human thought as essentially involving the kind of structured experience that comes from having human bodies, especially from innate human sensory-motor capacities.

– Where objectivist cognition sees meaning in terms of a “correspondence theory”, as the association of symbols with external objects, experientialist cognition sees meaning as essentially involving an *imaginative projection*, using mechanisms of schematization, categorization, metaphor and metonymy to move from what we experience in a structured way with our bodies to abstract cognitive models.

– Where objectivist cognition sees thought processes as the manipulation of abstract symbols by a great many highly-structured algorithms, experientialist cognition posits a small number of general cognitive processes whose application to abstract highly-structured cognitive models constitutes reason.

Corresponding differences arise in the case of language. Since theories of cognition affect theories about the psychological status of a grammar,

these differences have equally great consequences for the conception of what a natural language is.

– Objectivist cognition, by definition, sees the syntax of a natural language as a set of algorithmic principles that manipulate symbols without regard to their meaning.

– Experientialist cognition sees the syntax of a language as

1. providing grammatical categories and constructions that are semantically-motivated,
2. giving the semantic and functional motivations for those categories and constructions, and
3. indicating the relationships among the constructions – relationships based both on form and on meaning.

Each grammatical construction is a form-meaning pairing with the structure of a cognitive model. Constructions are combined by superimposition and sentences are processed by general cognitive processes. The principles that provide semantic, pragmatic, and functional motivation for aspects of syntax are called *generative semantic principles*.

For a detailed example of grammatical constructions, the generative semantic principles that motivate them, and the relationships among constructions within a grammar, see Lakoff, 1987, case study 3.

Experientialist theories of cognition provide a view of the mind and of human nature that is very different from the view given by objectivist theories. It is therefore of the utmost importance that we consider the evidence that has led experientialist theorists to move to a very different view of mind. What is at stake is not merely an academic matter, but a view of what human beings are like in the most fundamental sense.

A Case of Philosophy Versus Science

Philosophy is most powerful when it is invisible. Over the course of centuries philosophical theories may become so engrained in our culture and our intellectual life that we don't even recognize them as theories; they take on the cast of self-evident truth, part of the intellectual landscape that serves as a background for theorizing. Such virtually invisible philosophical theories are often harmless. But when they are false and become widely accepted within important academic disciplines, invisible philosophical theories can stand in the way of scientific investigation. Because they are invisible, they are neither questioned nor taken into account.

This has occurred on a grand scale in the cognitive sciences. The philosophical theory in question is what Johnson and I (1980) have called "objectivism", which is essentially the same as what Putnam (1981) has referred to as "metaphysical realism". It is indicative of their per-

vasiveness and invisibility that the collection of philosophical views that we are referring to had no well-established name; we had to make up names for them. Yet those views have permeated establishment thinking in Anglo-American philosophy, linguistics, cognitive psychology, and artificial intelligence.

Before describing those views, it is important to see that there is important common ground between objectivism on the one hand and anti-objectivist views such as Johnson's and my experiential realism, Putnam's internal realism, and the views of cognitive linguists such as Langacker and Fauconnier. What we share with objectivism is *basic realism*:

– A commitment to the existence of a real world, both a world external to human beings as well as the reality of human experience. None of us are solipsists or pure idealists.

– A link of some sort between human conceptual systems and other aspects of reality.

– A conception of truth that is not based merely on internal coherence.

– A commitment to the existence of stable knowledge of the external world.

– A rejection of the view that "anything goes" – that any conceptual system is as good as any other.

– A commitment to standards of "objectivity" in science, that is, to standards within scientific communities that rule out the biases and prejudices of individual investigators.

None of this is being challenged. Realism and scientific objectivity are not the issues. The above philosophical assumptions are shared by all parties concerned, and it is worth stating them explicitly. Misunderstandings arise, however, when such a basic realism is confused with objectivism.

Objectivism (what Putnam calls "metaphysical realism") goes far beyond basic realism. Let us begin with *objectivist metaphysics*, which posits what Putnam (1981) has referred to as a "God's Eye View" of reality: In short, objectivism does not merely hold that there is a mind-free reality; it holds in addition that that reality is structured in a way that can be modeled by set-theoretical models, which consist of abstract entities (which model real-world entities), sets of abstract entities (defined by the common properties of their members), and sets of *n*-tuples (corresponding to relations among entities).

The basic tenets of objectivist metaphysics can be characterized by four intimately interrelated doctrines:

Doctrine 1: The world consists of entities with fixed properties and relations holding among them at any instant. This structure is mind-free, that is, independent of the understanding of any beings.

Doctrine 2: The entities in the world are divided up naturally into

categories called *natural kinds*. All natural kinds are sets defined by the essential properties shared by their members.

Doctrine 3: All properties are either complex or primitive; complex properties are logical combinations of primitive properties.

Doctrine 4: There are rational relations that hold objectively among the entities and categories in the world. For example, if an entity x is in category A and if A is in category B , then x is in B .

These are interrelated doctrines. Natural kinds are correlates of essential properties of objects. Rational relations are defined in terms of categories (which correspond to properties). Logical combinations are understood in terms of rational relations. Doctrine 2, the doctrine of natural kinds, is central to objectivist metaphysics because it claims that categorization is built into objective reality — and it is categorization that links the properties and relations of doctrine 1 to the rational relations of doctrine 4 and the compositional structure of complex properties in doctrine 3. That is why philosophers have paid so much attention to natural kinds in recent years. The doctrine of natural kinds is crucial to the entire enterprise, and it is that doctrine that we will be most concerned with.

Objectivist metaphysics is not a collection of self-evident truths: it is a *theory* about the nature of reality. It is not just a falsifiable theory; it is a false theory. It is demonstrably false for one of the most basic cases that it is supposed to work for: biological kinds. Ernst Mayr of Harvard, one of the principal figures in modern evolutionary biology, has taken pains to point out the fallacies in viewing biological species as natural kinds, that is, as sets defined by the essential properties of their members. The natural kind view was characteristic of pre-Darwinian biology, but has been known to be false since Darwin. Mayr (1984) cites seven properties of species that are at odds with the idea that they are sets defined by essential properties.

First, species do not have a homogeneous structure with all members sharing defining properties. Only statistical correlations among properties can be given.

Second, since a species is characterized partly in terms of reproductive isolation, it is defined not purely in terms of internal properties of individuals, but in large part with relation to other groups.

Third, a species is not defined only by properties of individual members. It is characterized in terms of its gene pool, though no individual has more than a small portion of the genes in the pool.

Fourth, if one considers populations distributed over broad areas, there is not always a distinct point at which one can distinguish one species from two.

Fifth, the concept “belongs to the same species as” is not transitive. There are documented cases of populations A , B , C , D and E in contiguous

areas, such that A interbreeds with B , B with C , C with D , D with E , but A does not interbreed with E . Since “belongs to the same set as” is always a transitive relation, species cannot be sets.

Sixth, biological species do not always have necessary conditions for membership. Both interbreeding capacity and morphological similarity go into the characterization of a species. But they may not always go together. There are three kinds of cases: (a) One population may split into two, which may retain the same physical characteristics, but may no longer be able to interbreed. (b) Physical characteristics may change, while interbreeding capacity remains. (c) In cases of uniparental reproduction, interbreeding is not a factor.

Seventh, status as a separate species may depend on geographic location. There are two cases: (a) Two populations may interbreed in one habitat, but not in another. (b) Two populations in the same habitat may not interbreed at one point in history; neither population changes, but the habitat changes, and interbreeding becomes possible. Natural kinds, on the other hand, are not defined relative to habitat.

For all these reasons, evolutionary biology is inconsistent with the idea that natural kinds of living things are sets defined by the shared essential properties of their members. In its view of natural kinds as sets of this sort, objectivist metaphysics is in conflict with Darwinian biology, which is perhaps the best-substantiated scientific theory of the modern age. It is a case of philosophy versus science, and it required, in Mayr's words, “an emancipation of biology from an inappropriate philosophy”.

Before we go on, let us stop to consider why this failure of objectivist *metaphysics* is important for cognitive science. Why, after all, should metaphysics matter in the study of cognition? It probably shouldn't. But in the objectivist theory of cognition, metaphysics matters plenty. In fact, it plays an extremely important role. The most essential feature of objectivist cognition is the separation of symbols from what they mean. It is this separation that permits one to view thought as the algorithmic manipulation of arbitrary symbols. The problem for such a view is how the symbols used in thought are to be made meaningful. The objectivist answer is that the symbols are meaningful by virtue of their association with things in the external world. This answer presupposes three philosophical doctrines in addition to those of objectivist metaphysics.

Doctrine 5. The doctrine of truth-conditional meaning: Meaning is based on reference and truth.

Doctrine 6. The “correspondence theory” of truth: Truth consists in the correspondence between symbols and states of affairs in the world.

Doctrine 7. The doctrine of objective reference: There is an “objectively correct” way to associate symbols with things in the world.

Here's where metaphysics comes in. Objectivist metaphysics is *required*

at this point in order to guarantee that the world is structured in just the right way to accommodate these three doctrines.

It is worthwhile pausing for a moment to ponder this aspect of objectivist cognition. In claiming that meaning consists in the relation of symbols to the external world, the objectivist cognitive scientist is bringing *metaphysics* of a very special kind into to study of *cognition*. This is necessary for technical reasons. Algorithms are mathematical objects of a certain well-investigated kind.

They manipulate symbols and their manipulations are defined in such a way that they cannot take into account the meanings of the symbols. But they are mathematically precise, and precision is highly desirable. It is not the only kind of precision possible, but is one that proponents of objectivist cognition would like to make use of. But since thought is meaningful, it is necessary that the symbols be given meaning. Moreover, they must be given meaning in a way that does not compromise the mathematical precision of algorithms. The objectivist solution is to adopt doctrines 5 - 7, the objectivist doctrines of meaning, truth, and reference. This permits another well-investigated form of mathematics to be used: model-theory. If an objectivist metaphysics is assumed, then the set-theoretical models used in model-theory can be assumed to model the world accurately. Add doctrines 5 - 7 to give an account of reference, truth, and meaning, and the symbols used in the algorithms can be made meaningful. At present, this is the *only* idea that has been proposed for giving meaning to those symbols in a mathematically precise way.

We can now see why the doctrine that natural kinds are sets is so important. Most of our reasoning is not about individuals, but about categories. Even when we reason about individuals, we reason about them *as members of categories*. If I think about my desk, I rarely think about it as a unique object in itself distinct from all other objects. Rather I think about it as a desk, as a member of the category *desk*. If thought is viewed as symbol-manipulation, then many, if not most, of the symbols manipulated will represent categories, not individuals. Objectivist cognition claims such category-symbols can be made meaningful in only one way – by being associated with CATEGORIES IN THE WORLD. This brings in objectivist metaphysics. Categories of just the right kind must be assumed to exist objectively in the world if category-symbols are to be made-meaningful. And if the mathematics of model-theory is to be used, the categories in the world must be sets – sets defined by necessary and sufficient conditions on their members. Otherwise, the mathematics of model-theory cannot be used to “give meaning” to category-symbols. The doctrine that natural kinds are sets of this sort is absolutely necessary if the mathematical apparatus of objectivist cognition – algorithms and models – is to be used.

It is at this point that evolutionary biology is in conflict with the

mathematics used to make the philosophical theory of objectivist cognition work. Symbols for species would have to be given meaning via reference to sets defined by necessary and sufficient conditions on their members. But, as Mayr has taken great pains to point out, that is inconsistent with the concept of species needed for evolutionary biology.

It is particularly interesting that no empirical evidence is ever given for the view that natural kinds are sets defined by necessary and sufficient conditions on their members. It is simply assumed to be true. It is one of those many doctrines of objectivist philosophy that are assumed without question. The case of objectivist cognition versus evolutionary biology is particularly ironic. The whole point of objectivist cognition is to be scientific – to bring mathematical precision into the study of the mind, which is a highly laudable goal. But the peculiar way in which mathematical precision is achieved goes against the most thoroughly documented body of scientific knowledge of the modern age!

The Putnam Paradoxes

Objectivist cognition claims the advantages of mathematical rigor. Yet Hilary Putnam, one of our most distinguished philosophers of mathematics and of mind, has shown that, far from being rigorous, objectivist cognition suffers from fatal internal contradictions that undermines all claims to formal rigor. By looking closely at the mathematical properties of the apparatus of objectivist cognition, Putnam (1981) proved a theorem that can be used to show internal contradictions both within the objectivist doctrines of reference and meaning (doctrines 5 and 7 above). To see just where the contradictions occur, we need to look closely at both model theory and doctrines 5 through 7.

Within model theory, models consist of abstract entities and sets constructed out of those entities. Model theory provides a precise way of associating such entities and sets with meaningless symbols. The set-theoretical structures in the models are also meaningless in themselves. Model theory thus provides a way to associate elements of meaningless models with meaningless symbols. The question is whether such symbol-to-model associations can “give meaning” to meaningless symbols, as objectivist cognition requires.

Here is where objectivist metaphysics and the objectivist doctrines of meaning, truth and reference come in. Objectivist metaphysics says that the world has the structure of a set-theoretical model. Thus, it is the job of metaphysical doctrines 1 through 4 to give meaning to the otherwise meaningless models. Viewing a set-theoretical model as corresponding to the world is taken as making the model meaningful. A one-to-one model-to-world correspondence is presupposed. The doctrine of objective reference says that there is a “correct” way to assign elements of

such a world-model to the meaningless symbols in terms of which we presumably think. Such a "fixing of reference" is supposed to make the meaningless symbols meaningful. The job is supposed to be accomplished through (1) the mathematics of model theory, (2) objectivist doctrines 1 through 7, and (3) one of the currently fashionable theories of reference.

Putnam has pointed out two major embarrassments for this pairing of perfectly good mathematics with objectivist philosophy. The embarrassments come from certain well-known mathematical properties of model-theory. The first embarrassment concerns the doctrine of objective reference. Within model theory a reference assignment function is a set of pairs (A, B) , where A is a symbol and B is an element of a model. Let S be the set of pairs for such a reference assignment function. An initial embarrassment arises because reference itself is a human concept and a symbol like the word "refer" in English must be assigned a referent. Its referent must be the set of pairs S defining the reference assignment. For example, given that

– "Candlestick Park" refers to Candlestick Park
the pair consisting of the name "Candlestick Park" and the stadium it names must be part of the set of pairs, S , referred to by "refer". That is, S is the set of pairs of the form

(linguistic expression, object or set)

for all expressions of the language that refer. Since "refer" itself refers to S , the pair ("refer", S) must be in S . But this yields the vicious circularity

$$S = \{ \dots, ("refer", S), \dots \}.$$

in which S is defined in terms of itself. The circularity is vicious, because the inner S must also be of the form:

$$S = \{ \dots, ("refer", S), \dots \}.$$

No matter how far we go, the reference of "refer" never gets pinned down. In short, it is nonsense to believe there is a reference relation of this kind.

One might try to avoid this embarrassment by providing a theory of reference that assigns some other relation R to "refer". But in the mathematical framework being used, such a theory can only be specified by some countable set of "sentences", that is, symbol sequences. The philosophical requirement (doctrine 7) says that reference must be objectively correct. That is, "refer" must be satisfied by one and only one set of pairs of the form

(symbol of the language, element of the model).

But now another mathematical property of model theory gets in the way of the philosophical doctrines: No countable sequence of symbols can be satisfied uniquely, that is, no sequence of sentences of a formal language is true in one and only one model. Other models always exist which can make any countable collection of sentences true. Therefore

any theory of reference, which is such a sequence of sentences, cannot be satisfied uniquely. There is always more than one pairing of symbols and model-elements that will satisfy the sentences of any purported theory of reference. Kripke's causal theory of reference would be an example. In short, the unique, objectively correct account of reference that is required to give meaning to the symbols within objectivist cognition is not mathematically possible, given the proposed mathematical tools. The mathematics is just not appropriate.

Such an embarrassment would be bad enough. But Putnam has pointed out what seems to me to be an even worse embarrassment. It concerns a fundamental requirement that any adequate theory of meaning must meet:

– The meaning of the parts of a sentence cannot be changed significantly without changing the meaning of the whole.

Putnam takes a standard philosophical example, "Some cat is on some mat". He observes correctly that one should not be able to change the meaning of "cat" to cherry and "mat" to tree without changing the meaning of the whole sentence. He then shows how this can be done using model theory interpreted according to doctrines 1 - 7, that is, assuming that meaning is based on truth and reference, and reference is made to elements of models. Putnam then goes on to prove a theorem based on well-known properties of model theory showing that model theory cannot meet the fundamental requirement given above. The crucial fact made use of is the fact that elements of a model have no meaning in themselves; all they have is set-theoretical structure, and such structures can be distinguished only up to isomorphisms. For this reason, it is possible in model-theoretical semantics to change the "meaning" of the parts of a sentence – often radically – while keeping the "meaning" of the whole sentence constant. Thus, what model-theorists call "meaning" cannot be meaning. Whatever it is, it is not the concept that is needed to provide a theory of natural language semantics.

David Lewis (1984) has correctly perceived the powerful implications of Putnam's argument and has attempted to provide what he calls "saving constraints" to prevent Putnam's results. But I have been able to show (Lakoff, 1987, chap. 15) that Lewis' saving constraints cannot work, nor will any of the wide range of proposed saving constraints that I am familiar with. The mathematical tools of objectivist cognition – algorithms plus model theory – are inappropriate for the characterization of meaning.

Again we have an irony. Objectivist cognition became popular within cognitive science because it came with precise mathematical tools. Those mathematical tools are indeed, so precise that they can be shown to be inappropriate for what they were supposed to be used for. The irony is that the very precision of the mathematical tools used to justify objectivist cognition has been used to demonstrate its inconsistency.

Categorization

Since most of our reasoning concerns categories, the concept of what a category is is central to any account of cognition. Within objectivist cognition, conceptual categories are what have come to be called "classical categories":

Doctrine 8: Conceptual categories are designated by sets characterized by necessary and sufficient conditions on the properties of their members. According to objectivist metaphysics, the only kinds of categories that exist in the world are sets. Given that the world is assumed to consist of entities with properties and relations, classical categories can be defined by necessary and sufficient conditions on the properties of entities. Conceptual categories are represented by symbols that designate real-world categories. Some of these symbols are complex – bundles of *features* that designate properties of category members. Such feature-bundles characterize the properties shared by all and only the entities in the category; they are the symbolic correlates of necessary and sufficient conditions defining classical categories in the world. Feature semantics is thus also a consequence of objectivist doctrine.

Within the past two decades an enormous amount of evidence has accumulated that shows that not all the conceptual categories used by human beings are classical categories, that is, that doctrine 8 is wrong. It should be understood at the outset that the failure of doctrine 8 does not imply that no conceptual categories have a classical structure. Some do. That is not the point. The point is that there are conceptual categories of many other kinds as well, and that the existence of such nonclassical categories is inconsistent with objectivist cognition.

I should also state at the outset that the nonclassical categories I will mainly be concerned with are *not* fuzzy sets (in the sense of Zadeh, 1965). Though fuzzy sets are not objectivist in the strict sense, the extension of objectivist cognition to admit fuzzy sets would not change things all that much. If one assumes the world is structured fuzzily (not too bold an assumption), one might well maintain that fuzzy conceptual categories could be represented by symbols that got their meaning by being associated with fuzzy real-world categories. This would still fit objectivist cognition. I assume that fuzziness is a real phenomenon in categories, but I will be concerned with other phenomena – phenomena that take the study of conceptual categories well beyond objectivist theories of cognition.

Each of the cases we will discuss is one in which a conceptual category has structure that cannot be accounted for by an association with something in objective reality. There are a number of kinds of cases:

- Cases where some imaginative aspect of the mind – schematic organization, metaphor, metonymy, or mental imagery – plays a role in the nature of the category.

- Cases where the nature of the human body (say, perception or motor capacities) determines some aspect of the category.

In both kinds of cases, the category is not a mere reflection, or representation, of nature. Rather, human bodily and imaginative capacities come into play. It should not be surprising that such conceptual categories exist. What is surprising is that a view of mind that excludes them could be taken seriously.

Color

Philosophers as far back as Locke have distinguished between "primary" and "secondary" properties. The primary properties are those that objects have as part of their very nature. The secondary properties are those that objects appear to have because of our perceptual apparatus. Color is the classic example of a secondary property. We now know an enormous amount about color. Color categories do not exist objectively in the world. Wavelengths of light exist in the world, but wavelengths do not determine color *categories*. Color categories seem to be determined by three factors:

- A neurophysiological apparatus.
- A universal cognitive apparatus.
- Culturally-determined choices that apply to the input of the universal cognitive apparatus.

The neurophysiological apparatus involves a system of color cones in the eye and neural connections between the eye and the brain. These determine response curves whose peaks are at certain pure hues: pure red, green, blue, yellow, white, and black. Other colors – for example, orange and purple and brown – are "computed" by a universal cognitive apparatus given neurophysiological input. A cultural-specific cognitive apparatus takes this input and determines a system of color categories by shifting color centers, determining major contrasts, etc. As a result, human color categories have certain general properties. They are not uniform – they have "central" best examples, which are either neurophysiologically determined pure hues or cognitively computed focal colors that are perceived as "pure" – pure orange, brown, purple, etc. Color categories are fuzzy at their boundaries, where response curves dip and overlap. Category boundaries vary greatly from culture to culture. Central colors do not vary much, but do show some variation due to culturally determined choices of contrast.

From all this it is clear that categories of color do not reside objectively in the world external to human beings. They are determined by the reflective properties of real-world objects plus our bodies and our minds. None of this would have surprised John Locke; color, after all, is a secondary property. But what does objectivist cognition have to say about color,

or other “secondary” qualities? The answer is nothing. The objectivist tradition in philosophy has been concerned with primary qualities – what is assumed to be in the world independent of human perceptual and cognitive capacities. No theory of meaning at all is given for secondary properties that have no objective existence.

Color provides another embarrassment to objectivist cognition. Color categories are, after all, real cognitive categories. Objectivist cognition must deal with them. But it has only one mechanism for doing so. It must represent color categories by arbitrary symbols and claim that they are made meaningful by reference to objectively-existing categories in the external world. But to do this is to treat color as if it were a primary property. For example, Barwise and Perry (1984) interpret their models as characterizing objective reality. They simply include a set of red things for the referent of “red”, assuming that “red” has a referent in the objective world. Analyses of this sort are simply at variance with our present detailed and clear scientific understanding of color.

This is not a simple oversight or an easily correctable error. It is one of many fatal flaws of objectivist cognitive theories. To view meaning as residing only in the relationship between symbols and external reality is to make the implicit claim that neither color categories, nor any other secondary category, should exist as meaningful cognitive categories. Yet color categories are real categories of mind. They are meaningful, they are used in reason, and their meaning must be accounted for. But the mechanism of objectivist cognition cannot be changed to accommodate them without giving up on the symbolic theory of meaning. But to do that is to abandon the heart of the objectivist program.

Basic-Level Categories

The objectivist view of meaning for conceptual categories is often presented as being plausible on the basis of a certain range of examples of middle-sized physical objects: cats and mats and elephants and chairs and tables. Substances like gold and water are also used as examples. They usually seem like good examples of cases where there is some discontinuity in the external world that our conceptual categories fit well. In such situations, it doesn't seem implausible that our conceptual categories are symbols that acquire meaning by correspondence with real-world categories.

Brent Berlin, Eleanor Rosch, and their co-workers have studied examples of categories like this in great detail. They have shown that such examples, when understood, do not support an objectivist view of cognition; indeed, they provide strong counterevidence to objectivist cognition. What Berlin, Rosch, and others found was this: Examples like the above (cat, mat, elephant, gold, table) are instances of categorization at

a *particular level*. It is a level that is cognitively basic; hence the term “basic-level”.

The basic level is neither the highest nor the lowest level of categorization. It is somewhere in the middle. For example, *animal* is a superordinate category for *cat*, while *manx* is subordinate. The basic level is the level at which human beings interact with their environments most effectively and process and store and communicate information most efficiently. It is a level that is characterizable only in cognitive terms. Here are some of its properties:

- It is the level at which category members have similarly perceived overall shapes.
- It is the highest level at which a single mental image can reflect the entire category.
- It is the highest level at which a person uses similar motor programs for interacting with category members.
- It is the level at which subjects are fastest at identifying category members.
- It is the level with the most commonly used labels for category members.
- It is the level first named and understood by children.
- It is the first level to enter the lexicon of a language in the course of history.
- It is the level with the shortest primary lexemes.
- It is the level at which terms are used in neutral contexts.
- It is the level at which most of our knowledge is organized.
- It is the level at which most culturally-determined functions for objects are defined.

Basic-level categories are thus basic in four respects:

Perception: Overall perceived shape; single mental image; fast identification.

Function: General motor programs; general cultural functions.

Communication: Shortest, most commonly used and contextually neutral words, first learned by children and first to enter the lexicon.

Knowledge Organization: Most attributes of category members are stored at his level.

Let us consider some examples. Take mental images. We can form a general mental image for *cat* or *table*. But with superordinate categories like *animal* or *furniture*, there is no single mental image that covers the entire category. Thus, we have mental images for chairs, tables, beds, etc., but none for a piece of furniture that is not an image of a table, chair, bed, etc. Similarly, we have general motor programs for using chairs, tables, etc. But we have no motor programs for using furniture in general.

Or consider knowledge organization. We have a lot of knowledge about cars, which are basic-level. If you ask someone what they know about a car, it will turn out that they know a great deal. If you ask what they know about vehicles (the superordinate category), it will turn out not to be very much compared to what is known about cars. If you ask someone what they know about sportscars, it will not be very much more than what they know about cars. Thus, most of our knowledge is organized at the basic level.

The basic level is also the level at which people categorize real world objects most accurately. Berlin, Breedlove, and Raven (1974) and Hunn (1977), in massive studies of Tzeltal plant and animal names, found that at the basic level, folk terminology for plants and animals fit biological taxonomies almost perfectly. At higher and lower levels, accuracy dipped sharply. They hypothesized two reasons for this, one having to do with the world and the other, with the nature of human perception and cognition. In the case of plants and animals, the basic level corresponds to the level of the biological genus. This is one level above the level of the species. In any given local ecosystem, one species of a given genus usually adapts better than other species. Thus, it is most common in a local environment to find only one species representing a genus. This results in relatively easy-to-perceive differences in overall shape among species in a locale. Since perception of overall shape is one of the determinants of the basic level, it makes sense that judgements of category membership are most accurate at this level.

Let us now return to the plausibility arguments often given for objectivist cognition, arguments based on the fact that conceptual categories like *cat*, *mat*, *elephant*, *table*, *gold*, etc. really do correspond to significant discontinuities in nature. There are two reasons why this is not evidence for objectivist cognition:

– First, superordinate and subordinate conceptual categories do not correspond to the discontinuities in nature all that well. Yet they are conceptual categories too. If the accuracy of categorization for basic-level categories makes objectivist cognition plausible, then the corresponding inaccuracy at other levels makes it implausible.

– Second, what defines the basic level is not present in the external world; the determinants of the basic level have to do with human bodies and minds. Basic-level categorization is defined not merely by what the world is like, but equally by how we interact with the world given our bodies, our cognitive organization, and our culturally-defined purposes. The level hierarchy is defined not just by what is in the world objectively, but by our nature as living beings and by our interactions within a real environment. Objectivist cognition, which posits a disembodied mind, is too impoverished to characterize the level hierarchy.

– Third, the level hierarchy is not fixed. It varies along certain limited parameters with age, culture, and individual knowledge and interests.

We appear to have a capacity for forming basic-level categories and categories at other levels. Objectivist cognition, in positing a disembodied mind, cannot characterize that capacity and therefore cannot account for variations in category level in different individuals and cultures.

Basic-level categorization points to an embodied, experientialist view of cognition rather than a disembodied, objectivist view.

Categories Defined by Schemas

What is the meaning of “Tuesday”? If, as objectivist cognition suggests, symbols get their meaning only by being associated with things in the world, then weeks must be things in the world. But weeks do not exist in nature. Different cultures have different lengths of weeks. In Bali, there are many kinds of weeks of various lengths, all of which exist simultaneously. Weeks are an imaginative creation of the human mind. In order to know what “Tuesday” means, we need to know what weeks are and how they are structured.

The kinds of imaginative structures required for the definition of concepts such as “Tuesday” have been called “frames” or “schemas”. The central claim of contemporary cognitive anthropology is that most of our cultural reality resides not in the artifacts of society, but in the culture-specific schemas imposed by human beings (see Holland and Quinn, 1986). Complex collections of schemas that characterize the culturally-accepted structuring of domains of experience are called *folk theories*. Charles Fillmore has argued in a host of works on frame semantics (see annotated bibliography) that words are defined only relative to such schemas. “Tuesday” is meaningful only relative to a *weeks*-schema. The need for such schemas has become generally accepted throughout the cognitive sciences.

How do schemas of this sort square with objectivist cognition? Is a *week*-schema an “internal representation of external reality”? Does “Tuesday” refer to an aspect of “external reality” – reality external to human beings? Obviously not. That reality is constituted by the minds of human beings collectively – it is not an “external” reality. “Tuesday” cannot get its meaning by reference to a reality external to and independent of human minds. Neither can “bar mitzvah”, “associate professor”, “second base”, “fiancee”, nor any of the thousands upon thousands of realities defined by reference to cultural schemas. These realities reside in human minds, not in anything “external”.

Such cultural schemas and the concepts defined only within them do not jibe with the objectivist theory of cognition, since they do not get their meaning by being associated with things external to the mind. One of the reasons that schemas have become popular within the cognitive sciences is that they can be represented as symbolic structures and

manipulated algorithmically. The schemas are meaningful, but they do not derive their meaning via correspondence with an external reality. Culturally-defined schemas are a product of human imaginative capacities and, as such, do not have a place within objectivist cognition.

Again, this is not a trivial matter that can be adjusted merely by claiming that such schemas are made meaningful by reference to a mind-internal reality. This reason is this: In objectivist cognition, all thought is characterized as the manipulation of symbols that are *meaningless* without being associated with something external to the mind. The objectivist mind, in itself, contains nothing but meaningless symbols. There is nothing meaningful in the objectivist mind to give meaning to culturally-defined schemas.

For the working cognitive scientist, this is anything but a trivial matter. Take the question of definition. Much of cognitive science research involves natural language semantics, and every such study requires – explicitly or implicitly – an account of definition. Objectivist cognition comes with a doctrine on definition.

Doctrine 9: A complex concept is DEFINED by a collection of necessary and sufficient conditions on less complex (and, ultimately, primitive) concepts.

This constitutes the objectivist definition of “definition”. It is a consequence of the doctrine of atomic primitives (doctrine 3 above) together with the central doctrine of objectivist cognition. Within the objectivist paradigm, this is the only way that a symbol can be given meaning in terms of other symbols; the other symbols must already have been made meaningful via an association with entities and categories in the world. It must be borne in mind that doctrine 9 is only a doctrine. It does not characterize what definition “really is”.

Within Fillmore’s frame semantics and other variations on it (e.g., theories of scripts, schemas, cognitive models, etc.) definition is defined very differently. Each word designates an element in a frame (or schema or script or cognitive model). Such frames are not defined as getting their meaning via correspondences with objectively characterized external reality. Frames are special cases of what I have called idealized cognitive models (Lakoff, 1987); they are idealizations and abstractions that may not correspond to external reality well or at all. Fillmore (1982b) looks in detail at the classic case of *bachelor*, which he argues is defined in terms of necessary and sufficient conditions – relative to an idealized cognitive model of social structure, not relative to reality. In the idealized model, everyone is heterosexual, marriage is monogamous, people get married at roughly a certain age and stay married to the same person, married men support their wives, etc. A bachelor is just an unmarried man of marriageable age, relative to this idealized model.

The model, of course, doesn’t accord very well with reality. In the idealized model, the question of whether the following are bachelors does

not arise: The pope, Tarzan, a moslem who is permitted to have four wives but only has three, a man who has been in a coma since childhood, etc. These are not good examples of bachelors, and whether one would want to call them bachelors at all depends on how one would want to stretch the definition. “Stretching the definition” means ignoring or modifying certain aspects of the idealized model – while leaving the necessary and sufficient conditions of the idealization intact.

In some cases, the cognitive models may be metaphorical in nature. A case in point is the English modal verbs (*must, may, can*, etc.) which Sweetser (in press) argues are defined via metaphor. Other such examples are given in Lakoff and Johnson (1980). Metaphorical definitions and various other kinds of definitions go beyond Fillmore’s frame semantics and, correspondingly, beyond Putnam’s stereotypes, and classical schema theory. For a detailed discussion, see Lakoff, 1987, chapters 5-7 and case studies 1 and 2.

Schemas Versus Objectivist Cognition

Let us consider a case where schema-based semantics comes into conflict with objectivist semantics. It is a case in which objectivist philosophers have proposed a semantic analysis based on objectivist cognition, proposing what they see as logical principles that are supposedly absolutely true in the real world. Counterexamples to the logical principles can be supplied, yet the principles do seem to have a certain validity, though not within objectivist cognition. Rather than being objectively true, the principles have the character of folk theories – schematically-represented commonplace ways of understanding experience, but which in many cases do not fit any external reality. The insights about the subject matter are basically correct, but the theory in which the insights are framed fails because it is based on objectivist cognition. Here is the example:

Barwise and Perry (1984) propose a logic of vision within their theory of situation semantics. Among the Barwise-Perry principles are:

Veridicality: If *a* sees *P*, then *P*.

Substitution: If *a* sees *F* (*t*₁) and *t*₁ = *t*₂, then *a* sees *F* (*t*₂).

These principles are justified by the following kinds of examples:

Veridicality:

If Harry saw Max eat a bagel, then Max ate a bagel.

Substitution:

- Russell saw G.E.Moore get shaved in Cambridge.
- G.E.Moore was (already) the author of *Principia Ethica*.

– Therefore, Russell saw the author of *Principia Ethica* get shaved in Cambridge.

It is easy to find counterexamples to such principles. Goodman (1978, chap. V) observes that well-known experiments in the psychology of vision (see Johansson, 1950, and Gilchrist and Rock, 1981) violate veridicality. For example, two lights, *A* and *B*, flashed in quick succession will appear to subjects as a single light moving from the location of *A* to the location of *B*. Suppose Harry is the subject in such an experiment. Then it will be true that

Harry saw a single light move across the screen and false that

A single light moved across the screen.

This contradicts veridicality, which is supposed to be a *logical* principle – part of the *logic* of seeing – and which therefore is supposed to hold in *all* situations, not just normal ones.

Similarly, one can construct a situation that violates substitution. Imagine a story in which a prince has been turned into a frog. On the Barwise-Perry account, the following inference would be logically true.

The princess saw the frog jump into bed with her.

The frog was really the prince.

Therefore, the princess saw the prince jump into bed with her.

The conclusion does not clearly follow from the premises. The case is problematic to say the least. The inference should still follow, on the Barwise-Perry theory, even if the princess did not know the prince had been turned into a frog. One might claim that she did not know what she saw, but not that she did not see what she saw. Frogs don't look like princes. She saw a frog, but not a prince. The inference is not logically valid.

There is no question that the Barwise-Perry account of the semantics of seeing has certain validity – but not *logical* validity. It has folk-theoretical validity. We seem to have a folk theory of seeing. We take it for granted in normal cases, assuming certain *ceteris paribus* conditions: You are alive and awake, are functioning normally, have normal vision and relevant knowledge, are not being fooled, etc. The folk theory of vision goes like this:

- You see things as they are.
- You are aware of what you see.
- You see what's in front of your eyes.

If you see things as they are, then vision is veridical and the way things are described doesn't matter and substitution should hold.

The difference between the Barwise-Perry theory and the folk theory is all-important for the issue at hand, the question of whether objectivist cognition is correct. Is the word “see” to be given meaning via correspondence with a reality governed by the Barwise-Perry *logic* of see-

ing, a logic that must be valid in all situations? This is what is required if we assume that the mathematical constructions of their situation semantics is to be interpreted in terms of objectivist cognition, that is, if situations are taken as modelling reality directly. Under the objectivist interpretation (which Barwise and Perry give to their work) real contradictions arise, as we saw above. The contradictions can be avoided if the Barwise-Perry principles for seeing are interpreted as principles in a folk theory. The word “see” would then be defined relative to the cognitive schemas characterizing this folk theory. The folk theory would then provide a way of *understanding* a real-world situation, but only if the relevant *ceteris paribus* conditions held. In the counterexamples given, those conditions do not hold. To take the latter course is to give up on the idea that meaning is based on reference and truth and to give up on objectivist cognition. The reason is that the inferential properties of “see” would be characterized relative to a cognitive schema, which is not part of external reality.

To make the problem concrete, let us take a pair of sentences that cannot be made meaningful in a Barwise-Perry semantics for seeing:

- Harry saw *one light* move, but there were really many of *them* flashing in succession. He saw *it* move in a circle; but *they* were just arranged in a circle and were flashing rapidly in sequence.

Notice the use of pronouns. *It* is used for the single light that Harry saw, while *they* is used for the many lights that were actually flashing. Fauconnier's theory of mental spaces, which is a form of cognitive semantics, has no problem with such a case: The space that characterizes what Harry saw is distinct from the reality space. The former space has one light; the latter space has many. But the Barwise-Perry semantics of seeing can offer no such solution.

As we have seen, objectivist cognition fails in many ways in its account of semantics. Still more of its failures are documented in the works referred to in the annotated bibliography at the end of this paper. Objectivist cognition in general rests on its claim to be able to explain how arbitrary symbols get their meaning. The failure of objectivist semantics calls all the objectivist doctrines listed above into question, and warrants taking a very different general approach, not just to semantics but to cognition generally.

Let us now turn to a very basic semantic phenomenon that objectivist cognition can have little, if anything, to say about: systematic polysemy.

Systematic Polysemy as Evidence for a Cognitive Semantics

One of the most important and pervasive of semantic phenomena is polysemy – the fact that individual words and morphemes typically have

many meanings that are systematically related to one another. Where such systematic relationships exist, it is part of the job of semantics to discover the general principles governing those relationships. Much of the cognitive semantics literature to date has been concerned with discovering such principles. I will limit myself here to the discussion of three kinds of principles that have been found: image-schema transformations, metaphor, and metonymy.

Kinaesthetic Image-Schemas

One of Mark Johnson's basic insights is that experience is structured in a significant way prior to, and independently of, any concepts. Existing concepts may impose further structuring on what we experience, but basic experiential structures are present regardless of any such imposition of concepts. This may sound mysterious, but it is actually very simple and obvious, so much so that it is not usually considered worthy of notice.

In *The Body in the Mind*, Johnson (1987) makes an overwhelming case for the embodiment of certain kinaesthetic image-schemas. Take, for example, a CONTAINER schema – a schema consisting of a *boundary* distinguishing an *interior* from an *exterior*. The CONTAINER schema defines the most basic distinction between IN and OUT. We understand our own bodies as containers – perhaps the most basic things we do are ingest and excrete, take air into our lungs and breathe it out. But our understanding of our own bodies as containers seems small compared with all the daily experiences we understand in CONTAINER terms:

Consider just a small fraction of the orientational feats you perform constantly in your daily activities – consider, for example, only a few of the many *in-out* orientations that might occur in the first few minutes of an ordinary day. You wake *out* of a deep sleep and peer *out* from beneath the covers *into* your room. You gradually emerge *out* of your stupor, pull yourself *out* from under the covers, climb *into* your robe, stretch *out* your limbs, and walk *in* a daze *out* of your bedroom and *into* the bathroom. You look *in* the mirror and see your face staring *out* at you. You reach *into* the medicine cabinet, take *out* the toothpaste, squeeze *out* some toothpaste, put the toothbrush *into* your mouth, brush your teeth, and rinse *out* your mouth. At breakfast you perform a host of further *in-out* moves – pouring *out* the coffee, setting *out* the dishes, putting the toast *in* the toaster, spreading *out* the jam on the toast, and on and on. (Johnson, 1987)

Johnson is not merely playing on the words *in* and *out*. There is a reason that those words are natural and appropriate, namely, the fact that we conceptualize an enormous number of activities in CONTAINER terms. Lindner (1981) describes in detail what is involved in this for 600 verbs containing the particle *out*, not just physical uses like *stretch out* and *spread out*, but in metaphorical uses like *figure out*, *work out*, etc. As Lindner observes, there are a great many metaphors based on the CONTAINER

schema and they extend our bodily-based understanding of things in terms of CONTAINER schemas to a large range of abstract concepts. For example, emerging *out* of a stupor is a metaphorical, not a literal emergence from a container.

Let us consider some of the properties of this schema.

The CONTAINER Schema

Bodily experience: As Johnson points out, we experience our bodies both as containers, and as things in containers (e.g., rooms) constantly.

Structural elements: INTERIOR, BOUNDARY, EXTERIOR.

Basic Logic: Like most image-schemas, its internal structure is arranged so as to yield a basic "logic". Everything is either inside a container or out of it – P or not P. If container A is in container B and X is in A, then X is in B – which is the basis for modus ponens: If all A's are B's and X is an A, then X is a B. This is the basis of the Boolean logic of classes.

Sample Metaphors: The visual field is understood as a container: things *come into* and *go out of sight*. Personal relationships are also understood in terms of containers: one can be *trapped in a marriage* and *get out of it*.

The "basic logic" of image-schemas is due to their configurations as *gestalts* – as structured wholes which are more than mere collections of parts. Their basic logic is a consequence of their configurations. This way of understanding image-schemas is irreducibly cognitive. It is rather different from the way of understanding logical structure than those of us raised with formal logic have grown to know and love. In formal logic there are no such *gestalt* configurations. What I have called the "basic logic" of a schema would be represented by meaning postulates. This might be done as follows: Let CONTAINER and IN be uninterpreted predicate symbols, and let A, B and X be variables over argument places. The logic of the predicates CONTAINER and IN would be characterized by meaning postulates such as:

For all A, X, either IN(X,A) or not IN(X,A).

For all A,B,X, if CONTAINER(A) and CONTAINER(B) and IN(A,B) and IN(X,A), then IN(X,B).

Such meaning postulates would be strings of meaningless symbols, but would be "given meaning" by the set-theoretical models they could be satisfied in.

On our account, the CONTAINER schema is inherently meaningful to people by virtue of their bodily experience. The schema has a meaningful configuration, from which the basic logic follows, given basic cognitive operations such as superimposition and focusing. An example is given in Figures 1-4.

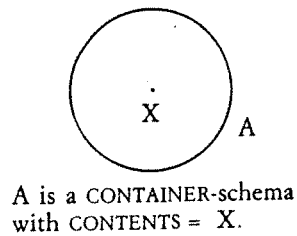


Figure 1

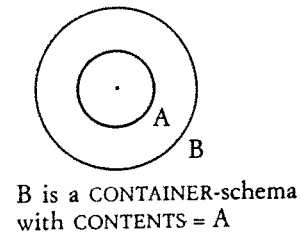
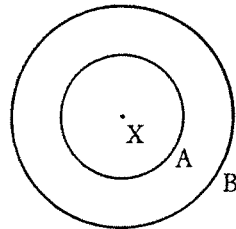
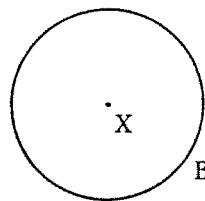


Figure 2



Superimposition of Figures 1 and 2

Figure 3



B is a CONTAINER-schema with CONTENTS = X.
This is the result of focusing on X and B in Figure 3.

Figure 4

On our account, the very concept of a set, as used in set theoretical models, is understood in terms of CONTAINER schemas (see Lakoff, 1987, case study 2 for details). Thus, schemas are not to be understood in terms of meaning postulates and their interpretation. Rather, meaning postulates themselves only make sense given schemas that are inherently meaningful because they structure our direct experience. The logician's meaning postulates are nonetheless useful as description in another vocabulary. From our point of view, they should be construed as precise statements of certain aspects of the logic inherent in schema-configurations.

Let us consider a few more examples of image-schemas.

The PART-WHOLE Schema

Bodily experience: We are whole beings with parts that we can manipulate. Our entire lives are spent with an awareness of both our wholeness and our parts. We experience our bodies as WHOLEs with PARTS. In order to get around in the world, we have to be aware of the PART-WHOLE structure of other objects. In fact, we have evolved so that our basic-level perception can distinguish the fundamental PART-WHOLE structure that we need in order to function in our physical environment.

Structural elements: A WHOLE, PARTS, and a CONFIGURATION.

Basic logic: The schema is asymmetric: If A is a part of B, then B is not a part of A. It is irreflexive: A is not a part of A. Moreover, it cannot be the case that the WHOLE exists, while no PARTS of it exist. However, all the PARTS can exist, but still not constitute a WHOLE. If the PARTS exist in the CONFIGURATION, then and only then does the WHOLE exist. It follows that, if the PARTS are destroyed, then the WHOLE is destroyed. If the WHOLE is located at a place P, then the PARTS are located at P. A typical, but not necessary property: The PARTS are contiguous to one another.

Sample metaphors: Families (and other social organizations) are understood as wholes with parts. For example, marriage is understood as the creation of a family (a whole) with the spouses as parts. Divorce is thus viewed as *splitting up*. In India, society is conceived of as a body (the whole) with castes as parts, the highest caste being the head and the lowest caste being the feet. The caste structure is understood as being structured metaphorically according to the configuration of the body. Thus, it is believed (by those who believe the metaphor) that the maintenance of the caste structure (the configuration) is necessary to the preservation of society (the whole).

The LINK Schema

Bodily Experience: Our first link is the umbilical cord. Throughout infancy and early childhood, we hold onto our parents and other things, either to secure our location or theirs. To secure the location of two things relative to one another, we use such things as string, rope or other means of connection.

Structural Elements: Two entities, A and B, and LINK connecting them.

Basic Logic: If A is linked to B, then A is constrained by, and dependent upon, B. Symmetry: If A is linked to B, then B is linked to A.

Metaphors: Social and interpersonal relationships are often understood in terms of links. Thus, we *make connections* and *break social ties*. Slavery is understood as bondage, and freedom as the absence of anything tying us down.

The SOURCE-PATH-GOAL Schema

Bodily Experience: Every time we move anywhere there is a place we start from, a place we wind up at, a sequence of contiguous locations connecting the starting and ending points, and a direction. We will use the term "destination" as opposed to "goal" when we are referring to a specifically *spatial* ending point.

Structural Elements: A SOURCE (starting point), a DESTINATION (end point), a PATH (a sequence of contiguous locations connecting the source and the destination), and a DIRECTION (toward the destination).

Basic Logic: If you go from a source to a destination along a path, then you must pass through each intermediate point on the path; moreover, the further along the path you are, the more time has passed since starting.

Metaphors: Purposes are understood in terms of destinations, and achieving a purpose is understood as passing along a path from a starting point to an endpoint. Thus, one may *go a long way toward* achieving one's purposes, or one may get *sidetracked*, or find something getting *in one's way*. Complex events in general are also understood in terms of a source-path-goal schema; complex events have initial states (source), a sequence of intermediate stages (path), and a final state (destination).

Other image-schemas include an UP-DOWN schema, a FRONT-BACK schema, a LINEAR ORDER schema, etc. At present, the range of existing schemas and their properties is still being studied. Image-schemas provide particularly important evidence for the claim that abstract reason is a matter of two things: (a) reason based on bodily experience, and (b) metaphorical projections from concrete to abstract domains. Detailed evidence is provided by Johnson (1987). Johnson's argument has four parts:

- Image-schemas structure our experience preconceptually.
 - Corresponding image-schematic concepts exist.
 - There are metaphors mapping image-schemas into abstract domains, preserving their basic logic.
 - The metaphors are not arbitrary, but are themselves motivated by structures inhering in everyday bodily experience.
- For a detailed discussion, see Johnson, 1987, and Lakoff, 1987, chapter 17.

The Nature of Image-Schema Transformations

There are certain very natural relationships among image-schemas, and these motivate polysemy, not just in one or two cases, but in case after case throughout the lexicon. Natural image-schema transformations play a central role in forming radial categories of senses (Lakoff, 1987, chap. 6 and case study 2). Take, for example, the end-point-focus transformation. It is common for words that have an image-schema with a path to

also have the corresponding image-schema with a focus on the end-point of the path, as Bennett, 1975, observed. Here are some typical pairs:

- Sam walked *over* the hill. (path)
- Sam lives *over* the hill. (end-of-path)
- Harry walked *through* that doorway. (path)
- The passport office is *through* that doorway. (end-of-path)
- Sam walked *around* the corner. (path)
- Sam lives *around* the corner. (end-of-path)
- Harriet walked *across* the street. (path)
- Harriet lives *across* the street. (end-of-path)
- Mary walked *down* the road. (path)
- Mary lives *down* the road. (end-of-path)
- Sam walked *past* the post office. (path)
- Sam lives *past* the post office. (end-of-path)

It should be noted that although such pairs are common, they are not fully productive.

- Sam walked *by* the post office. (path)
- Sam lives *by* the post office. (= *near*; ≠ end-of-path)

Here, *by* has a path schema, but no corresponding end-point schema.

- Sam ran *from* the house. (path)
- Sam stood three feet *from* the house. (end-of-path)
- Sam ran *to* the house. (path)
- *Sam stood (three feet) *to* the house. (≠ end-of-path)

From allows both path and end-of-path schemas, but *to* only allows a path schema.

Path schemas are so naturally related to end-point schemas that people sometimes have to think twice to notice the difference. The same is true of the schema transformation that links multiplex (sometimes called "plurality") and mass schemas. It is natural for expressions like *all* and *a lot* that have a mass schema to also have a multiplex schema.

- *All* men are mortal. (MX)
- *All* gold is yellow. (MS)
- She bought *a lot of* earrings. (MX)
- She bought *a lot of* jewelry. (MS)

This schema transformation, of course, doesn't hold for all quantifiers:

- She bought *two* earrings. (MX)
- *She bought *two* jewelry. (MS)

There are also verbs which have both schemas:

- He *poured* the juice through the sieve. (MS)
- The fans *poured* through the gates. (MX)

The same systematic polysemy obtains for other verbs of liquid movement, such as *spill*, *flow*, etc.

- The wine *spilled* out over the table. (MS)
- The fans *spilled* out over the field. (MX)

There is a special case of the multiplex-mass transformation in which the multiplex entity is a sequence of points and the mass is a one-dimensional trajector (that is, a continuous line). A variety of prepositions permit both schemas.

- There are guards posted *along* the road. (MX)
- There is a fence *along* the road. (1DTR)
- He coughed *throughout* the concert. (MX)
- He slept *throughout* the concert. (1DTR)
- There were stains *down* his tie. (MX)
- There were stripes *down* his tie. (1DTR)

There is a natural relationship not only between a one-dimensional trajector and a sequence of points. There is also a natural relationship between a one-dimensional trajector and a zero-dimensional moving trajector (that is, a point) that traces a path.

- Sam *went* to the top of the mountain. (ODMTR)
- The road *went* to the top of the mountain. (1DTR)
- Sam ran *through* the forest. (ODMTR)
- There is a road *through* the forest. (1DTR)
- Sam walked *across* the street. (ODMTR)
- There was a rope stretched *across* the street. (1DTR)

Certain image-schemas have what Lindner (1981) refers to as "reflexive" variants, in which two distinct elements of a given schema are identified. As a result, the schematic relation holds not between two distinct entities, but between one entity and itself. "RF" indicates a reflexive schema and "NRF" indicates a nonreflexive schema. The natural relationship between reflexive and nonreflexive variants of a schema yields systematic polysemy for words like *apart*, *over*, *up*, *out*, etc.

Here are some examples:

- He stood *apart* from the crowd. (NRF)
- The book fell *apart*. (RF)

- He rolled *over* me. (NRF)
- He rolled *over*. (RF)
- The cat walked *up* to me. (NRF)
- The cat curled *up*. (RF)
- She poured the syrup *out* of the jar. (NRF)
- The syrup spread *out* over the pancakes. (RF)

Let us consider for a moment what is natural about these image-schema transformations.

Path-focus ↔ *end-point-focus*: It is a common experience to follow the path of a moving object until it comes to rest, and then to focus on where it is. Also, many paths are traveled *in order* to arrive at an endpoint that is kept in sight along the way. Such everyday experiences make the path-focus / end-point-focus transformation a natural principle of semantic relationships.

Multiplex ↔ *mass*: As one moves further away, there is a point at which a group of individuals, especially if they are behaving in concert, begins to be seen as a mass. Similarly, a sequence of points is seen as a continuous line when viewed from a distance.

ODMTR ↔ *1DTR*: When we perceive a continuously-moving object, we can mentally trace the path it is following, and some objects leave trails – perceptible paths. The capacity to trace a path and the experience of seeing a trail left behind make it natural for the transformation linking zero-dimensional moving trajectors and a one-dimensional trajector to play a part in semantic relations in the lexicon. (Incidentally, the word *path* itself is polysemous, with meanings that are related by this transformation).

NRF ↔ *RF*: Given a perceived relationship between a TR and a LM which are two separate entities, it is possible to perceive the same relationship between (1) different parts of the same entity or (2) earlier and later locations of the same entity, where one part or location is considered LM and the other TR.

In short, these schema transformations are anything but arbitrary. They are direct reflections of our experiences, which may be visual or kinaesthetic.

The fact that image-schemas are a reflection of our sensory and general spatial experience is hardly surprising, yet it plays a very important role in the theory of image-schemas. Perhaps we can see that significance most easily by contrasting the image-schema transformations we have described with the names we have given to them. Take the transformation name "MX ↔ MS". The name "MX" and "MS" are arbitrary relative to the character of what they name: a group of individual entities and a mass. The transformation is a natural relationship, but the name of the transformation is just a bunch of arbitrary symbols.

The distinction is important because of objectivist cognition. On one theory of image-representation – the “propositional theory” – visual scenes are represented by arbitrary symbols which are linked together in network structures. Arbitrary symbols such as X and Y are taken as standing for some aspect of a scene, such as a point or an edge or a surface or an entire object. Other symbols are used to express relations among these symbols, for example, “ABV(X,Y)” and “C(X,Y)” might represent relations which are supposed to correspond to “X is above Y” and “X is in contact with Y”, but which, so far as the computer is concerned, are just symbols. Such a symbolization describes how various parts – points, edges, surfaces, etc. – are related to one another. Objects in a scene are described using such symbolizations.

According to objectivist cognition as applied to visual information and mental imagery (Pylyshyn, 1981), only such propositional representations are mentally real, while images are not real. This view stems from taking objectivist cognition *very* seriously. Since objectivist cognition requires that all cognitive processes work by the manipulation of such arbitrary symbols, objectivist cognition *requires* not only that visual perception and mental imagery be characterizable in such a “propositional” form, but also that such symbolic representations, and only those, are mentally real.

Our visual experience makes image-schema transformations natural and plausible on the assumption that they have an imagistic character. As relations among schematic *images*, they are natural; as relations among arbitrary symbols, they are unnatural and implausible. Moreover, the relationships defined by image-schema transformations do not exist objectively in the world external to human beings. They are relationships that are defined by the human perceptual and cognitive apparatus. Yet, relative to the English lexicon, they are *semantic* relationships, systematic relationships having to do with the meanings of words.

This is inconsistent with objectivist cognition, and the symbolic theory of meaning that it employs. On the objectivist view, all meaning concerns the relationship of symbols to external reality, and all semantic relations must be characterized in these terms. But the systematic semantic relations between senses of words that we have just discussed cannot be characterized by reference to external, mind-free reality. Those semantic relations have to do with image-schema transformations, which are characterized by the human perceptual and cognitive systems and not by any mind-free reality.

The very existence of systematic semantic relationships characterized by image-schema transformations thus conflicts with *both* parts of objectivist cognition.

– The fact that these *semantic* relationships (that is, relationships concerning the meanings of words) exist by virtue of the human perceptual and cognitive systems is in conflict with the idea that semantics can be

characterized only by the relation between symbols and external mind-free reality.

– The fact that these cognitively real relationships between the meanings of words can be characterized naturally only in terms of schematic *images* and not in terms of arbitrary symbols is in conflict with the idea that *meanings* are represented cognitively only by arbitrary symbols, as the algorithmic view of thought demands.

Both the symbolic theory of meaning and the algorithmic theory of cognitive processes are inconsistent with the very existence of *any* such phenomena.

The existence of systematic semantic relationships of the sort we have just described places a constraint of major importance on the representation of meaning in the mind. Cognitively real representations of meaning must make use of image-schemas. Image-schemas are not finitary arbitrary meaningless symbols whose internal structure is irrelevant. Image-schemas are nonfinitary (that is, continuous), nonarbitrary, meaningful (via perceptual-motor experience), with a semantically-relevant internal structure.

The internal structure of image-schemas appears to be sufficiently rich and of the right character to permit one to characterize *general-purpose reasoning* in natural language in terms of image-schemas plus such general cognitive operations as superimposition, scanning, focusing, etc. operating on those schemas. This is significant for at least two reasons. It has been commonly assumed that reasoning in natural language makes use of finitary symbols and algorithmic operations using those symbols. This has resulted in a bifurcation between what has been called language-based or “propositional” reasoning on the one hand and the processing of mental images on the other. Kosslyn (1980) has argued that both kinds of processes exist. Pylyshyn has argued that only propositional operations exist and that the processing of mental images makes use of the algorithmic manipulation of finitary arbitrary symbols. The image-schema evidence points to the opposite conclusion – that natural language reasoning makes use of at least some unconscious and automatic image-based processes such as superimposing images, scanning them, focusing on parts of them, etc. It also raises the possibility that visual processing and reasoning using natural language may share some of the same cognitive operations.

Summary

Objectivist cognition is a false philosophical doctrine that stands in the way of research on the nature of meaningful thought. It brings with it a host of other false doctrines, doctrines about metaphysics, meaning, truth, reference, categorization and even definition. These doctrines have

been rejected within the cognitive semantics tradition.

The literature on cognitive semantics is now so voluminous that no introductory survey could do justice to it. The studies in this tradition have two aspects to them — a negative and a positive aspect. These works, in their negative aspect, argue against objectivist cognition, typically against the claim that semantics is characterized by the relationship between arbitrary symbols and mind-free reality. In their positive aspect, these works offer an alternative of a relatively clear character:

Meaning is based on the understanding of experience. Truth is based on understanding and meaning. Innate sensory-motor mechanisms provide a structuring of experience at two levels: the basic level and the image-schematic level. Image-schematic concepts and basic-level concepts for physical objects, actions, and states are understood directly in terms of the structuring of experience. Very general innate imaginative capacities (for schematization, categorization, metaphor, metonymy, etc.) characterize abstract concepts by linking them to image-schematic and basic-level physical concepts. Cognitive models are built up by these imaginative processes. Mental spaces provide a medium for reasoning using cognitive models.

Even though most of these ideas are less than a decade old, they have been investigated and thought through in considerable detail. Here is a selective annotated bibliography so that the interested reader can begin to approach this literature. The most general overall accounts are Lakoff, 1987, and Langacker, 1987.

Selected Annotated Bibliography

BRUGMAN, CLAUDIA

1981 *Story of Over*, University of California, Berkeley, M.A., Thesis. Available from the Indiana University Linguistics Club, Bloomington, Indiana.

This is one of the most detailed studies ever done of the relationships among the senses of a single lexical item. Brugman considers nearly 100 senses of over. She argues that the senses are characterizable by image-schemas and independently necessary metaphors applying to them. The senses form a radial structure, with a central sense and other senses linked to it by image-schema transformations and metaphors.

1983 "Extensions of Body-part Terms to Locating Expressions in Chalcatongo Mixtec", in University of California, Berkeley, Report No. 4 of the Survey in California and Other Indian Languages.

CASAD, EUGENE

1982 *Cora Locationals and Structured Imagery*, University of California, San Diego Ph.D. Dissertation.

The studies by Brugman on Mixtec and Casad on Cora demonstrate that space is conceptualized in those languages in a way that is radically different from the conceptualization of space in Indo-European languages. In Mixtec, relative spatial location is conceptualized in terms of the metaphorical projection of body-part concepts onto objects. In Cora, there is an extensive system of locational morphemes. Each phoneme in such a morpheme designates an image-schema, and the meaning of the morpheme is given by the superimposition of all the schemas.

FAUCONNIER, GILLES

1985 *Mental Spaces*, Cambridge, Mass., MIT Press.

Within cognitive semantics, mental spaces play many of the roles that possible worlds and Barwise-Perry situations play in objectivist semantics. They are partial models. They contain (mental) entities. They permit the explicit statement of conditions of satisfaction. Entailment can be characterized relative to them. They bear relations to one another. But they are cognitive in nature; they are not interpretable as fitting objectivist metaphysics. Mental spaces provide the apparatus needed for a precise cognitive model theory, without the limitations of objectivist philosophy. Fauconnier's book presents a unified account of metonymy, presupposition and referential opacity making use of mental spaces, connectors, and cognitive strategies. The strategies are formalized versions of the following:

- Avoid contradictions within a space.
- Distinguish between foregrounded and backgrounded elements.
- Maximize common background assumptions across adjacent spaces.
- Currently foregrounded elements are subsequently backgrounded.

Fauconnier demonstrates that these simple intuitive strategies provide a simultaneous solution for both referential opacity and the projection problem for presuppositions.

FILLMORE, CHARLES

1975 "An Alternative to Checklist Theories of Meaning", in *Proceedings of the First Annual Meeting of the Berkeley Linguistics Society*.

1976 "Topics in Lexical Semantics", in P. Cole (ed), *Current Issues in Linguistic Theory*, Bloomington, Indiana University Press.

1978 "The Organization of Semantic Information in the Lexicon", in *Chicago Linguistic Society Parasession on the Lexicon*.

1982a "Towards a Descriptive Framework for Spatial Deixis", in Jarvella and Klein (eds), *Speech, Place, and Action*, London, John Wiley.

1982b "Frame Semantics", in Linguistic Society of Korea (eds.), *Linguistics in the Morning Calm*, Seoul, Hanshin.

1984 *Frames and the Semantics of Understanding*, unpublished ms., Department of Linguistics, University of California, Berkeley.

Within frame semantics, lexical items are defined relative to frames (which are akin to cognitive models, schemas, scripts, etc.). Frames characterize a unified and idealized understanding of an area of experience and Fillmore argues that meaning must be defined in terms of such understandings, not in terms of truth conditions. The principle data that Fillmore draws on is the semantic relationships holding among words within semantic fields.

GENTNER, DEDRE, and DONALD R. GENTNER

1983 "Flowing Waters or Teeming Crowds: Mental Models of Electricity", in D. Gentner and A.L. Stevens (eds), *Mental Models*, Hillsdale, N.J., Erlbaum.

The authors show that reasoning about electricity by students learning about it is done using metaphorical models. The students get different answers to problems based on the metaphorical models used. The study is significant for cognitive semantics since it demonstrates that metaphorical models are used in reasoning, which contradicts objectivist cognition and supports cognitive semantics.

HOLLAND, DOROTHY, and NAOMI QUINN (eds.)

1987 *Cultural Models in Language and Thought*, Cambridge, Cambridge University Press.

This volume includes a number of papers that show the utility of cognitive semantics for characterizing culture-specific concepts. Quinn's paper is of special interest in its discussion of the use of image-schemas and metaphor in the characterization of the concept of marriage in America.

JANDA, LAURA

1984 *A Semantic Analysis of the Russian Verbal Prefixes ZA-, PERE- DO-, and OT-*, University of California, Los Angeles, Ph.D. Dissertation.

The semantics of the Russian verbal prefixes has been a perennial problem in Slavic linguistics. Using techniques of image-schematic analysis developed by Lindner, 1981, and Brugman, 1981, Janda is able to display for the first time the regularities among the many senses of four extremely complex verbal prefixes.

JOHNSON, MARK

- 1987 *The Body In The Mind: The Bodily Basis of Reason and Imagination*, Chicago, University of Chicago Press.

Johnson argues that our everyday bodily experiences are preconceptually structured by image-schemas, and that such structuring in our bodily experience provides the basis for our understanding of image-schematic concepts. It is by this means that the body plays a central role in characterizing rational processes. Johnson's book plays a major role in the characterization of experientialist cognition.

KAY, PAUL

- 1979 *The Role of Cognitive Schemata in Word Meaning: Hedges Revisited*, unpublished ms., Berkeley Cognitive Science Program.

- 1983 "Linguistic Competence and Folk Theories of Language: Two English Hedges", in *Proceedings of the Ninth Annual Meeting of the Berkeley Linguistics Society*, pp. 128-137. Reprinted in Holland and Quinn.

The theory of objective reference is a key part of objectivist cognition. Within contemporary philosophy there are two contending theories – Frege's view that sense determines reference and the Putnam-Kripke theory of direct reference. Kay observes that English contains expressions such as strictly speaking, loosely speaking, and technically whose meaning concerns the way reference is fixed. Strictly speaking and loosely speaking are defined relative to a folk version of the Fregean view, while technically is defined relative to a folk version of the Kripke-Putnam theory. Kay argues that this makes sense under Fillmore's theory that words are defined relative to cognitive schemata. In this case, the two cognitive schemata are about reference and are mutually inconsistent. But the meanings of these expressions cannot be given by association with anything in the external mind-free world. The reason is that the expressions are defined in terms of two mutually inconsistent accounts of reference, while at most one of these accounts of reference could be true objectively.

LAKOFF, GEORGE, and MARK JOHNSON

- 1980 *Metaphors We Live By*, Chicago, University of Chicago Press.

The book presents evidence that the phenomenon of metaphor can best be explained in terms of conceptual mappings from one conceptual domain to another. Under such a characterization, the meanings of a large proportion of ordinary everyday language can be seen to involve such mappings. The book argues that such a view of meaning is inconsistent with objectivist cognition.

LAKOFF, GEORGE

- 1987 *Women, Fire, and Dangerous Things: What Categories Reveal About the Mind*, Chicago, University of Chicago Press.

Since most reasoning concerns categories, empirical studies of categorization bear crucially on theories of the nature of meaningful thought. This book surveys research on categorization, especially research on basic-level categories and prototype theory. It argues that this research disconfirms objectivist cognition and confirms a version of cognitive semantics. The book also outlines a general theory of cognitive semantics and cognitive grammar and presents three detailed case studies that support the theory.

LANGACKER, RONALD W.

- 1987 *Foundations of Cognitive Grammar*, Vol. 1, Stanford, Stanford University Press. *This is the first of two monumental volumes laying out foundations for a general theory of cognitive semantics and a theory of grammar based on it. Langacker gives a meticulously detailed and carefully thought out account of his theory of "images" (what I have called "image-schemas") and of the cognitive operations needed to operate on them. The volume contains a great many insightful analyses of semantic phenomena.*

LANGACKER, RONALD, and EUGENE CASAD

- 1985 "Inside and Outside in Cora Grammar", *International Journal of American Linguistics*. *An oversimplified version of one chapter of Casad's dissertation. It is an accessible and short discussion of one aspect of the conceptualization of space in Cora.*

LINDNER, SUSAN

- 1981 *A Lexico-Semantic Analysis of Verb-Particle Constructions with Up and Out*, Univer-

sity of California, San Diego, Ph.D. Dissertation. Available from the Indiana University Linguistics Club.

- 1982 "What Goes Up Doesn't Necessarily Come Down: The Ins and Outs of Opposites", in *Proceedings of the Eighteenth Regional Meeting of the Chicago Linguistic Society*. *Lindner's dissertation represented a major advance in the description of polysemy using image-schemas and metaphors. Lindner took up a question that was previously thought to be intractable: How are the senses of particles, such as the out of figure out, space out, and fill out, related to one another. Lindner took as data more than 600 examples of out and more than 1200 examples of up in verb-particle constructions. She showed that systematic semantic regularities appear once image-schemas and metaphors are taken into account in the semantics. In the process, she discovered the existence of reflexive variants of image-schemas.*

PUTNAM, HILARY

- 1981 *Reason, Truth, and History*, Cambridge, Cambridge University Press.

Prior to this book, Putnam was one of the principal figures in objectivist philosophy. His functionalist thesis laid the contemporary philosophical foundation for objectivist cognition. In his classic paper "The meaning of meaning", he had both argued for the theory of direct reference and proposed a way of reconciling the objectivist account of meaning with a schema-based account of cognitive meaning (which he discussed under the rubric of "stereotypes"). In this book, Putnam rejects his former views about meaning and reference. He argues on the basis of a theorem proved in an appendix that all objectivist ("metaphysical realist") accounts of meaning and reference are internally incoherent, and that his own functionalist thesis, on which objectivist cognition depends, is equally mistaken.

REDDY, MICHAEL

- 1979 "The Conduit Metaphor", in A. Ortony (ed.), *Metaphor and Thought*, Cambridge, Cambridge University Press.

This is a classic paper showing the role of metaphor in cognition. Reddy shows that most of our language about communication is based on a single metaphor – the conduit metaphor. Reddy discusses in detail how the metaphor is used in reasoning about communication and what aspects of communication the metaphor hides.

SWEETSER, EVE E.

- 1984 *Semantic Structure and Semantic Change*, University of California, Berkeley Ph.D. Dissertation. Revised version to be published by Cambridge University Press.

Sweetser argues that the historical change of word meaning can only be accounted for by a cognitive semantics that makes use of image-schemas and metaphors. She also argues that the meanings of modal verbs in English (e.g., must, may, can, etc.) are metaphorical in nature and are based on Talmy's "force images".

TALMY, LEONARD

- 1972 *Semantic Structures in English and Atsugewi*, University of California, Berkeley Ph.D. Dissertation.

- 1975 "Semantics and Syntax of Motion", in J. Kimball (ed.), *Syntax and Semantics*, Vol. 4, New York, Academic Press.

- 1978 "Relation of Grammar to Cognition", in D. Waltz (ed.), *Proceedings of TINLAP-2 (Theoretical Issues in Natural Language Processing)*, Champaign, Ill., Coordinated Science Laboratory, University of Illinois.

- 1985 "Force dynamics in language and thought", *Papers from the Parasession on Causatives and Agentivity*, Chicago, Chicago Linguistic Society.

Talmy's work, over many years, has contributed to the development of cognitive semantics in many areas, especially to the role of image-schemas in cognition. His was the earliest detailed research in this area.

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Wendy G. Lehnert

The Analysis of Nominal Compounds*

If one surveys the standard representational techniques for natural language that have evolved in linguistics and artificial intelligence, it is difficult to find much uniformity in the theories proposed. Distinctions are made between linguistic performance and linguistic competence, syntactic regularities and conceptual content, formal semantics and common-sense inference, structural models and process models. An innocent bystander could easily come to the conclusion that the study of language is both ill-defined and lacking in systematic research methodologies. The whole business is rather reminiscent of the three blind men who conclude that an elephant is like a tree, a snake, or a wall: what you find depends a lot on where you poke around.

It is not my intention here to sort out all the conflicting research premises and competing methodologies associated with the study of language. Instead, I will briefly identify my own position with respect to some of these larger issues, and then proceed to discuss a specific problem associated with my end of the elephant. My interest in language addresses language as a vehicle for communication. I am concerned with the conceptual content of sentences and the cognitive processes that extract conceptual content from a text or a discourse. These processes must be described in terms of human memory models and concerns for psychological validity or at least a healthy respect for psychological plausibility. But I am not a psychologist because I do not run experiments on subjects or analyze data. I conduct my research by writing computer programs that simulate language processing behavior. These complex computer programs allow me to develop theories and sometimes test competing explanations within a single theoretical framework. I am happy to borrow ideas from linguistics and psychology, but the theoretical foundations for my work come from artificial intelligence.

I have been involved with the design of many natural language systems, including question answering systems (Lehnert 1978), story understanding systems (Lehnert et al. 1983), and summarization systems (Lehnert 1982, 1984). More recently I have been concentrating on problems specific to conceptual sentence analysis (Lehnert and Rosenberg 1985), a crucial component for virtually all other language tasks. Over the last ten years we have seen tremendous progress in this area, and more than

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