

WORD MEANING

V. C. Mueller Gathercole

One of the questions that has been of importance in the literature over the last half of the twentieth century and beginning of the 21st has been the question of how children acquire word meanings. Words, although small and seemingly straightforward, have proved to be hard to pin down, and many debates regarding the acquisition of word meaning remain unresolved. Research on the acquisition of word meaning has had to grapple with many of the thorniest issues that are at the heart of the nature of language itself--e.g., the nature of the relationship between linguistic symbols and their referents; the question of whether categories of referents are given or are extracted--or better, constructed--by human beings via a filter of human cognition and language; and issues concerning the universality and generality of language-learning processes--whether these are universal across languages and whether these are unique to language (i.e., are "domain specific") or are shared by language and other cognitive systems (are "domain general").

In this chapter, we will examine the major issues that have been of concern to researchers working on the acquisition of word meaning and will attempt to explore the strengths of the approaches taken. In order to understand researchers' proposals, we will first provide an overview of theoretical approaches to word meaning, followed by an exploration of theoreticians' proposed responses within the light of those more general theories.

The issues surrounding the acquisition of word meaning have centered on four primary questions:

(1) *Do children store word meanings in terms of examples of usage or in some more abstract form?*

This first question entails two more intricate questions (a) of how important contextual information is to children's meanings of words and (b) of the relationship between the child's knowledge of the extension of a word and his/her posited intensions for that word.

(2) *To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings?*

A related question is the extent to which semantic development interacts with cognitive development, and whether one is contingent or parasitic on the other.

(3) *To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?*

(4) *Finally, how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy to eliminate child-like forms in favor of adult-like forms, or does*

development towards the adult norm proceed as more common constructs get strengthened through the child's receptive and productive use?

As researchers have explored these questions, a number of child language phenomena have been of interest and have been seen as potentially providing important keys to discovering the processes by which children's word meanings develop. Among the salient phenomena are (1) certain types of uses and misuses of words as well as (2) facility in word-learning, accompanied by perceived preferences in children's applications of words.

Children's misuses of words include a variety of types: (a) Most generally, children may occasionally use words in a manner that appears to assign either the completely wrong word category (using a verb as if it were a noun) or an apparently totally incorrect mapping of the meaning of a word. Examples are given in (1), including cases of persistent misuse (such as Rachel's *too heavy* for "can't" and *mine* for "change of location" or "give").

1. Sadie 1;6.1 *cook* for "food"
- Sadie 1;8.15 *hungry* for "thirsty"
- Sadie 1;8.15 *reach* for "can't do X" (e.g., S was trying to fold a towel, and couldn't do it)
- Rachel 2;6.27 *too heavy* for "can't"
- [Mother suggesting that Rachel put on her own socks:]
Mother: You put on your socks.
Rachel: [āi] too heavy. [= "I can't"]
- Rachel 2;7.16 *It loves me.* [re: towel wrapped around her]
- Rachel 4;8.26 *marry* = ?
Rachel: I married you today.
Mother: You did?
[Rachel nods.]
Mother: Are you my husband?
Rachel: No, I'm your little girl, and I love you. [R hugging MOT].
- Rachel 1;7 *mine* = "give" / change of location?
- Rachel 1;7.5 *mine* [R holding out hands for bottle on table; like "give"]
- Rachel 1;7.20 *mine* [R handing MOT the salt].

Rachel 1;7.21 mine [R handing MOT MOT's hat].

Rachel 1;7.22 mine [R pulling her tray to herself].

Rachel 1;7.23 mine [R giving MOT milk carton].

Apart from such general mis-assignments of word category or meaning to a word, several other specific types of errors are frequently reported in the literature, two of which have to do with the range of usage and application of a word relative to the adult usage:

(b) Overextensions of words. Children use words beyond the range of usage normal in the adult language. Examples are shown in (2) (the last example, from Jaime, is included to show that such uses are not restricted to very young children):

2. Sadie 1;6.1 *dimple*: for dimples, lip, nipple

Mama: for mother or father

Sadie 1;7.9 *tie*: for tie or untie

marker: for any drawing implement: markers, pens, pencils, crayons

work: for "X works" or "X doesn't work"

queen: for kings or queens in books

Sadie 1;7.26 *coocoo* [= "cucumber"]: 1st for cucumber, then for moon, anything round shaped,
anything crescent shaped

duck: for any bird

Sadie 1;8.15 *burger*: for burger or sausage patty

Jaime 3;10.4 *buy*: for borrowing a book from the library:

One day we can buy a ABC book from my library.

Jaime 8;5.18 *stem*: for wick of a candle

(c) Underextensions of words. Children use some words for a narrower range of usage than is normal in the adult language. Examples are given in (3).

3. Sadie 1;6.1 *walk*: only for requesting to go for a walk

piggies: only for toe game of "piggy went to market"

baby: only for self

back: only for putting things back

The second set of salient phenomena that have been observed repeatedly in the literature have to do with the fact that, despite the errors evidenced, children on the whole appear to learn words rapidly. Accompanied with that facility for learning words is a certain preference for and consistency in children's early approaches to words. These include:

- (a) an apparent preference for learning words for referents at a 'basic' level of categorization (e.g., *dog*) over either a superordinate level (*animal*) or a subordinate level (*Chihuahua*),
- (b) a greater facility with 'unmarked' words (*big*) relative to their 'marked' counterparts (*little, tall*), and
- (c) greater attention to certain characteristics of referents than to others. For example, the shape of objects appears particularly salient to children and to be important in their usage of words, while the texture of objects does not appear to be so.

Theories of the acquisition of word meaning have largely been developed in attempts to explain and understand one or more of these phenomena in detail. The emphasis has changed over the years from an early focus on the first set of phenomena to a later focus on the second set. Before examining the positions that have been taken with regard to acquisition, however, it is helpful to review some of the most prominent theoretical positions on the nature of word meaning in languages in general, in order to view the acquisition literature in the light of these larger theories. The following section presents some of the major theoretical positions regarding how words have or encode meaning; this is followed by a presentation of some of the major positions researchers have taken, drawing on these various theoretical positions, regarding the acquisition of word meaning. We will end the chapter with current emergentist perspectives of the development of word meaning.

HOW DO WORDS MEAN?

We will group the theories of the nature of word meaning into two major contrasting camps, the objectivist and cognitivist traditions.

OBJECTIVIST POSITION

A useful starting point is a position that has been primary in the Western world over the centuries, what can be called the classical or 'objectivist' tradition (Lakoff 1987, Johnson 1987). Under the objectivist view linguistic meaning entails a mapping between a symbol (e.g., an expression such as *my sister*) and some referent in the real world. The world is made up of individual objects and substances, types of objects, types of substances, and so forth, and each of these can exemplify a

number of properties (color, texture, size, shape) and can participate in a variety of relations with other objects or substances (e.g., one being located relative to another -- X on top of Y, X behind Y, etc.; one acting on another--X falls on Y, X touches Y, etc.; one acting on several --X trades Y with Z; and so forth).

Under a logical, set-theoretical semantics approach to meaning, for every type of word there is a particular type of mapping from the word to the world. Thus, proper nouns (e.g., *Bill Clinton*, *Fran*, *Robbie Williams*) map onto individuals in the world. In the philosophical literature, such terms have been referred to as 'rigid designators' (Kripke 1972, 1980), in that the mapping between the term and that particular individual does not depend on the properties of that individual; the assignment of that linkage took place at the 'baptism' of that item with that particular name (Kripke 1972).

Compare this with common nouns, such as *girl*, *sister*, *mother*, *bachelor*, *dog*, and so forth. Each of these words refers not to an individual in the world, but to a set of individuals: *Sister* refers to everyone in the world who is a sister; *dog* to everything in the world that is a dog, and so forth. These sets thus form the 'categories' of SISTER and DOG.¹

This mapping of a word or phrase onto a set of individuals raises the question of how that mapping occurs. In an objectivist tradition, there is a clear distinction drawn between the *reference* or *extension* of a word (e.g., the set of sisters, the set of dogs) and its *sense* or *intension* (see, e.g., Chierchia & McConnell-Ginet 1992, Chap. 2). A word's intension can be expressed as a function that takes one from a word to its (correct) reference. (It is one's knowledge of a word's intension that allows one to use a word in relation to new, previously un-experienced members of the category.) The nature or content of that intension/sense is a crucial question for semanticists and is a major factor that differentiates distinct theories of word meaning, as we shall see below.

The reference of intransitive (or one-argument) verbs and adjectives is similar to that of common nouns; that is, they refer to sets of individuals. Thus, *eats*, *sleeps*, *(is) red*, and *(is) happy* refer to the sets of individuals or things that eat, that sleep, that are red, and that are happy. The sense or

¹ Throughout this chapter, cited words will occur in italics: the word *sister*; cited meanings will occur in quotation marks: the word *sister* means 'sister'; cited non-linguistic categories or concepts will occur in caps: the word *sister* refers to the category SISTER. Quotation marks are also used for uttered forms: He called her 'sister'.

intension of such words is usually treated in a fashion similar to that used for the sense of common nouns.

The reference of transitive (or two-argument) verbs is a set of pairs of individuals: thus *feeds* and *knows* and *follows* refer to sets of pairs of individuals; in the first case the pairs involve a feeder and a feedee, in the second, one member of the pair is a knower and the other what is known, and in the third the first member is a follower and the second the person or thing followed. In these cases, the sense or intension of such words will involve a relation between such pairs.

Finally, the reference of some words is a relation between objects, actions, and so forth. This is typical of, e.g., locative prepositions (*in, on, between*), which express a spatial relation between entities; temporal conjunctions (*before, during*), which express a temporal relation between actions or states; and causal conjunctions (*because, if...then:*), which express a causal relation between events or states.

Set-theoretic semantics is largely based on this type of language-to-world mappings. The meanings of complex expressions can, in principle, be computed from the meanings of the parts. Thus, e.g., a phrase such as *happy girls* refers to the intersection of the set of things that are happy and the set of things that are girls; *blue socks* to the intersection of things that are blue and the things that are socks, and so forth (see Kempson 1977, 2001 for details and some problems).

There are certain implications of an objectivist view, or certain assumptions intrinsic to this position that are important for considerations of language acquisition. These include, first, the assumption that some things / some phenomena--objects and sets and categories and relations--exist in the world. Language simply serves to label those objects and sets and categories and relations.

Another is that categories are objective and disembodied. That is, the fact that it is human beings who use and store meanings has no effect on the nature or structure of meaning. (We will see shortly that both of these assumptions have not gone unchallenged.)

Semantic Feature Theories

There are various theoretical approaches to word-level semantics that have been generated within this objectivist model. One approach that has had a long tradition is the Semantic Features approach, also referred to as Componential Analysis, Semantic Decomposition, or the Classical Model. Under the Semantic Features approach, words can be broken down into components of meaning, and the meanings of words, or their intensions, involve a set of semantic features specifying

the defining characteristics for membership in the category named by that word. For example, the category of *girl* would include any object in the world that exemplified the characteristics [+Animate, +Human, +Female, -Adult]; this set of features is, thus, the intension of the word *girl*. The word *dog* might have the semantic features [+Animal, +Four-legged, +Barks/ +Canine?]. The word *sister* would apply to any object in the world that has features something like [+Animate, +Female] and is in a relation expressible as [+Kin, +Same Generation, +Same Parents] with another person. Anything in the world that exemplified the intersection of one of these groups of features could be called *girl*, *dog*, or *sister*, respectively. And so forth.

Formal advantages: One of the attractions of the SF approach was that it could capture relations between words in a formal and elegant fashion. Words related in meaning fell into semantic fields, and the appropriate use of each word in the field could be specified according to a particular assignment of + and - values of the defining features relevant to that field. Thus, for example, the field of human beings might include the words and features shown in Table 1 (which includes *puppy* for comparison), and the field of words specifying spatial dimensions might be as in Table 2. (A "±" value indicates that the given feature may or may not apply--e.g., *short* might mean "short in height" (the opposite of *tall*) or "short in length" (the opposite of *long*). A "u" value ("unmarked") indicates that a given feature is irrelevant to the application of the given word--e.g., *big*, *little*, and *small* refer to overall size, not a particular dimension, thus the feature [Vertical] is unmarked for them.)

Table 1. Partial entry for Semantic Field for Human Beings

Semantic Feature	WORD					
	<i>man</i>	<i>woman</i>	<i>boy</i>	<i>girl</i>	<i>child</i>	<i>puppy</i>
[Animate]	+	+	+	+	+	+
[Human]	+	+	+	+	+	-
[Male]	+	-	+	-	±	±
[Adult]	+	+	-	-	-	-

Table 2. Partial entry for Semantic Field for Spatial Extent

Semantic Feature	WORD								
	<i>big</i>	<i>little</i>	<i>small</i>	<i>tall</i>	<i>short</i>	<i>long</i>	<i>high</i>	<i>low</i>	<i>wide</i>
[Spatial extent]	+	+	+	+	+	+	+	+	+
[Pole]	+	-	-	+	-	+	+	-	+
[Vertical]	u	u	u	+	±	-	+	+	-
[Primary dimension]	u	u	u	+	+	+	+	+	-

The list of features with the appropriate values assigned served to 'define' each word. Thus, *child* could be defined as [+Animate, +Human, ± Male, - Adult]. This featural approach to intensions was attractive, for one reason, because it allowed for the determination, in a straightforward, computationally elegant, way, of relations between words. Two words were clear synonyms (had the same meaning) if they had identical semantic features and values for their defining features. Thus, *little* and *small*, as specified in Table 2, can be seen as synonymous by virtue of their shared featural specification. Similarly, words were clear antonyms (had opposite meanings) if they shared all the same features, and all of the features except one had the same + or - values. Thus, *boy* and *girl* can be seen as antonyms in Table 1, as can *big* and *little* in Table 2. Similarly, words like *bachelor*, [+Male, +Adult, -Married], and *spinster*, [-Male, +Adult, -Married], could be treated as clear antonyms. And so forth. In addition, this approach allowed for a distinction between 'analytic' truths and 'synthetic' truths: Analytic truths could be defined as propositions that were necessarily true because their truth value is wholly determined by the meanings of the words in the proposition. For example, *Her husband is a man* is necessarily true because the meaning of *husband* includes all of the features that define the word *man*, [+Animate, +Human, +Male, +Adult]. This could be contrasted with propositions such as *Her husband is bald*, whose truth value could only be determined 'synthetically', by checking the empirical facts.

Important characteristics: Certain characteristics set a SF approach apart from other approaches. First, under the SF approach, the application of a word was based on some necessary and sufficient conditions for the use of that word. That is, for example, in order for someone to be called 'boy', all of the features under *boy* in Table 1 must apply, and these features are sufficient for the application of the word. (Any other characteristics present in the referent, or even common across those referents [e.g., short, having high-pitched voices] are therefore irrelevant to calling that person a 'boy'.) Or, to call someone a 'bachelor', that person must be male, adult, and unmarried, and regardless of what other characteristics he might show that may or may not be stereotypical of bachelors, these characteristics are sufficient to license labelling him a 'bachelor'.

This categorical approach to word meaning is probably the most ingrained in our concept as Westerners of what meaning is. It underlies any kind of discussion that entails looking for the 'essence' of something -- e.g., 'What is REAL art?' 'Are digitally modified images REAL photography?' 'Who is the REAL mother of that IVF child?' Such questions reveal people's belief

that it is possible to come up with some necessary and sufficient conditions for membership in the category.

Another important implication of SF approaches to word meaning was that there are clear boundaries between words. Thus, either a person is or is not a member of the set of *bachelors*, or a particular piece of food either is or is not a member of the set of things called *fruit*, or a painting or sculpture either is or is not a member of the things called *art*. Thus, e.g., a tomato belongs either to the set called *vegetable* OR to the set called *fruit*; it is just a matter of determining which it is (e.g., we can call in the experts, the biologists, and have them explain to us the 'true' nature of tomatoes) (Putnam 1973, 1975).

In addition, under a SF approach, all members of a category or set should be equal members. Thus, anyone who can be called 'bachelor' is as good a representative of a bachelor or as good a member of the category ([+Male, +Adult, -Married]) as any other member. Similarly, if the experts tell us that a tomato is indeed a 'fruit', then it is as good a member of this category as any other fruit.

One other aspect of the SF approach that is important is that it made a clear distinction between a 'dictionary' entry for a word and an 'encyclopedia' entry for a word. The dictionary entry would include just those features that were the 'defining' features for the word, such as those listed above for *bachelor*. The encyclopedic entry would include any information beyond that that might influence our knowledge of the application of the word. This could include, e.g., connotations of the word and one's knowledge of non-defining properties of referents of words. Thus, for example, for *dog* the encyclopedic entry might include information on normal size, whether one's experience with dogs had been of a friendly or vicious nature, and the like, and for *bachelor*, the encyclopedic entry might include a stereotypical type of lifestyle, and connotations of desirability and sexual activity. Note that by the dictionary definition, according to this approach, *bachelor* and *spinster* are antonyms. However, the encyclopedia entries for these two are radically different: The words *bachelor* and *spinster* typically call up different lifestyles, different desirability quotients, different levels of sexual activity, and the like.

The heyday of the SF approach was during the 1960's and 1970's. But as investigators discovered many of the problems associated with this approach, they turned to other theories of how words mean. The first of these was the Prototype Theory.

Prototype Theory

In its original formulation, prototype theory, like SF theory, fell into the objectivist tradition. Prototype theory, which grew out of the work of Wittgenstein (1953) and Rosch (e.g., 1973, 1975, Rosch & Mervis 1975, Rosch, Mervis, Gray, Johnson, & Boyes-Braem 1976), arose in the face of evidence that not all categories have the type of structure entailed by a SF approach. Whether looking at the full range of application of words or at how people apply words to members of categories, there are aspects of the uses of words that are at variance with the featural analysis approach.

For example, Wittgenstein (1953) noted the internal inconsistencies in the use of the category GAME. He noted that there was no set of characteristics shared by all members of this category. Games variously involve amusement, competition, luck, strategy, and skill, or combinations of these. What links these members is shared 'family resemblances', in that games resemble one another in a variety of ways, just as members of a family do. No classical, objectivist approach to categories was able to handle such a category structure.

Wittgenstein also noted that there were no fixed boundaries to categories: The category GAME could be extended, as long as new games resembled old games to some extent. And finally, Wittgenstein observed that categories can have central members and peripheral members. For example, the category NUMBER can be defined in various ways (to include or exclude irrational numbers and complex numbers), yet any definition will include integers. Integers have a central status for the category NUMBER, a status that no other member can replace.

Rosch complemented this work with experimental evidence indicating that speakers treat categories as having internal structure: Categories include members that are good, 'prototypical', examples and members that are less good, 'non-prototypical', examples. Rosch observed that speakers can respond differently in experimental settings to prototypical and non-prototypical members of categories: They can identify good and less good members of categories, they tend to name good examples first, they react more quickly when making category judgments about prototypical members than about more peripheral members of categories, and the like.

Important characteristics: Based on these facts, prototype theory made the claim, first, that, contrary to the implications of a Semantic Features approach to meaning, there were not necessary and sufficient conditions for membership in a category. Wittgenstein's discussion made this clear, for example, for games. Another example was *fruit*. One might speculate that the defining features for *fruit* might be something like [+Edible, +Grows on trees, +Sweet, +Spherical shape, +Colorful peel, -

Edible seeds or pit]. All of these features are exemplified in fruits such as oranges, apples, peaches. But few, if any, of these features are necessary (e.g., a watermelon does not grow on trees, a lime is not sweet, a banana is not spherical, a kiwi does not have a colorful peel, etc.) and what features may be common to all fruits (e.g., [+Edible]) do not constitute sufficient criteria for membership in the category.

A second tenet of prototype theory, in contrast to the Semantic Features approach, was that categories have graded membership. There are good and less good members. Oranges, apples, and peaches are good examples of fruits; watermelons and kiwis less good. In Rosch's work, experimental participants were able to respond more quickly in making judgments about category membership when the members were central or good exemplars than when the members were more peripheral.

A third tenet of Prototype theory was that there do not have to be clear-cut boundaries between categories; there are often fuzzy boundaries between categories. Take, for example, the case of tomatoes. They are neither a good example of the category FRUIT nor of the category VEGETABLE. Tomatoes fall at the borderline between the two because they have certain characteristics in common with a prototypical fruit, and certain characteristics in common with a prototypical vegetable. (See Hampton, 2007, for a clear recent discussion of the relationship between graded membership, typicality, fuzzy boundaries, and vagueness; see Aarts, Denison, Keizer, & Popova 2004 for a collection of recent works on these issues.)

In the original formulation of prototype theory, Rosch and her colleagues (e.g., Rosch & Mervis 1975) argued that the prototypical structure of categories existed because of the distribution of attributes in the world. The prototype for a category was taken as the member or members of a category that 'bear the greatest family resemblance to [i.e., 'have attributes which overlap those of', Rosch & Mervis 1975: 575] other members of their own category and have the least overlap with other categories' (Rosch & Mervis 1975: 598-599). Differences between categories were maximal between the prototype of one category and the prototype of the next; members of a category that were more on the periphery might share many features in common with those on the periphery of an adjacent category.

Within this conceptualization of prototypes, Rosch developed the notion of 'basic categories', categories such as DOG, which occur at an intermediate level in a network of words, between

superordinate categories (ANIMAL) and subordinate categories (CHIHUAHUA). Basic categories are 'the categories which mirror the correlational structure of the environment' (Rosch & Mervis 1975: 602); 'basic categorization is the most general and inclusive level at which categories can delineate real-world correlational structures' (Rosch, Mervis, Gray, Johnson, & Boyes-Braem 1976: 384).

Basic level categories contrast with those at superordinate and subordinate levels: The members of basic categories share many attributes amongst themselves, but few with members of other categories. In contrast, the members of superordinate categories have few attributes in common, and the members of subordinate categories share many attributes with members of contrasting categories. In addition, the members of basic categories, more than members of superordinate or subordinate categories, were also purported to elicit similar motor sequences by humans, to be easily identifiable by shape, and to be learned first by children (Rosch et al. 1976) (but see Anglin 1977 on evidence that children do not always begin with words at a basic level).

In somewhat later formulations, Rosch moved away from placing categories and their structure 'out there', and towards looking at prototypical effects as arising from human processing of categories. (See discussion in Lakoff 1987.) Rosch et al. (1976) state,

'It has been argued that categories reflect both real world correlational structure and the state of knowledge of that structure of the people doing the categorizing. Since the structure of the environment differs greatly in different parts of the world, one expects the categories of different cultures to differ. In addition, interest in and knowledge of attributes and their correlation for specific domains differ among cultures, subcultures, and individuals' (pp. 434-435),

and

'The correlational structure of the environment, modified by selective ignorance and exaggeration of the attributes and structure of that environment, are mirrored in categorization' (p. 435).

Rosch (1978) goes even further:

'prototypes themselves do not constitute any particular model of processes, representations, or learning.... To speak of a *prototype* at all is simply a convenient grammatical fiction; what is really referred to are judgments of degree of prototypicality.... Prototypes do not constitute a

theory of representation for categories....[T]he facts about prototypes can only constrain, but do not determine, models of representation' (pp. 40-41).

That is, prototype effects do not necessarily reflect the structure of the category at all, but, rather, human ways of using, remembering, and processing categories. In addition, she remarks,

It should be emphasized that we are talking of the perceived world and not a metaphysical world without a knower. What kinds of attributes *can* be perceived are, of course, species specific. A dog's sense of smell is more highly differentiated than a human's and the structure of the world for a dog must surely include attributes of smell which, as a species, we are incapable of perceiving. Furthermore, since a dog's body is constructed differently from a human's, his motor interactions with objects are necessarily differently structured. The "out there" of a bat, a frog, or a bee is surely more different still than that of a human. What attributes will be perceived given the ability to perceive them is undoubtedly determined by many factors having to do with the functional needs of the knower interacting with the physical and social environment. One influence on how attributes will be defined by humans is clearly the category system already existent in the culture at a give time. (Rosch 1978: 30)

This brings us to more non-objectivist positions regarding words.

COGNITIVE LINGUISTIC APPROACHES

Cognitive semantics takes a radically different view of word meanings from that in the objectivist tradition, in that meanings are placed squarely within cognition. We can find non-objectivist approaches in the work of cognitive linguists such as Lakoff 1987, Langacker 1987, 1990, Croft & Cruse 2004, Taylor 1995, Fillmore 1976 (see Ungerer & Schmid 1996 for a general introduction). Meaning is placed within the cognitive realm in two ways--first, meanings are embedded within cognitive patterns of knowledge and belief, and, second, words refer to categories that do not exist out in the world, but, rather, within human cognition of that world.

Meanings are embedded in knowledge structures

Under a cognitive semantics approach, meaning is seen to derive from cognitive structures that shape and link networks of knowledge about the world, about social structures, about human experience, and the like. Johnson (1987) remarks, 'a theory of meaning is a theory of how we understand things....' (p. 190). Johnson continues, '...this is not merely a matter of how some *individual*

might happen to understand something but rather about how an *individual as embedded in a (linguistic) community, a culture, and a historical context* understands' (p. 190).

Words and categories are only meaningful within their frames of reference². For example, Lakoff discusses the use of the word *bachelor*. This category exists within a cultural tradition in which the expected norm is for male adults either to be single or to marry one woman once, and only after a certain (mature) age. An unmarried adult male in such a context can comfortably be referred to as a 'bachelor'. When words are removed from such frames of reference, their application appears odd, non-prototypical, or inappropriate. For example, place the word *bachelor* into a Muslim context in which males can be married to more than one woman at a time, or into a religious context in which the expectation is that a male will never marry, or into a cultural context in which young boys can marry at age 12--and the use of *bachelor* becomes odd: Can a Muslim male who has one wife but is available to marry another woman be called a 'bachelor'? How about a priest or an unmarried 12-year-old?

Given such knowledge structures or frames of reference, individual words get their meanings 'by "profiling", or highlighting, a particular region or configuration in the relevant domain.' (Taylor 1995: 84) 'Profiling entails the structuring of a domain by means of an appropriate "schema", or set of schemas.' (Taylor 1995: 84-85) Thus, *week, day, and Monday* involve the domain of time, with bounded regions profiled by a bounding schema, and sequenced by a sequencing schema.³

Implications: With such a cognitive approach to meaning, the distinction between dictionary and encyclopedic knowledge is abolished. Thus, for example, the meaning of *bachelor* necessarily includes reference to (Western style) schemas of marriage and to cultural interpretations of an adult

² A variety of terms have been used by various authors for similar, overlapping concepts. These include 'frame', 'script', 'schema', 'scene', 'idealized cognitive models', and others. See Taylor (1995: 87) for discussion.

³ If a lexical item corresponds to a number of different domains, one of these domains might be more salient than the others. Differences in the salience of domains can distinguish near-synonyms, such as *salt* and *sodium chloride* (with primary domains of food vs. chemical composition, respectively) and *on land* vs. *on the ground* (primary domains: sea voyage vs. flight) (Taylor 1995, Langacker 1987, Fillmore 1979).

male's motivations for not marrying (see Taylor 1995: 95-97). The contrast between the cultural interpretations of an adult male's failure to marry and an adult female's failure to marry accounts for the lack of strict antonymy between *bachelor* and *spinster*.⁴

Furthermore, the establishment of relations between words is not a necessary element in the establishment of the meanings of individual words. Taylor argues that 'a meaning is, in principle, independent of whatever other cognitive structures happen to be lexicalized in a particular language' (1995: 83). He gives the example of *toothbrush*: One does not need to have contrasting forms such as *nailbrush* and *hairbrush* to be able to understand *toothbrush*. It is the role that a toothbrush plays in dental hygiene that gives the word *toothbrush* its meaning.

Finally, under the cognitive semantics approach, the distinction between 'literal' and 'metaphorical' meaning is also blurred. Recent neurological evidence (Nieuwland & Van Berkum 2006) supports this suggestion: ERP evidence revealed that discourse expectations (regarding animacy) that differed from 'literal' lexical meanings were seen to override those lexical meanings.

Meaning is embodied

In contrast to an objectivist approach, the cognitive semantics approach to meanings and categories denies that categories exist *out there*, in the world. Instead, we human beings take part in the establishment of what those categories are. We do this partly through language, partly through our understanding of our bodies, and partly through our relationship with the world and our peculiarly human way of processing the world. It is how human beings look at the world that imposes structure on it. It is in that structuring that several aspects of meaning that were peripheral or went unrecognized in objectivist views come to the forefront. One is the centrality of cognitive frames/models to meaning, discussed above. Another is the importance of processes such as metaphor and metonymy to meaning, and the resulting predominance of 'radial' categories in language.

⁴ It should be noted that a word's meaning may not include all of one's knowledge about an entity or category, but may instead be related to only a subset of the encyclopedic knowledge associated with it (e.g., perhaps those aspects that show up in linguistic expressions or those aspects that are shared or are believed to be shared by a community of speakers (Taylor 1995)).

Lakoff and Johnson (1980, Lakoff 1987, Johnson 1987) argue that metaphorical and metonymic uses of words are central to meaning, whereas under the classical, objectivist approach, metaphorical uses are considered peripheral. Take the word *sister*, for example. In addition to literal uses of *sister*, defined by the features [+Animate, +Female, +Kin, +Same Generation, +Same Parents], we can use this word in relation to referents that lack some or all of these features: e.g., we can use *sister* in relation to nuns, by a metaphorical extension beyond the prototype, or we can extend it to someone who is a friend that we think of as or like a sister. These extensions are real uses of the word, but they don't have the above features as necessary and sufficient conditions. Under the classical approach, the fact that nuns and friends can be called *sister* is viewed as unimportant and non-problematic. The central interest of the classical theory lay in the 'literal' meanings of words, not their metaphorical extensions. In contrast, the cognitive semantics approach argues that metaphorical uses are an integral part of the meanings of words.

Lakoff argues, in sympathy with Rosch's later position, that it is just such metaphorical and metonymic processes used by humans in storing and interpreting categories that generates the prototypical effects observed for categories. For example, metonymy (using a part for the whole, including treating one member as representative of a whole category), can lead us to treat certain members of a category as more salient or more representative of a category. This can lead to prototype effects in how people process or respond to that member.

Metaphorical and metonymic processes also lead to meaning structures that are 'radial' in form: The category is based, not on a set of members that all share the same central characteristics, but on metaphorical and metonymic links between related uses of words. Thus, the word *sister* applies not only to biological kin, but also to nuns, to close female friends, to nurses (in British English), and so forth. The complete range of uses does not necessarily share any core features or necessary and sufficient conditions in common, but the distinct uses can be seen as generated from each other, often in a kind of complexive chain. The language itself and the received conventions in the dialect being spoken play a role in the establishment of this structure. Thus, British English has allowed the use of *sister* for nurses, while American English does not allow that extension; conversely, American English allows *sister* to refer to African American women (see Aretha Franklin's 'Sisters are doing it for themselves'). We cannot predict *a priori* what the links will be; however, such links are 'motivated' and make sense (Lakoff 1987).

In summary, the crucial differences between a cognitive semantics position and an objectivist position are threefold: First, words/ categories and their use are embedded within complex cognitive schemas within which they derive meaning. Second, categories are embedded in cognitive organizations imposed by humans and languages; they do not exist 'out there' in the world. Third, membership in a category may not be a matter of meeting a set of necessary and sufficient conditions that apply to all members.⁵ Rather, categories can involve radial structures that include metonymic, metaphoric, and image schematic links between uses.

Connectionist Networks/Construction Grammars

A somewhat different focus is taken in connectionist models of language and in construction grammars, especially Radical Construction Grammar (Croft, 2001). Under these approaches, the constructions and words with which a given word is related take on major importance in determining the meaning of that word. It is by virtue of these linguistic links that words derive meaning or by which meanings are established.

While many connectionist models have aimed at modelling aspects of morphology and syntax, a number of connectionist approaches to language have explored the extent to which lexical relations can emerge from distributional information in the input. Such research has provided compelling demonstrations that distributional information alone is sufficient to provide extensive information on word classes and on word relations.

Chater and colleagues (Redington & Chater 1998: 167) conducted 'cluster analyses' of words (i.e., analyses examining which words appear regularly within similar linguistic contexts), based on contextual windows of a few words before or after the word in question. Whether the input to the computer consisted of transcribed adult speech or of written corpora, such cluster analyses yielded dendograms, or hierarchical trees, with clusters of words and word types that were highly reminiscent of standard groupings of words. The groupings that emerged reflected both syntactic categories (verbs, nouns, adjectives, prepositions, etc.) and semantic sets (*{sitting, standing, lying}*; *{telling, asking, listening}*; *{running, jumping, writing}*; *{drawing, painting}*; etc) (Redington & Chater 1998: 170, Fig. 6; see also Fig. 10, p. 180).

⁵ It can be, however, as in the case of 'odd number'. See Lakoff (1987) for discussion.

Similar findings were reported in a number of studies by Burgess and Lund (1997, 1998). For example, in one study (Burgess & Lund 1998), analyses of the co-occurrence of words within a window of text correctly sorted words for animals, words for locations, and words for body parts into separate groups.

Landauer & Dumais (1997) similarly showed that a computerized associative model could 'learn' the meanings of words from simple co-occurrences between words in a text. Their Latent Semantic Analysis model merely counted and analyzed direct and indirect associations between words and the frequency with which they did and did not co-occur. Their model was given a synonyms task from the Test of English as a Foreign Language, and it performed as well on this test as a large sample of applicants to US colleges from non-English-speaking countries did.

More recent work by Li and colleagues (Li, 2003, in press; Li, Farkas, & MacWhinney, 2004) has demonstrated that their DevLex model can process child-directed speech and move progressively from a scattered distribution of distinct types of words towards more compactly dispersed distributions reflecting the bringing together of forms based on syntactic and semantic regularities and similarities.

These computational models of language showing that relations between words and types of words can be derived from co-occurrences within discourse strings have their counterpart in a recently emerging theoretical approach to language, construction grammar, especially Radical Construction Grammar (Croft 2001). Under Radical Construction Grammar, like other construction grammars (e.g., Goldberg 1995), the grammar of a language consists of constructions, conventional symbolic units in which form and meaning are paired. Constructions are of varying degrees of abstraction, ranging from very concrete, or 'substantive', constructions, such as (1), to quite abstract, or 'schematic', constructions, such as (2).

(1) [*kick*-TNS *the bucket*]

[*green*]

(2) [SBJ *be*-TNS Verb-*en by* OBL] (passive construction)

[ADJ] (syntactic category)

Abstract constructions exist only insofar as there is commonality across several constructions. They are, thus, always *language-specific*. Radical Construction Grammar differs from other construction grammars in that it posits that constructions—especially complex syntactic units—are primitive,

while grammatical categories ('Noun', 'Verb', 'Subject', and the like) are derived and are closely tied to--in fact exist only as parts of--the structures in which they occur.

According to Croft (2001), primitive meaning structures are frames in which constructions are used. The meanings of individual components of a meaning structure will be derived from those frames, and, as is the case with syntactic elements in a construction, have no independent existence outside those constructions. However, abstractions from constructions are possible when semantic elements/components recur across constructions, much as abstractions of syntactic constructs are possible when syntactic elements/components recur across constructions (Croft, personal communication). These semantic elements will, like syntactic constructs (see Croft 2001), be language-specific, even though they map onto a universal cognitive space.

What is distinctive about these approaches found in connectionist modeling and in Radical Construction Grammar when it comes to word meaning is the following:

(1) Word meaning resides in the associations and relational links of a given word with other words and with larger structures. Thus, a word's meaning is derived from, resides in, and is inseparable from its relation with its 'neighbors' (in a network of linked associations).

(2) According to Radical Construction Grammar, recurrent elements of meaning (recurrent across words or across constructions) may emerge and have independent status if--and only if--the structural properties of the language encourage an independent existence for them. Thus, while a universal cognitive space is available for understanding language, semantic elements, separate from that cognitive space, may be seen as emergent within a given language as abstract elements of constructions that are linked to syntactic (and lexical) forms.

ACQUISITION OF WORD MEANING

Most of the work on the acquisition of word meaning has taken place within the perspective of one or more of these general theories for meaning. As is the case for the historical development of adult semantic theories from a strictly objectivist view towards more cognitivist views, theories for the development of word meaning in children can be seen as having moved largely from more 'objectivist' positions towards more cognitivist and emergentist perspectives. Initially, in an objectivist vein, the child was viewed as having to discover the meanings of words, with those

meanings existing 'out there', in the adult language⁶. These approaches eventually gave way to positions that attempted to recognize and incorporate the role that children themselves might play in establishing word meanings; many researchers explored what predispositions or biases the child might bring to the task of discovering word meanings. This has gradually given way, in turn, to more emergentist positions in which a complex set of factors is seen to contribute to the emergence of meaning. These factors include information provided to the child via a number of contextual variables, including discourse and social contexts in which words are embedded, input characteristics that vary from language to language, and structural properties of the language itself, which can again vary from language to language.

The following sections review some of the major positions that have been taken concerning the acquisition of word meaning. The goal is to examine how those positions have attempted to answer questions like those set out at the outset of this chapter and, ultimately, to explore how these theories have together illuminated the processes by which children acquire words and their meanings.

EARLY POSITIONS: INTERNAL SEMANTICS OF WORDS

Semantic Feature Hypothesis

Let us start with some of the earliest concerns researchers raised about the acquisition of word meaning, beginning in the 1970's and early 1980's. (See also Greenberg & Kuczaj 1982, Merriman 1986a, Ingram 1989, Dromi in press for insightful reviews.) The initial focus was primarily on the phenomenon of children's overextensions and attempts to discover what these revealed about children's semantic representations of words.

Much of this work was inspired by Clark's influential (1973a) work on word meaning. Drawing on the Semantic Feature Hypothesis for adult language, Clark proposed that children acquire word meanings by gradually adding semantic features, one by one, to words. Clark was interested in the fact that young children produce many overextensions in their speech—for example, using the word *doggy* in relation not only to dogs, but also to lots of other animals, such as cows, cats,

⁶ There are exceptions to this generalization, of course. One notable exception is that Nelson's position has from the beginning recognized the importance of social context, and the embedding of objects within such contexts, in the child's establishment of word meanings.

and horses. She compiled numerous examples of these kinds of overextensions from others' reports in the literature. Clark (1973a:80) reported, for example, that one child used *mooi* (from *moon*) in relation to cakes, round marks on windows, writing on windows and in books, round shapes in books, tooling on leather book covers, round postmarks, and the letter 'O'. Another used *buti* (from *burti* 'ball') for a toy, a radish, stone spheres at the park entrance. *Tick tock* is another example: the first referent was a watch, but it was extended to clocks, all clocks and watches, a gas meter, a fire hose wound on a spool, a bath scale with a round dial. One child extended *tee* (from *Timmy*) to a cat, dogs, cows, sheep, and a horse. In another case, a child used *bébé* 'baby' first in reference to its own reflection in a mirror, and then to a photo of itself, to all photos, to all pictures, to all books with pictures, and to all books.

Clark attempted to explain the mechanism by which children make these extensions. Her hypothesis was that for a word like the above word *tee*, initially applied to a cat, the child at first filled in only one or two semantic features--e.g., perhaps [+Animal, +4-legged]. The implication was that the child at that point thought that the word *tee* meant 'any 4-legged animal' and applied it to other 4-legged creatures--dogs, cows, sheep, horses. With time, the child added other semantic features to the lexical entry, and, as a consequence, gradually narrowed down the reference for the word--in this case, narrowing *tee* down to cats (or a particular cat) only.

Some important aspects of this theory are worth noting. First, children were purported to fill in semantic features from top to bottom--that is, from more general features (e.g., [+Animal]) to more specific features (e.g., [+Barks]). This applied not only to words for concrete objects, but also to other types of words. For example, words for spatial extent (*big, little, tall*, etc.) would be filled in with [+Spatial Extent] before the features for polarity or dimension were added; words for quantities (*more, less*) would have the feature specifying reference to amounts ([+Amount]) before polarity; and so forth.

A second important aspect of the Semantic Feature Hypothesis was the claim that the features that children filled in were perceptual features (very often involving shape), not functional attributes. In the examples cited by Clark, for example, the word for moon (*mooi*) was extended to items that shared shape with the original referent, the moon. The word for ball was extended to round things. Other perceptual features were also in evidence. Some examples Clark gave showed

overextensions based on movement, size, sound, and texture: The word *sch* was used by a child (reported in Leopold 1949) first for the noise of a train, and then it was extended to music and the noise of any movement; *sizo*, from *sciseaux* 'scissors' (Grégoire 1949), was extended from scissors to all metal objects, an extension based on texture. In another example (from Shvachkin 1948), the original referent for the word *va* was a white plush dog, and the word was extended to a muffler, a cat, a father's fur coat, extensions based on texture.

Another important aspect of the Semantic Feature Hypothesis was the notion of how children narrowed down the meanings of words. If a child had all 4-legged animals initially named by the same label (e.g., *bow-wow*), how did he or she get from that point to a more sophisticated point, where the child's speech was more adult-like? Clark's answer was that as children learned competing words--i.e., other words for animals--they started breaking down that semantic domain or field into sub-parts. Eventually the domain would be broken down enough that it ended up like the adult semantic domain. (This critical feature of the Semantic Feature Hypothesis carried over into Clark's later work on Contrast, discussed below.)

Related to this was the notion that words belonged to semantic domains or fields. In the example above, *bow-wow* applied to the semantic domain of dogs, then of dogs, cats, cows, horses, and sheep. Gradually the child broke that down, with the division of the domain first into things called *bow-wow* versus *moo*, then into *bow-wow*, *moo*, versus *gee-gee*, and so forth. The words were assigned to the same semantic field, with the implication that the child had a notion of the relationships between those words, and that those relationships were evident in the features that the words shared.

One final important characteristic of the Semantic Feature Hypothesis was the predictions it made regarding relational words and marked/unmarked pairs of words. As noted above, according to the theory, children initially had incomplete semantic entries for words. In her earliest formulation of the theory, Clark predicted that this would mean the asymmetric acquisition of antonyms and the mis-use of a marked member of a pair as if it were the unmarked member. (See also Donaldson & Wales 1970, H. Clark 1970, Klatzky, Clark, & Macken 1973.) Thus, *big* would be learned before *little*, *more* before *less*, and so forth; furthermore, children should initially treat *little* as if it meant *big*, and *less* as if it meant *more*, since both members of each pair would have the same semantic entry ([+Spatial Extent, +Pole] and [+Amount, +Pole], respectively).

There was initially some support for such predictions. For example, in tests of children's use of spatial adjectives, it was discovered that children often mis-interpreted the more marked adjectives as their unmarked counterparts, or used the unmarked forms where the marked form should be used. Similarly, it was found that in tests of children's understanding of *more* and *less*, when children were presented with two piles differing in quantity and were asked which was *more* or which was *less*, they would respond to both words by choosing the larger amount; thus, it looked as if children thought *less* meant 'more'. Under the 'full' Semantic Feature Hypothesis, Clark argued that children must think that both of these words mean [+Amount, +Pole], reference to a large amount. Eventually they had to correct that, so that only *more* is [+Amount, +Pole], and *less* is [+Amount, -Pole].

However, a flurry of research testing children's understanding of *more* and *less* (see review in Gathercole 1979, Richards 1979) led to a change in perspective. Research made it clear that children were responding in part on the basis of non-linguistic strategies and preferences. That is, it became clear that *less* did not mean 'more' for children, but that children were simply preferring to choose larger amounts in experimental settings. In response to this research, Clark revised her position to the 'partial' Semantic Feature Hypothesis (Clark 1973b, 1975), under which both of the words *more* and *less* were taken to initially mean [+Amount] (i.e., they refer to something about amounts), but children hadn't yet filled in the feature of polarity. This partial semantic knowledge combined with their non-linguistic preferences in experimental contexts, and generally led children to choose the greater amount for both *more* and *less*. Thus, it only appeared that children thought *less* meant 'more'.⁷

The major positions of the Semantic Feature Hypothesis can thus be summarized as follows:
In the child's acquisition of word meanings:

1. Words were divisible into semantic features/components of meaning.
2. Features were filled in gradually.
3. Features were filled in from top to bottom.
4. Overextensions were due to incomplete semantic entries.
5. Perceptual attributes formed the basis for overextensions, not functional attributes.

⁷ See Clark (1977) for a later position allowing for overextensions based on a communicative strategy, rather than as a result of having entered too few features for the semantic entry of a word.

6. Overextensions got narrowed down with the acquisition of new, competing words.
7. There was asymmetric acquisition of antonyms.
8. Children went through stages in which they treated marked terms as if they were their unmarked counterparts; however, this was hypothesized to be due in part to non-linguistic strategies children used in experimental contexts to deal with words they did not have a full grasp of.

Before comparing the Semantic Feature Hypothesis with other theories, let us reflect on the stance this theory took in relation to the major questions at the outset:

- (1) *Do children store word meanings in terms of examples of usage or in some more abstract form?*

The Semantic Feature Hypothesis clearly treated children's semantic entries as abstract from the start, involving abstract semantic features, and implying decomposed lexical entries right from the beginning.

- (2) *To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings?*

How does semantic development interact with cognitive development?

While the Semantic Feature Hypothesis did not directly address this question, it did hold that children assumed that new words competed with old/known words. The acquisition of new words caused the child to narrow her use of old words to a smaller set of referents, by adding semantic features that helped to differentiate the meanings of the two words. Furthermore, this theory was clearly concerned with the content of lexical items, not with the child's understanding of the categories to which those words referred. In the Full Semantic Feature Hypothesis, children's application of a word was seen as arising entirely from the semantic content they had posited for that word; under the Partial Semantic Feature Hypothesis, a child's application of a word was seen as a function of the interaction of the child's lexical entry with his or her non-linguistic preferences. This theory, thus, recognized a clear distinction between the semantic entry for a word and the child's non-linguistic knowledge of or behavior towards the world.

- (3) *To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?*

The Semantic Feature Hypothesis seems to have included components of both the acquisition of words in isolation and their acquisition in relation to other words. Initially, a child hypothesized a feature (or features) for a given lexical item. However, it was only by comparing this word with

other related words that the child was able to fill in the full set of semantic features defining that word. So the network of words was a crucial element of this early theory.

(4) Finally, *how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy, or does development towards the adult norm proceed as constructs get strengthened through the child's receptive and productive use?*

The Semantic Feature Hypothesis included the (roots of) the notion of pre-emption, developed further and more fully in Clark's later work, discussed below. According to the Semantic Feature Hypothesis, the entry of a new lexical item (e.g., *cat*) and its use for a referent (e.g., a cat) that had previously been called by another name (e.g., *doggy*) led the child to narrow down the reference of the latter word, *doggy*, to exclude what was newly referred to with *cat*.

Functional Core Hypothesis

We can contrast the Semantic Feature Hypothesis with a number of other hypotheses prominent in the 1970's. The first is Nelson's Functional Core Hypothesis, contemporaneous with the Semantic Feature Hypothesis. In contrast with Clark, Nelson's concern was not so much children's overextensions. She was focusing, first, on children's earliest uses of words, and their knowledge of concepts with which words were related. Nelson's position drew in part on the Piagetian position that children learn through their own interactions with the world and through the interactions of objects in the world. She argued that it is no accident that children's earliest words refer to things that the child can interact with or that move themselves--e.g., dogs, cats, cars, balls, shoes. From these interactions, concepts emerge that have a 'functional core synthesized from the various relationships and acts into which each concept enters' (Nelson 1974: 278).⁸ The child then matches words to these concepts.⁹

The development of a concept, according to Nelson, did not depend on analysis of attributes of instances, but, rather, on a synthesis of the functional or dynamic relations into which an element entered. (In later work, Nelson (1983) discussed this knowledge of the relations into which objects/concepts enter as knowledge of script representations of events--thus, one might talk of a 'ball

⁸ See Nelson (1979: 49) for the delineation of four major types of function.

⁹ At a later point in development, however, the child's acquisition of semantic knowledge can be language dependent.

script' (p. 183).) So, for example, in acquiring the concept of BALL, according to Nelson, the child noticed the actions and relations in which a ball participated--including that of bouncing or being throwable. This concept could develop from a single instance. Initially, the child's concept contained all of the known relational information, including actors and locations. Eventually, the child detached the functional object concept from the totality of its relationships so that the functional core ultimately contained only the object-specific functional properties.

At the same time, the child abstracted out a set of identifying (perceptual) attributes and stored these with the concept. These later simply served to help the child identify new instances; the functional core remained the determining element; the referential features were purely probabilistic. Nelson (1979, 1981) argued that children's extensions of words to new instances could largely be based on form and identificational features, but the functional core still remained the definitional core. Most overextensions were likely due, according to Nelson, to the fact that 'children are learning simultaneously about language and about object classes in the world' (Nelson 1981: 153), not to a specifically linguistic problem of having to learn what words refer to.

These aspects of the FCH can be summarized as follows:

In the acquisition of word meaning:

1. The child's interaction with objects was important; therefore, functions were central to categorization or concepts of those objects.
2. The child attached a word to the concept developed non-linguistically concerning a referent.
3. Abstraction of features was not an essential component of concept formation; rather, synthesis of functional relationships was primary.
4. While functional characteristics formed the core of a concept, the child's analysis of perceptual attributes could help serve to identify new instances of the category.

To return to the major questions posed at the outset of the chapter, we can delineate Nelson's position as follows:

(1) *Do children store word meanings in terms of examples of usage or in some more abstract form?*

The functional core of a concept was not abstract, and did not depend on abstraction of features. The theory maintained, however, that the child would eventually abstract from the functional core those functional properties that were essential to the concept. In addition, the child would abstract out perceptual attributes, which served to help identify new instances of the concept.

(2) *To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings? How does semantic development interact with cognitive development?*

Concepts were derived from the child's sensorimotor knowledge and the child's learning through interaction with the world. In addition,

'The concept depends upon a prior notion of the boundaries of objects, events, and their relationships. The ball is not confused with self, floor, mother, or playpen, nor is it seen as an unbounded collection of attributes; identity as whole object has already been conferred upon it...[A]lthough the concept is defined contextually, the context is articulated from the beginning. Concept ball never exists as a vague undifferentiated situational whole' (Nelson 1974: 277).

A key difference between this approach (underlined in others' work as well --e.g., see Huttenlocher 1974, Huttenlocher, Smiley, & Ratner 1983) and one like the Semantic Feature Hypothesis is the contention that the important developments occurred in the conceptual system, and language was attached to developing concepts. This view had ramifications for the interpretation of other phenomena observed in the acquisition of words, e.g., in how one interpreted evidence that children knew that certain words were related to one another. The Semantic Feature Hypothesis and other theories like it interpreted this knowledge as reflecting the child's establishment of semantic fields and the assignment of words to semantic fields. Researchers such as Nelson and Huttenlocher, in contrast, discussed this knowledge as stemming from the conceptual realm, not the linguistic realm.¹⁰

¹⁰ For example, Huttenlocher (1974) attributes the fact that any confusions usually occur within domains of objects (e.g., body parts, foods), and not usually across domains, as evidence that the object-schemas for these objects are stored together. They are stored together for a number of possible reasons: First, the objects themselves might occur frequently in spatial proximity (as in case of words for body parts); secondly, the words are often heard in temporal proximity; and finally, the referents of the words may have perceptual and functional similarity. Huttenlocher notes that storing object-schemas close to each other does NOT necessarily imply that there exists a superordinate category (or semantic field) like 'food', 'body parts', etc.

(3) *To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?*

Nelson's perspective focused on the concepts behind words. While she contended that a given concept could be formed from a single instance / context / set of relations, it was the conceptual relations between elements of a context that formed the core of a new concept.

While in its original formulation the Functional Core Model did not address the question of movement towards an adult-like system or the question of relations among words or among concepts, some of Nelson's later work (1979) did. Nelson (1979) argued that eventually the semantic system is developed out of and differentiated from the conceptual system. While at the early stages 'one can discern what appears to be the beginnings of the formation of contrastive sets or semantic fields' (Nelson 1979: 62), a semantic system did not develop until later stages, with the syntagmatic-paradigmatic shift (Nelson 1982) and the development of links between superordinates, subordinates, coordinates, opposites, and synonyms.

(4) *Finally, how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy, or does development towards the adult norm proceed as constructs get strengthened through the child's receptive and productive use?*

The child's initial concept was embedded in context, with all relations (and attributes) specified. The child eventually determined which of the functional relations were the essential ones and which attributes were those with the highest cue validity. Other, optional functional relations got detached from individual contexts / concepts and became available for more (creative) combinations and entered into the child's early sentences.

Movement towards the adult system involved movement from 'the specific concept to a system of relationships and from the conceptual to the semantic level...' (Nelson 1979: 78). Furthermore, it entailed 'the reorganization of the conceptual system itself, which places a boundary between the extra knowledge derived from the child's situational-episodic experience and knowledge implied by the lexical term' (1979: 78)—i.e., from a more encyclopedic storage of lexical items linked to concepts that were embedded in situational-episodic contexts to a more definitional approach to lexical items. This allowed the learner to work 'at a more abstract, purely semantic, level where words do not imply all one's experience with things but only a common

subset of such experience. This development of exclusions is...the major development that takes place during the preschool years....' (Nelson 1979: 79).

'[I]n general we can see a progression of the following sort: from the last quarter of the first year to the last quarter of the second year the child moves simultaneously from the representation of whole events through the partitioning of these representations into reified concepts that can then be mentally manipulated to form new wholes; and through a proto-language state where vocal forms are used procedurally within scripts, to the emergence of lexical symbolic forms that are used to refer to concepts, and the formation of rules for combining words into combinations that can be used to communicate new meanings.

Throughout this progression, language and conceptual development interact.' (Nelson 1983: 186-187)

Missing Features Plus Haphazard Examples Theory

A second alternative to the Semantic Feature Hypothesis--or, in some ways, an expansion of the Semantic Feature Hypothesis--was Carey's (1978a) Missing Features Plus Haphazard Examples Theory. Carey argued that there were a number of major problems with the Semantic Feature Hypothesis. One was that it made some incorrect predictions concerning order of acquisition. The other was that children often knew more about the use of a word than the incomplete featural representation entailed.

With regard to the first of these, Carey examined children's acquisition of spatial adjectives and the prediction that children learned the dimension of comparison for these adjectives before the relevant polar information. Carey's review of empirical work revealed that children could use *big* and *little* contrastively by as young as age 2, and that 2- to 4-year-old children understood negative-pole spatial terms like *short* as well as positive-pole terms like *long*. On the other hand, children's interpretations of such adjectives did not always respect dimension. Carey thus concluded that children's immature entries for such terms had the specification [\pm Pole] filled in before the dimensional features.

A perhaps more significant aspect of Carey's theory was the proposal that children were storing 'haphazard examples' of occurrences of words with those lexical items. Carey argued that if children have immature lexical entries that treat, e.g., *tall* as having the same features as *big* (in Carey's terms: [Adjective] [Comparative] [+Pole]), then they should consistently treat *tall* as if it

means 'big'. However, in an examination of 16 children's performance on the adjectives *tall*, *short*, *fat*, and *skinny* across five different tasks, children's applications of words were inconsistent. Of the 39 patterns of response in which errors occurred, only one had a full pattern of responses that was consistent with the hypothesis that the lexical entry contains an immature set of features, and only that immature set of features. For this reason, Carey argued that children must store examples of the particular objects to which each adjective applies. E.g., *tall* might contain not only [Adjective] [Comparative] [+Pole], but also [___building, ground up; ___ person, head to toe]. Not only did such examples provide the child with dimensional information regarding the application of the word, but they could also 'provide the basis for abstraction of common features within the uses of a word....' (p. 287).

Furthermore, and importantly, these abstractions (features) could then become available as 'lexical organizers' for other words in the child's lexicon. Thus, for example, it was because the child had already posited a feature of polarity for the words *big* and *little* that that feature was readily available, at an early stage, for the specification of the semantic content of other spatial adjectives. Carey argued:

By "available as a lexical organizer," I mean already part of the lexical entry of some word.

Although the features underlying the dimensionality of the domain of spatial extent are part of the child's conceptual system, their linguistic relevance might not yet be recognized. That is, the child might not yet realize that the spatial concepts mark contrasts between words, but because of his knowledge of *big* and *little* (and possibly other relative adjectives like *fast* and *slow*) he does realize that [+pole] and [-pole] mark linguistically relevant contrasts. It is not unreasonable that features available as lexical organizers are mapped onto new words more easily than those that are not yet so available. (pp. 281-282)

In summary, Carey's theory advanced the theorizing regarding the acquisition of word meaning in two important ways: First, she corrected the order in which certain specific features were believed to be acquired. Second, and more importantly, Carey's theory added a number of important components to the Semantic Feature Hypothesis:

1. The Missing Features Plus Haphazard Examples theory posited that the child was storing instances of usage. This theory was thus one of the first to recognize the importance of the memory of instances of usage for the acquisition of words.

2. Carey drew a distinction between this low-level knowledge, based on the storage of instances, and a more abstract level of knowledge, contained in the features abstracted from those instances.
3. Third, the features/phenomena available at this abstract level were posited to be used as 'lexical organizers'--that is, they were available for use in the 'definitions' of other words entering the lexicon. This was the first explicit stance, then, that allowed that prior knowledge gained in acquiring one set of items might be able to facilitate the acquisition of later items.

To return to the initial questions:

- (1) *Do children store word meanings in terms of examples of usage or in some more abstract form?*

The clear response given by the Missing Features Plus Haphazard Examples theory was that children do both. Examples of usage are particularly important at initial stages. From these examples, children extract abstract lexical organizers. These become available for usage in new lexical items, thus enabling and guiding the development of the lexicon further.

- (2) *To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings? How does semantic development interact with cognitive development?*

The Missing Features Plus Haphazard Examples theory fell more on the side of emergentism than given knowledge. Lexical organizers developed from commonalities across usages of a word. These abstractions were thus clearly based on language, not on the child's prior categorization of objects in the world. Language use guided the child in the formation of the categories.

- (3) *To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?*

This theory posited that lexical organizers were abstracted out by the child on the basis of commonalities within the usage of a given word. However, the availability of such lexical organizers facilitated and guided the acquisition of other new word meanings.

- (4) *Finally, how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy, or does development towards the adult norm proceed as constructs get strengthened through the child's receptive and productive use?*

The theory's answer to this question is not clear. However, Carey was one of the first to suggest that the adult system may not actually be as abstract and as regular as was often assumed. She

noted, 'It is possible that even some adults do not discover all the regularities in the domain, never fully representing, for example, how *fat*, *wide*, and *thick* differ, although they know very well some paradigm cases of things that can be each' (p. 288).

Prototype Theory

Another type of response to the Semantic Feature Hypothesis grew out of closer examinations of children's overextensions. The Semantic Feature Hypothesis, at least according to the adult theory, implied that all uses of a word had some necessary and sufficient features that they all shared. The corollary of this was that if children were filling in features for a word one by one, they should use the word consistently with regard to the feature(s) that have already been filled in. So if a child has filled in the word *doggy* with the feature [+4-legged], the child should use that word ONLY for things that are 4-legged, and, conversely, all things that the child uses *doggy* for should have four legs. Similarly, if the child has filled in *moon* with the feature [+Round], all uses in that child's speech of the word *moon* should refer to things that are round. There should not be any variability, just as there shouldn't be in the adult language, according to the semantic feature approach. However, several researchers (Bowerman 1978, Anglin 1977, Greenberg & Kuczaj 1982) argued that this isn't what we find. Children's uses of words did not always exemplify this consistency, but rather varied from application to application, more in keeping with a prototype approach to word meaning.

Bowerman argued, based on children's productions, that the child learns a word with an initial referent and then that referent becomes the prototype of the category.¹¹ Extensions of the word can then be based on any subset of the features exemplified by that prototype. Thus, for example, Bowerman cited her daughter Eva's use of the word *moon*. Eva's first use of the word *moon* was for the real moon. The real moon embodies the features of (a) shape: circular, crescent, half-moon, (b) yellow colour, (c) shiny surface, (d) viewed at an angle from below, (e) flatness, and (f) broad expanse as background. Eva's uses of the word *moon* extended not only to the real moon but also to, e.g., a lemon slice (features a, b, and e), a dial on a dishwasher (a, c, d, e, and f), a shiny leaf (a, c, and e), a ball of spinach (a), circles on a wall hanging (a, d, e, f), a crescent-shaped orange blinker light (a, b?, c, e), steer horns on a wall (a, d, f), and so forth (Bowerman 1978: 279). Her extensions were

¹¹ That first referent may or may not coincide with the prototype for the adult; typically it would, because adults tend to use words for prototypical referents when they are talking to children.

'complexive', meaning that the extensions did not always include all of the same features. Sometimes they involved one (set of) feature(s), sometimes another.

Acquisition with a prototype was not limited to object words. Another example given by Bowerman was Eva's use of the word *kick*. Eva learned *kick* in relation to the kicking of a ball with the foot so that the ball was propelled forward. This involved the features (a) a waving a limb, (b) sudden sharp contact, and (c) an object being propelled. Eva then used *kick* for, e.g., kicking a floor fan with her foot (a, b), looking at a picture of a kitten with a ball near its paw (all features), watching a moth fluttering on a table (a), just before she threw something (a, c), and pushing a teddy bear's stomach against her sister's chest (b) (Bowerman 1978: 273). (See Gathercole 1983, 1985b for further evidence that non-object words are learned around prototypes.)

Another proponent of a prototype approach to acquisition came out of Anglin's (1977; Kay & Anglin 1979) work on children's comprehension of naturally occurring words. He observed that, not only did children overextend words, but they also underextended words--in his work, approximately twice as frequently as they overextended. One of the major factors influencing children to undergeneralize was 'the degree of exemplariness or goodness or centrality' (Anglin 1977: 249) of instances: Children included instances that were central to a concept and often failed to include instances that were peripheral. One of the most important determinants of overextensions was perceptual similarity of a non-instance to the prototype of a category. Anglin noted that preschoolers had difficulties in providing definitions of words and instead often provided instances of a class. Anglin proposed that children's concepts are instance-oriented, with those instances forming a prototype based on their experience. Young children have not yet realized which properties are defining ones, and 'the meaning of the word has not crystallized for the child at the outset, which is why he will overextend it (and underextend it) in production and comprehension' (p. 254).

Anglin speculated on the development from the initial instance-based storage of a word towards more adult-like knowledge: 'The prototype will initially be based upon the first object which is named in the presence of the child and therefore will consist of whatever perceptual information the child remembers of that object although it may also incorporate other information the child had previously stored about such objects. As the child encounters more instances his prototype will become a more generalized conception, a central tendency.' (pp. 260-261). Furthermore, with

development, the child's experience with each concept, with a greater number of concepts, and with relations between concepts will expand, and concepts will gradually become adult-like as a result.

These positions were echoed by Greenberg & Kuczaj (1982). These authors concluded, like Anglin, that 'object-class concepts of young children are characterized primarily by the storage and representation of particular examples of the concept, some of which are prototypic examples.' (p. 298) Greenberg & Kuczaj argued further that the stored representations of particular instances were holistic, rather than being based on some formation and utilization of abstract prototypes and/or specific attribute analysis and comparison. These authors also concurred with Anglin that the child learns to accurately extend object class concepts through more experience with exemplars and nonexemplars, and through implicit and explicit feedback about past and present decisions concerning a concept's extension.

These theorists' positions varied regarding the role of perceptual versus functional attributes in children's uses of words. Anglin reported that, although children often mentioned functional properties when describing instances of a category, the primary basis for classification was perceptual. Both Bowerman and Greenberg & Kuczaj, in contrast, agree that children use both perceptual and functional information in their overextensions of object terms.

The key components of prototype theory for acquisition, then, were the following:

- (1) It allowed, first, that many of the very first uses of words may involve underextensions, or at least will not involve overextensions.
- (2) Secondly, the child was claimed to first use a word in conjunction with the most frequently modeled referent(s). A critical feature of prototype theories was their insistence that children were storing examples of usage for words.
- (3) The child's overextensions of a word could shift complexively, involving various combinations of subsets of the features of the prototype on different occasions.
- (4) Finally, those overextensions could be based on perceptual or functional characteristics.

With regard to the four major questions set out at the outset:

- (1) *Do children store word meanings in terms of examples of usage or in some more abstract form?*

Prototype theory posited that children's usage of a word was grounded in the first exemplar(s) of the use of the word. Any extensions of the word were based on a referent's shared characteristics with that initial referent.

(2) *To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings? How does semantic development interact with cognitive development?*

Prototype theory, like the Missing Features Plus Haphazard Examples hypothesis, placed the child's knowledge of the use or meaning of a word in his or her experience with that word. Any consolidation of a word's meaning, or more systematic understanding of a word's use was posited to come about through further experience with the uses of the word, and perhaps also of other words.

(3) *To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?*

The focus here was on the child's use of single words. The theory did not focus on acquisition across words.

(4) *Finally, how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy, or does development towards the adult norm proceed as constructs get strengthened through the child's receptive and productive use?*

The primary answer, provided by Anglin and Greenberg & Kuczaj, was that as the child gained experience--with the use of the word, with the concepts underlying the word, and with related concepts--the child's understanding would evolve to become more adult-like.

Contrast + Prototype

The Prototype theory for child language focused primarily on the nature of children's overextensions and tried to explain the lack of consistency in these overextensions. However, it largely did not directly address the question of how those overextensions ceased or what the child's knowledge was of the relations between words. To address this issue, Barrett (1982) suggested a combination of the prototype theory with the notion of contrast (Barrett 1978).

Barrett agreed with the prototype theorists that a child could initially learn a word from a single instance, but he argued that the child must eventually contrast words to extract features. In order to do this, Barrett argued, the child goes through a sequence. (1) First, the child learns the word with a prototype, often a single referent. At this point, underextensions can occur. (2) The child then identifies some of the more salient attributes of the prototype. (3) On the basis of these attributes, s/he assigns the word to a semantic field (e.g., of animals or of color terms). (4)

Subsequently, the child identifies the features that distinguish the prototypes of words in the same field. This process allows for the systematic subdivision of the semantic field. And by the end of this process, the child stores the meaning of each word in terms of

'a prototypical referent, a set of features that serve to define the semantic field to which that word belongs, and a set of features that differentiate the prototypical referent of that word from the prototypical referents of the other words within the same semantic field' (p. 319).

During this process, the child's overextensions cease when s/he acquires another word in the same semantic field for the referent in question.

Barrett made two major additions to the prototype theory for child language, then:

- (1) an account of the child's assignment of words to semantic fields, and
- (2) the child's use of a principle of contrast to enable the efficient break-down of the semantic field and contrasting of similar words. (As we have mentioned, this notion of contrast was already a component of the Semantic Feature Hypothesis from its earliest expression, and will recur below in Clark's later work.)

To return to the initial questions:

- (1) *Do children store word meanings in terms of examples of usage or in some more abstract form?*

Barrett's clear response was, like Carey's, that children stored both.

- (2) *To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings? How does semantic development interact with cognitive development?*

Barrett's position entailed initial acquisition with a prototype, from which children extracted an initial set of attributes. But once the word was assigned to a semantic field, further lexical development and differentiation was guided by a principle of contrast. This included the notion that old uses of words could be pre-empted by new words.

- (3) *To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?*

Only the very initial step was isolated. Immediately afterwards, the child was seen to assign words to semantic fields. From that assignment and from comparison with other words, the child determined the semantic entry for the word.

(4) Finally, *how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy, or does development towards the adult norm proceed as constructs get strengthened through the child's receptive and productive use?*

Movement towards the adult norm would presumably occur through the gradual break-down of semantic fields into all the sub-sections specified and labeled in the adult lexicon.

Unfinished Business: Comprehension vs. Production

One issue that arose during these early debates was the question of the relationship between word use in comprehension versus production. Most of the overextension literature focused on children's spontaneous productions. Yet children's comprehension of words might help resolve the question of whether overextensions in production reflected the child's semantic entry for a word or a more ad hoc choice of a word to fill a momentary lexical gap (as proposed by Barrett 1982). In the former case, one would expect similar overextensions in comprehension as in production; in the latter, one would not expect the child to overextend in comprehension.

One of the first to raise this issue was Huttenlocher (1974). In an examination of the early use of words by four subjects aged 10 to 13 months at the beginning of the study, she found 'no evidence for overgeneralization in comprehension, although there was overgeneralization in production for these same children' (p. 354). Huttenlocher thus rejected Clark's (1973a) hypothesis that children overgeneralize words in production because they have incomplete semantic entries for those words. Instead, she suggested two possible sources of errors in production: a child may have some 'prepotent object or action preference' (p. 358) that he or she attaches to the wrong verbal input, or a child may have several 'poorly known words within a single cognitive-semantic domain' (p. 358), such as when children learn the words for body parts. Huttenlocher observed that when children made errors of this type, they 'seemed quite aware of uncertainty' in the choice of words (p. 358).

Kuczaj (1982) challenged the notion that children never overextend in comprehension and argued that this result may be an artifact of the way in which comprehension is tested. He argued that if children are given multiple opportunities to respond to a word, rather than a single opportunity, they may favor prototypical referents in their first choice(s) of exemplars for the word, but if given the chance, then also be willing to overextend the word to non-adult-like referents. When Kuczaj examined young children's interpretations of words that they overextended in

production, he found that the children were likely to first choose prototypical referents for each word, but then also extended the word to non-prototypical referents.

Kuczaj differentiated three distinct patterns of overextension as reflecting different word learning phenomena: When overextensions occur in both production and comprehension, this indicates a common underlying semantic representation used in both modes, and, hence, an immature semantic entry for the word. When overextensions occur in production only or in comprehension only, this could reflect an initial instability for the meanings the child has attached to the word. Finally, overextensions in production only could also result from communicative needs, whereby the child deliberately overextends a word, perhaps to comment on a similarity between objects. (See also, e.g., Gelman, Croft, Fu, Clausner, & Gottfried, 1998, for further more recent evidence on overextensions in comprehension.)

MORE RECENT POSITIONS: LEXICAL CONSTRAINTS AND THE RAPID UPTAKE OF WORDS

Proposed Constraints

While many of the questions regarding overextensions and the child's representation of the semantics of words remained unanswered, researchers' attention shifted somewhat in the 1980's. First, an influential study by Carey and Bartlett (1978) revealed that children could pick up aspects of the meaning of a new word from a single exposure to that word. With such evidence, researchers turned their attention to the problem of how this 'fast mapping' is accomplished by children. In addition, the philosopher Quine (1960) had raised the issue of how a person can figure out the meaning of a new word when it is presented in ostensive contexts. For example, if a rabbit runs past an observer who has no knowledge of the language, and someone points to it and says 'gavagai', Quine asked how that observer knows what the word *gavagai* refers to, out of the infinite number of possible meanings. If children are learning words in such ostensive contexts, how do they home in on the meanings of those words?

The answer that many researchers proposed is that children have certain lexical constraints, or certain lexical biases that they use in trying to figure out the meanings of new words. Lexical constraints are biases or principles that children were hypothesized to use to make good first best guesses about the meanings of new words. They could help explain how children learn so many vocabulary items so quickly, learning thousands of vocabulary items by the time they are 5 or 6 years of age.

A variety of proposals have been made; for the purposes of discussion, I will group these into four sub-types: (1) proposals regarding 'fitting' new words in with old words, (2) proposals regarding the type of referents or categories favored for new words, (3) proposals regarding the child's preference for adult-like forms, and (4) proposals regarding how the child jumps into word learning in the first place.

(1) Lexical constraints involving 'fitting in' new words.

First, there were a number of proposals that argued that children have some bias that will prevent them from using two different words for the same meaning, or for the same referent, or will lead children to use new words to fill gaps in word-referent pairings.

(a) The theory of Contrast was proposed by Clark (1980, 1983a, b, 1987, 1988, 1993), drawing on elements of her earlier Semantic Features Hypothesis. The theory of Contrast held that children assume that no two words can have the same meaning. This constraint would help the child narrow down the meaning of a new word, because any new word would have to mean something different from all other words the child knows. For example, suppose a child has the word *doggy*, used for all animals, and then the child hears a word like *horse* in reference to a horse, a member of the set of things she would have called *doggy*. Contrast might, in the most straightforward cases, help the child to break up the semantic space into sub-components--e.g., the child could assume that the words must refer to different sets of things. However, the child could also make a number of more complex assumptions regarding the relationships of *horse* to *doggy*. One might be that *horse* does refer to dogs, but applies at a different level in the hierarchy from *doggy* (e.g., it might mean 'animal' or 'Dachshund'); alternatively, *horse* might refer to a part or the texture or some other attribute; or it might have the same extension as *doggy* but be used at a different register (e.g., one could be a formal word and one an informal word)¹² or belong to different dialects. Thus, Contrast might aid in the acquisition of words at the same level or at distinct levels and in the acquisition of words for parts, textures, and the like.

¹² 'Register' refers to different levels of formality present in each speaker's speech. These are used in different social contexts--e.g., *man* is relatively neutral with regard to formality, *guy* more informal, *gentleman* more formal. When you are at home, you may speak in one register, while at work in another, using slightly different vocabulary items, slightly different structures, and so forth.

(b) A set of related hypotheses were Mutual Exclusivity (Markman 1987, 1991; Merriman 1986b; Merriman & Bowman 1989; Au & Glusman 1990; Au & DeWitt 1993) and the Novel-name Novel-category (N3C) principle (Golinkoff, Bailey, Wenger, & Hirsh-Pasek 1989; Golinkoff, Mervis, & Hirsh-Pasek 1994). These were not identical, but they aimed to explain the same phenomenon: Typically, in experimental contexts, if a child has a name for one object, but not for another, and the adult uses a novel word-- 'Go get my blicket'--the child will get the object that s/he does not have a name for. The explanation for this, according to these theories, is that there is some lexical bias or constraint that brings children to think that the new word refers to the unnamed item. Mutual Exclusivity (ME) argued that the child assumes that any given object can only have one name, which leads him or her to (a) reject the second word as referring to the same object as the first, or to (b) revise his/her understanding of the first word to exclude some referent that s/he had previously included (see Merriman & Bowman 1989). Markman acknowledges that ME, of course, cannot work forever for children, as they have to learn that objects can have more than one label, as in the case of *doggy* and *animal* for dogs. N3C (Novel name-novel category) principle of Golinkoff et al. (1989, 1994) proposed that children simply follow a principle whereby novel names get attached to novel categories. N3C differed from ME in predicting children's behavior in contexts in which the child hears a new word in relation to a single item for which they already have a word. Under ME, the child should reject the new name for the named item, and she might look around for something else that could be 'blicket', or she will try and figure out what else 'blicket' could be besides the named object. Under N3C, there's no unnamed object in this environment, so N3C does not apply. The child will have to draw on other resources like linguistic and non-linguistic input to try and figure out what *blicket* means.

(2) Lexical constraints involving favoring certain types of referents

Another set of proposed constraints aimed at delineating what aspects of referents were of prominence in children's first guesses about the meanings of words and their extensions.

(a) A number of proposals claimed that children initially assume that a new word refers to a whole object: Markman's (1990, 1991, 1992, 1994) Whole Object principle, Mervis' (1989) object category as referent principle, and Golinkoff *et al.*'s (1989, 1994) object scope principle. These proposals said that the child will assume that a new word refers to a whole object, not to its parts, not to what it's made of, or anything else. Markman argued that the whole object bias worked in interaction with ME: If

the child already had a word for the whole object, ME forced her to assume that the new word refers to something other than the whole object--a part of the object, its substance, etc.

(b) Another set of proposed constraints were the Taxonomic Bias (Markman & Hutchinson 1984; Waxman & Kosowski 1990; Waxman 1990; Markman 1992, 1994) and Categorical Scope (Golinkoff *et al.* 1994). These proposed that children will assume that words are extendible to members of the same class as the initial referent (e.g., *doggy* to cats), rather than to things that are thematically related to the initial referent (*doggy* to bones). Although it was not always explicit what 'same taxonomic class' might mean, Hutchinson (1986) defined objects of a 'similar kind' as 'objects that share perceptual and functional properties as well as internal structure'; Golinkoff *et al.* proposed that, for the child, objects of the same category are going to be things of the same shape as the original.

(c) A related constraint was the Shape Bias for count nouns (Frank, Graham, Poulin-Dubois 1993; Jones, Smith, & Landau 1991; Landau & Stecker 1990; Landau, Smith, & Jones 1988, 1992; Smith, Jones, & Landau 1992; Jones & Smith 1993; Subrahmanyam & Landau 1993). This proposed that children assume that count nouns¹³ are extendible on the basis of shape, not size, not texture, nor any

¹³ Count nouns, in English, are words that can co-occur with the modifiers *a*, *another*, *many*, *few*, numerals, and the plural. An example is the word *ball*: 'a ball', 'balls', 'many balls', 'few balls', 'five balls'. This contrasts with mass nouns, which cannot occur in these contexts, but can occur, instead, in the singular with *some*, *much*, *little*. An example is the word *cheese*: 'some cheese', 'so much cheese', 'so little cheese'. This distributional difference is related to a semantic difference. Count nouns occur in linguistic contexts that provide some type of individuation. So things that are referred to with count nouns come--or we understand them as coming--in individuated, countable units. In contrast, mass nouns occur in linguistic contexts that do not provide individuation. So things that are referred to with mass nouns we understand as coming in non-individuated chunks. (It's not that they necessarily do in the real world for either of these, but that's our understanding. There are exceptions. For example, if you take a word like *magnet*. This is a count noun ("a magnet", "magnets", "so many magnets", etc.), but in a sense magnets don't need to come in individuated pieces of a particular shape or anything like that. If you chop a magnet in half, you end up with two magnets. Whereas with real individuated things in the real world, if you chop them in half, you don't end up with two of that thing. If you take a ball and chop it in half, you don't end up with two balls. So

other property. This position is similar to that taken under Categorical Scope, but note that this theory applied only to count nouns.

(3) Constraint involving a preference for 'received' forms.

Another proposed principle aimed at explaining how children eventually correct errors in forms or in the form-meaning correspondences that they have established. Conventionality (e.g., Clark 1983a) proposed that children are aiming for conventional forms and will eventually give up child-like incorrect forms like *goed* in favor of the conventional form, *went*.

(4) Constraints involving jumping into word learning

Finally, there were a number of principles that addressed how children get started in the first place to acquire words. Two of these were Reference and Extendibility (Golinkoff et al 1994).

Reference simply said that children assume that 'words can be mapped onto the child's representations of objects, actions, events or attributes in the environment' (Golinkoff et al. 1994: 130). Without this assumption, children can't get anywhere in the acquisition of word meaning. By Extendibility children assumed that words are extendible beyond the initial referent. The argument was that without this assumption, children would treat all words as if they were like proper nouns.

Golinkoff et al. (1994) argued that one could set up a sequence of development across these many constraints. Early on (by the beginning of the second year of life, p. 150) the child observes Reference, Extendibility, and Object Scope. Only later (by the middle of the second year of life) will Categorical Scope, N3C, and Conventionality kick in.

An even more recent proposal has been developed by Imai, Kita, Nagumo, & Okada (2008), a "sound symbolism bootstrapping" hypothesis. Imai has proposed, from research on the acquisition of Japanese, that children use phoneme-to-meaning correspondences to bootstrap into the meanings of novel words. Her evidence comes from Japanese-speaking children's abilities to draw on (real) words like *choko choko* (onomatopoetic for a type of motion) to guess that the meaning of a novel word *choka choka* is likely to mean something similar.

there are certain properties that typically go with count nouns--heterogeneity, not being able to break it down, etc.--and that typically go with mass nouns -- homogeneity, being able to break it down, etc.) (See Gathercole 1986.)

Problems

These constraints were during the 1980s and 1990s very prominent in the child language literature and are still assumed by some to hold. However, there were multiple problems with the constraints, both with the individual constraints proposed and with the overall theoretical stance that the constraints represent.

(1) Timing.

First, there were important disagreements within the constraints theorists on the timing of certain phenomena in children's speech—for example, with regard to children's attention to shape. On the one hand Golinkoff et al. posited that children attended to shape early on, as early as the child's observance of Object Scope, by 12 months of age. Markman, on the other hand, said that children did not pay attention to shape until later on, because while children are using the whole object bias, they are treating referents as holistic objects, not breaking them down into components, such as shape.

Another issue relevant to timing was just when the constraints were posited to come in. In the initial formulation of lexical constraints, the constraints were posited to be the key to the child's entry into the lexicon. They should therefore be in evidence very early, or else they would not be of much use to the child in terms of resolving the Quinean dilemma of reference in ostensive contexts. However, the empirical facts did not necessarily support this: Markman argued, for example, that ME is present even at age 2. Merriman & Bowman (1989), in contrast, provide evidence that ME becomes much stronger at age 4 than at age 2. Empirical evidence showing that biases are more discernible at later ages opened the door to the possibility that children's patterns of responses were reflecting what they had learned about language, rather than what they brought to the language-learning task as internal biases. This same criticism might be made with regard to more recent claims, such as Imai and colleagues' claim for sound symbolism bootstrapping. Their (2008) data appear to show stronger effects in older children than in younger children. Again, this suggests that children have been learning from how their language works, rather than using the "principle" as an initial mechanism for making the first steps into language easier.

(2) 'Constraints' versus 'Biases'.

A second issue that arose early in the debates was what researchers meant by the term 'constraint'. Nelson (1988, see also Gathercole 1987) pointed out that constraints should predict 100% conformity in children's use of words. The child language data were full of exceptions, whichever of

these constraints one examined. The constraints theorists answered that the principles compete with each other, so on a given occasion one principle might take precedence over another; in addition, there are other pressures on children, so we might not expect them to follow these all the time.

(3) Lexical constraints or Noun constraints?

One further problem was the question of whether these constraints only applied to nouns or were relevant to other types of words as well. As formulated, many of the principles were supposed to apply to all lexical items initially, with one of the assumptions being that the majority of early words in children's lexicons are nouns for concrete referents (see, e.g., Gentner & Boroditsky in press; but see Nelson 1988). Regardless, Golinkoff, Hirsh-Pasek, Mervis, Frawley, & Parillo (1995) have argued that the constraints are applicable to other types of words, such as verbs, as well.

However, for certain constraints, such as the whole object bias, children would have to override the constraint to acquire the appropriate meanings of non-nominal words, such as adjectives. Indeed, there is clear evidence that children can use the linguistic context in which a word occurs fairly early to infer the possible meaning of the word, treating distinct categories of words differently. For example, Smith et al. (1992) found that if non-object properties of referents are salient enough, young children differentiate novel nouns from novel adjectives, treating nouns as referring to objects and adjectives as referring to properties of objects. If one abandons the notion that constraints such as Whole Object apply to all types of words and allow that they apply only to nouns, it again raises the question of whether children have simply learned what types of references nouns can have.

(4) Logic.

A further problem internal to the constraints proposed is some of the logic behind them. For example, Clark reasoned that Contrast aids the child to eliminate overregularized forms like *goed* and *falld*, when they also often have the irregular forms (*went* and *fell*) in their lexicon: According to the theory, Contrast tells children that no two words can have the same meaning, so they should know that only one of these forms is appropriate. (Convention tells them to retain the form that they hear adults using.) The problem is that if children are assuming that no two words can mean the same thing, they could never get to a point when they knew that *goed* and *went* mean the same thing. Under Contrast, they should assume that there is some subtle difference in meaning between *goed*

and *went*, and so they should search for a dialectal, register, hierarchical, or meaning difference between the two. They should be able to retain them both. (See Gathercole 1987, 1989 for discussion.)

(5) Words are not learned in ostensive contexts, but rather in rich linguistic and non-linguistic contexts.

Apart from these issues that are internal to the proposed constraints, there are more general theoretical problems. The first of these is that the environment in which words are learned is not as is assumed under the Quinean dilemma, nor as is experienced in the experimental contexts common in these studies (Nelson 1988, 1989; Levy & Nelson 1994, Tomasello 2000; Tomasello & Barton 1994; Tomasello, Strosberg, & Akhtar 1996). The real contexts for word learning involve social and contextual support providing multiple cues to the meanings of new words, whether those cues are linguistic or non-linguistic. Children can infer people's intentions with regard to meaning (Tomasello & Farrar 1986, Tomasello & Barton 1994), and children's first guesses about the meanings of new words are highly influenced by attentional factors and by the pragmatic and linguistic input provided with a new word (Merriman & Bowman 1989; Merriman, Marazita, & Jarvis 1995; Smith 1995). If children are presented with a novel object alongside an 'old' object (i.e., one that they have had a chance to play with), they tend to prefer attaching a new word to the novel object, even if they do not have a name for the old type of object; when researchers contrast the referent of a new word with that of an old word, children are more likely to observe ME than when these researchers highlight the similarities between the referents (Merriman and Bowman 1989).

(6) Constraints are not universal.

A more problematic issue is that although many of the constraints theories either implicitly or explicitly entail universality, almost all of the research that has been done supporting these constraints has been conducted on English-speaking children. English-speaking children know English. Or they're learning English. English has certain characteristics in its lexical structure that are not be shared by other languages. Children learning distinct languages seem to start out with different first best guesses about the meanings of new words--and, importantly, those different first best guesses appear linked to differences in the structures of the languages they are learning.

For example, English nouns show several important features that highlight object-hood. There is a clear singular-plural distinction, corresponding to the individuability and quantifiability of referents, two properties that are central to 'objects'. Basic, unmarked forms of nouns for concrete

referents in English typically refer to single whole objects (82% of the time, Gathercole et al 1999); if we want to refer to something different from that, we ADD something: *books*; *five books*. This contrasts with a language like Welsh, in which there is a class of nouns that refer, in their basic, unmarked, forms, to collections; if you want to refer to one member out of that collection, you ADD something. Thus, *plant* refers to 'children', *coed* to 'trees', *sêr* to 'stars', and if you want to refer to one child, tree, or star, you ADD something as a suffix (there may also be an internal vowel change)--*plentyyn*, *coeden*, *seren*.

Research shows that English- and Welsh-speaking children perform differently in word-learning tasks (Gathercole, Thomas, & Evans 2000, Gathercole, Thomas, & Kim 1999). If you present children with a referent that is ambiguous between a single object reading versus a collection reading for a new noun and give children a choice of extending that noun to another single object or to a collection, English-speaking children choose the single object more often than Welsh-speaking children, and Welsh-speaking children choose the collection more often than English-speaking children. This is true even at the youngest age tested, 2 ½ years, but strengthens with age, with greater differences at age 4. This is indicative that the language being learned is guiding children to make their first guesses about the meanings of new words. Their first best guesses appear to be linked to what they have learned so far about the semantic structure of words in the particular language they are learning, which knowledge grows with age.

(7) Foundation in objectivist semantics.

One final theoretical problem with some of the constraints is that they appear to be based, at least implicitly, on an objectivist approach to word meaning and categories. This problem is most apparent in the Taxonomic Bias. The taxonomic bias says that children assume that a word is extendible to things of the same kind, not to things related thematically. 'Same kind' means sharing perceptual, functional, and structural properties (Hutchinson), or at least perceptual properties (Golinkoff et al.).

This appears to ride on an assumption that things that belong to the same category have to have certain necessary and sufficient conditions in common, or certain features in common across the board. Hutchinson (1986) and Markman (1990) argue that most single count nouns refer to objects that are categorically related, not thematically. Markman (1990) asserts,

'...single nouns rarely encode thematic relations. For example, English does not have a single

word for thematically related objects such as a boy and his dog, or a spider and its web, or a baby and its bottle.' (p. 59)

This assertion is blatantly false. The work in cognitive linguistics has made it clear that categories and words related to them involve radial structures and that the referents of a word are not necessarily things that have something in common but may be things that are related somehow thematically. Words with thematic links are not that hard to find, once one starts looking. These include the following:

window

- pane that gets inserted into a hole in the wall ('We need to go to the hardware store to buy some windows')
- the hole in the wall ('Caernarfon Castle has little windows all around the top')

book

- hard-bound sequence of pages with writing on them ('I bought a book on Chomsky in Bookland today.')
- manuscript that is intended to end up as a hard-bound sequence of pages with writing on them ('Sue Grafton just finished writing her new 'P' book in her alphabet crime series.')
- idea in an author's head of content that may end up eventually in a hard-bound sequence of pages with writing on them ('I don't know if I have another book in this brain of mine.')
- hard-bound sequence of pages with no writing on them ('This book is for noting down any interesting ideas you have.')

bar

- a long pole located at a certain height along a wall ('The ballet dancers practiced at the bar')
- a long pole or structure located at a certain height and on which people put drinks, especially alcoholic drinks ('There were four men drinking Scotch at the bar.')
- an establishment in which there is a long pole or structure located at a certain height and on which people put drinks, especially alcoholic drinks ('Let's go to a bar and have a few drinks')
- a section or corner of a room in a home where alcoholic drinks are located and/or served ('In this room, there's a bar over in the back corner')

tea

- a drink made from an infusion of leaves ('The British know how to make the best tea')
- the leaves from which such a drink is made ('This tea is grown in India')
- a meal that includes a drink made from an infusion of leaves, as well as solid food ('That restaurant serves high tea')
- a meal that is taken at a certain time of the day (but does not necessarily include a drink made from an infusion of leaves) ('I need to give the horse his tea now') [British English only]

The list could go on and on, including the British use of *toilet*, the meaning of *mother* and *healthy* (Lakoff 1987), body part terminology (often extended from one part to another on the basis of parallel functions, Anderson 1978), and so forth. There has been little work examining children's acquisition of such thematically related uses of words (although our research has begun to examine this in detail, Gathercole and colleagues, in preparation). The objectivist paradigm has blinded us to the prevalence of such words in language and has led us to overlook the acquisition of many types of words. We need a much broader approach that will encompass the acquisition of words beyond those more central to the objectivist tradition.

Because of these numerous and pervasive problems, researchers have examined alternative approaches. Before turning to these alternatives, however, let us sum up the constraints positions in relation to the four questions posed at the outset.

(1) *Do children store word meanings in terms of examples of usage or in some more abstract form? How important is contextual information to children's meanings of words? What is the relationship between the child's knowledge of the extension of a word and his/her posited intension for that word.*

The constraints literature has not focused on this issue directly. However, some of the proposed constraints can be seen to have focused on the child's attention to the extensions of words (e.g., ME, Taxonomic Constraint), while others entailed the child's postulation of intensions for new words (e.g., Contrast). One shared characteristic of the theories, however, has been that they have all minimized the role of non-linguistic, social, and contextual information, as well as the role of frequency of linguistic input, in the child's first attempts at discerning the meanings of new words.

(2) *To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings? How does semantic development interact with cognitive development?*

The constraints theories as originally proposed fell on the side of given or pre-ordained knowledge guiding the development of word meaning. In recent work (e.g., Woodward & Markman 1998, Hirsh-Pasek, Golinkoff & Reeves 1994), many of these authors have acknowledged a role for social and pragmatic factors in the development of word meanings, but still argue that the constraints are essential for language development (see discussion in Gathercole et al. 2000; see below).

(3) *To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?*

While this issue was not a major focus for these theories, a number of them entailed the comparison of words for the postulation of the meaning or extension of a new word. These include Contrast, ME, and Conventionality. Some of the others, however, including the whole object bias and the shape bias for count nouns, viewed the acquisition of each word as a relatively isolated phenomenon.

(4) *Finally, how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy, or does development towards the adult norm proceed as constructs get strengthened through the child's receptive and productive use?*

Contrast, ME, and Conventionality clearly involved continual reorganization of word-meaning-referent linkages as new words entered the child's lexicon. Conventionality explicitly stated that children would eventually abandon immature forms in favor of adult-like forms.

MORE RECENT DEVELOPMENTS: EMERGENTIST AND CROSS-LINGUISTIC PERSPECTIVES

Given the growing awareness of problems with the word meaning bias theories, and with a concomitant surge in interest in connectionist models of language development (e.g., Plunkett 1998), a radically different approach to the acquisition of word meaning has been proposed in recent years. This alternative approach views the child's knowledge of the possible meanings of words as emerging from the child's accumulated experience with those words and with the language he or she is learning. Two types of research have been key to these developments: research drawing on

connectionist models of language and language learning, and research focusing on acquisition in distinct languages.

A number of researchers have begun to explore the extent to which phenomena that have been observed in children's acquisition of words can derive from simple associations in the input. Perhaps one of the most eloquent defences of the emergentist approach to word meaning lies in Smith's (1995, 1999) discussion of children's attention to shape across ages (see also Landau, Smith, & Jones 1988, 1992). She traces the development of a 'shape bias' from a tendency around 24 months of age to attend to shape. She argues that this attention both strengthens with development and becomes more specific, becoming restricted to count nouns. Importantly, the shape bias increases just after children have acquired around 50 count nouns in their productive vocabularies. Smith concludes that 'learning words *creates* a shape bias' (Smith 1999: 287).

Smith also provides evidence that a shape bias can be 'taught' to children who have not yet acquired 50 count nouns and have not yet developed a shape bias. When such experimental subjects were introduced to four new names for categories whose members shared shape (and non-members did not share that shape), they were able both to extend those names to new exemplars on the basis of shape and to extend other new names for novel objects on the basis of shape. Furthermore, these subjects' word learning outside the laboratory accelerated at a greater pace than control subjects (166% increase versus 73% increase in the number of count nouns).

Smith (1999) reports, further, that other attentional biases emerge from the acquisition of other types of words, such as adjectives. In an experiment in which children were asked to extend novel adjectives to new instances, children who already had more than 50 adjectives in their vocabularies were able to extend novel adjectives on the basis of texture, rather than shape. Smith (1999) concludes that

'ordinary mechanisms of associative and attentional learning...make attentional biases that then promote and speed up the learning of lexical categories consistent with the statistical regularities in that language' (p. 295).

'It is only because words, the syntactic frames of count nouns, regularly predict the context relevancy of shape that these words come to control attention' (p. 296).

Merriman (1999) similarly examines the question of whether a simple associationist model can account for the emergence of phenomena that have been attributed to lexical principles like

Shape/Categorical Scope and Mutual Exclusivity. He has developed a model called CALLED, for Competition, Attention, and Learned LEXical Descriptions. Within the model, associations are formed between representations of features of the world and representations of spoken words. The model incorporates attentional responses to words and forces that direct attention, including the weighting of dimensions and features according to the history of experience with that word, with its context, and with similar or related words and contexts. Merriman argues that the model can explain the emergence of the Shape bias, as a consequence of the dominance of shape in the representation of the first object names that children acquire. Because the dimension of shape is heavily weighted in the cohort of representation of familiar objects, attention will be drawn to shape when a novel count noun is heard.

Similarly, Mutual Exclusivity emerges as a consequence of the competitive retrieval of several words for the same referent. According to the model and consistent with the model's procedures for strengthening and weakening associations, a second label for an object is easy to learn only if that second label leads the child to shift attention to features that are not strongly associated with the first label.

Finally, the model can accommodate children's propensity to choose an unfamiliar object over a familiar one in response to a novel term. The likelihood of choosing the unfamiliar kind is relative to how much the novel object activates the new name relative to how much the known object does. The latter activation will always be lower, because the activation ratio is based on the activation with the novel name divided by the activation with all other words; for the novel object, few other words are likely to be activated, while for the known object, relevant known words will be activated.

Golinkoff, Hirsh-Pasek, & Hollich (1999) are sympathetic to the emergentist approach, allowing both that principles develop and that their two tiers of principles emerge with the child's experience with word learning. However, they argue that the principles cannot be abandoned totally, that there must be something there from the start to explain how word learning gets off the ground. They argue for a "hybrid" account, involving both constraints and social-pragmatic factors contributing to the acquisition of word meaning. What must be present from the beginning, they argue, is, e.g., an immature principle of reference, or knowledge that a word "goes with" a referent. Lexical principles then are "constructed" (p. 324) in the first 24 months of life, and "each of the word

learning principles...undergoes development, becoming reined as a result of word learning experience" (p. 327).

However, researchers have begun to model the acquisition of word meaning with connectionist modeling, and are beginning to demonstrate that phenomena reported in the bias literature can emerge directly from linguistic input. Smith (1995) reported that she and her colleagues were able to demonstrate the emergence of a shape 'bias' with such a computer simulation. Gasser & Smith (1998) demonstrated that the reported advantage of nouns over adjectives in acquisition can be simulated in a connectionist model of word learning. They argued that the earlier, faster acquisition of nouns by children is attributable to "mundane" associative learning: Nouns refer to items in the world that show many inter-related and correlated properties, which are uniformly and closely bounded in all directions. Nouns refer, in Gasser & Smith's terms, to a "hypercube" or "hypersphere". Adjectives, in contrast, refer to objects that are alike on only one property--their application is tightly constrained in only one direction; adjectives refer to a "hyperslab". Thus, the within category similarity is greater for nouns; learning about adjectives "requires discovering and selectively attending to one relevant direction in the multi-dimensional space" (p. 274). In addition to these differences regarding nominal versus adjectival reference, there are differences in the linguistic forms with which nouns and adjectives are linked. Nouns are linked frequently in speech to children with the question "What is this?", while adjectives are variously linked with many different question types: "What color is this?", "How do you feel?", "How big is it?", and so forth. Part of the process of acquiring the category Noun lies, according to Gasser & Smith, in setting up such linguistic linkages. (This suggestion is reminiscent of Rice's (1980) suggestion in the early 1980's that children's first steps in the acquisition of color terms—often before they map a term onto the correct color-- is the linkage between the question "What color is this?" and the color term.)

Gasser & Smith's models were successful in learning the noun categories more quickly than the adjective categories. These authors argue that this is not because of *a priori* conceptual distinctions but because 'underneath all this might be a...mundane distinction, one based on the tendencies of nouns and adjectives to delineate particular sorts of regions in multidimensional perceptual space' (p. 304).

Other computational modelling has revealed similar results with even more complex semantic organization of the language. For example, Li and colleagues (see Li in press) have fed their

DevLex model real-language parental input, from CHILDES transcripts, and observed the extent to which the model developed language-relevant structures. Using a simple unsupervised learning mechanism, whereby the system observes transitional properties of co-occurrences of words in the input and strengthens the associative strength between units when they are activated simultaneously, the model has been capable of developing word classes (nouns, verbs) and semantic classes (e.g., animals, food), as well as covert classes such as the *un-* cryptotype. An important finding of such work is that initially, organization and category membership is diffuse and scattered; it is only with repeated exposure and adaptation to the input structures that the organization becomes more focused and more localized.

In addition to increased attention in the literature to what can emerge naturally from unstructured input, there has been growing attention over the last decades to what crosslinguistic studies of word learning can reveal. Research responding to the word meaning bias literature has made it clear that children learning distinct languages show different approaches to the meanings of new words, and, as noted, the differences are consistent with differences in the structures of the languages they are learning. Imai and Gentner (1997) found differences between Japanese and American children even by age 2 in whether they treated new words for 'simple objects' as referring to objects vs. substances. Gathercole & Min (1997) found similar differences in Korean-, English-, and Spanish-speaking children. As noted above, Gathercole et al (2000) also found differences in Welsh- and English- children's interpretations of new nouns as referring to single whole objects versus collections, already by age 2, but with the differences growing more pronounced at age 4.

Beyond this, however, there has been a surge in crosslinguistic work examining children's acquisition of word meaning and word meaning structures. This work has revealed consistent effects indicating that children are guided from the start by the ways in which the language being learned structures semantic space. Work by Bowerman and Choi and colleagues has made it clear that children's expression of locative relations across languages conforms more with the options encoded in the corresponding adult languages than they do to one another (Choi & Bowerman 1991; Bowerman, de León, & Choi 1995; Bowerman 1996a, 1996b; Bowerman & Choi 2001, 2003). Similar findings have been reported for many domains, including words expressing containment (Narasimhan & Brown in press), words for 'falling' and 'eating' (de Leon in press), dynamic event words (McCune 2006), expressions for spontaneous and caused motion

(Hickmann & Hendriks 2006; Berman & Slobin 1994), and the like. It is clear that in some ways, at least, the language "invites" the child to structure semantic space in particular ways. Learning word meanings is, in part, taking up that invitation.

How, then, do emergentist positions answer the questions posed at the outset?

(1) Do children store word meanings in terms of examples of usage or in some more abstract form? How important is contextual information to children's meanings of words? What is the relationship between the child's knowledge of the extension of a word and his/her posited intension for that word.

According to an emergentist perspective on the acquisition of word meaning, context is everything, at least at initial stages. It is from context--pragmatic, social, linguistic--and from the repetition of words in the same and different contexts that the child can extract patterns of associations. It is clear that the emergentist approach also entails, however, some level of abstraction, or at least systematization of knowledge initially gained on a case by case, piecemeal basis. It is only through such abstraction or systematization that the child is able to make use of knowledge gained in association with one word or set of words in order to acquire another word. Smith (1999) has argued that the child is able to take advantage of experience with the salience of shape with learned count nouns to rely on shape as a critical characteristic in the acquisition of new count nouns; Gathercole et al (2000) have argued that Welsh children's experience with unmarked nouns referring to collections makes them more prepared to treat novel nouns as referring to collections than their English- and Spanish-speaking counterparts, whose languages do not typically provide unmarked nouns that are associated with collections.

(2) To what extent is the direction of development of meaning given or pre-ordained, and to what extent is it derived or emergent? Do children come equipped with some initial knowledge about probable word meanings? How does semantic development interact with cognitive development?

The majority of research in this area has argued that children do not have to come equipped with any type of knowledge specialized for the acquisition of word meaning. The acquisition of words can take place through simple abilities to make and store associations.

(3) To what extent does the acquisition of the meanings of individual words take place in isolation, and to what extent is it related to the child's knowledge of relations between words?

According to connectionist and emergentist models, associations between elements in the system are critical. Associations that are recurrent, both in type and token, are those that are most likely

to get strengthened; those that occur infrequently are likely to become weak and are susceptible to being lost (see Braine 1987, Merriman 1999).

(4) Finally, *how do children move towards adult norms for word meanings? Is there any sense in which children observe a pre-emption strategy, or does development towards the adult norm proceed as constructs get strengthened through the child's receptive and productive use?*

Emergentist approaches see movement towards the adult norm as an inevitable consequence of experience. Through exposure, exposure frequency, and weighting of characteristic associations in the input, a more mature network of associations will evolve. Such approaches eschew any type of pre-emptive principle as an unnecessary complication to the system.

CONSENSUS AND INTEGRATION

After half a century of intense work examining the acquisition of word meaning, what is the picture that emerges as we look forward during this first decade of the 21st century? There are several conclusions that are clear and for which there appears to be little doubt. These are the following:

- (1) Children learn words in context. Examples of underextensions indicate clearly that children's first uses of words are often embedded within a non-linguistic context, which provides a frame for the use of the word. It has been apparent even from some of the earliest theories (e.g. Carey, Barrett) that instances of usage for words are being stored by children for later reference. Those instances may include non-linguistic contextual information (what type of referents has this word been used for, who used this word, what type of contextual frame of reference the word is applicable to, etc.) as well as linguistic (what linguistic frames has this word occurred in, what question was this word used in answer to, and so forth). Recent research indicates that this stored information is likely to include or be affected by frequency of use (Ellis 2002). The more often a word is heard in relation to a given frame or context or other linguistic form, the more the connection between them will be strengthened.
- (2) In addition, children can use words creatively beyond their initial contexts. However, the level of creativity may depend on type of word (Tomasello, Akhtar, Dodson, & Rekau 1997; Sethuraman & Goodman 2004; Goldberg, Casenhiser, & Sethuraman 2004).
- (3) Early usage of words can be quite susceptible to shifting applications, so that uses appear complexively extended. Children may not initially appreciate which are the defining characteristics for the use of a word (Anglin 1977), and the concepts associated with words gradually approach adult-like usage only with experience.

(4) It has also been clear from quite early that children draw out general patterns embedded in words they are learning; this allows them to generalize beyond learned uses, often as a result using words beyond the range of usage in adult language. We can see this process occurring (a) in the application of a single word (e.g., for *tall*, children begin with examples of usage and with time abstract out a feature of verticality as important to usage), and (b) in the application of groups of words (e.g., children's realization that time and space words are semantic neighbors can lead them to overgeneralize a word from one context to the other).

(5) Children can take advantage of regularities in semantic-syntactic linkages learned in relation to one set of words to infer possible meanings of other new words, even by 2 years of age. Thus, children who have learned a core number of nouns in English (especially count nouns, or words that can occur in the syntactic frame 'a...') will discover that shape is a consistent element relevant to the application of those words, and will allow this prolifically to guide their application of new nouns. Korean- and Japanese-speaking children, on the other hand, learn early that nouns can refer to substances and use this knowledge to infer the meanings of new nouns, and Welsh-speaking children learn that nouns can refer to collections and similarly allow that new nouns can refer to collections. Children make use of such regularities to construct 'semantic templates' available for application to new words.

(6) Finally, children acquiring different languages can thus show influence from the language they are learning right from the beginning. That influence guides children's semantic structure to become consistent with that of the adult language.

These conclusions are consistent with an emergentist or constructivist-cognitivist account of semantic development in children. Such an account must incorporate several aspects to adequately account for acquisition:

- Children acquire language in context, from which the language derives, or in which the language encodes meaning. Outside of the contexts of reference, the language loses the full meaning associated with the words and expressions as used in context.
- Yet, in order for language to be used productively, the child's knowledge of the language must go beyond those contexts. The mechanism for going beyond contexts is one of abstraction of the common recurrent associations of form with meaning and of words with linguistic and non-linguistic

contexts. These common associations act as semantic templates available for use with new words and expressions.

- Such a process will be dependent to a large extent on language-specific structures governing the packaging of semantics. Insofar as languages differ widely in how meaning gets packaged, children's acquisition of languages will differ accordingly.

- At the same time, the possible semantics that a child might entertain as linked with a linguistic form will be dependent in part by the current cognitive abilities of the child: The meanings of early dynamic event words will be dependent on early sensorimotor intelligence, but the particular language being learned will "mold" this consistent early cognition in language-specific ways (McCune 2006); children's discovery of commonalities across the usage of nouns for similar shape or similar substance, rather than, e.g., function, are in part dependent on the greater cognitive accessibility of such overt characteristics over more covert characteristics like functional properties. Perceptual characteristics are often more accessible than functional ones—so even though functions are important for adult categorization, they may be less likely to be used as 'lexical organizers' early on (Gathercole & Whitfield 2001). Similarly, the child's understanding of social structures and of the world in general will set limits on the abstractions that can be drawn out, as will the fact that children are HUMAN processors of the world. We will return to this issue in chapter 8.

- The ultimate semantic structures that a child will arrive at will necessarily be consistent with those offered by the language being learned. Such structures go well beyond what has largely been examined in the child language literature, involving not only classical categories--the type of categories that have been traditionally studied in the acquisition of word meaning--but also more complex semantic organization. We do not know much about how children acquire radial categories involving a variety of types of internal links, including multiple metonymic and metaphoric links.

In fact, many of the types of words that have been studied in the past have actually entailed radial categories, but the focus of studies has normally been on only one aspect of each word's meaning. For example, as noted, considerable research has gone into children's acquisition of expressions for spatial relations, both in English and in other languages. We have learned a great deal from this research. Yet most spatial expressions such as spatial prepositions (*in, on, under, over,* etc.) involve quite complex radial categories (see, e.g., the analysis of *over* in Lakoff 1987), and we know very little about the child's knowledge about the full range of application of such words. Our

focus has for too long been on just one type, and one aspect, of word meaning; only by exploring the acquisition of all types of word meanings will we gain a complete picture of development.

- Finally, one other, related, question that is still not very well understood is how children discover or establish the outside boundaries of word usage. We know that children overextend words, in both production and comprehension. But how do they come to the realization that some usages are beyond the normal range of application of a word? Is exposure enough to explain this? Is pre-emption? How does the child come to appreciate that some uses of words constitute 'normal' extensions of words (e.g., *sister* for nurses in British English), while other uses are metaphorical extensions of words? How do children come to appreciate when two uses of the 'same' word are different meanings of the same word (polysemy), while another two uses of what sound like the same word are two 'different' words (homophony)? Some of the answer to these questions may lie in the emergentist principles of strengthening of associations that comes with repeated exposure. However, little is known about what other factors might be involved beyond this.

Current work within more emergentist and constructivist models of acquisition has begun to address some of these issues. Research over the next few years must take seriously the challenges that cognitive linguistic approaches to meaning have raised. It is the norm, rather than the exception, (a) that words are multi-polysemous (one just has to look at any page of a dictionary to see that this is the case), (b) that meaning is embedded in frames of reference, and (c) that meaning of a given utterance is constructed not only from semantic contributions from abstract lexical entries but also from contributions from the discourse, whose semantic structure can override those of the lexical entries (see, e.g., Nieuwland & Van Berkum 2006). Acquisition of meaning needs to be examined in a dynamic light, where words, the syntactic structures in which they are embedded, and the contexts in which they are used all contribute to the child's development of those words. The interaction of these over time in the child's experience, in combination with their interaction with the child's cognitive processing (see chapter 8), will provide the ultimate picture of children's development of word meaning.

An example of this approach can be seen in Gathercole (in press), in which children's developing use of a variety of forms, including *more*, comparatives, superlatives, *too*, *enough*, *as...as*, *much*, *many*, and similar forms, is traced from the earliest usage through age 6 in two children's speech. It is not possible to describe the child's growing understanding of any one of these forms in

isolation, nor without reference to the developmental trajectory over time. A simple example is Gathercole's daughter Rachel's acquisition of the words *many* and *much*. Her initial usage of the term *many* was restricted to use in "the many" in reference to age: e.g., in "This is the many I'm gonna be. I'm gonna be three in a minute" (2;11.6). This expands to use in "how many", also initially for age, as in "And there was a little boy that told me **how many** I am" [i.e., '...that asked me how old I am'] (3;0.26). This early usage of *many* in relation to age seems to have grounded its meaning from the start as being linked with number. The result was that in later developments in her use of *many*, Rachel never deviated from associating *many* with number. Even in the rare case where she used *many* where *much* would have occurred in the adult speech, it was when the quantifier was linked with number: "You know **how many** times I love you? I love you one hundred times" (4;10.7).

This trajectory was radically different from the trajectory for *much*, a word that in the adult language is intimately connected with *many*. *Much* entered Rachel's speech as a second word in the expression *too much* (at 2;11), was later extended to use in *that much* (around 3;6), and then extended further to use in *so much*, *how much*, *as much* (around 4;2). Around 4;6, she began to use several forms, including *much* (*even*, *enough*, *more*, *so*, *very*, *how*) immediately before *A-er*: "enough closer", "even bigger", "more funner", "much bigger", and this was followed around 4;10 with the use of *even* or *much* before *more A-er*: "even more better", "much more bigger". The semantics of *much*, unlike the early restriction of *many* to number, was indiscriminate with regards to number (which is a common pattern for children learning English, Gathercole (1985a, 1986)). Furthermore, unlike for *many*, the developmental course for *much* appears to have been a key element pushing syntactic development forward (see discussion in Gathercole in press).

The picture is similar for each of the other forms examined: Each word begins on a trajectory with early limited usage and gradually expands in usage, both through the child's experience with that word and through the child's growing facility with the lexical, syntactic, and semantic interactions that are relevant to the structures in which that word participates. Even the cases of *many* and *much* are much more complex than the above short summary suggests. Their development was contingent in part on the developments of each of the other forms with which they interacted (*as*, *very*, etc.) and each of the structures in which they could occur (simple structures, complex structures ("There has to be as many people... " [R says she doesn't know how to say it, then:] "There has to be **as many** people ... um ... **that as many** words there are" 5;2.15; Gathercole in press), and the like).

The developmental patterns are influenced, further, by the interactions between the child's developing cognitive knowledge and the semantic and pragmatic import of the linguistic forms.

It is expected that future explorations of semantic development that take such an approach, considering the wider range of semantic, syntactic, lexical, pragmatic, and cognitive factors influencing the child's use of a form, will provide us with a richer picture of the development of word meaning than has been available through more traditional perspectives.

REFERENCES, w.m.chapter

- Aarts, Bas, Denison, David, Keizer, Evelien, & Popova, Gergana. 2004. *Fuzzy grammar: A reader*. Oxford: Oxford University Press.
- Andersen, Elaine S. 1978. Lexical universals of body-part terminology. In Joseph S. Greenberg (ed.), *Universals of human language, Vol. 3*. Palo Alto: Stanford University Press. 335-368.
- Anglin, Jeremy M. 1977. *Word, object, and conceptual development*. N.Y.: Norton.
- Au, Terry K., & DeWitt, Jennifer E. 1993. Acquiring object and attribute names: Preschoolers' use of mutual exclusivity within one language and across two languages. Poster presented at the 60th Biennial Meeting of the Society for Research in Child Development, March, New Orleans, LA.
- Au, Terry K., & Glusman, Mariana. 1990. The principle of mutual exclusivity in word learning: To honor or not to honor? *Child Development* 61, 1474-1490.
- Barrett, Martyn D. 1978. Lexical development and overextension in child language. *Journal of Child Language* 5, 205-219
- Barrett, Martin D. 1982. Distinguishing between prototypes: The early acquisition of the meaning of object names. In S. A. Kuczaj (ed.), *Language development, vol. 1: Syntax and semantics*. Hillsdale, N.J.: Erlbaum. 313-334.
- Berman, R. A., & Slobin, D. I. (1994). *Relating events in narrative: A crosslinguistic developmental study*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Bowerman, M. 1974. Learning the structure of causative verbs: A study in the relationship of cognitive, semantic, and syntactic development. *Papers and Reports on Child Language Development*, 8, 142-178.
- Bowerman, Melissa. 1978. The acquisition of word meanings: An investigation into some current conflicts. In N. Waterson & C. Snow (eds.), *The development of communication*. Chichester: Wiley.
- Bowerman, M. 1982a. Evaluating competing linguistic models with language acquisition data: Implications of developmental errors with causative verbs. *Quaderni di Semantica, Vol. III*, no. 1, 5-66.
- Bowerman, M. 1996a. Learning how to structure space for language -- A crosslinguistic perspective. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (eds.), *Language and space*. Cambridge, MA: MIT Press, pp. 385-436.
- Bowerman, M. 1996b. The origins of children's spatial semantic categories: cognitive vs. linguistic determinants. In J.J. Gumperz & S.C. Levinson (eds.), *Rethinking linguistic relativity*. Cambridge, UK: Cambridge University Press, pp. 145-176.
- Bowerman, M., & Choi, S. 2001. Shaping meanings for language: universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman & S. C. Levinson (eds.), *Language acquisition and conceptual development* (pp. 475-511). Cambridge: Cambridge University Press.
- Bowerman, M. & Choi, S. 2003. Space under construction: Language-specific spatial categorization in first language acquisition. In D. Gentner & S. Goldin-Meadow (eds.), *Language in Mind* (pp. 387-427). Cambridge: MIT Press.
- Bowerman, M., de León, L., & Choi, S. 1995. Verbs, particles, and spatial semantics: Learning to talk about spatial actions in typologically different languages. In E.V. Clark (ed.) *Proceedings of the Twenty-seventh Annual Child Language Research Forum* (pp. 101-110). Stanford: Center for the Study of Language and Information.
- Braine, M. D. S. (1987). What is learned in acquiring word classes: A step toward an acquisition theory. In B. MacWhinney (ed.), *Mechanisms of language*. Hillsdale, New Jersey: Erlbaum. pp.65-87.
- Burgess, C., & Lund, K. (1997). Modelling parsing constraints with high-dimensional context space. *Language and Cognitive Processes*, 12, 177-210.
- Burgess, C., & Lund, K. (1998). Modeling cerebral asymmetries in high-dimensional space. In M. Beeman & C. Chiarello (eds.), *Right hemisphere language comprehension: Perspectives from cognitive neuroscience*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers. pp 215-244.
- Carey, Susan. 1978a. The child as word learner. In M. Halle, J. Bresnan, & G. A. Miller (eds.), *Linguistic theory and psychological reality*. Cambridge, MA: MIT Press.
- Carey, Susan, & Bartlett, E. 1978. Acquiring a single new word. *Papers and Reports on Child Language Development*, 15, 17-29.
- Choi, S. & Bowerman, M. 1991. Learning to express motion events in English and Korean: The influence of language-specific lexicalization patterns. *Cognition*, 41, 83-121.

- Chierchia, Gennaro, & McConnell-Ginet, Sally. 1992. *Meaning and grammar: An introduction to semantics*. Cambridge, MA: MIT Press.
- Clark, Eve V. 1973a. What's in a word? On the child's acquisition of semantics in his first language. In T. E. Moore (ed.) *Cognitive development and the acquisition of language*. N.Y.: Academic Press.
- Clark, Eve V. 1973. Non-linguistic strategies and the acquisition of word meanings. *Cognition* 2, 161-182.
- Clark, Eve V. 1975. Knowledge, context, and strategy in the acquisition of meaning. In D. P. Dato (ed.), *Georgetown University Round Table on Language and Linguistics 1975: Theory and applications*. Washington, D.C.: Georgetown University Press.
- Clark, Eve V. 1977. Strategies and the mapping problem in first language acquisition. In J. MacNamara (ed.), *Language learning ad thought*. N.Y.: Academic Press.
- Clark, Eve V. (1980). Lexical innovations: How children learn to create new words. *Papers and Reports on Child Language Development* 18, 1-24.
- Clark, Eve V. 1983a. Convention and contrast in acquiring the lexicon. In T. B Seiler & W. Wannenmacher (eds.), *Concept development and the development of word meaning*. N.Y. : Springer Verlag.
- Clark, Eve V. 1983b. Meanings and concepts. In P. H. Mussen (ed.) *Carmichael's manual of child psychology*. Vol. 3, *Cognitive development*. N.Y.: Wiley.
- Clark, Eve V. 1987. The principle of contrast: A constraint on language acquisition. In B. MacWhinney (ed.), *Mechanisms of language acquisition*. Hillsdale, N.J.: Erlbaum.
- Clark, Eve V. 1988. On the logic of contrast. *Journal of Child Language*, 15, 317-335.
- Clark, Eve V. 1993. *The lexicon in acquisition*. Cambridge: Cambridge University Press.
- Clark, Herbert. 1970. The primitive nature of children's relational concepts. In John R. Hayes (ed.), *Cognition and the development of language*. N.Y.: Wiley. 269-278.
- Croft, William. 2001. *Radical Construction Grammar: Syntactic theory in typological perspective*. Oxford: Oxford University Press
- Croft, W., & Cruse, D. A. 2004. *Cognitive linguistics*. (Cambridge Textbooks in Linguistics.) Cambridge: Cambridge University Press.
- de León, L. in press. Mayan semantics in early lexical development: The case of the Tzotzil verbs for 'eating' and 'falling down'. In V. Gathercole (ed.), *Routes of language: Studies in honor of Melissa Bowerman*. Taylor & Francis.
- Donaldson, Margaret, & Wales, Roger. 1970. On the acquisition of some relational terms. In John R. Hayes (ed.), *Cognition and the development of language*. N.Y.: Wiley. 235-268.
- Dromi, E. in press. Old Data - New Eyes: Theories of Word Meaning Acquisition. In. V. C. Mueller Gathercole (ed.), *Routes to Language: Studies in Honor of Melissa Bowerman*. Taylor and Francis.
- Ellis, N. C. 2002. Frequency effects in language acquisition: A review with implications for theories of implicit and explicit language acquisition. (Target article) *Studies in Second Language Acquisition*, 24, 143-188
- Fillmore, Charles. 1976. Frame semantics and the nature of language. In *Annals of the New York Academy of Sciences: Conference on the Origin and Development of Language and Speech*. Volume 280: 20-32.
- Frank, Ilana, Graham, Susan A., & Poulin-Dubois, Diane. 1993. Constraining the noun-category bias: The effect of perceptual similarity. Poster presented at the 60th Anniversary Meeting of the Society for Research in Child Development, March 25-28, New Orleans, LA.
- Gasser, Michael, & Smith, Linda B. 1998. Learning nouns and adjectives: A connectionist account. In Kim Plunkett (ed.), *Language acquisition and connectionism*. Hove: Psychology Press. 269-306,
- Gathercole, Virginia C. Mueller. 1979. The acquisition of *more* and *less*: A critical review. *Kansas Working Papers in Linguistic*, Vol. 4, 99-128.
- Gathercole, Virginia C. 1983. Haphazard examples, prototype theory, and the acquisition of comparatives. *First Language*, 4, 169-196.
- Gathercole, Virginia C. 1985. "He has too much hard questions": The acquisition of the linguistic mass-count distinction in *much* and *many*. *Journal of Child Language* 12, 395-415.
- Gathercole, Virginia C. 1985. More and more and more about *more*. *Journal of Experimental Child Psychology*, 40, 73-104.
- Gathercole, Virginia C. 1986. Evaluating competing linguistic theories with child language data: The case of the mass-count distinction. *Linguistics and Philosophy*, 9, 151-190.
- Gathercole, Virginia C. 1987. The contrastive hypothesis for the acquisition of word meaning: A reconsideration of the theory. *Journal of Child Language*, 14, 493-531.
- Gathercole, Virginia C. 1989. Contrast: A semantic constraint? *Journal of Child Language*, 16, 685-702.

- Gathercole, Virginia C. Mueller, Thomas, Enlli Môn, & Evans, Dylan. 2000. What's in a noun? Welsh-, English-, and Spanish-speaking children see it differently. *First Language* 20, 55-90.
- Gathercole, V. C. M., & Min, Haesik. 1997. Word meaning biases or language-specific effects? Evidence from English, Spanish, and Korean. *First Language* 17, 31-56.
- Gathercole, V. C. M., Thomas, E. M., & Kim, S. 1999. Cue coordination: An alternative to word meaning biases. In Barbara Fox, Dan Jurafsky, & Laura Michaelis (eds.), *Cognition and function in language*, Stanford: CSLI Publications. 120-135.
- Gathercole, Virginia C. Mueller, & Whitfield, Lisa J. Cramer. 2001. Function as a criterion for the extension of new words. *Journal of Child Language* 28, 87-125.
- Gelman, Susan A., Croft, William, Fu, Panfang, Clausner, Timonthy, & Gottfried, Gail. 1998. Why is a pomegranate an *apple*? The role of shape, taxonomic relatedness, and prior lexical knowledge in children's overextensions of *apple* and *dog*. *Journal of Child Language* 25, 267-291.
- Goldberg, Adele. 1995. *Constructions. A Construction Grammar approach to argument structure*. Chicago: University of Chicago Press.
- Goldberg, Adele E., Casenhiser, Devin, & Sethuraman, Nitya. 2004. Learning Argument Structure Generalizations. *Cognitive Linguistics* 14 3. 289-316.
- Golinkoff, Roberta, Bailey, Leslie, Wenger, Neill, & Hirsh-Pasek, Kathryn. 1989. Conceptualizing constraints: Why and how many? Paper presented at a symposium entitled 'The case for "constraints" on early lexical acquisition' at the Biennial Meeting of the Society for Research in Child Development, April, Kansas City, MO.
- Golinkoff, Roberta Michnick, Hirsh-Pasek, Kathy, Mervis, Carolyn B., Frawley, William B., & Parillo, Maria. 1995. Lexical principles can be extended to the acquisition of verbs. In Michael Tomasello & William E. Merriman (eds.), *Beyond names for things: Young children's acquisition of verbs*. Hillsdale, N.J.: Erlbaum. 185-221.
- Golinkoff, Roberta Michnick, Hirsh-Pasek, Kathy, & Hollich, George. 1999. Emerging cues for early word learning. In B. MacWhinney (ed.), *The emergence of language*. Mahwah, N.J.: Erlbaum. 305-329.
- Golinkoff, Roberta, Mervis, Carolyn B., & Hirsh-Pasek, Kathryn. 1994. Early object labels: The case for a developmental lexical principles framework. *Journal of Child Language* 21, 125-156.
- Greenberg, Jeff, & Kuczaj, Stan A. 1982. Towards a theory of substantive word-meaning acquisition. In Stan A. Kuczaj (ed.), *Language development, Vol. 1: Syntax and semantics*. Hillsdale, N.J.: Erlbaum. 275-311.
- Grégoire, A., 1949. *L'apprentissage du langage: la troisième année et les années suivantes*. Paris: Droz.
- Hampton, James A. 2007. Typicality, graded membership, and vagueness. *Cognitive Science* 31, 355-384.
- Hickmann, Maya, & Hendriks, Henriëtte. 2006. Static and dynamic location in French and in English *First Language* 26.1, 103-35.
- Hutchinson, J. 1986. Children's sensitivity to the contrastive use of object category terms. Paper presented at Stanford Child Language Research Forum, Stanford, CA, April 1986.
- Huttenlocher, J. 1974. The origins of language comprehension. In R. L. Solso (ed.), *Theories in cognitive psychology: The Loyola Symposium*. Potomac, MD: Erlbaum. 331-368.
- Huttenlocher, J., Smiley, P., & Ratner, H. 1983. What do word meanings reveal about conceptual development? In T. B. Seiler & W. Wannemacher (eds.), *Concept development and the development of word meaning*. N.Y.: Springer-Verlag. 210-233.
- Imai, M., Kita, S., Nagumo, M., & Okada, H. 2008. Sound symbolism facilitates early verb learning. *Cognition* 109, 54-65.
- Imai, Mutsumi, & Gentner, Dedre. 1997. A cross-linguistic study of early word meaning: Universal ontology and linguistic influence. *Cognition* 62, 169-200.
- Ingram, David. 1989. *First language acquisition: Method, description, and explanation*. Cambridge: Cambridge University Press.
- Johnson, Mark. 1987. *The body in the mind*. Chicago: Chicago University Press.
- Jones, Susan S., & Smith, Linda B. 1993. The place of perception in children's concepts. *Cognitive Development* 8, 113-139.
- Jones, Susan S., Smith, Linda B., & Landau, Barbara. 1991. Object properties and knowledge in early lexical learning. *Child Development* 62, 499-516.
- Kay, D. A. & Anglin, J.M. 1979. Overextension and underextension in the child's receptive and expressive speech. SRCO, San Francisco, Calif., March.
- Kempson, R. 1977. *Semantic Theory*. Cambridge: Cambridge University Press.
- Kempson, R. (2001). Pragmatics: Language and communication. In M. Aronoff & J. Rees-Miller (eds.), *Handbook of linguistics*. Malden, MA: Blackwell.

- Klatzky, Roberta L., Clark, Eve V., & Macken, Marlys. 1973. Asymmetries in the acquisition of polar adjectives: Linguistic or conceptual? *Journal of Experimental Child Psychology*, 16, 32-46.
- Kuczaj, Stan A. 1982. Young children's overextensions of object words in comprehension and/or production: Support for a prototype theory of early object word meaning. *First Language*, 3, 93-105.
- Kripke, Saul. 1972. Naming and necessity. In Donald Davidson & Gilbert Harman (eds.), *Semantics of natural language*. Dordrecht: Reidel. 253-353.
- Kripke, Saul. 1980. *Naming and necessity*. Oxford: Blackwell.
- Lakoff, George. 1987. *Women, fire, and dangerous things: What categories reveal about the mind*. Chicago: University of Chicago Press.
- Lakoff, George, & Johnson, Mark. 1980. *Metaphors we live by*. Chicago: University of Chicago Press.
- Landau, Barbara, Smith, Linda B., & Jones, Susan S. 1988. The importance of shape in early lexical learning. *Cognitive Development* 3, 299-321.
- Landau, Barbara, Smith, Linda B., & Jones, Susan S. 1992. Syntactic context and the shape bias in children's and adults' lexical learning. *Journal of Memory and Language*, 31, 807-825.
- Landau, B., & Stecker, D. S. 1990. Objects and places: Geometric and syntactic representations in early lexical learning. *Cognitive Development* 5, 287-312.
- Landauer, T. K., & Dumais, S. T. 1997. A solution to Plato's problem: The latent semantic analysis theory of acquisition, induction, and representation of knowledge. *Psychological Review* 104, 211-240.
- Langacker, Ronald W. 1987. *Foundations of cognitive grammar, Vol. I: Theoretical prerequisites*. Stanford: Stanford University Press.
- Langacker, Ronald W. 1990. *Concept, image, and symbol: The cognitive basis of grammar*. N.Y.: Mouton de Gruyter.
- Li, P. (2003). Language acquisition in a self-organising neural network model. In P. Quinlan (Ed.), *Connectionist models of development: Developmental processes in real and artificial neural networks* (pp. 115-149). Hove, UK & New York: Psychology Press.
- Li, Ping. in press. Meaning in Acquisition: Semantic Structure, Lexical Organization, and Crosslinguistic Variation. In V. Gathercole (ed.), *Routes to language: Studies in honor of Melissa Bowerman*. Taylor & Francis.
- Li, P., Farkas, I., & MacWhinney, B. (2004). Early lexical development in a self-organizing neural network. *Neural Networks*, 17, 1345-1362.
- Leopold, W.F., 1949. *Speech development of a bilingual child*. Evanston, IL: Northwestern University Press .
- Levy, Elena, & Nelson, Katherine. 1994. Words in discourse: A dialectical approach to the acquisition of meaning and use. *Journal of Child Language* 21, 367-389.
- Markman, Ellen M. 1987. How children constrain the possible meanings of words. In , Ulric Neisser (ed.), *Concepts and conceptual development: Ecological and intellectual factors in categorization*. Cambridge: Cambridge University Press. 255-287.
- Markman, Ellen M. 1990. Constraints children place on word meanings. *Cognitive Science* 14, 57-77.
- Markman, Ellen M. 1991. The whole object, taxonomic, and mutual exclusivity assumptions as initial constraints on word meanings. In James P. Byrnes & Susan A. Gelman (eds.), *Perspectives on language and cognition: Interrelations in development*. Cambridge: Cambridge University Press.
- Markman, Ellen M. 1992. Constraints on word learning: Speculations about their nature, origins, and domain specificity. In Megan R. Gunnar & Michael P. Maratsos (eds.), *Modularity and constraints in language and cognition*. Hillsdale, N.J.: Erlbaum.
- Markman, Ellen M. 1994. Constraints children place on word meanings. In Paul Bloom (ed.), *Language acquisition: Core readings*. Cambridge, MA: MIT Press. 154-173.
- Markman, Ellen M., & Hutchinson, Jean E. 1984. Children's sensitivity to constraints on word meaning: Taxonomic versus thematic relations. *Cognitive Psychology* 16, 1-27.
- McCune, L. 2006. Dynamic Event Words: From Common Cognition to Varied Linguistic Expression. *First Language* 26(2): 233 - 255.
- Merriman, William E. 1986a. How children learn the reference of concrete nouns: A critique of current hypotheses. In Stan A. Kuczaj, II & Martyn D. Barrett (eds.), *The development of word meaning: Progress in cognitive development research*. N.Y.: Springer-Verlag. 1-38.
- Merriman, William E. 1986b. Some reasons for the occurrence and eventual correction of children's naming errors. *Child Development* 57, 942-952.
- Merriman, W. E. (1999). Competition, attention, and young children's lexical processing. In B. MacWhinney (ed.), *The emergence of language*. Mahwah, N.J.: Erlbaum. 331-358.
- Merriman, W. E., & Bowman, Laura L. 1989. The mutual exclusivity bias in children's word learning.

- Monographs of the Society for Research in Child Development, Serial No. 22, Vol. 54, Nos. 3-4.*
- Merriman, W. E., Marazita, John M., & Jarvis, Lorna H. 1995. Children's disposition to map new words onto new referents. In Michael Tomasello & William E. Merriman (eds.), *Beyond names for things: Young children's acquisition of verbs*. Hillsdale, N.J.: Erlbaum. 147-183.
- Mervis, Carolyn B. 1989. Operating principles and early lexical development. Paper presented at a symposium entitled 'The case for "constraints" on early lexical acquisition' at the Biennial Meeting of the Society for Research in Child Development, April, Kansas City, MO.
- Narasimhan, Bhuvana, & Brown, Penelope. in press. Getting the INSIDE story: Learning to express containment in Tzeltal and Hindi. In V. Gathercole (ed.), *Routes to language: Studies in honor of Melissa Bowerman*. Taylor & Francis.
- Nelson, Katherine. 1974. Concept, word, and sentence: Interrelations in acquisition and development. *Psychological Review*, 81, 267-285.
- Nelson, Katherine. 1979. Explorations in the development of a functional semantic system. In W. A. Collins (ed.), *Children's language and communication: The Minnesota Symposia on Child Psychology, Vol. 12*. Hillsdale, N.J.: Erlbaum.
- Nelson, Katherine. 1981. Acquisition of words by first-language learners. In H. Winitz (ed.), *Native language and foreign language acquisition*. N.Y.: The New York Academy of Sciences. 148-159.
- Nelson, Katherine. 1982. The syntagmatics and paradigmatics of conceptual development. In Stan A. Kuczaj (ed.), *Language development, Vol. 2: Language, thought and culture*. Hillsdale, N.J.: Erlbaum. 335-364.
- Nelson, Katherine. 1983. The conceptual basis for language. In T. B. Seiler & W. Wannenmacher (eds.), *Concept development and the development of word meaning*. N.Y.: Springer-Verlag. 173-188.
- Nelson, Katherine. 1988. Constraints on word learning? *Cognitive Development*, 3, 221-246.
- Nelson, Katherine. 1989. Comments on constraints. Presented at the Biennial Meeting of the Society for Research in Child Development. Kansas City, April 27.
- Nieuwland, Mante S., and Van Berkum, Jos J. A. 2006. When Peanuts Fall in Love: N400 Evidence for the Power of Discourse. *Journal of Cognitive Neuroscience* 18:7, pp. 1098-1111.
- Plunkett, Kim. (ed.) 1998. *Language acquisition and connectionism*. Hove: Psychology Press. 97-104.
- Putnam, Hilary. 1973. Meaning and reference. *Journal of Philosophy* 70, 699-711.
- Putnam, Hilary. 1975. Mind, language, and reality. *Philosophical Papers, vol. 2*. Cambridge: Cambridge University Press.
- Quine, W. Van Orman. 1960. *Word and object*. Cambridge: Cambridge University Press.
- Redington, Martin, & Chater, Nick. 1998. Connectionist and statistical approaches to language acquisition: A distributional perspective. In Kim Plunkett (ed.), *Language acquisition and connectionism*. Hove: Psychology Press. 129-191.
- Rice, Mabel. (1980). *Cognition to language: Categories, word meanings, and training*. Baltimore: University Park Press.
- Richards, Meredith Martin. 1979. Sorting out what's in a word from what's not: Evaluating Clark's semantic features acquisition theory. *Journal of Experimental Child Psychology*, 27, 1-47.
- Rosch, E. 1973. On the internal structure of perceptual and semantic categories. In T. E. Moore (ed.), *Cognitive development and the acquisition of language*. N.Y.: Academic Press.
- Rosch, Eleanor. 1975. Cognitive representations of semantic categories. *Journal of Experimental Psychology: General*, 104, 192-233.
- Rosch, Eleanor. 1978. Principles of categorization. In E. Rosch & B. B. Lloyd (eds.), *Cognition and categorization*. Hillsdale, N.J.: Erlbaum. 27-48.
- Rosch, E., & Mervis, C. 1975. Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology*, 7, 573-605.
- Rosch, E., Mervis, C., Gray, W., Johnson, D., & Boyes-Braem, P. 1976. Basic objects in natural categories. *Cognitive Psychology*, 8, 382-439.
- Sethuraman, Nitya, & Goodman, Judith C. 2004. Learning to Generalize Verbs to New Syntactic Environments. 32nd Stanford Child Language Research Forum.
- Shvachkin, N.H. (1948). Razvitije fonematičeskogo vosprijatija reči v rannem vozraste. *Izvestija akademii pedagogičeskikh nauk RSFSR*. 13, pp. 101-132.
- Smith, Linda B. 1995. Self-organizing processes in learning to learn words: Development is not induction. Minnesota Symposium on Child Psychology.
- Smith, Linda B. 1999. Children's noun learning: How general learning processes make specialized learning mechanisms. In B. MacWhinney (ed.), *The emergence of language*. Mahwah, N.J.: Erlbaum. 277-303.
- Smith, Linda B., Jones, Susan S., & Landau, Barbara. 1992. Count nouns, adjectives, and perceptual

- properties in children's novel word interpretations. *Developmental Psychology* 28, 273-286.
- Subrahmanyam, K., & Landau, Barbara. 1993. Perceptual properties and syntactic context in children's learning of count and mass nouns. Poster presented at the March 1993 Meeting of the Society for Research in Child Development, New Orleans, LA.
- Taylor, John R. 1995. *Linguistic categorization: Prototypes in linguistic theory, 2nd ed.* Oxford: Clarendon Press.
- Tomasello, Michael. 2000. Perceiving intentions and learning words in the second year of life. In Melissa Bowerman & Stephen C. Levinson (eds.), *Conceptual development and the acquisition of language*. Cambridge: CUP.
- Tomasello, M., Akhtar, N., Dodson, K. & Rekau, L. (1997). Differential productivity in young children's use of nouns and verbs. *Journal of Child Language*, 24, 373-387.
- Tomasello, Michael, & Barton, Michelle. 1994. Learning words in non-ostensive contexts. *Developmental Psychology* 30, 639-650.
- Tomasello, M., & Farrar, J. (1986). Joint attention and early language. *Child Development*, 57, 1454-1463.
- Tomasello, Michael, Strosberg, Randi, & Akhtar, Nameera. 1996. Eighteen-month-old children learn words in non-ostensive contexts. *Journal of Child Language* 23, 157-176.
- Ungerer, Friedrich, & Schmid, Hans-Jörg. 1996. *An introduction to cognitive linguistics*. London: Longman.
- Waxman, Sandra R. 1990. Linguistic biases and the establishment of conceptual hierarchies: Evidence from preschool children. *Cognitive Development* 5, 123-150.
- Waxman, Sandra R., & Kosowski, Toby D. 1990. Nouns mark category relations: Toddlers' and preschoolers' word-learning biases. *Child Development* 61, 1461-1473.
- Wittgenstein, L. 1953. *Philosophical investigations*. N.Y.: Macmillan.