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**Identifying Verbs Early in Language Learning:
The Roles of Action and Argument Structure**

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April, 1995

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfilment of
the requirements of the degree of
Doctor of Philosophy

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To John

ὁ λόγος ἐστὶν εἰκὼν τοῦ νοῦ, καὶ ὁ νοῦς τοῦ θεοῦ.

—Ερμῆς τρισμέγιστος

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ABSTRACT

This dissertation describes and evaluates a thesis about the means of identifying verbs early in learning a language, and a first language in particular. The thesis is presented briefly in the first section. The second section provides a critical review of theories about children's early part-of-speech identifications. Section 3 presents a new theory of verb identification. I argue that learners initially identify members of a category, *predicator*, that subsumes verbs and adjectives. Predicators have argument structures. Learners identify a predicator through an inference that the word must take noun-phrase arguments because the phrase containing the word is interpreted into a *nonseparable* phenomenon – a property or relation that exists or occurs only by virtue of one or more individuals (i.e., the bearers of the property, or the participants in the relation), the referent(s) of the argument(s). Actions are prototypical of that which is nonseparable (being dependent for their realisation upon one or more participants), and so words for actions will usually be identified as predicators. This tendency will be augmented when an unfamiliar predicator appears in an utterance with its one or more noun-phrase arguments, and the noun phrases are interpretable (by the learner) into the one or more individuals that are the participants in an ongoing action (or other nonseparable phenomenon); under these conditions, the learner should readily divine that the novel word is a predicator and the noun phrases are its arguments. These conjectures form the *nonseparability hypothesis*. To identify verbs in particular, a learner must first discover a distinction between verbs and adjectives, where it exists in a language, through distributional analyses within phrases. Subsequently, details of syntax and morphology will reveal to the learner a predicator's subcategory (*verb* or *adjective*). Section 4 contains reviews of literatures that provide support, in varying degree, for the theory's assumptions, proposals, and predictions. Section 5 lays out the major predictions generated by the nonseparability hypothesis. Section 6 describes the positive results of three experiments that tested these predictions. The final

section presents a summary and my conclusions, which are generally positive about the prospects for the theory.

RESUME

Dans ce mémoire, on décrit et évalue une thèse qui porte sur des moyens d'identifier les verbes au début de l'apprentissage d'une langue, et d'une langue maternelle en particulier. La thèse est présentée brièvement dans la première section. Dans la deuxième section, on trouve une critique de la littérature traitant du problème de l'identification des différentes parties du discours chez les jeunes enfants. Dans la troisième section, on présente une nouvelle théorie sur l'identification des verbes. Je soutiens que les débutants identifient, au début, les membres d'une catégorie supérieure aux verbes et adjectifs, que j'appelle *prédicatif*. Les prédicatifs sont les mots qui acceptent des arguments. Les débutants identifient un prédicatif au moyen de l'inférence que le mot doit prendre des syntagmes nominaux comme arguments, puisque le syntagme qui contient le mot est interprété par un phénomène *non-séparable*, c'est à dire une propriété ou une relation, qui n'existe que grâce à un ou plusieurs individus (c'est à dire ceux qui ont la propriété, ou ceux qui sont les participants de cette relation), les référents des arguments. Les actions sont prototypiques de ce qui est non-séparable (étant dépendantes pour leur réalisations d'un ou de plusieurs participants), donc les mots interprétés par les actions seront identifiés, en général, comme prédicatifs. Ces identifications seront plus fréquentes quand un prédicatif inconnu apparaît dans une déclaration avec ses arguments (des syntagmes nominaux), et les syntagmes nominaux peuvent être interprétés (par un débutant) par les individus qui sont participants d'une action en cours (ou d'un autre phénomène non-séparable); dans ces conditions, le débutant peut deviner facilement que le mot inconnu est un prédicatif et que les syntagmes nominaux sont ses arguments. Ces conjectures forment *l'hypothèse du non-séparable*. Pour identifier les verbes, en particulier, un débutant doit découvrir, premièrement, une distinction entre verbes et adjectifs, si une telle distinction existe dans une langue donnée, par les analyses distributionnelles à l'intérieur des syntagmes. Par la suite, les détails de la syntaxe et de la morphologie vont révéler au débutant la sous-catégorie du prédicatif (*verbe* ou *adjectif*). Dans la quatrième section, on fait un résumé de la littérature

qui vient corroborer, plus ou moins, les suppositions, propositions, et prédictions de la théorie. Dans la cinquième section, on présente les prédictions majeures de l'hypothèse du non-séparable. Dans la sixième section, on décrit les résultats positifs de trois expériences qui ont testé ces prédictions. Dans la dernière section, on présente un sommaire et des conclusions, qui sont, en générale, positives quant aux perspectives de la théorie.

Identifying Verbs Early in Language Learning: The Roles of Action and Argument Structure

1. THE THESIS

[A verb or adjective] is a sign of those things that are attributed to something else; . . . and it is always a sign of those things that come to be in dependency, of things of the sort that are attributed to a subject. (Aristotle, *On Interpretation* 3, 16^b7-10)¹

The thesis of this dissertation is that people in the early stages of learning a language (e.g., young children just learning their first language) identify a novel word as a predicator (i.e., a verb or an adjective) through an understanding that the word must have an argument structure if that which is signified by any phrase it heads is to be revealed in an utterance. A prototypical circumstance in which the word requires arguments is one in which any phrase headed by the word signifies an action of a particular type, because actions occur only by virtue of their participants, namely the entities that perform the actions, and sometimes entities that are the objects of the actions. (Additional participants, such as instruments, may also be involved.) More generally, a word's use in the signification of any relation or property necessitates its having an argument structure, for the relation or property cannot exist independently of the individuals signified by the noun-phrase arguments of the word. In an utterance containing an unfamiliar verb, identification of the word as a predicator will be facilitated by the presence in the utterance of noun phrases that signify the participants in an ongoing action (for instance) and that can be interpreted, therefore, as arguments of an action word (or, more generally, of a word for a property or relation). The verb category is discovered, as a subcategory of the predicator category, through distributional analyses within phrases, where the phrase boundaries are identified by means of prosodic clues or otherwise; subsequent to the discovery of the verb subcategory, verbs can be identified from their linguistic contexts.

¹Wherever I present a quotation from Aristotle that is my own translation of his Greek text, as in this case, I have used the Oxford edition of his text.

The theory is intended primarily as a description of predicator and verb identification during first-language learning, but the theory should also apply to the early stages of language learning in adults (e.g., in second-language learning, or in learning a miniature artificial language in an experiment) when that learning occurs under conditions similar to first-language learning – in particular, when the learning occurs as a result of immersion or simple exposure to the language in everyday situations, without explicit instruction, and where opportunities for direct translation from the language being learned to a more familiar language are absent (i.e., where synonymous words in the learner's native tongue cannot be looked up in a bilingual dictionary, and where the learner makes no use of a translator). The theory does not suppose that children use any learning methods to which an adult would not have access. The discussion will focus on young children learning a first language, but most points should apply equally well to adults in the early stages of learning a language under conditions similar to those present during first-language learning.

A detailed presentation of the theory will be preceded by a critical review of alternative theories about young children's identification of members of part-of-speech categories. None of these theories is specific to verbs; they aim to account for word classification in general.

2. EXISTING THEORIES OF PART-OF-SPEECH IDENTIFICATION

2.1. Distributional Analysis

Words have characteristic *distributions*, that is, they appear in certain positions in sentences with respect to other elements (either tokens or types). Gleason (1961) describes the distribution of a morpheme as "the sum of all the contexts in which it can occur in contrast to all those in which it cannot occur" (p. 56). Z. S. Harris (1951) describes the "distributional relations among the features of speech" as "the occurrence of these features relatively to each other within utterances," and he describes distribution per se as "the freedom of occurrence of portions of an utterance relatively to each other" (p. 5). For a morpheme, the "features" or "portions" of speech that are relevant to its distribution include root morphemes, affixes and inflexions. These definitions were provided in the context of descriptions of a set of methods supposedly used by descriptive linguists, methods known collectively as "distributional analysis." Linguists were purported to use distributional analysis of a corpus of utterances as a preliminary to describing a tentative grammar for a language. Prior to describing a grammar, they would need to determine the elements that would be used in describing linguistic structure. Z. S. Harris states that "to be relevant, these elements must be set up on a distributional basis: x and y are included in the same element A if the distribution of x relative to the other elements B, C , etc., is in some sense the same as the distribution of y " (p. 7). In other words, x and y will be identified as members of the same class (A) if they can be freely *substituted* for one another in a set of frames (e.g., a set of utterances) in the sense that such substitution preserves the well-formedness of the word string.

As it turned out, these supposed discovery procedures do not work; they do not operate at a sufficiently abstract level (Chomsky, 1979). Consider the frame "_____ is good," which might be expected to facilitate a linguist's discovery of an element we call a noun phrase through considering strings that substitute freely for one another in this frame (e.g., "The man is good"; "My milk is good"; "Democracy

is good"). But as Lees (1964) points out, all of the following (underlined) strings can be substituted for one another in this frame: "The man is tall and is good"; "I don't know whether he is good"; "They said that the man is good"; "Either the man is bad or is good." None of these strings is a noun phrase. (See Pinker, 1979, for other problems with distributional analysis.) But for a time, the notion that elements such as parts of speech and phrases could be discovered through purely distributional analyses held sway.

The earliest answer to the question, "How do children acquire the parts of speech?" was that children behave like a descriptive linguist was imagined to behave: They examine a corpus of utterances to discover distributional regularities in the form of sets of items that can substitute for one another in a set of environments, and they classify words on this distributional basis. Perhaps the first theorist to suggest this solution to the acquisition problem was Jerry Fodor (1966):

It may be that the techniques of substitution and classification traditionally employed in attempts to formulate linguistic discovery procedure will prove useful here. . . . I am proposing . . . that the child may employ such relations as substitutability-in-frames to arrive at tentative classifications of elements and sequences of elements in his corpus (p. 117).

He argued that children might employ

. . . a process [that will] provide tentative abstract representations of the derived structure of the corpus by employing techniques that would, presumably, depend in part upon the assumption that distributionally similar sequences often belong to the same class (p. 117).

He further suggested that,

It is . . . unreasonable to deny *a priori* that in learning his language the child may take advantage of distributional regularities in his corpus. Such regularities would be good guides to the tentative analysis of the corpus into classes, and it is precisely such tentative analyses that are required if he is to employ rules that project putative descriptions of underlying structure (p. 118).

Children differ from linguists in that they do not have a corpus of utterances stored on audiotapes, and the literature on memory suggests that they

could not have a complete (or even large) corpus stored in memory either; not even adults store the surface form of the sentences they hear (see Braine, 1988; Sachs, 1967). Perhaps for this reason, the existing fully developed learning theories based on distributional analysis do not require the child to memorise utterances as such. In these theories, word strings lead to the immediate creation and modification of stored representations of words or stored formulae (tentative rules), and analysis proceeds over these representations, not over utterances – or else it is implicit in the acquisition process. I will describe two such theories in detail.

2.1.1. Kiss's Model

Kiss (1973) developed an explicit model of distributional learning and tested it in a computer simulation. Kiss took issue with Braine's (1963b) claim that because a word's position can be defined meaningfully only with respect to elements of phrase structure, word classes can be extracted on a distributional basis only through learning words' positions relative to phrase structure units. Kiss argued that children do not have access to the form-class information needed to describe phrase structure early in their acquisition of language, and that "some simpler mechanism is needed . . . to get the 'bootstrapping' under way" (p. 14). Kiss defined a word's context more simply, in terms of neighbouring words alone (and ignoring inflexions). Like earlier stimulus-response (S-R) chaining models (e.g., Jenkins & Palermo, 1964), Kiss's model takes associations between adjacent words as the basis for learning; his model differs from S-R models in that he allows internal representations for the parts of speech. For the purposes of computer simulation, Kiss defined a word's *context* as its immediate successor. In his model, internal representations of words are connected by "transmission links" in a representational network. The strengths of transmission links are correlated with transition probabilities; the strength of a link between two word representations is a function of the frequency in the input of transitions from one of the words to the other.

Kiss includes in his model a mechanism that forms and represents word classes on the basis of the similarity of a given word's strengths of links to other words, or rather on the basis of similarity in the set of other words activated when the word is activated. (The word's activation causes other words in the network to become activated in proportion to the strength of its links with them.) In this way, words that tend to be followed by words from a given set (e.g., determiners, which are followed by words in the class *noun*) will be placed in the same class (i.e., they will be linked to the same word-class representational node).

Kiss's learning mechanism leads to graded membership in part-of-speech categories. The representation of a word category is more strongly linked with words that are, on average, more similar to other words in the category in terms of their capacity to activate other words. So some nouns will be more "noun-like" than others.

Kiss tested the model with a computer simulation of learning, using as input a 15,000 word corpus, which was a transcription of the speech of seven mothers talking to their children. Kiss applied the grouping mechanism to the high-frequency words in the corpus. The simulation succeeded in grouping together nouns, and in grouping adjectives, but nouns and adjectives also developed strong interrelations. The simulation was less successful with verbs, although they did show some cohesion. The simulation failed to group prepositions, creating stronger links between prepositions and verbs than among prepositions. This finding can be attributed to the tendency of both transitive verbs and prepositions to be followed by a noun phrase. The simulation did well for pronouns and determiners.

One of the major problems with Kiss's model is the inclusion of a mechanism that analyses patterns of activation in order to determine what classes exist and to establish the links between word representations and class representations. Any theory in which classes must be discovered through an analysis or series of analyses before words can be assigned to them raises the following question: When is the analysis performed, and what triggers it? Is the

analysis performed daily? Or just once after sufficient information has been stored (but how does the system know when it contains enough information)? Does a child go to bed one night with no parts of speech in his or her grammar, and wake up the next morning with a full set of parts of speech and all words in the lexicon identified as members of one or another such category? It seems more plausible that children identify words as members of existing categories in the grammar one by one as they are learning the words (i.e., that the part of speech of a word is identified "on-line").

Another problem with the model is the equation of membership with an associative link to a representation of a category. Kiss points out that words can belong to more than one part-of-speech category (e.g., "walk" can be a noun or a verb), and his model accounts for dual membership by allowing associative links with two class "nodes." He seems to ignore the fact that membership in two categories implies two separate but related meanings for a word. The verb "walk" is used to signify activity of a certain type, but a noun phrase containing the word "walk" signifies an *instance* of performing activity of that type, with boundaries (e.g., temporal boundaries) distinguishing that instance from others. If a word is represented as a single node but has two distinct meanings, each associated with a different part of speech, how does "activation" of the associative link to the verb category signal that the verbal meaning of the word is in force?

The graded membership in a category that results from the learning process is also problematic. Membership is realised in the model as a link with a representation of a part of speech, and graded membership implies that some links are stronger than others. Variations in strength translate into variations in the capacity to activate a category node, such that the category node is activated to different levels by different words. Rules of grammar are formulated over parts of speech, though, in an all-or-none fashion. An English noun phrase, for example, contains a noun slot – a slot for a word that *is* a noun, not for a word that is "noun-like" to some degree. If membership in the category *noun* is graded, is there some arbitrary threshold of activation of the noun node that must be exceeded for

a word to become eligible to fill a noun slot? Or will any amount of activation of the noun node qualify a word for this position in a noun phrase? Given the associative nature of the network of nodes for words and categories in Kiss's model, with direct or indirect links between all words and all category nodes, might we not expect that a verb, adjective, determiner, or preposition might sometimes activate the noun node to some degree, even if only very slightly? Would the word then become eligible for entry into a noun slot? Graded membership in part-of-speech categories seems incompatible with rules of grammar, which are stated over discrete categories.

2.1.2. Maratsos and Chalkley's Theory of Acquisition

The best known advocates of grammatical-category learning on a distributional basis are Maratsos and Chalkley (1980). Ironically, their theory gives a central role to semantics as well, namely to the interpretation of all the various elements of a sentence.

Maratsos and Chalkley propose that the relevant "input" to the learning mechanism is the parsed utterance along with a complete description of its meaning, so that all inflexions, words from closed classes, and so on, are interpreted. They argue that interpreted elements of utterances allow children to discover similarities in the distributions of words, similarities that permit word classification. (Gordon, 1985, and P. Bloom, 1990, 1994a, 1994b, make a similar claim for count nouns and mass nouns in particular, namely that a word is classified as a count noun if it appears with the ending -s which the child has interpreted as the plural marker, or if it appears after the word "one," which the child has interpreted as a discrete quantifier, etc. They do not explain how a child would be able to learn the correct interpretation of these elements prior to noun classification.)

Maratsos and Chalkley's theory depends crucially on the availability to the child of a complete interpretation of an utterance; otherwise, the distributions of words would lead to incorrect classification. Take, for example, the ending -s in

English. This ending can signal plurality or the possessive when it appears on a noun, or the third person singular when it appears on a verb. If the child did not have access to the intended meaning of this ending for any given utterance, then the child might place nouns and verbs into one category on the basis of distributional evidence.

Maratsos and Chalkley do not explain how a child is able to interpret every element of an utterance before any parts of speech are established in the child's grammar. Available evidence suggests that children are not able to interpret closed-class words (e.g., determiners and prepositions) or inflexions in the early stages of learning a language. If Maratsos and Chalkley's theory were accepted, then we would have to conclude that young children without a full command (in comprehension) of all the elements of sentences have no parts of speech. Moreover, children would have to be able to learn the interpretations of closed-class words and inflexions without the benefit of part-of-speech information about the open-class words with which they appear; children would have to learn to interpret the plural and possessive markers before they had the category *noun*, the third person singular conjugation before they had the category *verb*, and so on. This implication of the theory seems implausible. Imagine a young girl learning her first language. For the girl to learn the semantic force of the plural marker, for instance, it would seem that she would have to notice its occurrence with words for atomic individuals of some kind when and only when entities of the kind signified by one of those words were present in quantities greater than one. If the child notices that all these words are words for atomic individuals of some kind, then she already has a basis for uniting these words into one class (i.e., the nature of their referents). If she does not notice that these words are for atomic individuals, then she will not be in a position to notice that multitudes of atoms are the referents of these words whenever they end in /s/. And if she does not treat such words as members of a single class, she will have no reason to seek a common interpretation for the ending /s/ whenever it occurs with these words – or to seek some other interpretation when it occurs with words in some other class

(e.g., with verbs in the third person singular). In any plausible account of learning to interpret inflexions, word classes are presupposed. So it seems likely that some categorisation of words must have occurred before children can arrive at something approaching a full comprehension of all elements of utterances.

The authors give a central role to a word's contexts because they are unable to discover any viable semantic definition for any part of speech. They argue that words in different part-of-speech categories (e.g., "*like*," and "*be fond of*") overlap in meaning to such an extent that semantic analyses alone could never lead to correct categorisation:

There exists, simply, no semantic boundary which can adequately deal with the profligate crossover of meanings of terms of different syntactic categories. (p. 178)

Humility would demand that the authors should have claimed, instead, that they were not able to *discover* any semantic boundary that would adequately differentiate words in different part-of-speech categories. Macnamara and his colleagues (La Palme Reyes, Macnamara and Reyes, 1994b; Macnamara, 1991; Macnamara & Reyes, 1994) claim to have discovered semantic definitions for the categories *proper noun*, *count noun* and *mass noun* that apply to all and only members of those categories.

Maratsos and Chalkley do not define parts of speech in adult grammar in purely formal terms, or in purely semantic ones. Instead, they treat part-of-speech labels as summary statements about correlations among interpreted contexts for words:

Syntactic categories such as verb and adjective, or gender class, are actually summaries of the productive systems of correlated sets of distributional-semantic-phonological contexts into which such classes of terms fit. (p. 189)

It is not the contexts themselves that are defining, but the correlations among them:

. . . Grammatical categories such as verb, adjective, gender class, or grammatical subject stand for the convergence of a number of correlated semantic-distributional patterns on a set of terms or

constituents. We find that such categories cannot be defined by the inherent semantic characteristics of their members; they are instead defined by, and participate in, productive processes because of the speaker's knowledge (somehow encoded) of the correlation to one another of different semantic-distributional frames: knowing one often arbitrarily assigned pattern use of a term or constituent, we know other possible uses. (p. 182)

And later,

. . . Categories come to be defined as a result of semantic-distributional patterns coming to specify their appropriate general scope of application. Because of the frequent overlap in terms to which various sets of patterns apply (such as verb tensing and negation uses), category specifications of certain large sets of semantic-distributional patterns come to be connected to, and thus predict, each other. Participation in such a network of mutually predicting category specifications we then call being a verb, or an adjective, or a member of an arbitrary gender class – that is, being a member of a syntactic category. (p. 195)

According to this definition of parts of speech, a word is not a (common) noun *because* it can appear after determiners such as "a" and "the," after quantifiers, or after a combination of one of these with one or more adjectives; rather a word is a noun because its appearance after "the" predicts its possible appearance (in well-formed utterances) after "another," or after "a," or after a determiner-adjective combination, and so on. I think that this sort of definition is favoured by the authors because the overlap in contexts for words belonging to one part-of-speech category is less than complete. If verbs were *defined* as words that can appear with the past-tense marker *-ed*, etcetera, then the word "bring" could not be a verb. But if, instead, we say that "bring" is a verb because its pattern of use in contexts acceptable for other verbs predicts its appearance with *-ed* – even though a convention of English blocks that use – then an irregularity in the language cannot bar "bring" from membership in the verb category.

The motivation for this type of definition becomes clearer upon consideration of the type of explicit learning model the authors advance. They propose the existence in a child's mind of a "scanner" that analyses the relative

positions of morphemes in a sequence and registers the meanings of those morphemes. They further suggest that the child stores a general formula that is an abstraction from an observed sequence; for instance, upon hearing the word "spilled," the child analyses it as *spill* + *-ed*, and then records the formula $X + -ed$, where X is a variable ranging over words. (One might ask why the child does not instead store the formula *spill* + X ; the authors do not explain how the child recognises *-ed* as an affix, or at least as a closed-class morpheme, and *spill* as an open-class member. For that matter, why does the child not register $X + X$, or *spill* + *-ed*, as the relevant formula?) This formula is stored together with its interpretation: "past occurrence of the meaning denoted by X ." In addition, the variable X is "connected to" a representation of the word *spill*. Over time, a given word becomes linked to several variables X in different formulae (or "semantic-distributional patterns," to follow the authors' terminology). Other words become linked to the same set of formulae (or some subset of that set). Maratsos and Chalkley argue that, with use, the "pathways" between any two variables within formulae, all of which pass through representations of lexical items, become more numerous and "stronger" — in some abstract sense. They argue that overgeneralisation can occur when a word such as "know," which appears in many "verb contexts" but cannot appear with *-ed*, activates a pathway that runs from the word's representation through one or more variables within formulae, then back through the representation for another word, and then to the variable slot in the formula $X + -ed$! If the child seeks a method of communicating that an act of knowing occurred in the past, the child is likely to utter the ungrammatical word "knewed" because an indirect pathway exists between the representation of "know" and the formula $X + -ed$. (The authors argue that overgeneralisation stops when inhibitory blocks are placed on certain pathways, blocks that might be effected through modifications in connections, for example.)

In this model, the links to a common set of variables within formulae constitute part-of-speech category membership. We say that "know" is a member of the same category as "run" because these words are linked to a common set of

formulae, such as the set containing the formula *didn't* + *X*. What the words have in common is that appearance in one context is predictive of appearance in a particular set of other contexts – because they are linked to many of the same formulae.

Maratsos and Chalkley (1980) argue that adult parts of speech (and other grammatical categories, such as *subject*) are "largely arbitrary and 'formal' distinctions among sets of semantic-distributional patterns" (p. 185). This claim raises the following question: If part-of-speech distinctions (e.g., *noun* versus *verb*) are arbitrary in adult grammar, why do they correlate so well with conceptual distinctions (e.g., *object* versus *action*) in child, or even adult, grammar? The authors describe the problem in this way:

But there is an underlying problem to be dealt with. For there are some striking *tendencies* towards clustering around various semantic poles in form class categories, or, within languages, in subject versus object NP [i.e., noun phrase] uses. If agency is not somehow a central organizer for NP argument grammatical properties, why does it predict as well as it does the clustering of grammatical privileges such as case marking, NP argument position, pronominal usage, and number agreement in Indo-European languages? Why do the major form class categories of adjective, verb and noun cluster as strongly as they do around the poles of action, state, and object reference, if not because of a correspondence to a basic conceptual division among actions, qualities, and objects which is being marked by the grammatical system? (pp. 185-186)

The solution favoured by the authors is that parts of speech were originally (at some time in the past) defined in conceptual terms (e.g., object words, state words, and action words for nouns, adjectives, and verbs), but as new words were introduced to languages, words that could arguably fit into either of two categories (according to the authors), speakers disagreed about the relevant conceptual elements for part-of-speech classification, so that the words within a given part-of-speech category became progressively more diffuse in meaning from any given speaker's point of view. Ultimately, semantics proved too unreliable for it to form part of the definition of any category, leaving formal properties as the only source of viable definitions:

. . . We find it natural for speakers to use both semantic and correlated distributional analyses. However, in current languages and perhaps increasingly so during the evolution of language, semantic-based definitions are not reliable because the semantics of the category members have become too diffuse. This diffusion of meaning results in the speaker being left with only one reliably accurate system of analysis: the use of the correlated sets of grammatical privileges to define grammatical categories. (p. 189)

Maratsos and Chalkley argue that, for this reason,

The child encountering the language for the first time might thus tend to rely more heavily on an analysis employing the correlations of semantic-distributional patterns in which terms appeared. (p. 188)

One wonders, though, why the child would not resemble its ancestors in creating an initial division of words along conceptual lines. If one equates a semantic description of parts of speech with a description based on ontological distinctions such as those among objects, states, and actions, then one must indeed conclude that words in adult part-of-speech categories are diffuse in meaning; but this is not the case for the words young children use and hear. The vast majority of such words fall rather nicely into such ontologically based categories (e.g., Macnamara, 1972). This property of child vocabulary was the impetus for a number of theories of part-of-speech acquisition, which I will now describe.

2.2. Approaches Based on Correlations with Ontological Categories

It is well known that most of children's early words can be described as words for physical objects, physical stuff, actions, and properties or attributes of objects. This fact of early language has been interpreted by several theorists as an indication that children make use of ontologically based categories in early part-of-speech identifications.

The first author to make such a suggestion was John Macnamara (1972, 1982). Macnamara argued that children begin with word categories such as "words for kinds of objects," "words for kinds of stuff," "words for types of actions," and "words for types of attributes." Over the course of learning a language, these ontologically based categories evolve into linguistic categories defined in terms of

details of word combination and inflexion. Words that signify a kind of object or stuff become nouns, words for a type of action become verbs, and words for attributes become adjectives. Macnamara (1982) describes the acquisition of the category *noun* as follows:

The mature grammatical category noun and its subdivisions . . . is a linguistic category of words, not a semantic one; it is distinguished from others by the particular phrase structure and morphological rules of the language. The learning begins on the semantic basis. This yields a division of bound morphemes and of sentence structures. Subsequently, for linguistic purposes, the child abandons the semantic description of the divisions while holding onto the divisions. (p. 142)

The child abandons the semantic description of the category that will become the part of speech *noun* after hearing words in the same contexts (e.g., in possessive form) that do not signify an object or some stuff of some kind. The parts of speech come to be defined distributionally, that is, in terms of syntactic and morphological rules that are specific to the language being learned.

A related approach to learning, which has come to be known as "the semantic bootstrapping hypothesis," was first suggested by Grimshaw (1981) and later developed in detail by Pinker (1982, 1984, 1987). Some of its underlying assumptions appear to have their source in modern linguistic theory. Linguists generally assume that parts of speech are innate (i.e., part of universal grammar) and undefined prior to the learning of their language-specific morphosyntactic correlates, or that they are defined as heads of phrases (e.g., a noun is the head of a noun phrase), a type of definition that is of little use because of its circularity (Macnamara, 1991): What is a noun phrase except a phrase headed by a noun?²

²Chomsky (1965) offers a noncircular definition of the category verb, but one restricted to transitive verbs: The lexical category of words that obtain their features, such as +animate or +abstract on their subject or object arguments, "from selectional rules involving two or more N's [i.e., nouns]" (p. 116); in his theory, nouns "select" for verbs with a subcategorisation frame that matches them in features on its arguments such as animacy. He defines the lexical category *noun* as "the one that is *selectionally dominant* in the sense that its feature composition is determined by a context-free subcategorization rule, its features being carried over by selectional rules to other lexical categories" (p. 116). Chomsky conceptualises a word's features as purely "syntactic features" (p. 82)

(continued...)

Semantic definitions of the parts of speech are not considered because syntax is believed to be autonomous of semantics (due to Chomsky, 1957).

If the categories noun, verb, and adjective are innate and initially undefined, what distinguishes them in the child's mind? How is a child able to determine which of the undefined parts of speech matches up with a particular class of words in the input language? And secondly, how does a child classify words in such a way that the word classes formed will correspond to parts of speech? These problems appear to provide the primary motivation for the semantic bootstrapping theory. Grimshaw says,

It is universally agreed by linguists that the syntactic categories of a language are defined in structural not semantic terms. Syntactic categorization is autonomous, since syntactic category membership is not reducible to meaning.

How are syntactic categories identified? The problem falls into two parts: LAD [i.e., the "language-acquisition device"] must group words and phrases together into classes, and must assign the appropriate labels to those classes. UG [i.e., universal grammar] simplifies the task considerably: if LAD can analyze words correctly, $\bar{X}$ [i.e., "x-bar"] theory will project the categorization of phrases from the lexical categorization But UG does not provide a universal structural definition for lexical categories.

Some developmental psychologists . . . have argued that LAD can successfully determine category membership on the basis of purely distributional evidence.

. . . Even if a purely distributional analysis could result in successful division of words into grammatical classes, it is not at all clear that the classes would be labeled appropriately. It is one thing to know that words fall into three major (open) categories, quite

²(...continued)

comparable to phonetic features such as voicing, so that his definitions are intended to be syntactic ones; but his characterisation of a noun amounts to a formal treatment of the consequences of certain semantic facts, namely the fact that nouns signify kinds of individuals (see section 3.1) whereas predicators (i.e., verbs and adjectives; see section 3.2.2.1) are used in signifying properties or relations (see section 3.2.2.2), the fact that nouns type predicators but not vice versa (see section 3.2.5.5), and the fact that this typing is itself a consequence of the dependence of properties and relations upon the individuals by virtue of which they exist (see sections 3.2.1, 3.2.2.2, and 3.2.5.5) so that the nature of a property or relation depends upon the nature of the kinds of individuals by virtue of which it can come to be.

another to discover which class is the class of nouns, which the class of verbs, and so forth. (Grimshaw, 1981, pp. 172-174)

If syntax is autonomous of semantics, such that universal parts of speech cannot have universal semantic definitions, and if parts of speech (and other grammatical categories) are defined in purely formal terms, but universal grammar provides no universal formal definitions of parts of speech, then the innate category labels must be undefined prior to language learning. The theoretical problem created is that of explaining how classes of words, however they are identified, are matched up with the innate category labels in the right way.

Pinker is also concerned about how a child might match word classes to grammatical-category labels correctly, even though he does not view innate category labels as completely devoid of any characterisation prior to learning. For him, too, the innate grammatical category labels must be undefined prior to learning. He accepts the notion that grammatical categories are defined in structural terms; he says, for instance, that "grammatical entities do not have semantic definitions in adult grammars" (Pinker, 1984, p. 39), and that "the child uses formal categories at all stages" (p. 42); further, he calls the syntax of adult language "autonomous" (Pinker, 1982, p. 679); so he seems to accept the idea that grammatical categories are defined by language-specific details of syntax and morphology. But he claims that something other than a definition keeps one innately specified grammatical category separate from others, something he calls a family resemblance structure; he argues that for each grammatical category, some set of phenomena must exist, a subset of which any language must exhibit, for otherwise it would be nonsense to speak of universal grammatical categories:

. . . In using a single name to refer to symbols in grammars for different languages, one is committing oneself to the hypothesis that there exist symbols with universal properties across languages. On pain of circularity, this hypothesis must be translated into the hypothesis that certain phenomena tend to be correlated with one another across languages, the names themselves merely denoting the symbols that enter into the correlated set of phenomena. The correlations need not be perfect, and it is not strictly necessary for there to be some subset of phenomena that invariably accompany

the symbol; a family resemblance structure will suffice to give meaning to the concept of a universal grammatical symbol. (Pinker, 1984, p. 43)

Of course, if there are no true substantive universals – that is, no family resemblance structures involving collections of semantic and formal phenomena – then the semantic bootstrapping hypothesis cannot be true. (Pinker, 1984, p. 45)

Pinker cannot have in mind that a family resemblance structure for a grammatical category is its definition, for he allows semantic phenomena to be part of such structures (e.g., the correlation between agents of actions and grammatical subjects in active sentences, and the correlation between names for individuals and nouns), and yet he claims that grammatical categories are always formally defined. He cannot make these hypothetical sets of correlated phenomena definitional if he is to maintain the stand that syntax is autonomous of semantics, unless, of course, he excludes semantic phenomena in his description of the family resemblance structures; but he cannot exclude semantic phenomena, for these are possibly the only universal (or nearly universal) phenomena characteristic of the categories! Take, for instance, the category *verb*. What purely formal phenomena might characterise verbs uniquely and universally? Pinker does not describe linguistic phenomena that might be part of a family resemblance structure for any specific part of speech, such as *verb*; it might be difficult, if not impossible to do so; even such prototypically verbal phenomena as tense and aspect marking are not unique to verbs across languages, that is, nouns can be marked for tense and aspect in some languages, such as the Nootkan languages; even the property of heading a verb phrase is not universal, for some languages have no phrase structure (see section 4.1); moreover, the circularity of the notion of "heading a verb phrase" due to a verb phrase being defined as a phrase headed by a verb robs this verbal property of any utility in characterising verbs. In section 3.2, I describe the semantic character of verbs in a way that makes their semantic characterisation (or definition) universal and that explains their universal property of taking arguments (a property that cannot properly be regarded as purely formal, since its

basis is purely semantic, and the formal consequences of the fact that a verb takes arguments are very far from universal, e.g., in some languages the arguments appear in surface structure as noun phrases, in others, such as the Nootkan languages, they can appear as morphemes contained within the same word [see section 4.1], in pro-drop languages such as Japanese one or more of the arguments typically find no realisation in surface structure, and so on).

Pinker's adoption and development of the semantic bootstrapping theory appears to be motivated by a consideration in addition to those that were of concern to Grimshaw. He says that,

. . . the semantic bootstrapping hypothesis . . . is intended to explain how the child knows *which* formal categories to posit in response to particular input sequences. . . . [The hypothesis] claims that children always give priority to distributionally based analyses, and is intended to explain how the child knows *which* distributional contexts are the relevant ones to examine. (Pinker, 1984, pp. 42-43)

For Pinker, then, the child is faced with the task of discovering the distributional regularities that characterise words in one class and that enter into its definition, but the child needs some means of limiting the contexts for distributional analyses. This limitation of contexts can be accomplished if the child has some means of placing words into classes that are, if not identical with grammatical categories, at least subclasses of grammatical categories so that the distributions of words in individual classes can be examined by the learner. In addition, Pinker shares Grimshaw's concern that the word classes identified are properly matched up with innate grammatical category labels.

Grimshaw's and Pinker's solution to these problems is a built-in procedure that maps from a set of conceptual categories into the set of innate linguistic categories. Words for kinds of objects are mapped into the category *noun*; words for types of actions are mapped into the category *verb*; and so on. (Actually, Pinker and Grimshaw do not speak of words being identified as members of part-of-speech categories, but rather of words being assigned a part of speech, that is, a label; but their treatment of parts of speech as labels rather than sets of words

should not have any impact on my analysis of the theory.) Grimshaw describes the process as follows:

There is plenty of evidence that at an early stage of linguistic development, children have ready command of semantico-cognitive categories like "object" and "action." Suppose then that LAD uses these categories as the basis for assigning syntactic categories to words. If a word is the name of an object, it is assigned the category N. If it describes an action, it is assigned the category V [i.e., *verb*]. Thus certain cognitive categories have what I will call a Canonical Structural Realization (CSR): CSR (object) = N, CSR (action) = V. LAD employs a CSR principle: a word belongs to its CSR, unless there is evidence to the contrary. (Grimshaw, 1981, p. 174)

Once some words have been categorised in this way, the rules of phrase structure can be learned by analysing the contexts of instances of categories. These rules can, in turn, be used to categorise words that do not conform to the innate principle, and to learn closed categories such as *determiner* which are not associated with any innate mapping:

LAD can construct phrase structure rules for NP and VP [i.e., verb phrase], by drawing on example sentences whose lexical items can be assigned category labels by the CSR principle. In so doing, LAD will in effect be establishing a set of structural generalizations governing the distribution of N, V, and so on. These can be used as evidence in the analysis of any new categories (such as Det, Modal) for which no CSR is defined. The rules will also make it possible to assign category labels to words like "belong": "belong" is a verb because it behaves like one with respect to the phrase structure rules. (Grimshaw, p. 175)

Pinker (e.g., 1982, 1984, 1987) goes further than Grimshaw in suggesting mappings between conceptual and grammatical categories for the closed categories such as *preposition* and *determiner* – categories that could, in principle, be defined over their members. Pinker borrowed from Pylyshyn (1977) the term "bootstrapping" to describe the mapping process that gets the learner into the linguistic categories. He regards "semantic bootstrapping" as part of a parameter-setting process in which an initial identification of the grammatical categories of words in utterances allows parameters such as word order to be set; once all the parameters are set, the structure of a sentence provides clues to the grammatical

categories of its constituent words, and so semantic bootstrapping is no longer necessary. He describes the bootstrapping process as a temporary expedient which is later abandoned (although he does not explain how or why the mechanism is abandoned):

Grimshaw . . . [1981] and Macnamara . . . [1982] have suggested one way to give learners access to information about which aspects of their innate schemata should be brought to bear on the current inputs. The proposal is to "flag" the elements of each syntactic schema with some feature in the semantic representation of a sentence (since most people agree that the child can construct some version of a semantic representation of an utterance by perceiving its nonlinguistic context). These universal "semantic flags" would not have to represent invariant meanings of syntactic elements in the adult grammar; they would simply serve as parts of the learning mechanism that could become dormant as soon as they had fulfilled their function in setting the relevant parameters. Once a set of parameters was "bootstrapped" into the grammar by these semantic means, the rules thereby fixed could be used in conjunction with further data to set the rest of the parameters in the grammar. . . . Let us call rule acquisition relying on semantic flags *semantic bootstrapping* and further acquisition relying on existing rules *distributional learning*. (Pinker, 1982, p. 678)

Both Grimshaw and Pinker are forced to restrict semantic bootstrapping to an early phase of learning because of their assumption (after Chomsky, 1957) that syntax is independent of semantics in adult grammar:

It is a consequence of the autonomy of syntax that syntactic form and semantic type will not be in one-to-one correspondence in any principled way. . . . UG does not permit deduction of a syntactic analysis from an analysis of the semantics of a phrase, and of course the same point holds for categorization of words. Thus the child must learn the two kinds of information separately; he must figure out what a word or phrase means, and what its syntax is. (Grimshaw, 1981, pp. 167-168)

If the autonomy of syntax is to be realised, "semantic bootstrapping" must be abandoned, leaving no links between meaning and syntactic structure.

These theories have the advantage of being grounded in observation of children's early use of language, in which the ontological categories seem to adequately capture children's vocabulary. But the theories fail to explain the

relations of ontological categories to linguistic (part-of-speech) categories. Why should words for objects be associated with count nouns? The category *count noun* includes many words that do not signify an object kind, but this is not the main issue. If the category *count noun* has no semantic or conceptual basis in adult grammar, why should words for objects end up in this category and not in the category *verb*? Why should words for actions tend to be verbs? Why should not action words map into the category *noun*? (Some action words, including the word "action," are nouns in the mature use of language.) In short, what grounds the mappings? The links appear arbitrary in these theories because the mature categories are defined independently of ontological considerations – and, more generally, of any semantic considerations. As these theories stand, nothing **logically** bars action words from being placed in the category *preposition*. The map from action words to verbs looks like an accident of evolution. (I will try to establish the reasons for the apparent links between ontological and grammatical categories when I present the theory explored in this dissertation.)

The semantic bootstrapping hypothesis suffers from an additional weakness. The proposed innate procedures that map from ontological categories to grammatical categories are supposed to be universal, by virtue of their innateness, so that they will operate in children exposed to any language. This supposition creates a problem for the theory. Consider some of the usual assumptions implicit or explicit in accounts of semantic bootstrapping, namely that, (1) the child perceives the relationships of words and sentences to the situations with which they are paired in a way that will evoke the mappings (i.e., when observing an action, the child must interpret any verb as a word for the ongoing action; when looking at an object or stuff, the child must interpret any adjective as a word for a perceived attribute, etc.); (2) the innate maps are the only available means of identifying the part-of-speech categories of words during the bootstrapping stage of acquisition (e.g., so that syntactic or morphological clues do not yet play a role); Pinker (1982) calls this assumption an idealisation, but he does not provide evidence regarding the amount of and the timing of overlap between

bootstrapping and distributional learning; (3) words in the source categories, or domains, of maps (e.g., words for objects, words for actions) will be encountered in any culture, and (4) the operation of the mapping procedures is mechanistic and automatic (as suggested by Pinker's, 1984, talk of "acquisition mechanisms" and "language induction mechanisms" [p. 28], and by Grimshaw's, 1981, use of Chomsky's, 1965, term "the language-acquisition device") so that any encounter with a word in the domain of a map inevitably triggers a mapping into the associated target category, or codomain. Given these assumptions, the procedures will map into a fixed set of innate categories, regardless of the natural language being learned. If we accept the bootstrapping hypothesis as it is usually stated, then we might be forced to conclude that Mandarin Chinese and Chinook both contain an open class *adjective* that is distinct from the category *verb*, despite the lack of evidence in syntax and morphology for such a categorical distinction. Semantic bootstrapping seems to imply universality for all of the grammatical categories (and for all of the parts of speech, in particular) that are supposed to be innately specified – a universality that is not supported by the findings of comparative linguists. Most linguists agree that only two parts of speech are universally present in natural languages: *noun* and *predicator* (see Lyons, 1966b; linguists sometimes call the category *predicator* "verb"). It might be possible to rid the semantic bootstrapping theory of this weakness by adding provisions so that innate parts of speech such as *verb* and *adjective* could be collapsed into one part of speech (e.g., because their distributions do not differ). The theory would also have to provide a means for rewriting the rules initially stated over the categories *verb* and *adjective*, stating them over the category *predicator*, instead – or perhaps the rules stated over adjectives in particular could be expunged somehow. Also, some of the parameters set by the distributions of actions words and attribute words in the input might have to be reset or turned off when the verb and adjective categories were merged. Suppose, for instance, that a word-order parameter for attributive adjectives relative to nouns was set upon exposure to sentences in which a word for an attribute followed the subject noun phrase, so

that the language was deduced to be one like French in which most attributive adjectives follow the noun they modify (e.g., "Le chapeau noir"). Suppose, though, that adjectives do not actually form a class separate from verbs in the input language, and that the appearance of a word for an attribute after the subject noun phrase reflects a verb-like usage, as in the sentence "The girl runs"; that is, suppose that the sequence of the noun followed by the attribute word is to be interpreted as something comparable to "The hat blacks" where the meaning is 'The hat is black.' If the learning procedures allowed the verb and adjective categories to merge at some point in the face of distributional evidence (for instance), what would happen to this adjective-specific parameter? Would it be turned off? Without a great deal of further ado, the specification of a fixed set of innate parts of speech that encompasses all the cross-linguistically common subcategories of nouns and predicators poses a problem for the semantic bootstrapping approach.

2.3. Mixed Models

Maratsos (1981, 1982) and Braine (1987) suggest that grammatical categories are acquired on the basis of a mixture of distributional and nonlinguistic (semantic) information.

2.3.1. Maratsos's Categorical Evolution Model

According to the model proposed by Maratsos (1981, 1982), children register each two-word sequence to which they are exposed as "a rule for ordering two sequential nodes, X and Y, each of which is defined by just the properties of the terms defining them" (p. 248). A child exposed to the sequence "daddy walk" associates these two words with two nodes whose ordering constitutes a rule or schema, and each node is associated with properties of the word with which it is linked. The node linked to "daddy" is associated with properties such as *animate* and *human*, for example. In addition, the schema is described in semantic terms, such as $X + Y = \text{"movement of X initiated by X, including manner of movement"}$

described by Y." Maratsos assumes that children are predisposed to attend to and register certain properties that will be useful in combining words into categories. This assumption is necessary because the learning mechanism he proposes relies on Piagetian assimilation, such that words are assimilated to (i.e., become linked to) nodes by virtue of their *similarity* to other words linked to those nodes. The schema $X + Y$, where X is initially associated with properties of "daddy" and Y is associated with properties of "walk," evolves when the utterance "mommy walk" causes "mommy" to be assimilated to the X node because both daddy and mommy are animate and human. Eventually, the X node will come to be linked to many words characterised by the feature *animate*, and the Y node will become linked to many words for types of movement.

Like all theories relying on assimilation based on similarity, Maratsos's theory of acquisition raises many questions about what constitutes similarity and when assimilation will occur. Maratsos asserts that the sequence "Sally drop vase" will be assimilated into a schema described as "cause of activity + activity" on the basis of "sufficient similarity" even though all previous sequences assimilated into this schema involved intent on the part of the agent who caused the activity (e.g., "daddy sing"). He does not explain why the intentional nature of the activity does not become encoded as part of the schema, and as an essential part of it, so that the verb "drop" is barred entry as an instance of a node in that schema. Perhaps he would appeal to another innate bias, one toward causes in general versus causes involving intent. But he allows such biases to be overridden later in the evolution of the nodes, such that structural information affects judgements of similarity and guides assimilation. This structural information is ultimately responsible for the creation of word categories such as *noun* and *verb*.

Mature word classes come into being as follows:

... Over time, terms originally described for major constituent purposes as action-terms and object-terms acquire linkages to smaller-scale grammatical operations. When non-action and non-object terms are used in grammatical configurations similar to the new operations, they become similar enough in nature for

assimilation to the already existing categorical nodes to take place.

This process results in adult verb and noun classes. (pp. 251-252)

The verb category in particular begins as action terms that form part of an "actor-action" schema (which presumably evolves from earlier schemas such as "animate being-movement"):

. . . Over time, members of the original actional predicate class come to be linked to grammatical loci for smaller-scale grammatical patterns such as use of *do*-forms, *can't*, *will*, and various tensing operations. (p. 253)

Initially dissimilar categories such as actional words (e.g., "sing," "kick," and "go") and experience words (e.g., "like," "want," and "need") become "more similar because of shared properties such as taking *do*-forms, tensing morphemes, and other auxiliary forms" (p. 255). Words that once belonged to the *experience* category are assimilated into the *action* category such that the latter category evolves into the verb category. Maratsos assumes that the action category absorbs members of the experience category rather than the other way around because action terms are more frequent, "making this category more available for active assimilation" (p. 255).

Maratsos's proposed acquisition process leads to categories with a prototype structure in the sense that some members are "better" examples of the category because they have a larger number of properties that are characteristic of category members. A verb such as "kick" is among the "better" verbs because it signifies a type of action in addition to appearing in structural contexts characteristic of verbs. Grammatical categories end up being "codefined both by semantic and structural similarity" (p. 251). In this theory, the category *verb* is always linked to action because many of its members are characterised as actional, and those members are prototypical for this reason. But structural properties of a verb are sufficient for membership in the category. Mature categories are characterised by a network of properties which include formal ones, but structural properties have no special status in the characterisation of the category (even if they are the only ones that are shared almost universally by category members).

Maratsos's model of acquisition lacks parsimony in that the child must alternately create and abandon a large number of schemas (perhaps one for each two-word sequence the child hears) until words once linked with any schema end up being assimilated into a mature part-of-speech category. Assimilation based on similarity requires a large number of innate biases toward properties that will promote the correct collapsing of categories (i.e., the correct linking up of nodes) as members of one category are assimilated into another because of shared properties of members of the two categories. If word categories were formed in this way, one might expect to see a greater number and variety of errors in category formation at intermediate stages of language development than researchers have observed. Available evidence from children's early use of inflexions and negation with verbs suggests that children do not distinguish action verbs from experience verbs, as one might expect if those words belonged to separate categories (i.e., if they were linked to separate nodes) at some stage. Maratsos, Kuczaj, Fox, and Chalkley (1979) have shown, for example, that the past tense marker *-ed* is applied to a similar proportion of action verbs and experience verbs (such as "think" in the sense of 'have an opinion,' "know," "see," "hear," and "feel" – even though the resulting word is ungrammatical because these verbs are irregular). Overgeneralisation of the past tense marker occurs rather late in language acquisition (e.g., around age 2;6 to 3;0), and Maratsos (1982) suggests that the overgeneralisation reflects a rule specific to the verb category (versus any semantic subcategory), which forms late because its formation depends on extensive experience with words in this category. But in Maratsos's (1981) theory, categories corresponding to experience verbs and action verbs should be formed quite early because their formation is independent of distributional analyses; why does the past tense rule not become productive with members of one or both of these categories earlier in acquisition? In Cazden's (1968) examination of the speech corpora of three young children (the now famous Adam, Eve, and Sarah), she noted five inflexional errors in which an inflexion appropriate for verbs with action or process meanings was used with a verb with an experience or state

meaning (e.g., "I seeing Fraser"), suggesting that these two types of words formed an equivalence class. In her examination of negation, Bellugi (1967, as cited in Maratsos, 1981, 1982) found uses of "don't" and "can't" with experience verbs such as "want" and "like" (e.g., "I don't want it" and "I don't like it") as well as with action verbs. Maratsos (1981, 1982) interprets such findings as evidence for the learning of inflexions on a word-by-word basis, thereby discounting such evidence as a problem for the theory. Even if inflexions and other markers are initially learned word by word, nothing in Maratsos's theory precludes the child's realisation that such markers can appear with all members of a category before various categories such as that containing action words and that containing experience words have collapsed into the verb category. The theory does not explain why assimilation into the verb category is complete by the time children begin to use verb inflexions productively. Structural properties are as much a part of the category of actional words as they are a part of the verb category, and assimilation on the basis of shared properties yields no special status for structural properties in any category.

Maratsos claims that parts of speech end up being defined conjointly by semantic and structural commonalities among their members: ". . . The grammatical locus will come to be defined by a set of properties clustering around a central set, but imperfectly" (Maratsos, 1981, p. 251); but clearly no characterisation applicable to all and only the words in one category is possible, for the properties by virtue of which any given word comes to be linked to a part-of-speech node (e.g., by virtue of its use in signifying action) need not be uniquely characteristic of that part of speech (e.g., some action words are nouns), which means that no definition is possible (for one cannot properly call something a definition if it fails to define or delimit or determine the class). In reality, the categories can only be defined over their members, because the words in a given category are so classified for a variety of reasons. For an open class such as *noun*, a definition over its members precludes any fixed definition; the set of words in the category expands throughout life. Defining the categories over their members

also precludes any universal definition – that is, any definition common to all speakers of a language.

2.3.2. Braine's Semantic-Distributional Model

Braine (1987) describes a theory of acquisition that is perhaps closest to the one I will propose, although it differs from mine in certain critical ways.

Braine assumes that children have a distinction between a "predicate" (in the sense that comes from standard modern symbolic logic) and an argument of a predicate by the time they are ready to begin learning a language (and in fact he argues that this distinction is psychologically primitive and unlearned; see Braine, 1988). He assumes, further, that this distinction is linked to a distinction between relations and properties on the one hand, and objects on the other.

. . . At the time of acquiring language, children see the world as having objects that bear properties and are related to other objects, and they distinguish the objects from their properties, and relations from the entities related. (p. 70)

Braine further assumes that children expect arguments and predicates to be represented in utterances as phrases, and that the relevant phrases are somehow marked for their function (i.e., as argument or predicate) independently of learning. Noun phrases are assumed to be marked as arguments, and a verb or predicative adjective or noun together with any auxiliary verb is assumed to be marked as the predicate. (Braine's "predicate," which he calls a "verbal phrase," is thus not equivalent to the grammarian's sentential predicate, which may include an object noun phrase, a prepositional phrase, and so forth, and which does not, by most accounts, include the copula or auxiliary verb.)

Braine suggests that a learning mechanism performs distributional analyses *within* these phrases which lead to the discovery of the parts of speech of the language (e.g., *noun*, *determiner*, *verb*, *auxiliary*, and *adjective*). Limiting the contexts for distributional analysis to argument and predicate phrases eliminates many of the problems with distributional analysis, at least for English. Discovery of the category *noun* within noun phrases is trivial given a means of discovering

positions in short strings of words, and Braine cites evidence from artificial-language experiments showing that people are capable of discovering such regularities. The distinction between auxiliaries and predicators (i.e., verbs and predicate adjectives) is equally simple to acquire in English because the latter always appear after any auxiliary in a predicate phrase.

The distinction between verbs and predicate adjectives presents learners with a more complex task, but not one that is beyond the capabilities of people (according to the results of artificial-language studies). Braine argues that any conceptual differences between verbs and adjectives (e.g., actional versus stative) will not be useful to learners because they are not sufficiently consistent across members of these categories. Braine also points out that some natural languages do not distinguish verbs from adjectives in surface structure, and he concludes that the only basis for distinguishing them in acquisition is a distributional one. Other nonuniversal categories, such as gender subcategories of the category noun, will also be acquired on a distributional basis.

Braine's theory has many advantages over the others described in this section. The distinction between predicates and arguments is superior to the distinction between action words and object words as the basis for learning because verbs retain their predicator status and nouns (or noun phrases) retain their argument status in the mature grammar regardless of whether or not they are used in signifying actions or objects. So Braine's theory brings the child and the adult closer together conceptually, and, further, it requires no special mechanisms for language acquisition that must be abandoned during development.

In contrast to the semantic-bootstrapping hypothesis, Braine's model does not presuppose a full set of innate part-of-speech categories. In his model, all categories are acquired on a distributional basis. He attributes the universality of the noun category (if such universality exists) to the universal appearance of a noun slot within noun phrases (except where pronouns or proper names constitute noun phrases), with words that appear in that slot being labels for classes of entities (entities that support the properties and relations signified by predicates).

To clarify: The universality of the noun category and its inevitable discovery by learners are said to be explained by the combination of (1) a universal tendency to expect words for kinds to appear in phrases that are an argument of a predicator (because the individuals of those kinds possess the properties and relations that predicates signify; see La Palme Reyes et al., 1994b, regarding the category of kinds as a universal component of natural-language semantics), and (2) the noun's universal property of fixed position within a noun phrase, a property that permits its discovery through distributional analyses, and a property that arises, according to Braine, because of "the convenience of identifying an argument by making some reference to the class of the entity or entities that constitute the argument" (Braine, 1987, p. 72). The noun category, as a part of speech, is not innately given in the theory, but it arises universally because of a universal need to talk about scenes in the way we understand them, attributing properties and relations to individuals that are understood to be members of classes. When the individuals that are the referents of arguments are named as members of classes, each argument (i.e., noun phrase) must contain a noun slot, and this noun slot occurs in a position that is fixed relative to other elements of the phrase (i.e., determiners and so on; Braine does not explain why fixity of position within a noun phrase characterises noun slots universally). The fixed position of the noun in the noun phrase permits the discovery of the word class on a distributional basis. The distinction between verbs and adjectives is not universal because it has no consistent semantic underpinnings, and since both verbs and adjectives can appear in Braine's "verbal phrase" (which is interpreted as a logical predicate), they will only be distinguished through distributional analysis, and only when they differ in their distributions in the language. Similarly, noun subcategories such as nouns of different gender will be acquired only where the language provides distributional evidence for their existence.

The major weakness of Braine's model is the assumption that noun phrases and predicate phrases come marked for their functions as arguments and predicates prior to any distributional analysis. Since phrases are typed according to

their heads, it would seem that the only way to identify an argument phrase or a predicate phrase would be to identify the head as a class (or kind) label or as a predicator – but in Braine’s model, the classes of the individual words within a phrase are discerned subsequent to distributional analyses that distinguish members of open classes such as *noun* and *verb* from members of closed classes such as *determiner* and *auxiliary*, so the discovery of the head (i.e., open) category comes after the phrase is analysed for distributional regularities, and its part of speech is identified partly on the basis of the type of phrase it heads. It seems implausible that phrases could be marked for their function prior to the discovery of word classes within them through distributional analyses, and prior to the identification of their corresponding parts of speech.

Both the Maratsos model and Braine’s model suffer from a weakness of the ones described earlier, namely that they fail to account for the links between, on the one hand, parts of speech such as *noun* and *verb*, and, on the other hand, ontological categories such as *object* and *action*, or semantic categories such as *individual entity* and *relation or property*, or functional categories such as *argument* and *predicate*. If mature categories are defined distributionally (Braine) or by a mixture of structural and conceptual properties where none of the conceptual properties has any privileged status with respect to the category (Maratsos), why are nouns associated with objects, individual entities, and arguments, and why are verbs associated with actions, relations or properties, and predicates? Braine notes that (common) nouns have a universal conceptual basis (i.e., they label classes of entities, or kinds), but he does not go so far as to define the noun category on this conceptual basis (i.e., as names for kinds or members of kinds; see La Palme Reyes et al., 1994b; Macnamara, 1991; Macnamara & Reyes, 1994). By defining nouns as those words that occupy a particular position within an argument phrase, he provides a link between arguments and *noun phrases*, but none between arguments and *nouns*. Without taking the further step of *defining* nouns as names for kinds or their members, and explaining why these entities are linked with arguments (see section 3.2), he cannot account for the appearance of nouns

(versus verbs, adjectives, or prepositions) in argument phrases any more than Maratsos can account for the link between nouns and words for objects. A similar problem exists for verbs and adjectives, which Braine defines distributionally and which Maratsos defines in terms of a combination of distributional and conceptual properties (such as *movement*), with none of those conceptual properties being central to the definition. Unless these categories of words are defined in terms of their predicator status, and some semantic basis for such status is given, their relation to predicate phrases appears arbitrary. (Note that other words appearing in predicate phrases headed by predicators, such as the copula, are not predicators.) Similarly, if verbs are not defined as action words, their initial relation to action words is mysterious. Why should the structural properties associated with verbs coincide with the tendency to be used in signifying action? No existing theory accounts for such correlations.

Braine's theory has one other weakness. Noun phrases cannot or should not be marked universally as argument phrases because they do not always serve the function of an argument. In the sentence, "Natasha is a cat," the noun phrase "a cat" is a predicate and part of a predicable, namely "is a cat" (see La Palme Reyes et al., 1994b). There is no predicator in the sentence for which the noun phrase could be an argument. (The copula "is" cannot be considered a predicator unless we are willing to call all auxiliary verbs predicators, but their lack of argument structure suggests otherwise. And would we really want to call "be" a predicator in the sentence, "Natasha is a cat," but not in the sentences, "Natasha is running" or "Natasha is beautiful," where "Natasha" is the only noun phrase, and it is an argument of "running" or of "beautiful," not of "be"? Some auxiliary verbs, such as "be" and "have," can, at times, act as main verbs, of course, as in the sentences "I have two cats" and "Peace is.") Further, there are argument phrases that do not contain nouns as their heads. In the sentence, "I want my grandmother to get well," the object argument of "want" is the clause "my grandmother to get well." This argument phrase contains a noun, but that noun is not the head of the argument phrase. It is the *getting well* of the grandmother that is wanted, not the

grandmother. So Braine's reliance on argument phrases as the context for distributional analyses that lead to the discovery of the noun category is based on the false assumption that noun phrases and argument phrases stand in one-to-one correspondence.

2.4. Evolution and Merging of the Argument Types of Relations of Individuals to Their Properties and Actions

Schlesinger (1982, 1988) discusses children's acquisition of what he calls "relational categories," that is, categories of relations of individuals to their properties and actions, and categories of the argument types for these relations; examples of the relations with which he is concerned are *agent-action*, *patient-action*, and *attributee-attribute* (relations comparable to the linguist's "thematic relations"), and examples of the types of arguments of such relations are *agent*, *patient*, and *action*. Schlesinger has outlined a theory of acquisition for parts of speech that is based upon such relational categories.

Schlesinger claims that parts of speech such as *noun* and *verb* "are defined in terms of the arguments of relational categories" (Schlesinger, 1988, p. 169) such as *agent* and *action*, where the latter are descriptors for the arguments of the *agent-action* relation, that is, *a* and *b* in the formula *Agent-Action(a, b)*. Initially, the child will create one class for each type of argument: agent words, patient words, action words, and so on. The category *noun* emerges in a child's grammar when the child notices that certain words can appear in sentences as instantiations of the arguments of different relational categories. For example, the word "dog" can instantiate an agent argument of the *agent-action* relation (e.g., "The dog was running") or a patient argument of the *patient-action* relation (i.e., the relation of an object argument to an action argument instantiated by a verb in a sentence such as "The boy hit the dog"). Schlesinger argues that after children notice this phenomenon, they will generalise to other words that instantiate agent or patient arguments, inferring that any agent word can also appear as a patient word and vice versa. The class of agent words and the class of patient words will merge

because of this overlap. If the overlap extends to other argument types (e.g., *instrument*, *attributee*, and *possessor*), then classes of words associated with those argument types will merge with agent and patient words as well. Eventually, he argues, the extension of the class formed through such merging will be identical with the extension of the mature class *noun*. The parts of speech are constructed from such merging of argument classes.

Merging alone cannot account for mature categories, Schlesinger argues. In addition to merging, another process figures into the creation of grammatical categories: semantic assimilation. As part of the formation of the category *verb*, the category of action words must come to assimilate words that do not signify actions, such as "find" and "like." Initially, the child may analyse a non-action verb as signifying an action, as in Macnamara's (1982) example of Kieran thinking that "sleep" meant to put one's head on something and close one's eyes. Alternatively, the child may see a *similarity* between the activities signified by action and non-action verbs because the activity signified by a non-action verb may involve actions. For example, finding something can involve wilful acts of looking for it that, though not directly relevant to the meaning of the word "find," occur as part of the context of finding. So the child may initially analyse non-action words as instances of the *action* argument of the *agent-action* relation. The similarity of word order and other contextual information in sentences containing non-action verbs will also encourage the child to put action and non-action verbs into a single category. Over the course of such assimilation, the *agent-action* relation will evolve into a *subject-predicate* relation, according to Schlesinger. (It is not clear from his writings how children could distinguish among predicates containing verbs, adjectives, and noun phrases.) The end point of such evolution depends on the natural language to which one is exposed. The formal categories of the language being learned guide the process of semantic assimilation to shape relational categories. As the relational categories evolve, so do the classes of arguments. For example, the category of action words comes to include non-action words such as "find" and "like" through semantic assimilation, and this assimilation entails that

the meaning of "action" (i.e., of that type of argument) changes to include non-actional features. (Schlesinger restricts his treatment of the emergence of the category *verb* to discussion of relations containing an *action* argument. I doubt that he intends to create the impression that verbs necessarily emerge from the category of action words, and his theory does not demand it. If a relation other than *agent-action* forms the basis for NP-VP constructions, any perceived similarity in the significations of words associated with an argument of this relation and the *action* argument would cause the two argument classes to merge. The similarity of sentential contexts for words expressing the two types of argument would also favour a collapsing of the two categories. In theory, the category *verb* would ultimately emerge.)

Schlesinger's theory suffers from several difficulties. As he himself points out (Schlesinger, 1988), it shares with theories based upon distributional analysis a serious problem created by tracing the identity of a word through its phonological realisation. In many languages a word can shift between the categories *noun* and *verb* without any change in its sound (or in its appearance in written form). The merging process that Schlesinger describes should lead to a collapsing of action words and patient words when the child hears the word "find" used as both a verb and as an object noun (e.g., "We find a nice shell on the beach almost every day" and "We store our find in this cabinet"). Ultimately, nothing stands in the way of a merging of nouns and verbs into one category. Schlesinger offers the vague hope that such merging is prevented by requirements about the kind and degree of overlap that can lead to merging, but he does not make any suggestions about the nature of such requirements.

Another weakness in the theory stems from Schlesinger's desire to keep semantics (of the thematic-relational sort) at the core of linguistic categories. Nouns never lose their status as arguments (e.g., *agent*, *patient*, *instrument*, *possessor*, and *attributee* arguments); nor do verbs (e.g. *action* arguments) or adjectives (e.g., *attribute* arguments). But the argument classes lose so much of their original meaning through semantic assimilation, with new elements of

meaning added almost every time a new word enters into the class, they become a hodge-podge of semantic "features" that bear no obvious relationship to one another. The so-called *action* argument evolves into the set of semantic features of which a word in a verb context can have a subset! It would seem simpler to abandon the semantic definitions of the categories altogether and define them in distributional terms. The theory also implies that categories have different definitions across individuals and within individuals across times. The whole thing seems a bit messy.

Schlesinger gives semantic assimilation the key role in the evolution of word categories, distinguishing his theory from ones emphasising contextual analysis. The examples he gives of semantic assimilation based on similarity at the earliest stages of a category's evolution are not wholly implausible, but making a case for similarity-driven assimilation at later stages might be harder. It seems to me that category membership would typically be determined by similarity of sentential context (and Schlesinger often seems to be saying that similarity of context inclines the child to notice, or dream up, a similarity in meaning, contributing to the evolution of the argument classes). All that distinguishes Schlesinger's theory from those focusing on distributional analysis is Schlesinger's insistence that the categories retain their semantic nature, with, for instance, all verbs being conceptualised as "action-like" once the nature of the *action* argument has evolved to encompass non-action-like events such as thinking, feeling, reiterating, and encumbering.

2.5. Phonologically Signalled Category Identification

There is now considerable evidence in support of the hypothesis that children learn the gender subcategories of the noun category partially on the basis of phonological clues, at least in French (Tucker, Lambert, Rigault, & Segalowitz, 1968), Russian (Popova, 1973), German (Böhme & Levelt, 1979, as cited in Levy, 1983b, 1988) and Hebrew (Levy, 1983a, 1983b, 1988) – languages in which gender is correlated with such clues – although distributional evidence also plays a role

(see Mills, 1985, for a study of German, and Smoczynska, 1985, for a study of Polish). Data for languages in which gender has no strong phonological correlates (e.g., Icelandic; see Mulford, 1983, 1985) show that gender categories are learned relatively late in such languages, after children acquire the concept of natural gender (as late as their fourth year; see Bem, 1981).

Cassidy and Kelly (1991) argue that children's identification of words as members of part-of-speech categories in general, and of the verb category in particular, might be grounded in phonological information. They believe that the presence of correlations between parts of speech and phonology has been underestimated by theorists in this field, and they attempt to show that such correlations are numerous. They provide convincing data in support of the hypothesis that English verbs tend to have fewer syllables than English common nouns, with verbs being monosyllabic much more frequently (when inflexions such as *-ing* are excluded from consideration). In addition, among disyllabic English words, stress tends to fall on the first syllable if the word is a noun, but on the second syllable if the word is a verb. They argue that these differences can guide children in identifying words as verbs. They cite evidence from Kelly (1988) showing that adults use a disyllabic nonce word in a sentence as if it were a verb when the word receives stress on the second syllable, but they tend to use it as if it were a noun when the stress is on the first syllable. Cassidy and Kelly show that both adults' and four-year-olds' part-of-speech identifications are also sensitive to the number of syllables in a word. The adults and four-year-olds in their sample tended to identify monosyllabic words as verbs more often than disyllabic or trisyllabic words. (The study with four-year-olds did not include a measure of part of speech per se, but of the inferred meaning of the word: a type of action or a kind of object. The four-year-olds concluded that a nonce word signified a type of action more frequently when the word was monosyllabic.)

Cassidy and Kelly provide no data relevant to the universality of a tendency for verbs to be monosyllabic. If verbs do not tend to be monosyllabic in other languages, or do not even tend to have fewer syllables than members of other

part-of-speech categories, then the use of variation in the number of syllables as a guide to category membership would have to be a learned tendency, and the variation across categories would itself have to be learned. For children to learn about such variation, they would seem to need some *independent means* of identifying words' parts of speech, so that they could notice that words in one part-of-speech category (e.g., *verb*) differed from words in a distinct part-of-speech category (e.g., *noun*) in the average number of syllables. In the absence of universality for part-of-speech differences in syllable number, this property alone cannot account for category identification.

To test the hypothesis that verbs have fewer syllables than nouns, on average, for all natural languages, I examined verbs and nouns in one other language: Spanish. The words in my sample were the 150 most frequent verbs and nouns found in a sample of 500,000 Spanish words from written texts (Juilland & Chang-Rodriguez, 1964). I followed the methods used by Cassidy and Kelly in excluding pronouns (and proper names, which did not appear in Juilland & Chang-Rodriguez). Spanish verbs differ from English verbs in that they are always inflected (for person and number, at the very least), so that the root of the verb never appears in isolation. Inflexions marking person, number, and tense cannot be ignored in an analysis of Spanish aimed at understanding child language acquisition. English verb inflexions (such as *-ing*) are unstressed, creating the possibility that children often ignore them and process just the roots of verbs. But in Spanish, stress often falls on an inflexion, rather than on the root syllable. I calculated the number of syllables in a verb as the mode of the number for the simple present tense across persons and numbers. The number of syllables for person and number combinations that differ from the mode in the number of syllables (e.g., the first and second persons plural) always exceed the mode, and other tenses almost always involve additional syllables, so the calculated number is a conservative estimate of the actual number of syllables children would hear in everyday speech. The mean number of syllables was not significantly different for verbs and nouns ($t [150] = 1.62, p = .11$). The mean for verbs (2.55) was slightly

higher than the mean for nouns (2.42). The results of this analysis suggest that the observed difference in syllable number for verbs and nouns in English is not a universal property of language. Nonuniversality implies that children must learn about it where it is present in a language, which in turn implies that children most likely have some independent means of identifying parts of speech so that they can notice this and other properties of words in the different classes. If they have some independent criterion or criteria for part-of-speech identification that preexist(s) their knowledge of syllable-number differences for parts of speech, then syllable number cannot be the primary criterion. The same argument applies for any learned phonological properties of verbs. Without independent criteria for classifying words, the phonological properties of words in one class would have to be highly typical of members of the class, highly atypical of members of other classes, and strongly correlated with one another for classification to succeed on a purely phonological basis; even then, one suspects that word classification might be difficult unless the words in the class shared some other property, such as uniformity in word distribution (e.g., French feminine nouns have a strong tendency to end in a consonant sound, and they all appear after the determiner "la").

It does not appear that the phonological properties of verbs, or at least English verbs, are sufficiently uniform to permit learning on a purely phonological basis. In particular, syllable number alone does not appear plausible as an explanation of children's ability to identify verbs. Cassidy and Kelly's analyses show that the difference in the average number of syllables for nouns and verbs is small, although significant. This highlights the difference between statistical significance and theoretical significance. With a mean syllable number for nouns of 1.96, and a mean number for verbs of 1.68 (see Cassidy & Kelly, 1991, Table 1), syllable number is not a very reliable indicator of the part of speech! In adult speech to children, the difference was only slightly larger (see Cassidy & Kelly, Table 2), and the proportion of verbs (relative to verbs and nouns combined) containing just one syllable was only about 60 percent (see Table 3). Moreover,

when adults used a monosyllabic nonce word in a sentence, it appeared in verb contexts in just half the trials (i.e., they were equally likely to interpret the word as a verb or a noun), and when four-year-old children were asked to guess the meaning of a monosyllabic nonce word, they chose the action option on just two thirds of the trials. So the evidence suggests that the difference in mean number of syllables for verbs and nouns is neither a reliable clue to category membership, nor do people use it as such. There is some tendency to correlate part of speech and syllable number, but people do not appear to have a *rule* for category identification based on syllable number.

One might argue that syllable number alone cannot account for the identification of verbs, but its use in combination with other phonological clues could explain verb identification. For instance, the stress pattern characteristic of English verbs could, perhaps, provide the additional information needed to categorise words correctly. Suppose that children identified all monosyllabic words as verbs, but identified disyllabic words as verbs only when the stress was on the second syllable (as in the case of the verb "record"; the noun "record" receives stress on the first syllable). This procedure would obviously lead to incorrect identifications (because some nouns are monosyllabic, and because some words have an idiosyncratic stress pattern, e.g., the verbs "twinkle," "study," "bargain," "amble," "twiddle," "ambush," "trickle," "placate," "twitter," and "dazzle," and the nouns "barrette," "disguise," "account," "pipette," "supply," "tureen," "rebuff," "velour," "display," and "charade") – but a more serious problem exists for this hypothesis: Stress patterns are not universal. With Spanish disyllabic words, the position of stress is independent of the part of speech, but instead depends on the final phoneme (the first syllable is stressed if the word ends in a vowel sound, or in the sound /n/ or /s/; the second syllable receives stress if the word ends in a consonant sound other than /n/ or /s/; there are some exceptions, which are marked orthographically with an acute accent on a vowel in the stressed syllable). If stress patterns are not universal, one must conclude that patterns of stress are learned from exposure to the language – and existing evidence suggests that stress

patterns are, in fact, learned (Hochberg, 1988; H. Klein, 1984; Leopold, 1947). To learn which syllable is stressed for words belonging to one part-of-speech category (if any such association exists), children must have, it seems, some independent criterion or criteria for identifying words as members of that category. If stress patterns are language-specific, then we have no reason to believe that children have an unlearned tendency to expect words in any particular class to follow any particular pattern of stress.

Unless universal and uniform phonological properties of verbs can be discovered, an account of early verb identification cannot rest on phonology alone. The sort of correlations observed by Cassidy and Kelly may assist a child in a situation of ambiguity if the child has learned about them, but these correlations cannot explain the child's ability to identify verbs with a high degree of accuracy. Even within languages, no single phonological property or combination of properties is unique to this part-of-speech category or universal among its members.

Children's observed ability to learn gender categories from phonological (and distributional) regularities may appear to contradict my conclusions. But verbs differ from gender categories in that verbs are members of a major open lexical class, whereas gender categories are *subcategories* of a major open class (i.e., common nouns). McPherson (1991) showed that two-year-old children can identify a novel word as a count noun or mass noun by observing the nature of its apparent referent, such that a label for a kind of object is identified as a count noun, and a label for a kind of stuff is identified as a mass noun. (The measure of the part of speech was the interpretation of the string "a little" in "a little vok/vox"; two interpretations are possible: the indefinite article conjoined with the adjective "little" – an interpretation consistent with a count-noun identification – and the continuous quantifier "a little" – an interpretation consistent with a mass-noun identification.) Gordon (1985) obtained similar results with a production measure, showing that, among young learners, exposure to words applied to atomic objects and masses is sufficient for identifying count nouns and mass

nouns. Soja and her colleagues (Soja, 1992; Soja, Carey, & Spelke, 1991) obtained results suggestive of the same conclusion, although their concern was with word meanings rather than parts of speech; they used a measure that distinguished words for individual objects (i.e., atoms) from words for portions of stuff. But given the semantic definitions of count nouns and mass nouns (see Macnamara, 1986, 1991; Macnamara & Reyes, 1994; see also section 3.1), the tendency among Soja's young subjects to interpret a word applied to an atom as a word for a kind of atoms, and to interpret a word applied to a portion of stuff as a word for a kind of stuff (and often independently of syntactic clues) – this tendency amounts to interpreting a word as a count noun or mass noun respectively. Dickinson (1988) obtained results similar to Soja's with somewhat older children. It appears, then, that learners can identify count nouns and mass nouns from extralinguistic perceptual information about their referents. With words identified as members of the common noun category in this manner, the task of subdividing those words along gender lines is relatively simple – especially because the task is aided by strong regularities in phonology and in the distributions of nouns of one gender type (e.g., their appearance after a particular form of a determiner, or in particular inflexional forms, or both). Subdividing an existing category on a phonological basis or distributional basis or both is much easier than attempting to *discover* a category of words by analysing complete utterances, because the task reduces to an analysis of very limited contexts (e.g., noun phrases; see Braine, 1987, for a similar argument). In addition, the proportion of words with phonological characteristics typical of a category is higher for gender categories than for verbs (and especially for uninflected verbs), at least in languages with which I am familiar. (E.g., in Spanish, those common nouns that end in a vowel tend to be feminine when they end in *-a*, and masculine when they end in *-o*, and a large proportion of nouns end in a vowel. Other regularities exist; e.g., nouns ending in *-ión* are feminine.) Even when phonological clues to gender are strong, children seem not to learn gender categories *per se* through phonological analyses; instead, they place in one category all words with a given phonological property –

or at least behave as if they have done so. In particular, their choice of plural markers and articles is based on phonological properties alone prior to their discovery of real gender categories, which are defined over distributions (Böhme & Levelt, 1979, as cited in Levy, 1983b, 1988; Karmiloff-Smith, 1979; Levy, 1983b; Popova, 1973). This finding suggests that the phonological correlates of the verb category might permit children to identify words as members of phonological categories such as "monosyllabic words" and "disyllabic words that receive stress on the second syllable," but not as members of the verb category itself.

2.6. Conclusion

Each of the existing theories suffers from serious weaknesses, suggesting a need for an alternative. Most of the theories are driven partly by one aspect of early child language, namely the seemingly natural division of early vocabularies into ontologically motivated categories. The theorists creating these theories recognised that the mature categories do not match the ontological categories, a fact that led to the inclusion in their theories of categorisation based on distributional analysis at some stage. Any theory must account for these facts, but alternative means of accounting for the nature of early vocabulary and for the membership of mature categories must be explored.

3. A NEW THEORY OF VERB IDENTIFICATION

3.1. Lessons from a Theory of Noun Classification

Macnamara (1986, 1991; La Palme Reyes et al., 1994b; Macnamara & Reyes, 1994) argues that the categories count noun and mass noun are defined according to semantic criteria. In particular, a count noun is a word that signifies a kind with members that are atomic individuals. By "atomic," he means that the individuals cannot be combined (or divided) to form a larger (or smaller) individual of the same kind. A mass noun is a word with an extension that does not contain atomic individuals. To put it another way, the signification of a mass noun is a kind with members that are not individuated in any characteristic way. Lumps of clay, for instance, come in many shapes and sizes, and their lack of atomicity is clear: We can combine two lumps into a larger lump, or make two lumps from one, and the word "clay" is still applicable. (Quine, 1960, first described this property, calling it "cumulative reference.") In more recent work (La Palme Reyes et al.; Macnamara & Reyes), the extension of a mass noun is conceptualised as a sup-lattice of portions or masses.

Macnamara (1986, 1991; Macnamara & Reyes, 1994) argues that children identify words for objects as count nouns because an object presents itself perceptually as a distinct, atomic individual. Words for physical stuff (such as milk or pudding) are identified as mass nouns because the stuff lacks any characteristic form, and portions of stuff do not, therefore, present themselves as atomic individuals (although they do present themselves as individuals, i.e., three-dimensional figures against a perceptual ground). In other words, physical objects and portions of stuff are prototypical examples of atomic individuals and nonatomic individuals respectively.

Notice that the semantic definitions work for adult grammar as well as for child grammar because they do not restrict count nouns to words for kinds of objects or mass nouns to words for kinds of stuff (e.g., the count noun "way" names a kind of atoms, for two ways combined do not form one larger way, and

one way cannot be divided into two ways; the mass noun "contemplation" has a sup-lattice structure because any instances of contemplation can be combined and called "contemplation," and the contemplation occurring over a given period, for instance, can be divided into instances of contemplation occurring over shorter periods within that given period, such that each such instance can be called "contemplation"). And yet the nature of the definitions is such as to explain why objects and stuff are relevant to the categories count noun and mass noun. This theory differs in an important way from those making use of ontologically based word categories as (1) early grammatical categories, (2) the domains of maps, or (3) the prototypical "centres" around which mature categories are organised, where, in each case, the mature categories are supposed to be defined largely or wholly in formal terms. In those theories, the links between ontological categories and grammatical categories seem arbitrary. In Macnamara's newest theory, the links between objects and count nouns and between stuff and mass nouns are principled; they follow from the definitions of the categories.

A theory of verb identification along similar lines would supply a definition of the category that holds at all stages of maturity and that gives rise to an explanation for learners' tendency to identify action words as verbs. I now present such a theory.

3.2. The Nonseparability Hypothesis

The fact that early verbs tend to be words for actions has led to the creation of theories in which the set of words for types of actions is either the precursor of the verb class or the domain of a map for which the codomain is the category *verb*. I will argue that actions play a different role in identifying verbs.

3.2.1. Nonseparability

Actions – as well as activities, processes, states, changes of state, properties, qualities, and attributes – have an existence that is parasitic on, or dependent upon, members of kinds. They cannot be separated from the individuals in which

they come to be or by virtue of which they occur. They have no independent existence. Aristotle makes this point very clearly in his *Metaphysics*:

[Aside from beingness or "substance," *ousia*, i.e., basic-level kinds or individuals of such kinds, which are called "beingness" because they exemplify being best] other things that *are* get so called because some are quantities of that which *is* in this way [i.e., in the way beingness *is*], others qualities of it, others sufferings [or affections] of it, others some other such thing [attributed to it].

Wherefore one might even raise the question whether 'walking' and 'being healthy' and 'sitting' signify in each case being, and likewise in any other case of this sort; for none of them is either responsible for its own existence by nature or able to be separated from its beingness [or "substance"], but rather, if anything, it is that which is walking or sitting or being healthy that is something among those things that *are*; and these [i.e., walking, being healthy, and sitting] are made to appear more like beings because that bounded [or defined, or delimited] thing which is the underlying thing [i.e., the substrate] for them is something; and this is the beingness [or "substance"] and the individual, the very thing which is [noetically] apparent [i.e., implicitly brought to light; *emphainetai*] in such an accusation [i.e., predication; see Appendix B; something like walking cannot be unconcealed to the mind's eye unless its substrate is simultaneously unconcealed]; for that which is being good or that which is sitting does not get so called without this [i.e., underlying beingness]. It is plain, then, that it is through this [i.e., beingness] that each of those [i.e., walking, being healthy, being good, and sitting] actually *is*.

. . . Of the other accusations [i.e., categories of predicates and being; *tōn katēgorēmatōn*; see Appendix B], none is separated [or separable, i.e., capable of existing separately; *chōriston*], but it alone. And . . . in the definition [*logos*] of each [thing] the [definition] of its beingness is necessarily inherent. (Z.1, 1028^a18-36; the translation is mine)

Aristotle also points out that variation in the intensity of a quality or a transformation of a quality into its contrary (e.g., as hot becomes cold) is a change in the individual in which the quality exists; the quality is not separate from the individual, so when the quality changes, the individual changes, such that the change in the quality is understood only when the change in the individual is understood – because the quality is in the individual (*Categories* 5, 4^a10-4^b19).

Aristotle called that which is incapable of existence separate from a basic-level individual that which "is in an underlying thing [or substrate]" (*en hupokeimenōi esti*; see *Categories* 2, 1^a20-25). I call it *nonseparable*, and the property of being nonseparable *nonseparability*.

I will argue that children's identification of verbs depends, in part, on the intuition that certain phenomena, including actions, cannot exist separately from the members of kinds involved in their manifestation (e.g., the agent of an action). I call this the *nonseparability hypothesis*.

Nonseparability differs in one important way from Aristotle's idea about the parasitic nature of properties and relations. It is the difference between a psychological claim and a metaphysical claim.

Aristotle makes the metaphysical claim that primary substance is ontologically privileged in the sense that all else depends upon it for its existence (e.g., *Categories* 5, 2^b3-6). It is also conceptually or cognitively privileged in that it can be understood (or fully known) without reference to any other entity that underlies it (e.g., *Metaphysics* Z.1, 1028^a36-1028^b3). Now, a *substance* is characterised by *thisness* (τὸ τὸδε τι, 'that which is this something') and *separability* (τὸ χωριστόν, 'that which is separated,' or 'that which is separable' or 'the separable'). Gill (1989) translates τὸδε τι as 'this something,' and attributes to it two possible meanings: a particular member of a kind (e.g., "this man"), or a kind (species) understood as a subdivision of a more general (superordinate) kind (genus; e.g., "this animal," referring to the kind MAN). So thisness implies a kind or a particular member of a kind. In the *Metaphysics*, Aristotle uses the term "separated" or "separable" (χωριστόν) with two meanings, which Gill calls "separation in being or account," and "simple separation or separation in existence." The former implies conceptual independence – the possibility of definition without reference to something in which it is realised. Aristotle uses the example of snubness as something that fails this criterion for separability; snubness must be defined with reference to the noses in which it is realised (e.g., "concavity in a nose"). If something is simply separate, or separate in existence, then it is not

predicated of a subject, where predication is understood as an attribution of responsibility for the existence of a thing – for its coming to be (see section 3.2.4 and Appendix B) – and not as a syntactic relation of the part of a sentence we call the predicate (or of its higher projection, which includes the copula or an auxiliary) to the part we call the subject (see *Posterior Analytics* A.4, 73^b5-9 and *Metaphysics* Δ.18, 1022^a16-18, 30-32). In other words, that which is simply separate does not depend for its existence upon something else. Thus, a cat is simply separate, but the colour of its fur is not.

The entities that meet the criteria to be a primary substance (i.e., those that are simply separate) are recognisable to modern psychologists as individuals of the psychologically privileged basic-level kinds discovered by Eleanor Rosch and her colleagues (e.g., Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). The Greek word for a basic-level kind is *eidos*. This means ‘that which is seen,’ ‘appearance,’ ‘look,’ ‘shape,’ or ‘figure.’ A basic-level kind is also sometimes called an *idea*, which has a similar meaning, namely ‘look,’ ‘semblance,’ ‘form,’ or ‘outward appearance.’ The Latin word *speciēs*, which is the conventional translation for *eidos*, has the same meaning, namely ‘outward appearance,’ ‘shape,’ etcetera. These words reveal that the kind signified is the kind that is presented to us directly in perception – the kind revealed in the shape or appearance of the thing; it is the kind that corresponds to the perceptual type. Members of a basic-level kind (i.e., primary substances) are readily identified as such by their appearance (and, for atoms in particular, by their shape). Aristotle’s metaphysical claim amounts to this: Properties and relations depend for their existence on the basic-level individuals in which or by virtue of which they are realised.

The claim I wish to make is a psychological one, namely that we conceive of properties as inhering in or being present in individuals, and of relations as being part of one individual’s being with reference to some other individual. These individuals need not be conceptualised as members of basic-level kinds. In fact, the typing of predicators by kinds may imply that some individuals must be conceptualised at a level other than the basic one; a good teacher need not be a

good person. Goodness, when typed by the kind TEACHER, can be realised only in members of the kind TEACHER. It does not matter that the noun "teacher" is derived from the verb "teach," and that a good teacher is a member of the kind PERSON who teaches well. Aristotle's metaphysical claim may well be true: Good teaching may depend for its existence on its realisation in a person, a primary substance. But the human mind is able to conceive of an individual, a teacher, who comes into being, in some sense, when a person takes up teaching, and who ceases to be when the person gives up teaching. The identity of that individual is traced under the kind TEACHER, and he or she is not identical with a member of the kind PERSON (because a person can exist prior to becoming a teacher and continue to exist after having ceased to be a teacher). And that individual can be the support or basis for any property that is capable of finding its realisation in members of the kind TEACHER. I claim that this way of thinking is fundamental in our mental lives.

This psychological claim entails a view of separation that differs from Aristotle's. A teacher is clearly not simply separate, for the existence of a teacher is parasitic upon the existence of a person. Nor is the kind TEACHER separate in account, for any definition of "teacher" must include a reference to members of the kind PERSON. When one speaks of "a good teacher," the individual is not a primary substance (or even a substance). While the goodness is understood as belonging to an individual, and while the existence of that goodness is dependent upon the individual in which the goodness is realised, the individual is not a primary substance. And so the claim that the goodness depends for its existence upon the existence of a teacher is not a metaphysical claim. It is a claim about the way we understand kinds, their members, and the properties and relations that are typed by kinds.

For all that, the psychological claim approaches the metaphysical claim if we allow mappings from named individuals (e.g., "the teacher") into the substances that underlie them (see La Palme Reyes et al., 1994b; Macnamara, 1994). Even when "good" is typed by the kind TEACHER, the goodness of a teacher qua

teacher can be attributed to the person who underlies the teacher (see Appendix B) – a person who has the property of being a good teacher – by virtue of the fact that a teacher is an individual concomitant with a person, an individual that came to be in dependency upon a person for his or her very existence. So to say that a good teacher is a teacher who teaches well is equivalent to saying that he or she is a *person* who teaches well. Goodness of teaching can thus be regarded as something that is present in, and nonseparable from, a person – a substance. The possibility of mapping from concomitants into their underlying substances makes the psychological notions of separation and nonseparability identical with Aristotle's metaphysical accounts of them.

3.2.2. Verbs as Predicators

Before I can describe the theory of verb identification, I must take a detour and examine the category *verb*, for my conclusions about the nature of this category are basic to the theory. I claim that this category is prototypical of a more inclusive category which I will call, following Lyons (1966b) and others, *predicator*.³

3.2.2.1. The Category *Predicator*

Predicators are single words (i.e., lexical units) that are used in signifying properties of individuals (whether they be permanent or transitory) or relations of individuals with regard to other individuals; that is, predicators head phrases that signify properties or relations (phrases that coincide with predicates in propositions). (The word class *predicator* is distinct from the grammarian's notion of a *predicate*, which is a larger constituent of a proposition that signifies that

³The term *predicator* is not ideal for my purposes, for it suggests that predicators *predicate*. I will characterise predicators in terms of nonseparability or dependence for existence. Nonseparability involves being *in* a subject (not as a part of it, but as something that cannot be separated from it). As Aristotle shows (*Categories* 2, 1^a20-1^b8), being *in* a subject is distinct from being predicable of a subject (in the sense of predication given in Appendix B). But I will adopt the term *predicator* nonetheless, in keeping with a tradition in linguistics.

which is predicated of a subject. Except where predicators coincide with predicates, they are not, by themselves, predicated of an individual, although they do have some privileged status in the predicates of sentences, and their nature has points of contact with the nature of predicates; see section 3.2.4 and Appendix B.)

In English and many other languages, there are two general categories of predicator: verbs and adjectives. Case grammarians (e.g., Fillmore, 1968a, 1968b) and generative semanticists (e.g., G. Lakoff, 1970, 1972), whose goal was to describe the universal semantic base of natural languages, did not distinguish verbs from adjectives, because they were not able to find any semantic distinction between them. (For George Lakoff and Paul Martin Postal's arguments for the existence of the category *predicator*, see section 4.1 regarding evidence for the category.) In languages containing a distinction between verbs and adjectives, words in the two classes have different distributions – and in fact those different distributions are the basis for the claim that a language contains the distinction.

3.2.2.2. Nonseparability and Argument Structure

Predicators are distinguished from other open classes of word in one way that is critical to the theory, namely by their unique requirement of an argument structure.⁴ The requirement of arguments stems from the nature of what predicators are used to signify. Verbs and adjectives are used to signify properties or relations (e.g., actions, activities, processes, states, changes of state, or relatively stable properties such as colour), properties and relations that cannot exist in the absence of the individuals (or surfaces, etc.) signified by the arguments of the verb or adjective (whether the individuals are count or mass, that is, atomic or

⁴Some linguists argue that noun phrases within a prepositional phrase are the arguments of the preposition, probably because linguists link arguments with theta-marking, a role prepositions are said to play. I follow M. C. Baker (1988) in assigning the prepositional phrase to the verb as an additional argument in most cases. Baker provides evidence from linguistic data that benefactive and instrumental as well as certain locative prepositional phrases are arguments of a verb (see M. C. Baker, pp. 239-243). Putting aside the closed class of prepositions, we find no disagreement that among the open classes, verbs and adjectives alone (or possibly also nouns derived from them) take arguments.

nonatomic). An action occurs by virtue of an actor and, sometimes, an object of the action. Whenever running occurs, there is a runner. Whenever hitting occurs, there is a hitter and a hittee. Similarly, attributes such as colour and texture (or even beauty and spirituality) cannot exist except as they reside in individuals; they have no separate existence. Attributes inhere in or occur in atoms, stuff, or surfaces. For blueness to exist, there must be something that is blue. This dependence of properties and relations (including actions, activity, and so on) on bearers of the properties or on participants in the relations is the source of the necessity of an argument structure for a word that heads a phrase that signifies a property or relation. This dependency is also the reason Aristotle says that a verb or an adjective (a *rhēma*) 'is a sign of those things that are attributed to something else; . . . and it is always a sign of those things that come to be in dependency, of things of the sort that are attributed to a substrate' (or, more literally, it 'is a sign of those things that are spoken against something else [i.e., as accusations]; . . . and it is always a sign of those things that come to be in dependency, of things of the sort that are [spoken] against [or because of] an underlying thing'; "[*rhēma*] esti . . . tōn kath' heterou legomenōn sēmeion. . . kai aei tōn huparchoutōn sēmeion estin, hoion tōn kath' hupokeimenou"; see Appendix B; *On Interpretation* 3, 16^b7-10; the translation is mine). Being that is dependent for its being upon the being of its substrate cannot appear to the mind's eye if its substrate is not known, so any statement about the nonseparable must explicitly or implicitly (e.g., through the discourse context) reveal the substrate, the referent of one of a predicator's noun-phrase arguments. For relational being, both the substrate and the individual to which the substrate is referred must be named (or implied) in an utterance if the being is to be revealed through that utterance (see section 3.2.3.1). I define a predicator as a word that takes one or more arguments because the phrase it heads signifies the nonseparable or that which is dependent for its being upon one or more individuals.

The idea that properties and relations depend for their being upon the individuals that a predicator's arguments signify is implicit in the meaning of the

word "argument." This word is derived from the Latin *argūmentum*, a noun derived from the verb *arguō*, which means 'blame,' 'accuse,' 'demonstrate,' 'reveal,' or 'prove guilty' (among other things).⁵ The nominalising suffix *-mentum* signals the means by which, or the place where, an action occurs. An *argūmentum* is thus the means by which something is accused or by which guilt is revealed for something, or the place where one reveals guilt or responsibility. (See Appendix B regarding the connection between accusation and predication.) The single argument slot of a one-place predicator is filled with the name of the thing blamed or believed responsible for the being of the property that a predicate headed by the predicator

⁵The words *arguō* and *argūmentum* may have the meanings they do for a somewhat esoteric reason. The Greek word for bringing a charge against someone regarding property is *phasis*. When *phasis* is derived from *phēmi* rather than *phainō*, it signifies a proposition (see Appendix B; *phasis* comprises *kataphasis* and *apophasis*, that is, affirmations and denials of predicates to subjects). The primary meaning of this word when it is derived from *phainō* is 'appearance' (i.e., an appearing of what was concealed). The use of this doubly derived word for propositions may be intended to be doubly meaningful because propositions were believed to unconceal being (see Appendix B). This same word was used for the appearance out of hiding of the Moon and other celestial bodies, that is, for the heliacal rising of a star or planet after it has been hidden by the rays of the Sun for a number of days; the word was applied to diurnal risings of bodies above the horizon as well. It was also used for the appearances of different types of Moons, which we call the Moon's "phases"; Paulus Alexandrinus (378/1993) lists ten lunar phases: "Conjunction, Coming Forth [i.e., passing the Sun, an 'appearance' 'to the cosmos' or an intelligible appearance, but not a sensible appearance], Rising, Crescent, Half, Doubly Convex, Whole Moon, Doubly Convex again, Second Half, and Second Crescent" (p. 34); he also mentions an eleventh phase of which some had spoken, namely "With Full Light or Full Moon" (i.e., when the Moon is 150 degrees ahead of the Sun, and begins to look like a disk; see pp. 34-36). These phases were believed to be reflections of being – signs of mundane events (see, e.g., Valens, 150/1994, pp. 71-73), and so the phases are appearances that give rise to appearances to the mind's eye (i.e., unconcealments of being to those who can read the signs). The Moon, with its silvery white and shining appearance, was linked symbolically with silver – a metal that has an interesting power to reveal, by reflection, when it is smooth and polished. The Greek and Latin words for silver are *argyros* and *argentum*; the words for the shining whiteness characteristic of silver and the Moon are *argēs* and *argenteus*. The verb *arguō* and the noun *argūmentum* are derivationally related to these words. The word *arguō* may have been chosen to express 'reveal,' 'accuse,' 'prove,' and so on because all of these things involve bringing something hidden to light, unconcealing something, or making being (i.e., what *is*) appear to the mind's eye, through voiced *ratio* or *logos* (i.e., propositions, or arguments – syllogistic or otherwise – formed from conjoined propositions, both of which are instances of *logos*, according to Aristotle; see *On Interpretation* 5, 17^a8-9, 15-22; *Prior Analytics* A.1, 24^b18). *Logos* acts much like a mirror of polished silver, revealing being as a kind of reflection of ' ' or like the Moon, "bringing to light" what was hidden by "reflecting" being (as the Moon appears out of hiding by reflecting the light of the Sun), or making what *is* appear to the mind's eye by giving signs (as the Moon's phase is a sign of concomitant events of a certain kind – a sign of what *is* at that time). So *arguēns* ('arguing'), whether it be accusing or proving or demonstrating or revealing, produces a *phasis* of being, as do silver and the Moon.

signifies – its basis or reason for being. In the case of a two-place predicator, both arguments, together, give rise to the relation signified by the predicate, with the argument named as subject being held responsible for the relation, where the nature of the relation is determined by referring the signification of the subject argument to the signification of the object argument (see section 3.2.3.1). In mathematics, an early and still current use of the word "argument" is for the quantity upon which some other quantity depends or by virtue of which it comes to be. Given a function $F(a)$, the value of the function F depends upon the value of a ; the function has no value whatsoever unless its argument is a constant, that is, a specific number. By the same token, a formula in predicate logic containing a symbol for a property has no interpretation into extramental being unless its argument is a constant – some noun phrase interpretable into one or more individuals; $GENTLE(x)$ does not signify any realised gentleness, but $GENTLE(Lucy)$ does, if the statement is true, because gentleness is realised in the individual named Lucy; it is Lucy that gives rise to and is responsible for the being of gentleness in this instance.

3.2.3. Nonseparability and Relations

The dependence of a relation upon individuals is more complex than the dependence of a property upon a single individual or a set of individuals. To see how, we must explore in detail the nature of a relation.

3.2.3.1. What is a Relation?

The word "relation" is a nominalisation of "relate," which is derived from a participial stem of the Latin verb *referō*, 'refer.' The word *referō* is from *re-* and *ferō*; the latter is cognate with the Greek verb *ferō*. The Greek and the Latin *ferō* have many possible meanings, the most relevant of which are 'bear,' 'carry,' 'convey,' 'bring about, produce, give rise to,' and 'stretch, extend (toward).' The Latin prefix *re-* suggests movement back or in reverse, a reversal, or a response or opposition. So the word *referō* suggests a response or opposite action to a

conveyance, to something borne or carried to one, brought about in one, or extended toward one. A relation is always relative to something, referred to that thing; the thing conveys upon one that which is opposite to that which one conveys upon the thing, with the consequence that the relation of *A* to *B* is not identical with the relation of *B* to *A*. For instance, 2 conveys upon 4 doubleness, so that 4 is double relative to 2, whereas 4 conveys upon 2 halfness, so that 2 is half of 4, where half is the opposite of double. In each case, the relation resides in one individual as a part of its being, but only by virtue of the other individual, to which it is referred.

For any asymmetric relation, the nature of a relation cannot be understood except from the point of view of one of the individuals involved (and I argue later that the same is true of symmetric relations). Take, again, the rational relations of the numbers 2 and 4. From the point of view of 4, it is in the relation of *double* to 2. But from the point of view of 2, it is in the relation of *half* to 4. Double and half are distinct relations. Given 2 and 4, we cannot say what rational relation exists for them without taking the point of view of one number or the other. In propositions, the point of view taken is evident in the choice of a subject of predication. We say "Four is double relative to two" and "Two is half of four." Likewise, considering a relation involving a hitter and the recipient of a hit, the nature of the relation depends on whether the point of view of the hitter or the hittee is taken; the nature of the relation follows from the choice of the subject of predication in a proposition. If we wish to take the point of view of the hitter, we say, for instance, "Tom hit the ball," because the hitting of the ball is an aspect of Tom's being (see Appendix B); but if we wish to take the point of view of the hittee, we say, for example, "The ball was hit (by Tom)," because the undergoing of hitting is an aspect of the ball's being. The relation is different in the two cases. In the first sentence, the relation is one of hitting. In the second sentence, the relation is one of undergoing hitting, or suffering hitting. Until the verb "hit" is embedded in a proposition, we cannot tell whether it will be used to signify hitting or the undergoing of hitting. For this reason, it would be misleading to say that a

predicator with two arguments signifies a relation. As a lexical item, it signifies nothing (although it may bring to mind a mental representation); the predicate it heads signifies a relation. (The same conclusion is to be reached from a consideration of nonseparability, and so the same conclusion is reached for one-place predicators. For all predicators, nothing in extramental being is signified unless the individual[s] possessing a property or relation are named, or somehow implied, for a property or relation exists only by virtue of the individual[s] in which or through which it is realised. Just as nouns fail to participate in signifying individuals in extramental being until placed in a subject noun phrase in a proposition or in some other noun phrase not equivalent to the predicate, so predicators fail to participate in signifying any aspect of extramental being until they are embedded in a phrase within a proposition. Consequently, I do not say that predicators signify properties or relations, but rather that they are *used* in signifying properties or relations, or that the phrases they head signify properties or relations.)

Lest the reader think that I am merely distinguishing symmetric from asymmetric relations, or that I am merely pointing out that relations have converses, let me turn, for a moment, to symmetric relations. Take the relation of being married to someone. If John is married to Joyce, then Joyce is married to John; the relation is symmetric. But we must nonetheless take the point of view of one of the two persons, and treat the relation as an aspect of that person's being, if we are to understand the nature of the relation. "John and Joyce are married" does not necessarily imply that John and Joyce are married to one another; we cannot interpret being married to someone as a property that exists in both parties as subjects without any reference to one another – with at reference to any other individual. Even symmetric relations must be attributed to individuals as subjects relative to other individuals. John is married to Joyce, such that being married to *Joyce* is a part of John's being, and not a part of Joyce's being. The thing to which one is related determines, in part, the nature of one's relation to it. Being married to John is distinct from being married to Joyce.

My conclusion about the nature of a relation (i.e., that it is an aspect of a subject's being and has a nature that depends upon the subject) may seem to contradict my earlier claim that the arguments of a two-place predicator are interpreted into the individuals upon which a relation depends for its existence. If the nature of the relation changes with the subject, so that it differs for each argument as subject, how then can there be any relation that depends for its realisation upon both individuals into which the predicator's arguments are interpreted? The solution is that no unique relation depends for its being upon both individuals, but each of the two relations that phrases headed by the same predicator can signify depends upon the existence of both individuals because any relation is always defined *relative to* or *with regard to* something. As noted earlier, the relation of double is determined by the relative size of another individual, so that we can say "Four is double relative to two" because the quantity two defines the relation of double that is an aspect of the quantity four's being with regard to two; four is not double by virtue of itself alone; it is only by virtue of two that four can be double. So the relation of double depends for its existence upon both four and two, in this case; it has no existence except by virtue of the two individual numbers. Along similar lines, the relation of hitting depends for its existence both upon a hitter and the thing hit; without the latter, the subject is just flinging his or her arms about. Likewise, the relation of being hit depends not only upon the thing hit, which has the relation as a part of its being, but also upon the hitter, for being hit cannot come into being without someone hitting. Strictly speaking, a relation can only be considered nonseparable from the individual that has the relation as part of its being, that is, the subject (or substrate) of the relation. So the dependence of a relation upon the other individual is of a distinct sort; it is not nonseparability per se. So, if we take the noun phrase interpreted into that individual as an argument of the predicator, then we must allow that the need for an argument cannot always be explained by nonseparability; for arguments appearing in object position, the need may have its source in this other sort of dependency, dependency upon the individual to which the subject of a relation is

referred. (Any additional arguments of a predicator will be associated with different sorts of dependency again. The nature of the dependency will be signalled by prepositions in some languages, such as English, and by case forms in some languages, such as Latin; for arguments signifying instruments without which an action or activity could not be performed, the nature of the dependency is signalled by "with" in English, and by ablative case in Latin; for arguments signifying the recipients of things, the transference of which could not occur without recipients, the nature of the dependency is signalled by "to" in English, and by dative case in Latin; for arguments signifying goals toward which activities tend, the nature of the dependency is signalled by "to" in English, and by accusative case or by the preposition "ad" in Latin; for arguments signifying the source locations of actions, the nature of the dependency is signalled by "from" in English, and by ablative case with or without a preposition in Latin; and so on.)

The point I have been making, that a relation exists as part of a subject's being and its nature depends on the subject, is not to be skipped over lightly. The conventional modern understanding of a relation vacillates between consciousness and unconsciousness of the fact that a relation is always relative to something, so that a relation's nature is only understood from the point of view of one of the individuals (or sets of individuals) involved, the individual that has the relation as part of its being. Consciously, moderns regard a relation as something separate from the individuals involved, a third thing that is independent of any subject, something that exists *between* two individuals and that links them together in some way. (See Appendix A for an explanation of how this conceptualisation of a relation arose.) The nature of the relation is derived by unconsciously or implicitly taking the point of view of one individual, say the agent of an action, as if that individual were the subject of the relation, but the relation, with its nature thereby established, is then abstracted away from the individual and treated as something that exists in neither individual or in both somehow.

This modern view of a relation can be seen in mathematics. Although logicians use a syntax that recognises tacitly the relativity of relations (by placing

the subject first in the order of arguments), they speak of relations holding *between* individuals. Inclusion, for instance, is said to be a relation *that holds between* two sets (e.g., Tarski, 1946). But if one set is included in another, it does not follow that the latter set is included in the former. If A is included in B , then B *includes* A ; being included in a set and including a set are different relations. It makes no sense, therefore, to say that inclusion (either as being included or as including) is a relation holding *between* two sets, as if it were a part of the being of both sets treated as a single subject, or something separate from the two, or something "holding" equally of each. Mathematicians handle the subject-dependent nature of relations such as inclusion by using a fixed order of symbols, such that the symbol for the included set always appears on the left, implicitly taking the point of view of the included set and interpreting the inclusion relation as the relation of being included.

The absence of an explicit recognition and full understanding of relations as subject-dependent affects the way mathematicians formalise natural-language statements. In modern predicate logic, no distinction is made between hitting and undergoing hitting; both "Tom hit the ball" and "The ball was hit by Tom" would be stated formally as $HIT(Tom, the\ ball)$. As noted in Appendix B, Frege (1879/1952a), an early developer of symbolic logic, claimed that the semantic content of any two such related sentences is identical, and mathematicians in general seem to have adopted this view. But this conventional view flies in the face of our intuitions. Would you rather hit something with a bat or be hit by someone wielding a bat? If you have a preference for one or the other, then the two must be distinct types of phenomena. Hitting is not identical with being hit. The experience of the two is completely distinct (e.g., the latter is more likely to involve pain). In modern logical thinking, "hit" is a "two-place predicate" signifying a relation, implying that hitting has one leg of its being in one individual and another leg of its being in another (to borrow a way of speaking from Leibniz), with the point of view of the hitter taken implicitly and unconsciously so that the relation is understood as acting rather than the undergoing of action.

Modern linguists seem to have followed the lead of mathematicians in their failure to distinguish acting from undergoing action. In general, linguists treat a statement about undergoing hitting as a syntactic variant of a "deep-structure" statement about hitting; "The ball was hit by Marcus" is considered to be the product of a syntactic transformation ("the passive transformation") of "Marcus hit the ball," implying no change in meaning; the two sentences are believed to be interpreted into the same phenomenon, namely hitting (i.e., action of a certain type). This view is implicit in discussions of the subject of a proposition, as in this one from Lyons (1968):

. . . Many linguists have drawn a distinction between the 'grammatical' and 'logical' subject of passive sentences; saying that in "Bill was killed by John" the 'grammatical' subject is "Bill" and the 'logical' (or underlying) subject "John" whereas in the corresponding active sentence "John killed Bill" the noun "John" is both the 'grammatical' and the 'logical' subject (and "Bill" the object). (p. 343)

Katz and Postal (1964) made this distinction between an underlying subject and a surface subject, and this way of thinking played a large role in the creation of transformational grammars:

A crucial syntactic fact about languages is that there are sets of sentences whose underlying P-markers [i.e., phrase-markers, or labelled bracketings of sentences] are similar or identical although their derived P-markers may be radically different and conversely that there are other sets of sentences whose derived P-markers are similar or identical although their underlying P-markers may be quite different. Of overwhelming importance here is the fact that similarities and differences among the fundamental *grammatical relations* like 'subject,' 'object,' 'predicate,' etc., correlate *only* with the features of underlying P-markers. For an example of the first type, consider these sentences: . . . [1] John drank the milk, . . . [2] the milk was drunk by John, . . . [3] who hit someone, . . . [4] who did someone hit. It is evident to any speaker of English that in both . . . [1] and . . . [2] the relation of both *John* and *the milk* to the verb *drank/drunk* is the same, i.e., in each case *John* is the 'subject' of this verb while *the milk* is the 'object.' Yet there is no feature of the otherwise formally motivated derived P-markers for . . . [1] and . . . [2] that can represent this relation. Similarly, in . . . [3] it is evident that *who* is the 'subject' of *hit* while in . . . [4] the pronoun is the 'object' of that verb. Further, in these cases it is evident that in

. . . [3] *someone* is the 'object' of *hit* while in . . . [4] it is the 'subject.' Yet again there are no features of the derived P-markers of . . . [3] and . . . [4] which can represent in a non-*ad hoc* way the relational equivalence between *who* in . . . [3] and *someone* in . . . [4] and *who* in . . . [4] and *someone* in . . . [3]. (pp. 33-34)

The same view of subjects has been expressed by Chomsky:

. . . Consider such sentences as . . . : . . . "John was persuaded by Bill to leave." . . . "Bill" is the ('logical') Subject-of the Sentence, rather than "John," which is the so-called 'grammatical' Subject-of the Sentence, that is, the Subject with respect to the surface structure. (Chomsky, 1965, p. 70)

In this now-standard linguistic view, the *subject* of a proposition is equated with the *agent* of the action associated with the verb, implying that the verb rather than the predicate is regarded as signifying a relation, and that the relation signified is always an action, and never a suffering of an action.⁶ In considering a means of defining "subject of a sentence," Chomsky (1982) equates subjects with agents explicitly: ". . . The grammatical subject is the (usual) agent of an action and the direct object the (usual) patient . . ." (p. 10).

The identification of agents of actions with subjects carries over into psycholinguistics and the psychology of language acquisition. A good example can be found in Maratsos (1978):

In *John was kissed by Mary*, the initial NP *John* stands in the same relation to the verb *kiss* as the postverbal NP *John* in *Mary kissed John*; in both sentences *John* is the logical object of the verb.

⁶Linguists might not care to call an action a relation, because the word "relation," as used by linguists, seems to have become the exclusive province of relations of words or phrases to one another. Evidence of this is seen in the use of the terms "two-place relation" and "one-place relation" for the "logical argument structure" of a transitive verb and an intransitive verb respectively (e.g., Bresnan, 1978, pp. 14-15). The term "one-place relation" cannot be intended to signify an intransitive action, for such an action can be attributed to a subject without reference to or regard to any object. What seems to be meant is the relation of a verb to its single argument, or vice versa. If such a relation is taken to be what linguists call a *thematic* relation, then the argument is an agent or actor (for instance) with respect to the verb (or perhaps with respect to an action the verb is believed to signify; but some linguists insist that thematic relations are purely syntactic beings, having nothing to do with the interpretation of verbs). When linguists call predicators "relational," they seem to have in mind particularly "grammatical relations," such as that of a verb to its subject argument or object argument.

Correspondingly, in both sentences *Mary* is the one who kisses, the logical subject of the sentence. (p. 247)

In apparent contradiction to this way of thinking, Maratsos himself argues for the position that neither children nor adults treat the agent as if it were the "logical subject" in a passive, that is, as if the passive sentence were a syntactic variant of some active sentence (in "deep structure"). Maratsos even cites evidence in support of his position; he reviews findings suggesting that neither children nor adults treat a passive sentence as if it were a version of some other, active sentence. For instance, children have more difficulty comprehending and producing passives that include a "by" phrase naming the agent of the action than passives that fail to name the agent. Adults find passives with no named agent no more difficult to process than passives with named agents. If a passive sentence were created by transforming an active sentence, then a passive created by performing such a transformation and, in addition, deleting the noun phrase that names the agent should place greater demands upon the speaker; similarly, if comprehending a passive requires a transformation of it into an active sentence, then passives with no named agent should create difficulties in effecting this transformation and thereby hinder comprehension; but, in fact, passives with no named agent seem, if anything, simpler to produce and comprehend. Further, four- and five-year-olds who have become competent with passives for actional verbs fail to generalise this knowledge of passives to nonactional verbs such as "like" and "know," suggesting that they have not acquired a transformational syntactic procedure for the formation of passives, since any such procedure could presumably be employed with any verb. Maratsos concludes that,

The picture of initial acquisition (and acquisition for some time afterward) that these data suggest is that children do not initially relate passive grammatical structures to underlying activelike structures in which logical relations [i.e., subject, object, etc.] are uniformly represented. Apparently they make more surfacelike grammatical analyses of . . . passives . . . (Maratsos, p. 256)

and that,

. . . Evidence from adult language use fails to provide support for uniform grammatical representation of underlying relations.
(Maratsos, p. 262)

In short, neither children nor adults treat the agent of an action (for instance) as if it were a "logical subject" in a passive construction; nor do they treat the object of the action, named in subject position in the passive, as if it were a "logical object." This finding implies that they do not interpret an action verb into the acting that is part of an agent's being, but rather that they interpret the *predicate* headed by the verb into some aspect of the named subject's being, and, further, that they are sensitive to the distinction between acting and undergoing action and willing to attribute the undergoing of action to the individual acted upon as its subject. This suggests, in turn, that they understand a relation as an aspect of one individual's being, with a nature that depends upon its subject. There is no indication that they understand a relation as something that exists between two individuals, or as something that is independent of any subject, or as something with a nature that is tied to its being an aspect of an agent's being regardless of which individual is named as subject in surface structure.

A number of linguists and psycholinguists have questioned the idea that a passive sentence is a syntactic variant of an active sentence, one formed in "deep structure" and then transformed. Their reasons for doubting the existence of a passive transformation differ from mine, that is, they have no trouble with the modern concept of a relation that motivates the transformational view of passives; but they provide some interesting additional arguments for rejecting the notion that a passive is a syntactic variant of an active sentence.

R. Lakoff (1971) points out that passivisation would seem to have no point, if a passive is merely a syntactic variant of an active sentence:

Why passivize a sentence at all? Passivization is one of the few rules I know of that, while apparently [i.e., supposedly] adding little semantic material to the 'basic' active sentence, considerably complicate it syntactically and morphologically. (p. 149)

The use of passives and their use in so many languages appear strange if they do not differ in meaning from the active sentences that are supposed to underlie them.

Lyons (1966a) points out that the passive in some languages differs from the English passive in ways that suggest it is not derived by a transformation; in particular, an agent phrase (comparable to an English "by" phrase) is rarely present in the passives of some languages, such as Turkish; in addition, the Turkish passive (for instance) is not restricted to use with transitive verbs, as is the English passive. Lyons also points out the counterintuitiveness of the notion that "Thomas was killed" is syntactically more complex than "Thomas was killed by Adam" (because, according to the transformational theory, the latter is the product of the transformation, so that the former involves an additional operation, namely the deletion of the agent "by" phrase; see Lyons, p. 130; the same point is made by Fodor & Garrett, 1967).

Langacker and Munro (1975) question the assumption that an agentive "by" phrase appears in some passives as the result of postposition of the subject noun phrase of an active sentence that exists at the level of "deep structure." Such postposition would imply that the preposition heading an agentive "by" phrase is semantically empty (or at least redundant; Chomsky & Lasnik, 1977, would require "by" to be semantically empty since it can, according to the transformational theory, be deleted in truncated passives, and deletion is restricted to elements with no semantic content; see below); in the theory, the individual named in that phrase is understood to be the agent of the action, and the same selectional restrictions (e.g., ANIMAL) apply to that noun phrase as to the subject noun phrase of the related active sentence, by virtue of that noun phrase having been the subject in an active sentence from which the passive is supposed to be derived (and not by virtue of the meaning of "by"). Langacker and Munro argue rather that "by" (as in "Homer was executed by the terrorists") can convey the notion of agency, and thereby imply an animate individual, just as easily as the expressions "at the hands of" (e.g., "Homer was executed at the hands of the

terrorists") and "through the actions of" (e.g., "Homer was executed through the actions of the terrorists"). The preposition "by" certainly seems to convey meaning in the sentence "This sonata is by Vinteuil" where no main verb is present to impose selectional restrictions upon the noun phrase that follows "by" (see Langacker & Munro, p. 818). Langacker and Munro conclude that agentive "by" phrases could easily have an external source, implying that they need not be formed through postposition of a subject noun phrase.

Watt (1970) attacks the idea of a passive transformation from a different angle. Transformational grammarians argue that deletion, including the deletion of an agentive "by" phrase, is permissible only when the deleted element is recoverable, that is, when the deleted element could be supplied by any listener because it is somehow implicit in the utterance (e.g., Chomsky, 1964); otherwise, the meaning of the utterance would change by virtue of the deletion, but since meaning is supposedly assigned to the deep structure version of a sentence prior to any deletion of elements (Chomsky & Lasnik, 1977), such a loss in meaning is incompatible with the theory (for it would imply that the final surface structure had a meaning different from that of the deep structure; see Watt). Chomsky describes the problem in terms of ambiguity in surface structure:

. . . If it is true that the interpretation of a sentence is determined by the structural descriptions of the strings that underlie it (as is supposed in the theory of transformational grammar), then the degree of ambiguity of a sentence should correlate with the number of different systems of structural description underlying it. In particular, if . . . [the deleted element is not recoverable, that is, if no unique element suggests itself for recovery], the "elliptical sentences" . . . should be multiply, in fact, infinitely ambiguous, since they should each have infinitely many sources. Thus "the car was stolen" could derive from "the car was stolen by the boy," ". . . by the tall boy," ". . . by the tallest of all the boys in the school," etc. (Chomsky, 1964, p. 42)

In the case of passives, the recoverability condition implies that a deletion will be permissible only when the selectional restrictions of the verb upon its subject in an active sentence permit an inference about the nature of the deleted element (i.e.,

an agentive "by" phrase). The requirement that the deleted element be recoverable so that meaning is preserved leads to the conclusion that the deleted noun phrase in a passive must be indefinite (or "unspecific," e.g., "someone," "something"), revealing just those features of the subject that are relevant to the verb's selectional restrictions (e.g., PERSON or OBJECT). Chomsky argues that each part-of-speech category has one such indefinite pronominal element "designated" to participate in the underlying (i.e., "deep-structure") strings from which the element will be deleted:

Each major category has associated with it a "designated element" as a member. This designated element may actually be realized (e.g., *it* for abstract Nouns, *some (one, thing)*), or it may be an abstract "dummy element." It is this designated representative of the category that must appear in the underlying strings for those transformations that do not preserve, in the transform, a specification of the actual terminal representative of the category in question. In other words, a transformation can delete an element only if this element is the designated representative of a category, or if the structural condition that defines this transformation states that the deleted element is structurally identical to another element of the transformed string. A deleted element is, therefore, always recoverable. (Chomsky, 1964, p. 41)

Chomsky asserts that any sentence with a deleted element, such as a truncated passive, "is derived from a single source with an unspecified [i.e., indefinite] Noun Phrase instead of from infinitely many sources with different Noun Phrases, consistently with the manner in which these sentences are interpreted" (Chomsky, 1964, p. 42). Chomsky and Lasnik give a criterion for deletion that guarantees recoverability of the indefinite pronoun by virtue of a rule: ". . . Items from the lexicon cannot be deleted unless they are explicitly mentioned in the deletion rule" (p. 447). But, as Watt points out, few verbs have selectional restrictions that would permit recovery of the deleted element. Notice that Chomsky's (1964) candidate for the designated element for common nouns is *some (one, thing)*, such that it can be either "someone" or "something"; the ambiguity is even greater than Chomsky lets on, for the element could equally well be plural (e.g., "some people," "some things"). Linguists usually assume that "Bob was hit" is a truncated version of "Bob

was hit by someone"; but that which hits something need not be a person (e.g., we can say, "Bob was hit by the frisbee"), and so the deleted noun phrase need not be "someone"; also, it need not be singular, so it could equally well be "something" or "some people" or "some things"; in the language of "semantic markers" (Katz & Postal, 1964) or "syntactic features" (Chomsky, 1965), we cannot say if the deleted element is +human or -human, +plural or -plural, making recovery of the appropriate indefinite pronoun impossible. Chomsky and Lasnik refined the recoverability condition on deletion, asserting that an element can be deleted only if it lacks semantic content entirely; the deleted element can have purely syntactic features, such as case, number and gender, but no semantic features, such as +human (unless they are redundant, that is, present in a realised noun phrase with the same referent, as when "whom" is deleted from "the man whom I saw" to yield "the man I saw"; see Chomsky & Lasnik, p. 447, fn 46). This condition implies that the deleted element of a passive construction cannot be an indefinite pronoun such as "someone" or "something," for these have semantic content (i.e., in the linguist's jargon, the former has the feature +human, and the latter -human), content in the form of semantic features that are not redundant (i.e., not present in any coreferential element realised in surface structure). In taking this theory to its logical conclusions, one must invent a hypothetical pronoun (e.g., SOME-PRO) that carries only syntactic features – an invisible pronoun that is present in deep structure, and that undergoes deletion in the creation of truncated passives (see Radford, 1981, p. 275, regarding such a hypothetical pronoun for constructions involving *wh*-deletion, and see Chomsky, 1982, p. 20, regarding an abstract pronominal element which carries only the features of person, number and gender). One wonders, though, why a semantically empty element would ever appear in deep structure. The need to invent hypothetical, meaningless pronouns to save the theory highlights the inelegance of the transformational account of passives. An alternative account based on the view that relations are subject-dependent, and that they are the significations of predicates rather than verbs, would render transformations unnecessary.

Outside the realm of the passive, psycholinguists and researchers of language acquisition show themselves to have adopted the modern concept of a relation, for not only do they accept the linguist's identification of agents with subjects, but they also adhere to the modern view that a relation exists *between* two individuals, residing in neither, as if it were a third thing and independent of any subject. For actional relations supposed to provide a link of some sort between the participants, the nature they ascribe to the relation, through an unconscious process, is the nature of that relation which is an aspect of the agent's being (perhaps because of an identification of agents with subjects borrowed from linguists, or perhaps because of a psychological bias toward interpreting actional events as events of acting rather than events of undergoing action; see Appendix B). Braine (1988), for instance, says that,

A scene of a boy kicking a ball would be perceived as an action relation of kicking (predicate) between two objects, the boy and the ball (arguments). (p. 234)

Braine, like linguists, and like other psychologists studying language, fails to recognise that the scene can be interpreted in two ways, either as kicking or as undergoing kicking, depending on whether the observer takes the point of view of the boy or the ball.

The prevalence of the modern view of a relation among linguists, psycholinguists, and logicians is surprising given the complete absence of evidence in support of it in natural language, the domain of their studies. The structure of natural-language propositions reflects the fact that a relation is an aspect of the being of the individual(s) into which one argument of a predicator is interpreted — namely that argument which appears as the subject noun phrase. In any proposition containing a two-place predicator, just one of the predicator's arguments appears as the subject of predication, and the predicate signifies a relation that is an aspect of the subject's being (and not an aspect of the being of the individual[s] into which the predicator's other argument is interpreted; see Appendix B). In the sentence "Marcus hit the ball," the predicate "hit the ball"

signifies an aspect of Marcus's being, and in the sentence "The ball was hit by Marcus," the predicate "hit by Marcus" signifies an aspect of the ball's being. There is no subject-independent way of expressing a relation in natural language. Modern symbolic logic and modern linguistic theory, by treating hitting and being hit as equivalent, fail to capture the nature of relations, or the nature of natural-language statements attributing those relations to subjects.

The picture of relations I have presented is not original. Relations were understood in just this way in ancient times. The modern view of relations as subject-independent arose because of changes in certain concepts central to mathematics. A deep understanding of the modern view can come only through an exploration of historical change in the concept of a relation, an exploration that reveals the motivation for the new view. It will be seen that the motivation was independent of both linguistic and psychological considerations, suggesting that the modern view of relations has no place in a theory of language acquisition.

3.2.3.2. The Classical Concept of a Relation and Its Disappearance

The nature of a relation, as an aspect of a subject's being with reference to something else, was well understood in classical times. I will illustrate the classical concept of a relation by describing the way in which certain species of relations were understood.

In early Greek mathematics, the relations known as ratios were always conceptualised in terms of one individual magnitude or number referenced to another, with the latter magnitude or number determining the nature of the relation that was a part of the being of the former magnitude or number. It was understood that the number 2 determines or limits the number 4 to being its double, whereas the number 4 defines the number 2's relation with regard to it as that of being half; for this reason, a ratio was called a *logos* from the verb *legō*. R. Schmidt (personal communication, February 15, 1995) gives the core meaning of *legō* as 'determine' or 'bring to a limit.' Heidegger (1951/1975a, p. 60) gives the core meaning as 'lay down and lay before,' 'collect and bring together.' Most of

the possible meanings of the word that appear in Liddell and Scott's (1968) *Greek-English Lexicon* can be understood in terms of a gathering or collecting or bringing together that yields or permits a determination or definition, such as a measure or evaluation.⁷ As an instance of *logos*, a ratio is a bringing together of two numbers or magnitudes in a way that permits a determination of the relation of one to the other, with the nature of the relation that is in the subject (i.e., the antecedent) determined by the object (i.e., the consequent).

In Greek astronomy, a relation of angular separation such as opposition or conjunction involving two planets was not conceptualised, as it is now, as something between the two planets, belonging to neither planet (or both; it is difficult to get a handle on the modern view). To the modern astronomer, "The Moon is opposite the Sun" is equivalent to "The Sun is opposite the Moon." Both propositions are taken to mean that the Sun and Moon are 180 degrees apart. But the fact that a different luminary is the subject in each case should, by now, suggest that the relation must belong to one luminary or the other, and cannot be the same relation in the two propositions. The Greeks clearly distinguished the two relations. Given two planets separated by 90 degrees, for instance (which the modern astronomer would say are in quadrature), the planet behind the other planet on the ecliptic was said to be *looking at* the other planet as something 90 degrees ahead of it (or, actually, it was said to be looking at the other planet by square or in accordance with a square; see Antiochus of Athens, 175/1993 and Hephaistio of Thebes, 415/1994); the planet that was ahead of the other planet on the ecliptic was said to be *looked at* by the other as something 90 degrees ahead

⁷Counting and reckoning involve collecting individuals or collections into well-defined groups that yield a count or sum or total; pleading one's cause involves gathering together and laying out evidence and arguments which determine evaluations of guilt or innocence; speaking or telling a story involves combining words and sentences so that they define or determine one another's meaning, permitting judgements about meaning and truth.

of it (or to be looked at in accordance with a square).⁸ The relation was always understood as the relation of one planet relative to another – as a relation from the point of view of one planet – and the nature of the relation differed depending on which planet was the subject. This way of thinking may appear unnecessary to a modern reader; after all, if one planet is 90 degrees from another, and the latter planet is also 90 degrees from the former planet, so that the nature of the relation does not change with a change in the subject, why not just say that the two planets are in the relation of being 90 degrees apart? The wisdom of such a move is called into question by the fact that the 90-degree interval between the two planets is not an aspect of the being of either planet, and so the relation cannot be said to be a relation *of* the two planets (i.e., a relation *belonging to* the two planets). The same 90-degree interval exists between two invisible points at the planets' cores. The planets need not even exist for the interval to exist; it is a distance along an arc, and not a relation at all.

In Aristotle's logic, he distinguished clearly actions upon objects from the undergoing of actions, treating these two relations as two distinct types of predicates. Acting and undergoing or suffering action are distinct categories in his logic (see Aristotle, *Categories* 4, 1^b25-2^a4, and *Topics* A.9, 103^b22-23); his categories (*katēgoriai*) are types of predication or types of predicates (see Appendix B). A predicate is attributed to a subject of predication in a proposition such that the predicate signifies some aspect of the subject's being (see Appendix B), and Aristotle recognised that this attribution entailed different relations in propositions we would call "active" and "passive" containing verbal predicates. For events involving actions, he recognised that distinct relations are signified by the

⁸The terminology I have used is not quite correct. When one planet was behind the other it was said to "behold" or "look upon" (*epitheōreō* or *ephoraō*) or "bear witness to" (*epimarturō*) the other planet, whereas when it was ahead of the other planet it was said to "hurl (or cast) rays" (*aktinoboleō*) at it (see Antiochus of Athens, 175/1993 and Hephaistio of Thebes, 415/1994), perhaps because of the popular optical theory of Empedocles according to which a body being viewed throws off a ray. The point is that the 90-degree separation was not a relation *between* the two bodies, but was, instead, a relation of one planet to the other.

predicate when the actor is the subject and when the one undergoing the action is the subject.

By the last century, the concept of a relation had undergone radical change, resulting in the modern view of a relation. According to this view (which, though largely unconscious, is implicit in the way moderns talk about relations), a relation is a thing separate from its subject and object; it is a third thing that resides in none of the individuals involved; moreover, the number of individuals or sets of individuals involved may exceed two (e.g., "give" is said to be a three-place relation or predicate). In Appendix A, I examine some historical changes in mathematics that seem to have shaped the modern view of a relation. It appears that the major force behind change in the concept was the reconceptualisation of the ratio – the prototypical relation in mathematics – as a common fraction, that is, as a number. In modern thought, the ratio 6:3 is the number that results from the division of 6 by 3, namely 2. The number 2 is separate from both 6 and 3; it is a third thing. The reconceptualisation of a ratio as a number seems to have been tied to the reconceptualisation of number as continuous rather than discrete (i.e., as magnitude rather than multitude); the modern number continuum permits the division of a numerator by a denominator to yield a number even when the two numbers are incommensurable. This possibility, coupled with a practice of assigning numbers to ratios for computational purposes – a practice that began with medieval assignments to ratios of "denominations" (i.e., numbers and parts of numbers that represent the multiple that the antecedent is of the consequent) – resulted in the identification of ratios with numbers. Furthermore, the influential mathematician Leibniz was explicit in describing a relation that is separate from the individuals involved. He claimed that orders, arrangements of entities in tree structures, and geometrical figures are "relations"; in other words, any arrangement of things that contains implicit within it relations of pairs of things to one another was, for him, a relation. His view is essentially the modern view. Later mathematicians such as Hilbert came to include among "relations" mathematical formulae and functions (see Appendix B) which are, too, arrangements or

combinations of entities, where the arrangements or combinations ("relations") reside in none of those entities individually.

The Leibnizian view of relations cannot aid our understanding of relations as expressed in natural language, for their expression there does not reflect an understanding of a relation as any arrangement or combination whatsoever of individuals, as of multiple individuals in an order, or of those represented in a tree diagram, or of individual numbers entered into a mathematical formula. In this dissertation, a relation is always to be understood in the classical sense, and in the sense that is reflected in the structure of propositions (see Appendix B), that is, as an aspect of a subject's being that is understood with regard to or in reference to some separate object.

3.2.4. Predication

The idea of nonseparability, or, more generally, dependence for one's realisation, captures one relation of a property or relation to individuals, but it is not this relation that warrants the predication of a predicate to a subject. In a proposition, a predicate is affirmed or denied of a single subject of predication, regardless of the number of arguments taken by any predicator in the predicate, and regardless of whether the predicate is nominal (e.g., "The rabbit is an animal"), verbal (e.g., "The rabbit is hopping"), or adjectival (e.g., "The rabbit is white"), or even a locative phrase (e.g., "The rabbit is in the garden") – and so on.⁹ Further, although a predicate often signifies something that is nonseparable from the subject of predication, it does not always do so.

The term "predicator" would seem to imply that predication is somehow central to the nature or definition of a predicator. It is clear that, among open-class words, predicators have some privileged status in heading the predicate of a

⁹Note that many sentences are not propositions and do not involve predication. Propositions are sentences that can be judged true or false. Among the types of sentences that cannot be so judged are requests (e.g., "Please close the door"), demands (e.g., "Stop that!"), and prayers (e.g., "Grant me wisdom"). Notice that no subject of predication is named in such sentences.

sentence; as evidence of this, let one phenomenon stand for all: Given a proposition in which the predicate is headed by a predicator, the nonseparability of that which the predicate signifies has the consequence that one cannot usually switch the subject noun with the predicate to obtain a meaningful utterance (e.g., "That woman is dancing," but *"That dancing is a woman"; I am not considering reversals in the order of the subject and predicate that are made for purely stylistic purposes and that imply no change in meaning, as when one waxes poetic and says, instead of "His eyes are blue," "Blue are his eyes"; the plural form of "be" shows that the phrase "his eyes" is still to be regarded as the subject of the proposition, for "be" always agrees in number with the subject noun phrase); but given a proposition containing a nominal predicate, the nouns can usually be switched so that the proposition, though not always directly meaningful (i.e., though direct interpretations of the noun phrases do not always give a meaningful utterance – and the reason for this is made clear in Appendix B), the proposition is nonetheless interpretable by virtue of a mapping from the surface subject to some underlying substance (e.g., from "That dog is an animal," we can obtain "That animal is a dog," where we can map from the signification of "that animal" into the underlying dog so that the proposition is interpreted either as the tautology 'That dog is a dog' or as a means of providing the listener with the name of the substance's basic-level kind, or else we can map into a subspecies of dog, such as PEKINGESE, say because the subspecies is so unusual in appearance that the listener could not identify the species independently of the proposition; from "That man is a teacher," we get "That teacher is a man"; this sentence is not *directly* meaningful because, as explained in Appendix B, a teacher is something concomitant with a person, and not itself a substance, so the form of a substance cannot be attributed to it; but, by virtue of a mapping from TEACHER into PERSON, the proposition can be interpreted as 'That person is a man' which, by virtue of a further mapping, becomes 'That man is a man,' which would not be uselessly tautologous if the listener did not know the gender of the teacher, for instance, so that the proposition "That teacher is a man" permitted the listener to

map from PERSON to MAN instead of WOMAN; for a similar analysis, see Aristotle, *Metaphysics* Δ.7, 1017^a7-22). (See Appendix B for some reasons for the privileged status of predicators in predicates.) But I will claim that the argument-taking nature of predicators depends only on the nonseparability and dependency of what the phrases they head signify; the role of predicators in predication does not explain their taking of arguments (for noun phrases can be predicates, but the nouns that head them take no arguments), and so that role is not defining for predicators. Nonetheless, predication may play a role in verb learning, as we will see.

3.2.4.1. What is Predication?

The definition of predication has changed radically over the centuries, entrained with the changing *Zeitgeist*. It is instructive to study the changes in the concept, so that one does not mistake any modern concept of predication for something about which there has always been consensus. A partial history of the concept appears in Appendix B.

In mathematical logic, the conventional view of predication, which was already "established opinion" by the time of John Stuart Mill (1806-1873), is that a proposition states that the subject belongs to the class that can be constructed by considering all of the objects of which the predicate is true.

There are many problems with this view, the least of which is the fact that the classes are constructed from untyped or unsorted individuals, sometimes called "bare particulars" (see La Palme Reyes, Macnamara, & Reyes, 1994a); because a predicator, often the head of the grammatical predicate, is typed by kinds, such that its meaning changes across kinds, the individuals included in its extension must be members of a kind that types the predicator; otherwise, we would include in the class of "running things" mammals that are running, rivers that are running, sap that is running, and politicians running in an election.

The conventional approach in mathematics is also problematic because it treats all predicates as if they were predicators, and vice versa. And yet the subject

of predication is an argument only in cases in which the predicate contains a predicator; further, there is always just one subject of predication, but a predicator may take more than one argument.

There is another problem in addition to these: The construction of a class of individuals of which a predicate is true, which is supposedly necessary for predication to occur, presupposes predication of a different sort; as John Stuart Mill (1851) pointed out, one cannot construct the class of all white things without knowing what it means for something to be white, that is, without being able to predicate of any given thing that it is or is not white.

But the class-inclusion (or subkind-inclusion) approach suffers from a far more serious difficulty: It does not in any way speak to our intuitions about predication, and yet this should be the first priority for any theory of predication that finds its way into psychological theory. Consider the proposition, "The stove is hot"; this statement does not bring to mind all the hot things that ever were, are, or will be; it brings to mind just one thing, the one which the subject noun phrase signifies. Suppose that we reinterpret class or kind inclusion in terms of situations rather than individuals. According to that sort of account, "The stove is hot" says that among all the situations in which a certain stove is hot, this is one of them. But this proposition does not bring to mind all of the situations in which this or any other stove is hot, but just this one. The conventional approach in mathematics fails to capture our intuitions about propositions. It also fails to capture what is stated explicitly in a proposition such as "The stove is hot"; this statement makes the claim that hotness is currently an aspect of the being ("is") of a particular stove, the one signified by "the stove." If one were to have a desire to communicate the idea that a certain stove belonged to the subkind of hot stoves (or hot objects), then one would say "The stove is one among all hot stoves (or all hot objects)," or "The stove is a member of the subkind of stoves (or objects) containing hot stoves (or hot objects)," or simply, "The stove is a hot stove (or hot object)"; if one desired to communicate the idea that among all the situations in which a certain stove was, is, or will be hot, this is one of them, then one would

say, "The current situation is one among all those in which the stove is hot," or "This is an instance of the stove being hot," or something similar. Speakers do not lack the linguistic resources to make such statements. So when someone says "The stove is hot," we must trust that the thought expressed is the one intended, that thought being that hotness is present in a certain stove. More about this later. It may well be useful for certain purposes, such as syllogistic reasoning, to construct a subkind of individuals for which the predicate is true (or a set of situations in which the predicate is true of the subject; e.g., La Palme Reyes et al., 1994a), but such constructions are not the interpretations of predicates in the everyday use of language, nor is the membership of the subject in a subkind the intended meaning of a propositional utterance in ordinary discourse. (I note, in passing, that Aristotle's theory of the syllogism did not include a notion of predication resting on class inclusion or subkind inclusion; his notion of predication will be revealed shortly.)

The modern view of predication as resting on class inclusion went through a transformation around the turn of the century due to a new understanding of a *predicate*. The modern conventional view of a predicate in mathematics, which seems to have originated with Hilbert under the influence of Frege (see Appendix B), blurs the distinction between a predicate and a predicator, so that mathematicians speak of one-place, two-place, and three-place "predicates," thereby adopting Hilbert and Ackermann's (1938/1950) view that predicates can have "several subjects" (p. 45), and blurring the distinction between a subject and an argument. With "predicates" permitted to take multiple "subjects," predication came to be viewed as a claim about membership in classes or sets consisting either of individuals (for one-place predicates) or of couples, triples, etcetera (for many-place predicates).

Unfortunately, the modern mathematician's conceptualisation of a predicate is often imported into psychological theory, apparently upon the authority of logicians and for no other discernible reason. Rispoli (1995), for instance, says that in the sentence, "I took a spoon from the drawer," "*took* is a

verb that subcategorizes for an NP, *a spoon*, and a locative prepositional phrase, *from the drawer*. At the semantic level, *took from* is a predicate predicated of three arguments: I, spoon, and drawer" (p. 333) – this despite the fact that the sentence, like all propositions, contains a single grammatical predicate and a single subject noun phrase. Rispoli states explicitly that the term "predicate" when used in this sense "is borrowed from predicate calculus" (pp. 332-333). It is typical of such borrowing that no justification is given for it.

In modern linguistics, the notions of a predicate, predication and a subject of predication have all but dropped from sight, replaced with purely syntactic notions such as noun phrases and verb phrases with particular locations in a syntactic tree. Where the terms "subject," "predicate," and "predication" are used, they have purely syntactic definitions (e.g., Chomsky, 1965, defines a subject as the noun phrase immediately dominated by the sentence node, and a predicate as a predicate phrase dominated by the sentence node, where a predicate phrase consists of an auxiliary verb and a verb phrase; notice that he defines both the subject and the predicate in terms of a relation of a phrase to a sentence, and not in terms of a relation of the predicate to the subject); sometimes the notion of a subject is also included among the so-called grammatical functions (subject, direct object, indirect object), which are in one-to-one correspondence with the arguments of a verb in a particular sentence, and which make no room for the distinction of a subject from a predicate (or for predication, *per se*) because a predicate may contain some of a verb's arguments. Largely due to Chomsky's (e.g., 1965) influence, the traditional grammarian's distinction between a subject of predication and a predicate has been abandoned because it was deemed semantically incoherent. In the modern view, if the subject-predicate distinction has any meaning at all, it is a distinction between a topic and a comment, or between a thing talked about and something said about it, or between old and new information. Chomsky cites Wilson's (1926) demonstration that a noun in the subject noun phrase *or* in the predicate can be either the subject in the sense of topic or thing talked about, or the predicate in the sense of new information.

There is no doubt that an acceptance of the modern notions of what the subject-predicate distinction might mean renders the distinction meaningless, but this fact does not imply that the distinction is indeed without meaning. I will describe a definition of predication that seems to me to be meaningful.

Having found no revealing analysis of predication in the modern literature, I turned to older sources. The only useful and meaningful account of predication I found was Aristotle's, and his ideas on predication may have been unique to him. These ideas are almost completely lost in published English translations of Aristotle, and do not appear in any available commentaries on Aristotle's writings, so I found it necessary to undertake an exegesis of his Greek text. A complete exposition of Aristotle's theory of predication and a description of some of its implications for psychology, linguistics, and logic appear in Appendix B. I will provide just a brief summary of his theory here so that the role of predication in verb learning can be addressed in a later section (3.2.5.6).

Predication occurs in propositions. A proposition contains a subject noun phrase, a copula (which may be tacit), and a predicate. Every natural language that has a phonetically realised copula uses the word or morpheme meaning 'be' for the copula. The significance of this fact is this: Propositions are statements about what *is*. They reveal *being* to us. Plato said that a speaker, in uttering a proposition, "reveals something . . . about that which is or is becoming or has become or is to be . . ." (*Sophist* 262d; the translation is mine). For languages with tense marking, whether the being is, or is coming to be, or has come to be, or will come to be is signalled by tense markers. Among all types of utterances, only propositions can be judged true or false. The Greek word for truth means 'unconcealment'; truth is a revelation, or taking out of hiding, of being. So, by implication, those utterances that can be true or false, namely propositions, are those that can unconceal being; they can reveal what *is*. That is why propositions contain the copula. And that is why propositions are at the core of logical reasoning, which is aimed at discovering (or uncovering) what *is*.

In Aristotle's account of predication, the act of predicating something of a subject is equivalent to attributing responsibility, for the being of whatever the predicate signifies, to the subject of the predication. Thus, in the proposition "The stove is hot," the stove is claimed responsible for its hotness. And so it is, if the proposition is true. Hotness is nonseparable, and so it has being, or *is*, only as an aspect of some object's or surface's being, and only by virtue of that object or surface, the thing in which it has come to be (and out of which it will depart when it ceases to be). If the proposition is true, then hotness has come to be and remains within the stove signified by the noun phrase such that the stove is responsible for the hotness by virtue of being its substrate. If one predicates of a woman that she is running, uttering the proposition "That woman is running," then one attributes responsibility to a certain woman for her running. Any being for which a subject is responsible is a part of a situation of which the subject is *necessarily* a constituent, and so the predicate signifies some aspect of the subject's being. So a true affirmative proposition reveals some aspect of the subject's being, for which the subject is held responsible. When this aspect of being is *in* the subject, that is, when it is nonseparable from it, the predicate in the proposition will be headed by a predicator.

3.2.4.2. The Role of Predicators in Predication is Not Defining

Not all predicates are headed by predicators, in keeping with the fact that a subject can be responsible for a predicate without the predicate being a nonseparable aspect of its being (see Aristotle, *Categories* 2, 1^a20-1^b9); predication can occur without predicators, and when it does, the predicate is not something that is nonseparable from the subject per se (see section 3.2.5.6). Given that predication need not imply that the predicate is nonseparable from the subject, and that the predicate need not, therefore, be headed by a predicator, predication cannot be defining for predicators.

3.2.5. Means of Identifying Predicators

Having characterised all the fundamental concepts bearing upon my thesis, I can now present the theory of predicator identification.

Suppose that predicators are defined as words that take arguments, as a reflection of the nonseparability or the dependency of what they are used to signify, and that this definition is unlearned. How could a child or other learner come to recognise which words in the speech stream belong to this category at the earliest stages of learning a language?

The definition of the category predicator as the category of words that take arguments suggests a general approach to learning that I call the *nonseparability hypothesis*: For a young child or other learner to realise that a word is a predicator, he or she must understand that an expression of the word's meaning necessitates an argument structure. In other words, the learner must realise that any phrase headed by the word signifies a property or relation of some sort, such as action, so that the word must take (implicit or explicit) noun-phrase arguments to name the bearer(s) of the property or the participants in the relation – that is, the individual(s) without which or without whom the property or relation could not have come to be.

There are two types of circumstance in which a child (or other learner) is most likely to perceive a novel predicator's relation to something nonseparable and realise that it is a predicator, such that two different methods of identifying predicators can be described. In both types of circumstance, a novel predicator is used in an utterance that is intended (e.g., by a parent) as a comment on a situation that the speaker and the learner are observing.

3.2.5.1. Nonseparability Method of Predicator Identification

The first type of circumstance is one in which the relevant property or relation (e.g., an action) is the most salient aspect of a situation to which the child is attending (and about which a speaker is commenting) and the child knows no word for that aspect of the situation. An example is a situation involving a familiar

individual belonging to a familiar basic-level kind involved in some vigorous activity, where the child knows a proper name for the individual, a basic-level noun for the individual's kind, but no word for the type of activity. If the child's hypotheses about word meaning follow Clark's principle of contrast (Clark, 1980, 1983a, 1983b, 1987, 1988), such that different words are expected to have different meanings, and if the activity is salient (due to properties of the perceptual system or the cognitive system or both – properties not as yet unveiled to us), and if the child has a natural tendency to type activities, then this situation could lead to an identification of the novel word as a predicator. I will call this means of identifying a predicator the *Nonseparability Method* of predicator identification because the signification of the phrase containing the word is taken to be something nonseparable, that is, a property or relation, and its nonseparability leads to predicator identification. Except where a property or relation is highly salient, so that it cannot help but capture the learner's attention, a property or relational meaning will probably be considered only if the learner can at least rule out the most salient meaning hypothesis for a novel word, namely that it signifies a basic-level kind. Evidence suggests that this hypothesis is the first one that occurs to young children, and other meaning hypotheses are entertained only when children are familiar with a kind and know its name (Hall, 1991, 1994; Hall & Waxman, 1993; Hall, Waxman, & Hurwitz, 1993; Mervis & Crisafi, 1982; M. Taylor & Gelman, 1988). For a human, or for an animal that is kept as a pet, or which is of a kind that is commonly kept as a pet, a novel word may be interpreted as a proper name if one is not already known for the individual (Hall, 1991, 1994). It remains to be seen whether learners must have also ruled out other sorts of nominal hypotheses (e.g., subordinate and superordinate nouns, situationally restricted nouns including those restricted to a phase of life, such as "girl," and those restricted to situations in which a certain activity is being undertaken, such as "driver").

3.2.5.2. Interpreted Noun Phrase Method of Predicate Identification

The second type of circumstance provides more favourable conditions for identifying a predicate. Three conditions hold in such a circumstance. First, the sentence in which a novel predicate is embedded contains a number of noun phrases that matches the number of arguments taken by the predicate, and the nouns in those noun phrases are ones with which the child is familiar so that their status as nouns is known and the referents of the noun phrases can be identified. The nouns can be common nouns, pronouns, or proper nouns; the type of noun does not matter, as long as the child is able to identify the referent(s). Note that the thesis states that learning will be facilitated by the presence of *noun phrases* in an utterance, not by the presence of *common nouns* per se; common nouns do not signify individuals in extramental being, but noun phrases, of whatever type, signify specific individuals, say the participants in an action or the bearers of a property. It is interpretability into an individual that makes a noun phrase helpful in learning, according to the theory. Second, the sentence is uttered in a situation where it transparently comments upon an ongoing action, activity, process or event that involves a number of participants (e.g., objects or persons) that matches the number of noun phrases in the utterance, and those participants are ones for which or for whom the noun phrases are appropriate. Alternatively, the sentence is uttered while the learner's and the speaker's attention are focused on an individual, the obvious referent of the single noun phrase in the utterance, and that individual possesses some salient property or attribute. Third, the child does not know a word for the type of action, activity, process, event, property, or attribute, and the predicate in the utterance is the only word that is both salient (e.g., due to stress) and lacking any known meaning. Under these conditions, the learner should readily form the hypothesis that the salient and novel word is a predicate and each noun phrase is an argument of it. I will call this type of learning the *Interpreted Noun Phrase Method* of predicate identification. In this method of learning, noun phrases are interpreted into the individuals from which a property or relation is nonseparable or upon which it depends for its existence,

and the noun phrases are interpreted as arguments of the word for the property or relation. In this way, an argument structure for the novel word is inferred. Here, the term "argument structure" need not be interpreted in the modern sense (e.g., as in Grimshaw, 1990), namely as a complete representation of all the relations of a predicator to its arguments or vice versa (e.g., government relations, thematic relations, and so on). Although a child might, in an instance of learning, acquire much of the information that concerns the modern linguist, the child need not do so in order to identify a novel word as a predicator. The child need only infer an argument structure in the older sense of the term, namely the fact of taking arguments, and the number of arguments taken. It seems reasonable to expect, though, that the child may also acquire at least a subset of the predicator's selectional restrictions, that is, the child may identify a subset of the kinds to which the referents of the word's arguments can belong.

An example will help illuminate the Interpreted Noun Phrase Method. Imagine a young girl sitting with her mother by a window. Outside in the yard, the family cat is climbing a tree. The cat's name is Mick. Suppose that as the girl and her mother watch the event unfold, the mother utters the following words: "Mick is climbing the tree." The stressed morphemes in this sentence are "Mick," "climb," and "tree," so these are the morphemes to which the child will likely attend the most. Suppose further that the girl knows that "Mick" is the name of the cat, and she knows that the word "tree" signifies the kind of object the cat is climbing. If she does not already know the meaning of the word "climb," she should form the hypothesis that "climb" is a predicator which takes two arguments and which heads phrases that signify instances of relations of the type she observes to hold of the cat to the tree at that moment.

This method of predicator identification will only work in cases where one and only one salient relation holds of the referents of the noun phrases in the utterance; otherwise, the learner may realise the word is a predicator but be unable to identify the relation its phrase signifies, and therefore unable to learn the word. Hirsh-Pasek and her colleagues (Hirsh-Pasek, Naigles, Golinkoff,

Gleitman, & Gleitman, 1988, as cited in Hirsh-Pasek & Golinkoff, 1991) have shown that very young children (aged 1;6 to 1;9) cannot decide between transitive and intransitive versions of an action as the signification of an utterance containing two noun phrases that transparently signify the participants in both types of action. They showed children two videos simultaneously while a voice uttered the words of a sentence. One video showed Big Bird causing Cookie Monster to do something (e.g., pushing him into a squatting position, or making him turn around in circles); the second video showed both individuals performing the corresponding intransitive action (e.g., squatting or turning) in simultaneity. The sentence played contemporaneously contained the proper names of both individuals as well as a verb in either a transitive context or an intransitive context (e.g., "Look at Big Bird squatting Cookie Monster," or "Find Big Bird and Cookie Monster squatting"). Children under the age of 1;9 showed no looking preference for either video. Children between the ages of 1;10 and 2;6 showed a looking preference for the causative video in the transitive-verb condition, but no preference in the intransitive-verb condition, suggesting that they had learned the distributional features (including, perhaps, the word order SVO) associated with transitive verbs. (Word order alone cannot account for the ability of children aged 1;10 to 2;6 to interpret a transitive context correctly and the absence of this ability in children under 1;9. Hirsh-Pasek, Golinkoff, de Gaspe Beaubien, Fletcher, & Cauley, 1985, as cited in Hirsh-Pasek & Golinkoff, showed that children under the age of 1;6 were aware of English word order, and could use this knowledge to distinguish the case of Cookie Monster washing Big Bird from the case of Big Bird washing Cookie Monster on the basis of the positions of the nouns with respect to the verb. Further, children within the age range 1;10 to 2;6 showed a looking preference for a video showing an intransitive action when presented with the sentence "Big Bird is turning *with* Cookie Monster" versus "Big Bird is turning Cookie Monster"; this intransitive context orders the nouns in the same way as the transitive context, but includes a preposition to signal the conjunction of the two noun phrases.) The inability of children below the age of 1;9 to decide whether

the verb phrase signified the transitive (i.e., causative) or intransitive versions of the action highlights the importance of a lack of ambiguity of the role of noun phrases in an utterance with respect to a relation or property that is a possible interpretation of a phrase containing a predicator. But children are unlikely to encounter many situations in which the same individuals are simultaneously involved in both a relation of one to the other and in intransitive actions or activity of the same type.

The evidence presented by Hirsh-Pasek and her colleagues shows that for the youngest learners, the number of noun-phrase arguments and their intentional relations to observed individuals are initially the only available data relevant to learning; the syntactic structure of the sentence is not relevant in early learning because children have not yet learned which aspects of sentence structure signal the presence of a transitive verb or an intransitive verb (see section 3.2.5.4). The early identification of predicators cannot be supported by distributional analyses, but just by semantic analyses – by analyses of the relations of noun phrases to individuals, and analyses of relations of individuals to one another, or of properties of individuals – analyses that lead to hypotheses about relations of novel and salient words to nonseparable phenomena (see also Grimshaw, 1994, and Pinker, 1994).

3.2.5.3. The Role of Observability

For an action, activity, process, event, or state, the facilitating role of an interpretation of noun phrases into participants depends upon observable participancy, and therefore observable participants involved in some observable action, activity, process, event, or state. Although two participants are involved in the state of liking, this state is not directly observable (but must be inferred from time spent together, habitual proximity of participants, positive facial and body-language clues, and so on). It would be difficult for a child just learning predicators to acquire such a verb. This initial dependence on observable relations helps to explain the common conclusion that children learn verbs by observing

actions (e.g., Macnamara, 1982; Pinker, 1982, 1984, 1987), as well as the preponderance of action words among early verbs; verbs for unobservable mental processes (such as thinking, knowing, and remembering) are learned relatively late (e.g., Abbeduto & Rosenberg, 1985; Bretherton & Beeghly, 1982; Furrow, Moore, Davidge, & Chiasson, 1992; Johnson & Maratsos, 1977). Actions occurring in situations that support learning involve physically present participants who are moving through space-time and interacting in some physical and observable fashion. The importance of actions to learning lies not in some unlearned association with verbs, but in the observability and salience of actions and in the transparent need for an argument structure for words used to talk about actions. An advantage of the current theory over others is that it provides a principled link between actions and predicators (which are superordinate to verbs). The information upon which the child bases predicator identification, namely the inferred argument structure of the action word, is tied closely to the definition of the category.

For non-actional and non-activity one-place predicators (e.g., adjectives), early identification may depend on the observability of the property (e.g., a quality or attribute) signified by the phrase that the predicator heads. Further, the property must be salient, either because it contrasts with a property that is possessed by another object of the same basic-level kind, or because it is one that the perceptual system registers at an early stage (e.g., a particular colour; see Treisman, 1986, 1988; Treisman & Patterson, 1984) and for which no word is known. Macnamara (1972) suggests that words will be more readily interpreted as words for transient or varying properties of objects than as words for stable (unvarying) attributes. Transience or change in an attribute or property might augment its salience because of the existence of temporal boundaries and the tendency of human observers to attend to novelty and change. In addition to this salience, it is of course helpful if the sentence in which the predicator is embedded contains a noun phrase that the child knows is appropriate for the object that possesses the property, and if no other noun phrase is present in the

sentence (which might suggest that the argument structure is that of a two-place predicator).

It is possible that observability is greatest when the person carrying out an action or activity or possessing a property or state is the child learning the new word – especially when the relation or property does not involve movement or anything directly perceptible (e.g., the state of enjoyment, the state of sadness, or the relation of liking). Actions performed by the child, as well as actions performed at the child's request or suggestion, have another advantage in the learning situation: The child's attention is almost certainly engaged. (An advantage for learning the conventional word order of noun phrases with respect to verbs also obtains when one's own action is observed; the presence in one's own consciousness of an intention to act may help in learning the prototypical link between agents of actions and subject position for noun phrases.)

All of these considerations lead to the prediction that children will learn verbs most easily in situations in which they are the agent, actor or experiencer, or at least directing an agent or actor. The available data are in line with this prediction. L. Bloom, Lightbown, and Hood (1975) report that in one study, "encoding relations between objects and persons or between objects appeared to depend upon ongoing or intended action by the child or by another at the child's direction" (p. 32). Huttenlocher, Smiley, and Charney (1983) found that infants can perform requested actions long before they can identify instances of those actions in others, suggesting that they learned the words for those actions while they were performing them themselves (and they may not know what the actions look like when another agent performs them). Huttenlocher, Smiley, and Ratner (1983) examined parental utterances, and found that parents use a verb to signify a child's action somewhat more often than to signify an action observed by the parent and child; this finding suggests that adults may be aware of the learning advantage associated with commenting upon the child's action. (But Starr, 1974, as cited in Huttenlocher, Smiley, & Ratner, found that only about 5 percent of adult utterances are comments upon children's actions, so such learning opportunities

may be relatively rare.) Children themselves utter verbs most often when commenting upon their own actions and movements, or their own internal states, such as wanting and needing – or when demanding action of others (Benedict, 1979; Bowerman, 1976; Huttenlocher, Smiley, & Charney; Leonard, 1976). When they do comment on observed events, they tend to use verbs for movements rather than actions per se – that is, for phenomena that do not require an imputation of agency to the person or object in motion (Behrend, 1990; Huttenlocher, Smiley, & Charney); agency in others (i.e., their intent) is not observable, but must be inferred. Children use verbs and adjectives for internal phenomena such as emotions, percepts, and hunger earlier for their own internal states than for the internal states of others (Bretherton, McNew, & Beeghly-Smith, 1981). So it seems that adequate observability of and sufficient intensity of attention to a relation or property often entail the child being the agent, actor, possessor, or experiencer; even for phenomena that are potentially observable in others, the child's participancy increases the chances of the child's noticing the relation or property. The ideal learning conditions may involve an adult commenting on the child's action, as in a situation in which a mother says to her daughter, "You are pushing the box." If the girl can interpret the pronoun "you" into herself (whether or not she has mastered the speaker-dependent meaning of this word) and can interpret the count noun "box" so that she can determine the referent of the noun phrase "the box," she might be able to deduce the meaning of "push" and identify it as a predicator.

Some predicators may be easier to learn because of the nature of that which is signified by the phrases they head. Actions involving two or more participants may facilitate learning best of all, whenever the participants are named in an utterance; the actional relations of any one individual to another are readily observed, and there is likely to be just one salient actional relation of that individual to the other. Stable properties of individuals may lend themselves less readily to being the interpretations of phrases headed by novel predicators. A given individual has any number of observable properties, and none may stand

out. One might expect that children learn verbs for transitive actions before they learn adjectives for characteristic properties. This prediction receives support from descriptions of early vocabulary (e.g., see K. Nelson, 1973; Slobin, 1981). Adjectives for stable properties are among the last open-class words acquired (e.g., K. Nelson).

3.2.5.4. The Role of Distributional Phenomena

When the first predicators are identified, the relative order of the noun phrases in a sentence with respect to the predicator and with respect to one another should be irrelevant; word order is language-specific, and it is specified over parts of speech, including predicators, so it must be learned by noting the order of words for which part-of-speech membership is known. (The speech corpora of several children show relatively free word order in their early speech; see Braine, 1976, and Macnamara, 1982, for some examples.) So word order cannot provide clues about the roles of noun phrases with respect to a predicator, or about the possible part of speech of a word in a certain position, until some predicators have been identified so that the word order of the language can be deduced. Inflexions on a predicator should also be irrelevant to early predicator identification; the status of some words as predicators must be known before inflexional patterns for that category and its subcategories can be learned. This assertion is based on the seeming impossibility of arriving at the category predicator (or any other major part-of-speech category) by performing analyses of sentences in search of distributional patterns prior to any understanding of any constituents in the sentence (which is why even the best-known proponents of category learning through distributional analysis describe analysis over interpreted elements; see Maratsos & Chalkley, 1980). It is partly because of this problem that some authors (Grimshaw, 1981; Pinker, 1982, 1984, 1987) have proposed a process of "semantic bootstrapping."

Once a child has learned at least some of the language-specific rules of phrase structure, agreement, and conjugation for predicators, words can be

identified as members of this category or its subcategories (e.g., *verb* and *adjective*) on the basis of their distributions in sentences. Evidence exists for children's ability to identify words as members of semantically defined noun categories (count noun, mass noun, and proper noun) on the basis of their distributional contexts once they have learned the distributional regularities associated with the categories (P. Bloom, 1990, 1994a, 1994b; Gordon, 1985; N. Katz, Baker, & Macnamara, 1974; McPherson, 1991). Presumably they can do the same for verbs and adjectives.

Identifying the part of speech of a word on a distributional basis need not imply that the part of speech has come to be defined in purely formal terms. The distributions of words belonging to semantically defined part-of-speech categories are symptomatic of the semantic definitions, or, more generally, of the semantics of the words, and learners are likely to expect semantics to go hand in hand with distributions. The appearance of English count nouns, for instance, with the plural marker, with the indefinite article "a," with "another," and with numerals is symptomatic of the atomic nature of the individuals signified by noun phrases headed by count nouns -- a nature that is central to the definition of the category *count noun*. The distributional fact that English transitive verbs can be followed by a noun phrase is symptomatic of the semantic fact that two-place predicators head phrases that signify being which depends upon two individuals for its realisation. The distributional fact that some verbs end in *-ing* is a symptom of the semantic fact that these verbs head phrases that signify being that is not inherently enduring (e.g., because it is not an end state of some process or action, but is itself a process or action). The agreement of the copula, an auxiliary verb, or a verbal predicate with the subject noun phrase in person, gender, and number (for instance) is symptomatic of the fact that the predicate signifies an aspect of the subject's being. The appearance of forms of "do" and "will" with verbs is often a symptom of the fact that such predicators head phrases that signify something that comes to be only by virtue of a subject's acting upon an intention (or will; see Appendix B). In any language, the distributions of words signal some aspects of

their meanings, often including those aspects that are central to the definitions of their parts of speech; exceptions are facts of distribution associated with parts of speech that are defined independently of semantics, such as gender subcategories of *noun*.

3.2.5.5. The Dependence of Predicator Identification Upon Knowledge of Nouns

The nonseparability hypothesis may explain the late appearance in children's speech of verbs and adjectives relative to nouns. For learning to occur according to the Nonseparability Method, the learner must know a basic-level noun for an individual (and a proper name, for certain animate beings) if the learner is to entertain the hypothesis that a phrase containing a novel word signifies a property or relation that is realised by virtue of that individual. For learning to occur according to the Interpreted Noun Phrase Method, the learner must be in a position to interpret the noun phrases in an utterance into the one or more individuals involved in a relation or possessing a property, and so the learner must have learned the nouns that head those noun phrases at an earlier time. Both methods of predicator identification presuppose a knowledge of certain nouns, and the relative lateness of predicator learning may be due to this presupposition of some noun learning in predicator learning. The early appearance of nouns has led some investigators to the conclusion that the concepts associated with nouns are somehow more basic or simpler to acquire (see Gentner, 1978, 1982). I do not reject this possibility, but the theory described herein provides an alternative explanation for the delayed learning of predicators.

The presence of noun phrases in an utterance as a realisation of the arguments of a predicator may be helpful to learning for a reason other than the one I described in section 3.2.5.2. Predicators, both verbs and adjectives, are typed by the kind(s) to which their arguments can belong (for verbs, see Cruse, 1986; La Palme Reyes et al., 1994b; for experimental evidence of verb typing, see Gentner & France, 1988; for adjectives, see Bolinger, 1967; J. J. Katz, 1964, 1972; Lahav, 1989; J. R. Taylor, 1992; for experimental evidence of adjective typing, see Half,

Ortony, & Anderson, 1976; Medin & Shoben, 1988; Murphy, 1988; Murphy & Andrew, 1993; Sharpe, 1994). The kinds that type a predicator are not always basic-level kinds. The predicator "good," for instance, can be typed by many non-basic-level kinds, some of which are the domain of an "underlying" map (see La Palme Reyes et al., 1994b; Macnamara, 1994) with the basic-level kind PERSON as its codomain, kinds such as STUDENT, MOTHER, and THIEF. Basic-level kinds are associated with perceptual types, but the kinds that type a predicator need not be. A child cannot be sure, just from noting the perceptual types of individuals, which kinds type a novel predicator in a given instance of its use. If the utterance containing the predicator also contains argument noun phrases, though, then the kinds that type the predicator are explicit (or at least subsets of those kinds are explicit). (This is true even if the noun phrases consist of proper names or pronouns – including indexicals such as "I" and demonstratives such as "this" – because such words are necessarily interpreted into individuals *in basic-level kinds* such as PERSON and CAT; the kinds, which correspond to the perceptual types, individuate the referents of the expressions; see La Palme Reyes et al.; La Palme Reyes, Macnamara, Reyes, & Zolfaghari, 1993; Macnamara; Macnamara & Reyes, 1994; so the appearance of a proper name or a pronoun as a predicator's argument implies that the basic-level kind that individuates the referent of the noun is among those that type the predicator.) Children might be more inclined to enter a predicator into their lexicon if they can fully represent its inferred meaning, including the kinds that type it in that instance. (Later, upon hearing the word used with different nouns but without any apparent change in meaning, they may expand the set of kinds that are treated as equivalent in the typing. For evidence showing that children initially understand a verb to take, as its arguments, noun phrases headed by a restricted set of nouns, see Anglin, 1977; Feifel & Lorge, 1950; and Gallivan, 1988.)

Berman makes a similar point, using the functional language of mathematical logic, and following the convention in modern linguistics of characterising predicators as "relational," not because of their use in signifying

relations in extramental being, but because linguists conceptualise them as words that stand in relations to their arguments (see footnote 6):

Semantically, predicates are less autonomous than arguments. As relational terms, their interpretation depends on the arguments with which they are associated. Thus **intransitive verbs** are interpreted by reference to their subject nouns: compare the verb *is working* in association with NP subjects such as *that man*, *the horse*, *our car*, *my watch*, on the one hand, or *the system*, *our new project*, on the other; **transitive verbs** are interpreted in terms of their object nouns: compare the verb *play* when it occurs with NPs like *tennis*, *chess*, *the piano*, on the one hand, or with expressions like *a role*, *the fool*, or *havoc*, on the other; and **adjectives** are interpreted relative to the noun arguments to which they are assigned: Compare the sense of *fresh* when used to modify nouns like *eggs*, *air*, *complexion* as against ones like *starts*, *ideas*, and *talk* respectively (Keenan, 1979). This relationality of verbs and adjectives compared with nominal arguments will affect the task faced by children in distinguishing the categories in question. Nouns may have a privileged status in acquisition, since they constitute the constants with which V and A [*adjective*] will be associated as functions. (Berman, 1988, pp. 47-48)

3.2.5.6. The Role of Predication in Predicator Learning

So far, I have dealt exclusively with the role of nonseparability or dependency for being in predicator identification. What about predication? Does it also play a role? I argue in Appendix B that predication plays a role in determinations of predicator *meanings*; in particular, predicators are interpreted, wherever possible, as words for that which comes to be by virtue of an intentional act of the subject of predication, leading to the misinterpretation, for example, of intransitive verbs as transitive verbs. But I will argue that the role of predication in predicator identification per se is secondary.

I argued earlier (in section 3.2.4.2) that predication does not enter into the definition of a predicator. I then argued that predicator identification is guided by that definition. I will now explain in detail why predication, in the Aristotelian sense, cannot play any central role in predicator identification.

When the predicate of a proposition contains a predicator, the subject of predication will be an argument of the predicator, and it will be an individual from which that which the predicate signifies is nonseparable (in the case of a true, affirmative, active proposition). In this case, responsibility for the being signified by the predicate will coincide with nonseparability. But in other cases of predication, no such coincidence occurs. For instance, when the predicate is a nominal one, the subject may be responsible for the being signified by the predicate when the being is not of the sort that is nonseparable. The form of a kind that is predicated of a subject when the predicate is nominal cannot properly be said to be *in* the subject; it is, rather, either coextensive with it, being that which individuates (or informs) the subject, or else it is concomitant with that individuating form. Consider first predicates headed by basic-level count nouns. In the proposition, "Constance is a person," the person Constance, here the subject of predication, can be held responsible for the being of the form of a person – that is, the intension¹⁰ of the basic-level kind PERSON, the actual shape and

¹⁰The word "intension," from the Latin *intensiō(nem)*, a noun derived from the verb *intendō* ('stretch,' 'strain,' or 'aim toward,' as well as 'bring a charge against [someone]'), means literally a tending or tensing or stretching within (or toward) something. It is best applied to dimensional qualities that can vary in intensity, existing as gradations between opposites (e.g., hot and cold) that "pull" against one another – qualities (e.g., hotness) that come to be in an individual through intensification toward one contrary of a pair (e.g., hot), and cease to be through a relaxation of the tension toward that extreme, falling away in intensity. The word has come to mean the set of attributes that characterise whatever falls under a word's signification, with a word's "intension" contrasted with its "extension," that is, the particular instances of its signification; I use the word more or less in this sense. Whenever the predicate is headed by a predicator, that which is predicated of the subject is *in* it, though not always as a dimensional quality to which we could assign an intensity. My use of the word "intension" serves to contrast what is in a subject, prototypically intending toward one or the other pole of a dimension within the subject, with the subject itself, which is an extended being that provides the substrate for that which is predicated of it. When a basic-level kind or form (*eidos*) such as "person" is predicated of a subject, the form is not *in* the subject (but is, rather, coextensive with it, being that which informs or individuates the subject; see Aristotle, *Categories* 5, 3^b19-23), but the form is an intension in the sense that individuals tend toward the perfection of the form that informs them or individuates them (e.g., as a person grows into a mature person) and they deteriorate away from that relatively perfected state (e.g., as a person who has matured ages) in a play between the realisation of a form and the want of it or the privation of it that is analogous to the tension between opposite qualities. (Aristotle calls the want of a statue's shape that is in bronze or gold or marble the *opposite* of the shape: '... The want of figure and the want of shape and the want of order [are] that which lies over against [i.e., the opposite]'; *Physics* (continued...))

structure of a person, and its general nature as a member of that kind – because when Constance came to be, the form of a person came to be. But the form of a person is not nonseparable; it is not *present in* the subject as whiteness is present in a white body (see Aristotle, *Categories* 5, 3^a7-15); the form encompasses the *whole* being and the whole body of the subject, so that the (spatial and temporal and qualitative) boundaries of the person that define its being as a person are tied up with its form (i.e., its shape and structure, as well as its general human nature). Because an atom ceases to be when its form is destroyed, as a ball or a dog ceases to be (*as* a ball, or *as* a dog) when flattened by a steamroller, the form of an atom is not a nonseparable aspect of the atom's being (i.e., it is not *in* the atom), but rather something that defines its being as a certain kind of atom. To put it another way, the form of a person is the whole kind PERSON in the sense that an individual person is individuated by the kind's extension, since what constitutes an individual person can be determined with reference to those individuals that are members of the kind (e.g., what constitutes a hand can be determined with

¹⁰(...continued)

A.7, 190^b15-16; more generally, he calls the privation of a form [*eidos*] its opposite, according to one reading of his text as it survives: '... The form or definition is one [principle, or commanding origin, or governing source; *archê*], but further [there is] the opposite to this, the privation'; *Physics* A.7, 191^a13-14; the translations are mine.) A form can be present in different degrees, where the gradations are different degrees of perfection in realising the form. A form can be predicated of a subject if the subject is, to any degree, a realisation of that form. Aristotle (*Metaphysics* Δ.7, 1017^b1-9) gives, as one example, our use of the noun "corn" for corn that is not yet ripe; we even speak of "planting corn" when we sow corn seed, because the seed is informed by corn in the sense that it has the potential to become corn – to be something individuated by the form of a corn plant. For the same reason, we can predicate "person" of a newborn infant, or perhaps even of a fertilised ovum (if we take a physicalistic view of persons, or if we believe that the spirit or anima enters the body at conception, rather than at the first inspiration when the animal first becomes animated). (This intensional interpretation of a noun phrase applies only to nominal predicates. A noun phrase in subject or object position refers to an individual qua individual [as individuated by the named kind], which is not the sort of thing that can vary in degree; see Aristotle, *Categories* 5, 3^b33-4^a9.) By regarding the realisation of something and its privation as opposites toward which a subject can tend, we can understand other sorts of predicates as intensions as well; the signification of a locative predicate, for instance, such as "in the room," can be viewed as an intension (even though that which the predicate signifies is not *in* the subject), for there is a transition between being in a room and its privation, that is, being out of the room, such that in leaving a room, a subject makes a transition from being in the room to being out of the room, becoming, in increasing degrees, the privation of being in the room; in entering the room the subject is becoming being in the room while not yet in the room completely, so that the subject is in the room only to some degree.

reference to those individuals that are members of the kind HAND; each such individual is a part of an individual of the kind PERSON; see La Palme Reyes et al., 1994b). A whole kind is certainly not in one of its members. (See Aristotle, *Categories* 1, 1^a20-22, regarding the predicate "man" not being in an individual man, even though it can be predicated of a man.) Aristotle makes the same point; he says that the kind terms that can be predicated of primary substances signify certain qualities, but not qualities like warmth that are in a subject; they signify, rather, qualities that define the boundaries of subjects and their kinds (*Categories* 5, 3^b13-16, 19-23).

A similar argument can be made for the predication of a subject's genus (or superordinate kind). In the proposition, "A cat is an animal," for instance, the form of an animal that is predicated of a cat is not something that exists in the cat as a nonseparable aspect of it; something has the form of an animal only by virtue of the fact that it has the form of some specific animal, such as a cat. Whenever a cat comes to be, the form of an animal comes to be; for this reason, a cat can be held responsible for the coming to be and the being of the form of an animal. But among cats, that which is an animal is identical with that which is a cat, so the form of an animal is not *in* a cat as some nonseparable aspect of it. The form of an animal that is predicated of a cat is just the form of a cat; that form is not some nonseparable aspect of being present *in* a cat; it is, rather, that which individuates the cat.

For nominal predicates headed by nouns for kinds of concomitants, such as "passenger" or "teacher," the intension of the kind named is also something other than what is properly called nonseparable. When we say, "Bob is a teacher," we understand the teacher to be an individual concomitant with a certain person, such that the whole body of the person is also the body of the teacher; there is not just some part of Bob's body that is a teacher. The teacher is not *identical* with the person, because the person existed before the teacher came into being. But the spatial boundaries of the teacher are identical with the spatial boundaries of the person, and any property possessed by a teacher is possessed also by the

underlying person (even if the property is typed by the kind TEACHER, so that it's nature can be understood only in reference to this kind; if a teacher is a good teacher, then the underlying person is also a good teacher). If the form of the person is destroyed, so is the form of the teacher. Underlying every teacher is a person, and the definition of a teacher (e.g., "a person who teaches") includes a person, so the existence of a teacher is parasitic upon the existence of a person. Because a teacher is necessarily concomitant with a person throughout its existence, and coincides with the whole body of the person, and all of its properties are properties of the person, its form is not something nonseparable, *per se*.

Nonseparability also diverges from predicability for predicates consisting of prepositional phrases. In "Tristan is in the room," the predicate "in the room" signifies an aspect of Tristan's being, and one for which he can be held responsible (for being in a room comes to be by virtue of the thing that is in the room), but the being in the room is not a nonseparable aspect of Tristan's being; unlike the colour of his skin or the kindness of his manner, his being in the room is not *in* him. In general, any predicate headed by a word that is not typed by kinds and that takes no arguments does not signify something nonseparable.

Aristotle (*Categories* 5, 2^a19-34, 3^a7-28, 3^b2-5) provides a test for nonseparability, or being *in* a subject: If the *definition* (*logos*) of something can be predicated of a subject, then that thing is not in the subject as something nonseparable from it. The definition of "a person," namely "a rational animal," can be predicated of any individual of whom the predicate "a person" is true (e.g., "Stephen is a person" implies "Stephen is a rational animal"), so the predicate "a person" does not signify something nonseparable that is in an individual person. Suppose that the definition of "a teacher" is "a person who teaches"; this definition is clearly predicable of anyone of whom the predicate "a teacher" is true (e.g., "Rhonda is a teacher" implies "Rhonda is a person who teaches"); so the predicate "a teacher" must not signify something nonseparable — something that is in a subject. Similarly, the definition of the locative predicate "in a room" (e.g.,

"contained within the boundaries of a room") is predicable of something that is in a room (e.g., "Elena is in a room" implies "Elena is contained within the boundaries of a room"), showing that "in a room" signifies something that is not present in a subject. By contrast, the definition of "white" (e.g., "the colour with no hue at the bright extreme of the gray dimension") is not predicable of a subject in which whiteness inheres (e.g., "That rabbit is white," but *"That rabbit is the colour with no hue at the bright extreme of the gray dimension"; a rabbit is not a colour in the sense of actually being identical with a certain colour, understood as an individual colour among colours). Similarly, the definition of "running" (e.g., "coordinated movement of the legs resulting in rapid forward motion") is not predicable of a subject who is running (e.g., "James is running," but *"James is coordinated movement of the legs resulting in rapid forward motion"; James is not movement of a certain type). For the relational predicator "double," the definition (e.g., "a ratio of 2:1") is likewise not predicable of a quantity that is double relative to some other quantity (e.g., "Four is double relative to two," but *"[Relative to two] four is a ratio of 2:1"; four is not a ratio). For a transitive verb such as "kick," the definition of its associated active relation, say of "kicking" (e.g., "sharp movement of a foot so as to make impact with some object"), is not predicable of a subject to which an active predicate headed by "kick" applies (e.g., "Delia is kicking some object," but *"Delia is sharp movement of a foot so as to make impact with some object"). For the associated passive relation (i.e., that which is signified by a predicate consisting of the verbal participle "kicked"), the results of this test seem to indicate an absence of nonseparability; given the definition of "kicked" as "impacted by the foot of someone who moved his or her foot sharply in [one's] direction," then the truth of the proposition "Edwin was kicked" would seem to warrant the predication of the definition of "kicked" to Edwin (e.g., "Edwin was impacted by the foot of someone who moved his or her foot sharply in [his] direction"), suggesting that a passive relation is not present in a subject. If this conclusion is correct, sense might be made of it as follows: The sensation of another's foot against one's body that results from being kicked is certainly present

in oneself, but the kicking that exists as movement in the person kicking goes on entirely outside oneself when one is being kicked; so predicating the undergoing of kicking (rather than the feeling of the impact of a foot) is predicating being of a type that does not exist *in* the subject, even though it is an aspect of the subject's being.¹¹

¹¹A definition is necessarily a predicate, so this test requires converting a predicate into a subject so that the attributability of the definition can be evaluated. For adjectival predicates, this may or may not necessitate the affixation to the adjective of a nominalising suffix (e.g., *-ness*). For verbal predicates, the verb must be converted to a gerund (e.g., "running") or, alternatively, a nominal infinitive (e.g., "to run"). Noun phrases move freely between predicate and subject position. Locative phrases such as "in a room" can be nominalised only if a nominalised form of "be" (i.e., its gerund or infinitive) is included (e.g., "being in a room" or "to be in a room"). The same is true for passive verbal predicates; "kicked" cannot appear in subject position by itself, but "being kicked" and "to be kicked" can. (For past participles that are adjectival in nature, i.e., that have the semantic force of a perfect participle, so that they are used in signifying the end state of an action, activity or process rather than the undergoing of the action, activity or process, e.g., "tired," the participle can be nominalised with affixation, e.g., "tiredness.") For locative predicates and passive verbal predicates, then, one must nominalise, not the predicate, but the predicable (or predicate phrase). As an alternative, one may put the predicate and the definition in quotation marks to indicate that they are to be understood as linguistic entities (i.e., entities that refer to phrases made up of those words, and not to the aspects of extramental being that the phrases would signify in a proposition) and place "means" rather than "is" between the subject noun phrase and the definitional predicate (e.g., "In a room' means 'contained within the boundaries of a room'"). This amounts to showing that the two phrases are paraphrases of one another, so that they have the same meaning (and it does not involve attributing to the signification of the first expression the signification of the second expression).

The results of this test seem to depend on the nature of the change in meaning that occurs when a predicate is nominalised and placed in subject position. When adjectives or infinitive forms of verbs appear in subject position, they seem to behave semantically like proper names for properties or relations understood as individuals in a genus of properties or relations (e.g., in the genus of COLOUR, which includes White, Red, and Purple, or the genus of MOVEMENT, which includes To Run, To Walk, and To Somersault, or the genus of RATIO, which includes Double, Triple, and Quadruple). The genera that are named as part of their definitions (e.g., COLOUR, MOVEMENT, and RATIO) are genera to which substances cannot belong, so the definitions cannot be predicated of substances that possess the defined property or relation as aspects of their being. Gerunds and predicators nominalised by affixation (e.g., "dancing," "smoothness," and "construction") seem to behave like mass nouns signifying instances of qualities or activities taken collectively. The definition of any such word will include the name of some genus (e.g., MOVEMENT, TEXTURE, ACTIVITY) to which no substance that is the substrate for the quality or activity under consideration can belong. When a nominal predicate is converted to a subject noun phrase, the meaning changes from intensional to extensional, but any kind or genus named in the definition will be one to which an individual named as subject belongs because the intension is that which individuates the extension, and the extension will be such that membership in it implies membership in the kind named in the definition, either because the defined kind is a subkind of that kind (as PERSON is of ANIMAL) or because the defined kind is a kind of concomitant (e.g., TEACHER), a member of which comes to be in dependency upon an underlying substance of the kind named in the

(continued...)

It is clear, then, that the responsibility for being characteristic of a subject of predication need not coincide with the predicate's signification of something nonseparable. For this reason, predication per se does not imply that the subject of predication is an argument of the head of the predicate. A subject noun phrase will be interpreted as an argument only when the predicate signifies something nonseparable. It follows that novel nouns heading nominal predicates will not be interpreted as predicators (if their meaning is correctly divined),¹² and that predication plays no central role in predicator identification.

Predication may facilitate predicator identification if it increases the salience of the link between the subject noun phrase and the predicator heading the predicate. When an individual is both the ground for something nonseparable from it *and* responsible for its being, and especially when the responsibility for being goes beyond nonseparability (e.g., when responsibility is due to an intentional act; see Appendix B), the salience of the link between the predicator and this argument may be especially great. The fact of being responsible for an action (for instance) should increase the perceived participancy of an individual in an action event. This greater salience may promote a tendency to include the noun phrase in the novel word's structure, as its argument, and this in turn would facilitate an identification of the word as a predicator. Such facilitation might help explain the apparent advantage of action words over other predicators in learning.

¹¹(...continued)

definition (e.g., PERSON). Predicates that do not undergo conversion to noun phrases (e.g., locative predicates and passive verbal predicates) fail to undergo any change in meaning, so the definition is naturally attributable to them.

¹²Other factors may prevent learners from misinterpreting a noun heading a nominal predicate as a predicator (i.e., from interpreting the subject noun phrase as the noun's argument, and consequently taking the noun to be a predicator). Distributional clues may facilitate an identification of the noun as a noun; very early in language learning, the indefinite article (for instance) comes to serve as a signal to count-noun status for the word with which it appears (e.g., N. Katz et al., 1974). The dependence of predicator learning on noun learning (see section 3.2.5.5) may also help prevent the identification of a noun as a predicator. Because many nouns have been learned before many predicators come to be learned, learners beginning to acquire predicators are likely to be familiar with many of the nouns they hear in nominal predicates, so that their status as nouns is already known.

In addition to being observable and perceptually salient, actions occur by virtue of an intentional act of the individual who is usually named as the subject of predication. Because the subject is responsible for its action in the strongest sense of responsibility (see Appendix B), the perceived link between the subject noun phrase and the predicator (i.e., the action word) will be strong, and predicator identification will be facilitated. Notice, though, that such facilitation does not imply that a subject noun phrase is any more an argument of a predicator than any other argument. Argument status is solely a function of nonseparability or dependency for being.

3.3. How are Verbs Distinguished From Adjectives?

Some languages do not have formally distinct open categories of predicator that correspond to verbs and adjectives (e.g., Chinook; see Dixon, 1982; another example is Mandarin Chinese, which has a small closed class of adjectives, but no open class; see Li & Thompson, 1981). In effect, such languages treat all predicators alike.

In most languages, though, the two categories reveal themselves in distinct patterns of syntax or morphology. It is possible that children learn to distinguish verbs from adjectives on a purely distributional basis. If distributional analyses proceed *within phrases* (e.g., within the subject noun phrase and the phrase containing the copula or auxiliary verb and the predicate), they should succeed in discovering the relevant contextual information (Braine, 1987; Morgan, Meier, & Newport, 1987). Braine points out that the distributional differences between verbs and adjectives are highly salient (at least in English), making it plausible that children could distinguish the two categories just by noticing the contexts in which predicators appear. Attributive adjectives are particularly distinctive because they can appear within a noun phrase, but even predicative adjectives are relatively easy to distinguish from verbs because they follow different rules, rules reflected in their morphology (e.g., in English, adjectives have no agreement, but verbs are marked for tense and aspect with distinctive morphemes) and distributions (e.g.,

verbs can appear without any auxiliary verbs, as in "Bob wrote the book," and in front of a noun phrase).

Before concluding that children distinguish verbs from adjectives on a distributional basis, let us explore the possibility that verbs and adjectives differ semantically in ways that could facilitate their differentiation in utterances. Does any aspect of meaning distinguish them?

The ontological approach proposes that verbs signify types of action or changes of state and adjectives signify relatively stable properties (attributes). This account fails for adult language (e.g., "think," "know" and "like" are not words for actions), but it may provide a clue to more stable semantic properties of verbs and adjectives.

First, actions often involve an object. Grammarians distinguish transitive verbs from intransitive verbs to capture the difference between verbs that require a direct object argument (where "object" signifies, in this instance, a type of grammatical function) and verbs that do not. There is much movement between these two categories. So-called intransitive verbs can take an object argument (e.g., "She sang an old song," "He walked a mile," "They danced a jig"), and transitive verbs can appear with no explicit object argument (e.g., "I kicked as hard as I could"). Many verbs move freely between these two categories. One might argue, then, that verbs are characterised by the *possibility* of taking an object argument. In fact, they may also take additional arguments that appear in prepositional phrases. (M. C. Baker, 1988, argues that the preposition assigns a thematic role to the noun-phrase argument to indicate the function of the argument, but that the phrase is an argument of the verb in most cases.) "I ran" can be expanded to "I ran to the store." In this sentence, "the store" indicates the target of the running. The store cannot be understood as a target in the absence of some action directed toward it. The same is true of instrument arguments. In "She painted it with a roller," the roller can only have the function of instrument (signalled by the preposition "with") if some action is carried out. The action of painting can occur only when there is an instrument with which the action can be

performed, so the possibility of adding an instrument argument to the argument structure of the verb "paint" is essential. By contrast, prepositional phrases related to adjectives do not typically add an argument to the adjective, but function, instead, to narrow the referent (for instance). The prepositional phrase in "She was red in the face" serves to indicate that only part of the surface of the woman signified by "she" had the property of being red.

As an aside, the possibility for verbs of a number of arguments greater than one creates another difference between verbs and adjectives: Verbs (but not adjectives) can be typed (sorted) by more than one kind in a single instance of use. The verb "run" differs in meaning when it is typed by the kinds PERSON and WATER (e.g., "Bill ran some water"), from when it is typed by the kind PERSON alone (e.g., "Bill is running"), and from when it is typed by the two kinds PERSON and RISK (e.g., "Bill ran a risk when he made that decision"). The meaning of an adjective is determined by just one kind (or set of kinds) in a given use, that is, one kind (or set of kinds) sorts it in any given instance.

The picture I have painted is too simple. Some adjectives do take an object, which appears after a preposition (usually "of"): "I am fond of John"; "I am desirous of happiness"; "I am cognizant of that fact"; "I was oblivious of that fact"; "I am aware of the problem." Braine and Hardy (1982) argue that only one of the arguments of an adjective taking oblique arguments is "essential" (namely the subject argument), but this is not necessarily so. The adjective "fond," for instance, takes two arguments obligatorily. Other languages, and especially those with productive case marking, have many more transitive adjectives (e.g., German, Icelandic, Old English, Old High German; see Maling, 1983). So perhaps all we can say is that the appearance of arguments that number greater than one is more infrequent among adjectives than among verbs.

Adjectives differ from verbs in other ways. In some languages, they can appear next to a noun as well as in the predicate. When they do so, their function is typically to pick out a subkind of the kind associated with the noun (Bolinger, 1967; Lewis, 1976; J. R. Taylor, 1992; Warren, 1989; for experimental evidence,

see S. A. Gelman & Markman, 1985). Exceptions include certain adjectives derived from verbs, such as "alleged" in "the alleged criminal." If the person is not a criminal at all, then "alleged criminal" does not specify a subkind of the kind CRIMINAL. But Wasow (1977) argues that such words are not, in fact, true adjectives (or "lexical" adjectives). The adjective "concerned," derived from the verb "concern," does function like an adjective; for example, it can take adjectival degree modifiers ("He was very concerned"); it can be prefixed by *un-* ("He appeared unconcerned"); and it can appear with verbs that take adjectival complements ("He acted/became/looked/remained/seemed concerned"). But "alleged" retains verbal properties, or rather, it does not behave like an adjective, aside from its prenominal position; it resists the attachment of the adjectival prefix *un-* (*"He was an unalleged criminal when we met him"¹³) and cannot appear with verbs that take adjectival complements (*"He became alleged when witnesses placed him at the scene of the crime"; compare this sentence with the well-formed "He became suspect when witnesses . . ."; *"After the charges were laid, he remained alleged until he produced an alibi"; compare this with ". . . he remained suspect until . . ."). In general, then, a genuine attributive adjective conjoined with a noun picks out a subkind (and even a verbal participle combined attributively with a noun picks out a set of individuals, although not necessarily a subkind). Any proposition entails a subkind in some sense (e.g., "The men are sleeping" entails the existence of certain sleeping men as a subkind of MAN), but the conjunction of an attributive adjective and a noun (and a determiner, if necessary), when appearing in subject position or as any argument of a predicator, actually *refers* to a subkind. For a verb to be used in referring to a subkind or to a set of individuals, it must appear in a relative clause, as in "All the women who are running"; this option is also open with adjectives, as in "All the cats that are

¹³I follow linguistic convention in inserting an asterisk in front of any sentence that is likely to be judged ungrammatical by native speakers of the language.

black," as well as with nouns, as in "All the men who are carpenters," and prepositional phrases, as in "All the people who are in this room."

Adjectives differ from verbs in another way, one related to their ability to appear attributively. Many adjectives have distinct interpretations when applied to members of distinct kinds (just as verbs do), and one such kind can be in an underlying relation to another such kind (see La Palme Reyes et al., 1994b). The adjective "beautiful" can be applied to a dancer either as a dancer (i.e., as a member of the kind DANCER) or as a woman. When the former is intended, "beautiful" must appear attributively (e.g., "What a beautiful dancer she is"). When the latter is intended, "beautiful" may appear in the predicate (e.g., "That dancer is beautiful"), although it can also appear attributively, at the risk of ambiguity (e.g., "That beautiful dancer is my wife"). The use of an adjective to attribute a quality to a member of the kind associated with the surface noun in the subject noun phrase, as opposed to the kind underlying that kind, requires attributive position for the adjective. If the attribution is to be to a member of an underlying kind, such as WOMAN (where possible), the adjective can appear attributively or in the predicate (although it usually appears in the predicate). No such phenomenon exists for verbs, which always appear in the predicate. The sentence "That politician is running" is ambiguous in meaning because the verb "run" differs in meaning when it is typed by the kind POLITICIAN and the kind MAN. Where a verb can be typed by the kind associated with the surface subject noun *or* by a kind underlying that kind, the sentence cannot be disambiguated by placing the verb in the subject noun phrase – although some non-lexical form derived from the verb, such as the participle "running" in "the running politicians," might appear in the subject phrase, but the lexical verb itself does not. The possibility of appearance in the subject phrase of the lexical form of the predicator is restricted to adjectives. This phenomenon further highlights the role of adjectives in picking out subkinds: The possibility of attributive use facilitates identification of the appropriate subkind.

Adjectives differ from verbs in that they are usually associated with *dimensions* of quality, such that what they are used in signifying is usually capable of varying in intensity, that is, in intensive magnitude. For this reason, most adjectives take degree modifiers such as "very." High-frequency adjectives tend to fall into antonymous pairs such as "good" and "bad," "fat" and "thin," and "rough" and "smooth," with the members of a pair representing the opposite poles of a single dimension, where one pole is marked (e.g., tall in the tall-short dimension; "How tall is she?" can be answered "Very tall" or "Very short," but "How short is she?" cannot be answered "Very tall"; see Givon, 1984). In tests involving free associations to words, the most common response to an adjective is its antonym, that is, the word for the opposite pole of the dimension (Deese, 1964, 1965; G. A. Miller & Fellbaum, 1991). Many languages contain a set of devices for expressing the opposite pole of a dimension associated with an adjective; in English, many lower-frequency adjectives can take a prefix that serves this function (e.g., *un-* and *dis-*, as in "unfit" and "dishonest"; see La Palme Reyes, Macnamara, Reyes, & Zolfaghari, 1994). The dimensions associated with adjectives fall into three types: (1) continuous dimensions for a single quality (e.g., warmth, smoothness, beauty, intelligence, size), (2) continuous dimensions along which qualitative differences emerge, giving rise to separate adjectives that signify the different qualities (e.g., colour), and (3) discontinuous dimensions associated with two or more discrete values, some of which are ordered dimensions (e.g., relative place in time as signified by the adjectives "former," "present," and "future"), and some of which are unordered dimensions (e.g., nationality, gender). Even adjectives derived from verbs have a dimensional quality and take degree modifiers (if they are true adjectives, e.g., "tired," "interested," and "interesting"; see Wasow, 1977 regarding participles that resemble such adjectives in morphology, but retain verbal properties and cannot be considered true, or "lexical," adjectives). Verbs are not associated with dimensions per se. One person might be running more vigorously than another, but the dimension along which the two people differ is vigour; running is not a dimension. You cannot be slightly running or extremely running;

outside the brief period of transition between not running and running, or between running and not running, you are either running or you are not (although there might be some fuzziness at the boundary between walking and running, just as there is fuzziness at the boundary between ponds and lakes; but running is not a higher degree of walking; the type of movement differs).¹⁴

In many languages, tense, aspect and mood (mode) are marked on the auxiliary-verb and main verb. I have argued elsewhere that these categories cannot be involved in a universal semantic definition of the category *verb* (McPherson, 1989), and so they cannot provide an unlearned means for distinguishing adjectives from verbs. I will briefly reiterate some of the arguments. First, linguistic realisations of tense, aspect and mood are far from universal. Where they do exist, there is great variability in their use. Some languages have two divisions of time marked as tense, and the two divisions vary across languages (e.g., past versus non-past in some languages, future versus non-future or present versus non-present in others, etc.; see Lyons, 1968); some languages have three divisions of time, and some have more. Some languages do without tense, using realis and irrealis mood in its place – a possibility occasioned by the fact that past events are certain, whereas future events are still just possible (Comrie, 1985). Second, in the modern theory of syntax known as X' or $\bar{X}$ ("X-bar") syntax (Chomsky, 1970; Jackendoff, 1977), tense, aspect, and mood appear as features in the inflexional component of the auxiliary. Its next higher projection is the sentence itself, and so tense, aspect, and mood become features of the sentence as a whole. Semantically, it makes sense that a feature like tense should be a feature of the sentence rather than a feature of the verb. Tense places the situation or event signified by the sentence at a time specified relative to some other time, such as *now*. In the sentence, "Jane ran around the park," the past tense version of "run" places the whole event, including Jane and the park, in the *pāst*. It was true of Jane in the

¹⁴Pairs of oppositional verbs exist, such as "fall" and "rise," "ascend" and "descend," and "fail" and "succeed" (see G. A. Miller & Fellbaum, 1991); but the activities or events of an opposed nature are not the poles of a dimension.

past that she was running; the sentence does not assert that it is true of Jane *now* that she is running. Tense, when it exists in a language, may tend to be marked on the verb for purely syntactic or morphological reasons (e.g., because of the structure of the syntactic or morphological "tree" and the possibilities for the "movement" of "features" such as tense within the tree – to borrow a little linguistic jargon). In languages with unusual structures, such as many of the native Canadian languages of British Columbia that lack a copula or any auxiliary verbs, nouns playing the role of a predicate are marked for tense, aspect, and mood (e.g., Jacobsen, 1979; the author also points out that in Northern Paiute [Uto-Aztecan], nouns can carry a past participle suffix to indicate that the referent of the noun no longer exists; e.g., the suffix *-pi* appearing on the word for house indicates that the word is to be interpreted as 'ruins of a house'; see p. 149, fn 17). Third, aspect marking on a verb occurs only when the verb does not have inherent, or lexical, aspect; for verbs with inherent aspect, aspect marking produces ungrammatical utterances (e.g., **"He is liking me"*). It happens that adjectives are like certain verbs (e.g., "like," "know") in that they have inherent aspect. As a result, no aspect marking is needed to convey the ideas of duration across a region of time and atelicity (i.e., the lack of any distinct end point or completed goal; see McShane & Whittaker, 1988). Aspect marking may be unique to verbs because of the nature of that which some of them signify; non-dimensional properties (e.g., activities such as running) and relations involving multiple individuals, for instance, are not conceptualised as necessarily enduring for any length of time or lacking a distinct end point. The events and processes that phrases headed by verbs signify often contain an ordered series of changes (e.g., running consists of a series of movements that differ qualitatively, so that snapshots of various instants of a person's running may reveal different positions and movements), which may prevent their conceptualisation as qualitatively constant states that can persist, or as something that has no natural finishing point.

I have identified three major differences between verbs and adjectives. First, verbs can take more than one argument (and can be typed by a set of kinds

with a cardinality greater than one), whereas most adjectives take just one argument (and are typed by one kind). Second, lexical adjectives but not lexical verbs can be used in referring to a subkind (when used attributively in a subject or argument phrase) without the need for a relative clause. And third, adjectives are associated with dimensions of quality along which intensity can vary.

In passing, I note that from these facts of semantics, the link between verbs and actions follows. Actions very often involve an object of the action, and perhaps other entities (such as a source, target, or instrument) that create a need for additional arguments. Actions are usually too transitory for a speaker to have any desire to use them as a means of picking out a subkind (how often do you need to refer to all the people who are running at this instant?). And actions are not dimensions. In short, actions are prototypical of what a phrase headed by a verb signifies, just as physical objects are prototypical of what a phrase headed by a count noun signifies and masses of physical stuff are prototypical of what a phrase headed by a mass noun signifies.

If young children have the concept of the cardinality of a set of participants, the concept of a subkind determined by a quality, and the concept of a dimension of quality, then they have the potential to distinguish verbs and adjectives whenever they are able to discern the meaning of an utterance – on the assumption that they are predisposed to identify words as members of part-of-speech categories with these concepts in mind. A predisposition of this nature appears to conflict with the nonuniversality in surface structure of the distinction between verbs and adjectives. It turns out, though, that many languages that lack the open class *adjective* have a small closed class of adjectives that signify values on dimensions such as colour, size, and goodness-badness – although some languages have neither a closed nor an open class of adjectives (see Dixon, 1982). In any case, the existence of these two parts of speech in a person's grammar would in no way necessitate any difference in the distributions of words in the two classes at the level of surface structure (unless we were to insist that parts of speech be *defined* by characteristic distributional patterns).

In the absence of research addressing adjective identification under conditions involving systematic variation of the number of surface arguments, the relevance of subkinds, and the presence of qualitative dimensions, no conclusions can be drawn regarding the possibility of distinguishing adjectives from other predicators without distributional analyses. For the time being, I will maintain the hypothesis that distributional analyses are necessary.

3.4. Refining the Theory

I have argued that children (and other learners) identify a word as a predicator if they realise that its meaning implies the involvement of one or more individuals (as the bearer[s] of a property or as the participants in a relation) so that the word must have an argument structure, as in the case where the phrase headed by the word signifies action of a particular type. I claimed that the identification of a predicator is especially facilitated when the utterance in which it appears contains one or more noun phrases that are its arguments – noun phrases that the child is able to interpret into the participants in an ongoing action or activity or into the bearer(s) of a salient property. The picture I have presented so far hides certain subtleties that can be revealed by examining the possible interactions among a predicator, noun phrases, and an action (as prototypical of that which is nonseparable) in a situation in which a sentence containing a novel predicator and its noun-phrase arguments is uttered as a comment on an ongoing action.

I will describe the most psychologically plausible relationships among these three – a predicator, noun phrases, and an action – and only those that could lead to the identification of predicators. (And so I will not consider situations in which a novel word's status as a predicator is determined independently of actions and noun phrases, say on a distributional basis or a phonological basis or both.)

1. In one possible sequence of interpretive events, (i) the child (or other learner) realises that a phrase headed by a novel word signifies an action of a certain type (perhaps because of the perceptual salience of the action in the

situation, or perhaps because words are known for the participants' basic-level kinds and so on, or for both reasons combined), (ii) the child identifies the word as a predicator because actions occur only by virtue of individuals (and so the word must take arguments), and then (iii) the child interprets the noun phrases as arguments of the predicator (because their referents are participants in the action). The first link in this chain (from [i] to [ii]) is similar to the notion of semantic bootstrapping, except that the "mapping" from action words to predicators is not a built-in procedure, but is instead a principled deduction based on the child's understanding of the nonseparability of actions, and, further, the word is not identified as a verb in particular.

2. A second possibility is that the child (i) decides the word signifies an action (e.g., for the reasons stated above), (ii) realises that the noun phrases signify the participants in that action and interprets them as arguments, and then (iii) identifies the word as a predicator because it takes arguments.

3. The remaining possibility takes as its starting point the child's interpretation of the noun phrases in an utterance: (i) Suppose the child notices that the two noun phrases in an utterance signify two objects that are present, and that those objects are involved in some relation (e.g., one is performing an action on the other); (ii) the child might then realise that the phrase headed by the novel word in the utterance signifies the relation (i.e., the action); (iii) this realisation might then lead the child to identify the action word as a predicator (not because of some innate mapping procedure, as described in the semantic bootstrapping theory, but, in line with the nonseparability hypothesis, because the child understands that action interpretations imply predicators because of the nonseparability of actions; the fact that the word's arguments are explicit in the utterance could also serve to confirm the word's status as a predicator).

These three possible learning scenarios generate different predictions about learning.

The first scenario (action word $\rightarrow$ predicator $\rightarrow$ noun phrases are arguments) predicts that an action word will be identified as a predicator even when no noun-

phrase arguments appear in the surface structure of the utterance (e.g., "Look – dancing!"), as long as the action is salient and the child has no word for it (and the child knows a word for each participant's basic-level kind, etc.).

The second scenario (action word $\Rightarrow$ noun phrases are arguments $\Rightarrow$ predicator) predicts that action words will be interpreted as predicators only when their arguments are realised in surface structure as noun phrases. Otherwise, they will be identified as members of some other part-of-speech category (e.g., *noun*), or perhaps of none.

Both of these accounts lead to the prediction that children should be no more inclined to interpret the word as an action word when the utterance contains noun phrases than when it does not – that is, the presence of noun phrases should not increase the likelihood that the child will interpret the word as an action word.

The third scenario (noun phrases signify participants in a relation $\Rightarrow$ action word $\Rightarrow$ predicator) predicts that the presence of noun phrases in an utterance will increase the likelihood that the word will be interpreted as an action word *and* that it will be identified as a predicator. If one assumes that learning can occur in just this way, then a novel word should never be interpreted as an action word or as a predicator unless interpretable noun-phrase arguments appear in the surface structure of the utterance containing the word.

There is some overlap among the predictions of these three learning scenarios, but the number and pattern of different predictions is sufficient to allow a reduction of possibilities if relevant data can be obtained. In particular, the first two possibilities can be eliminated if it can be shown that children of the relevant age or adults just beginning to learn a new language will conclude that a word or its phrase signifies action only if noun phrases that signify the participants in the action are included in an utterance. If they are instead just somewhat more likely to draw that conclusion when noun phrases are present, then the possibility will remain that all three accounts describe learning in different instances. If a measure could be found for the part of speech of predicators in young children's grammar, then evidence could be obtained to distinguish instances of learning

described in the first account from those described in the second and third accounts: If when a word's phrase was taken to signify an action, explicit noun-phrase arguments were necessary for the word to be identified as a predicator, then the first scenario could be ruled out; if, instead, the presence of noun phrases just increased somewhat the frequency of predicator identifications in these circumstances, then all three accounts would remain as possible descriptions of learning in different instances. As an alternative to measuring the part of speech in the grammar of young children, relevant data could be obtained from adults (from whom part-of-speech data are relatively easy to obtain) if they were placed in a learning situation that mimicked that of a young child learning a first language (or that of a second-language learner in an immersion setting). (See section 6.3 for such a study with adults.)

3.5. Assumptions and Proposals of the Theory

I have given a general picture of a few related means of identifying predicators, as well as a means of identifying members of the verb subcategory. In this section, I would like to make explicit the assumptions behind the theory and my proposals about learning.

1. First, I assume that children have an unlearned ability to distinguish individuals (members of kinds), on the one hand, and properties of individuals and relations of individuals to one another, on the other hand.

2. I propose that children expect this distinction to show up in language as a distinction between words that head phrases that signify kinds or their members (nouns) and words that head phrases that signify properties or relations (predicators).

3. I assume that children can identify individual words. See section 4.2 and Appendix C for evidence relevant to this assumption.

4. I assume (after Macnamara, 1982, 1986, 1991, and Macnamara & Reyes, 1994) that children identify nouns as words applied to individuals (i.e., as the open-class words in noun phrases used to signify individuals). I propose that they

identify predicators as novel words in utterances that contain one or more noun phrases that plausibly could be the arguments of a predicator (because they obviously signify individuals that are present and that are involved in some observable relation or that possess some salient property). Alternatively, in situations where some relation or property is particularly salient, and where basic-level nouns (and proper names, for animate beings) are known for all individuals that are present and to which attention is directed, children could identify a novel word in an utterance as a predicator even when its arguments are not realised in surface structure.

5. I assume that children are able to discern the boundaries of phrases by attending to prosodic variations associated with phrasal boundaries, or by other means. I present, in section 4.3, evidence in support of the claim that children have this ability.

6. I propose that children can perform distributional analyses within phrases to discover subcategories of *noun* and *predicator* that are not universal (e.g., gender subcategories of *noun*, and the verb and adjective subcategories of *predicator*). Analyses of noun phrases – that is, phrases identified as noun phrases because they are headed by a noun – will lead to the discovery of gender subcategories. Analyses of the grammatical predicate – that is, that phrase identified as the predicate because it contains a predicator as its head – and of the higher-level phrase headed by the copula or an auxiliary verb and containing the predicate, will lead to the discovery of verbs and adjectives. When the predicate contains an object noun phrase, the analysis will not involve the relations of elements *within* that noun phrase, but it will involve the noun phrase as a constituent, the position of which relative to the predicator is relevant. (I assume that adjective phrases such as "the black cat" are a subtype of noun phrases because their semantic function is the signification of a subkind. But the presence of adjectives within some noun phrases suggests that the discovery of the category *adjective* will depend on analyses of both predicates and noun phrases.)

See section 4.4 for evidence in support of the hypothesis that distributional analyses within phrases can lead to the discovery of parts of speech.

7. As an alternative or adjunct to distributional analysis in dividing predicators into distinct classes, children may be predisposed to put into a separate class those predicators that never take more than one argument, that are used, in some cases, to pick out a subkind (a function that is concomitant with appearance within a noun phrase), and that signify dimensions or values along them – that is, adjectives.

3.6. Novel Aspects of the Theory

The nonseparability hypothesis differs from prior theories of verb identification in several ways. In it, words are identified as members of the category *predicator* before they are identified as verbs. In contrast to the semantic bootstrapping theory, children are not obliged initially to identify words as members of the categories *verb* and *adjective* even if those parts of speech are not manifest in the surface structure of the language.

The theory gives a critical role to the interpretations of words, but the relevant aspect of meaning is not couched in terms of actions in particular; any word with a meaning implying the involvement of individuals will be identified as a predicator. The semantic component of the predicator category remains constant throughout a speaker's life.

The theory is the first that provides an *explanation* for the link between actions and verbs: Verbs are predicators, and actions are prototypical of the type of thing for which a predicator is needed to reveal its being in an utterance, because actions occur only by virtue of one or more participants whose existence and kind(s) can be signified only through the arguments of a predicator. The importance of actions in particular to learners has its source in the ready perceptual availability and salience of actions (in contrast to other types of relations, such as liking and desiring, and to stable properties that do not draw attention to themselves or that are not perceptually available, e.g., wisdom).

The theory differs from those involving distributional analyses over entire utterances (Maratsos & Chalkley, 1980) or distributional analyses of contexts that are, as often as not, structurally meaningless, such as adjacent words (Kiss, 1973). As in Braine's (1987) theory, the categories *verb* and *adjective* are discovered through distributional analyses within a phrase – but they are not on equal ground with other words within the phrase, as they are in Braine's theory. Instead, they are identified as *subcategories* of the category *predicator*. Their discovery would appear to be even easier than in the learning scenario Braine describes, because the predicator category provides a focus for the distributional analysis, an analysis that is already simple by virtue of its restricted context. The theory presented here differs from Braine's in another respect: Phrases are not labelled as noun phrases or predicates prior to any interpretation of their contents. The identification of nouns and predicators occurs prior to the identification of noun phrases and predicates of different types (e.g., predicator phrases or nominal predicates). The nature of a phrase (i.e., noun phrase or predicator phrase of some type) is determined by the part of speech of the word that is its head (where prosodic factors such as stress and the inferred openness of the class will reveal to the learner which word is the head of the phrase).

4. EVIDENCE FOR THE THEORY'S ASSUMPTIONS AND PROPOSALS

4.1. The Category *Predicator*

Evidence for the psychological reality of the category *predicator* comes from several sources, the primary source being the work of comparative linguists. There is almost universal agreement among comparative linguists that two parts of speech are present, in some form, in all natural languages: *noun* and *predicator* (where the latter is sometimes called "verb"; e.g., Hockett, 1963, 1968; Lyons, 1966b, 1968; Sapir, 1921). To determine whether their conclusion is valid, we must first ask about linguists' methods for determining which parts of speech exist in a language. The specification of universal parts of speech is tricky; the demonstration of universality for a category presupposes universally applicable criteria for identification of the category (Robins, 1952). While no such criteria have ever been stated explicitly, comparative linguists appear to use the following procedure in practice: They search for *any* distributional or formal differences across sets of words, and, if any are discovered, they determine whether the words in a given formally distinct category can, in general, be translated into the linguist's first language using words belonging to one part-of-speech category. If the words tend to correspond to adjectives in the linguist's language, then the linguist calls the category "adjective." Insofar as a part of speech is semantically defined, this procedure amounts to the implicit use of semantic criteria, even though the formal distinctions leading to the discovery of the category become the "official" criteria for the category — in keeping with the orthodox view in linguistics that parts of speech have no universal semantic characterisations (Langacker, 1987; Robins). Greenberg (1963), despite his expression of faith that any universal category or phenomenon must have some universal formal characteristic, describes the possibility of translation from words in a class in one language to words in a class in another language as the ultimate criterion for differentiating word classes:

I fully realize that in identifying . . . phenomena [such as subject-predicate constructions and distinct word classes] in languages of

differing structure, one is basically employing semantic criteria. There are very probably formal similarities which permit us to equate such phenomena in different languages. . . . [But] the adequacy of a cross-linguistic definition of 'noun' would, in any case, be tested by reference to its results from the viewpoint of the semantic phenomena it was designed to explicate. If, for example, a formal definition of 'noun' resulted in equating a class containing such glosses as 'boy,' 'nose,' and 'house' in one language with a class containing such items as 'eat,' 'drink,' and 'give' in a second language, such a definition would forthwith be rejected and that on semantic grounds. (p. 74)

As long as no absolutely universal and purely formal characteristics of parts of speech can be identified, universality for a part of speech would seem to imply that its definition is semantic. Robins puts it this way:

Classifications and categories made wholly in formal terms are of necessity peculiar to each language, and cannot of themselves lay any claim to kinship with the formal categories of other languages. The insistence by present-day linguists on purely formal techniques as the only sound method of grammatical analysis makes the question of universals in grammar very pertinent. Previous theories of general grammar all, consciously or unconsciously, employed external, nonformal criteria for the establishment of at least their most important grammatical categories.

. . . Formal analysis, however, expressly excludes classifications made in terms of logical force, lexical meaning, or other extra-linguistic criteria, as being irrelevant and possibly harmful to the study of language. No consistent appeal can be made, therefore, to [semantic] criteria . . . for the purpose of establishing and defining any word-class.

. . . Are we then able to say that there are any universal categories in grammar other than purely segmental ones [e.g., *morpheme* and *word*]? Or must we, in strictly adhering to the principles of descriptive linguistics, say that nouns and verbs in the widely diverse languages of the world have nothing necessarily in common save the name, and that the assumption of a universal semantic content is but a relic of the uncritical ethnocentric theories of the past?

Against such a negative answer must be set the fact that . . . when two formally differentiated word-classes are established in any language as the basis of its grammatical system, a large proportion, at least, of the words in those two classes can be translated into the nouns and verbs, respectively, or nominal and

verbal phrases, of the analyst's language, to the satisfaction of a bilingual informant or of someone competent in the two languages concerned.

. . . So far as the words of two formally distinct classes in one language are found translatable into the nouns and verbs, respectively, of other languages, this must be attributed to a comparability of relations between words of these classes in different languages and their non-linguistic contexts. (Robins, 1952, pp. 293-297)

Relevant features of the nonlinguistic contexts are kinds and individuals of those kinds (into which noun phrases can be interpreted), and properties and relations that are realised by virtue of individual members of kinds (and into which phrases headed by predicators can be interpreted). While linguists have not consciously looked for words for kinds and words for properties and relations, their usual method of analysing a corpus of utterances would lead them to these classes in spite of themselves if the universal parts of speech, noun and predicator, are defined in these terms. In claiming otherwise, a linguist would be confusing his or her method of discovery with a definition. Langacker makes this point:

In the orthodox view, basic grammatical categories are defined for a particular language according to their morphosyntactic behavior (e.g., the class of verbs in English might be identified by their ability to inflect for tense and for subject agreement). This is eminently reasonable as a matter of analysis and practical description, since it is the parallel grammatical behavior of a set of expressions that alerts us to their status as a category. However, the behavioral properties responsible for our initial *discovery* of a category must be distinguished from its ultimate *characterization*. I maintain that the grammatical behavior of the noun or verb class is best regarded as *symptomatic* of its semantic value, not the sole or final basis for a criterial definition. (Langacker, 1987, pp. 54-55)

Because the use of formal criteria for the demarcation of word classes does not prevent the discovery of parts of speech with a semantic basis, the findings of comparative linguists about parts of speech are relevant to the question of universality for the parts of speech that we take to be defined semantically.

(As an aside, I note that the modern, Chomskian, definitions of parts of speech in terms of pairs of "syntactic features," namely $+/-N$ and $+/-V$, by

analogy with phonological features, might be appealed to as an alternative to semantic definitions as an explanation for universal parts of speech. But such distributionally motivated features cannot provide universal definitions for parts of speech because the syntactic impact of such features will differ from language to language, depending on the formal properties of parts of speech in a given language. In other words, the features themselves do not have universally applicable definitions or characterisations.)

Following the procedure outlined above, linguists have been able to discover, in almost all languages, a formally distinct category corresponding to nouns and a formally distinct category corresponding to predicators. For several languages of native North American nations, such as the Nootkan languages Nootka, Nitinat, and Makah, the Salish languages including Squamish and Clallam, the Kwakiutlan languages, the Chimakuan language Quileute, and Hopi, a formal distinction between nouns and predicators has been characterised as elusive or absent (e.g., Bach, 1968; Boas, 1911, 1947; Hockett, 1958; Kuipers, 1968; Swadesh, 1939; Thompson & Thompson, 1971; Whorf, 1941, 1945), but such a distinction reveals itself at the appropriate level of analysis (Dixon, 1975; Hockett, 1963; Jacobsen, 1979; Kuipers, 1967, 1969; Malotki, 1983; Sapir, 1924). It may appear at a level above the level of word stems or roots, such as at the level of words, where words contain nominalising or verbalising affixes. This phenomenon is not terribly weird among languages, despite what some of the linguists studying these seemingly anomalous languages would have us believe. One might think that an English word such as "walk" is clearly a verb (e.g., because it can take the aspectual marker *-ing*, the tense marker *-ed*, etc.). But in fact, the part of speech of "walk" is indeterminate until the word is placed in a sentence. It is a verb in the sentence, "I walk downtown every day," but a noun in the sentence "I take a walk downtown every day." So there is nothing particularly strange about a language for which the part of speech of a word cannot be determined until it appears in a sentence with an affix that signals its noun or verb status.

A distinction between nouns and predicators may also occur at a level below the word level, so that some part of a word (i.e., some morpheme) may function as a predicator and another part of the word may function as one of the predicator's arguments. In an especially excellent piece of scholarship, Jacobsen (1979) shows that a word in Makah, a Nootkan language, can contain within it parts that are in relationships to one another that we are accustomed to seeing among words, relationships such as the relationship of a verb to its object. For instance, a word can consist of a verbal suffix added to a noun-like stem that serves as the verb's object argument; the noun stem can appear separately in other utterances, and the verbal suffix can appear within other words. In Nootka, too, a predicator-like suffix may be added to a noun serving as its object argument to produce a word that is comparable to a predicate: "čapac" ('canoe') conjoined with "-oʔaɫ" ('see, perceive') yields "čapacoʔaɫ," which means 'see a canoe' (see Sapir & Swadesh, 1939, p. 236). A single word in Makah may constitute an entire proposition when a predicator-like actional suffix is conjoined with a noun-like morpheme for the object of the action, and the form of the suffix signals, tacitly, the subject argument by virtue of marking its person and number; for instance, in "laʔbiɫduxs," "laʔb(i)" means 'whiskey,' and "-duxs" is the first person singular form of the morpheme meaning 'look for,' so that the word can be taken to mean 'I am looking for whiskey' (Jacobsen, p. 108).

The arguments of embedded predicator-like morphemes may also appear as separate words in some of these languages. In Nootka, for instance, a word within which is embedded a predicator-like morpheme may be followed immediately by a separate word that is one of the morpheme's noun-phrase arguments. The idea 'A man goes' is conveyed by two words, the first of which has embedded within it a morpheme meaning 'goes' and the second of which means 'man': "waɫaʔkma qoʔas"; "waɫaʔk" means 'goes' and "qoʔas" means 'man' (Sapir & Swadesh, 1939, p. 235). The suffix "-ma" seems to function roughly like a copula; Sapir and Swadesh translate it as 'being' and translate the entire string as follows: 'He goes, being a man.' (No morpheme corresponding to "he" is in the

string; the authors appear to have translated the morpheme meaning 'goes' as 'he goes' because it is marked for the third person singular; in other words, they translated the morpheme as if it contained an implicit subject argument, as in pro-drop languages.) Jacobsen (1979) claims that Sapir and Swadesh translated the copula-like ending as 'being' in this and some other instances (but not in all instances) to give the impression that any noun that follows a word containing a predicator-like morpheme is a "frozen predication" (p. 87) rather than a noun-phrase argument, that is, to convey the impression that all individual words in the language are themselves little predicables or propositions (such that, e.g., the string under consideration is actually a proposition followed by something like a predicable, or a "potential predication" [Sapir & Swadesh, p. 235], so that it means 'he goes' followed by 'being a man' – despite the fact that the suffix they translate as 'being' is not attached to the word that means 'man'). If one translates the copula-like ending as 'is' rather than 'being,' and assumes no tacit pronoun, then the sentence can be translated as follows: 'Goes-is man'; this differs little from the English "The man is going," or "The man goes."

Inuktitut is another language in which predicators do not appear as isolated words; they are embedded in noun-like words. All quality-giving nouns have a suffix ("-juq" or "-tuq") that means 'something,' 'someone,' 'it,' 'he' or 'she' in various contexts. So "piujuq" means 'something or someone good,' and "ataataga piujuq" means 'my father, someone good' (Dorais, 1988, p. 114). Similarly, "illu aupartuq" means 'a house, something red,' or 'a house, a red object'; the idea 'the house is red' is expressed by inserting a copula-like infix "-u-" meaning 'be': The proposition "illu aupartuuvuq" means, roughly, 'the house, it is something red' (see Dorais, p. 115).

The linguists who claimed that such languages lacked any noun-predicator distinction appear to have been confused not just by the level at which the noun-predicator distinction appears, but also for other reasons. Jacobsen (1979) gives two reasons for linguists' blindness to the noun-predicator distinction in the Nootkan languages: The belief that tense, aspect, and mood are categories of

verbs alone (and the Nootkan languages mark these categories on nouns as well as on predicators; Whorf, 1940, 1945, used such marking as evidence for a lack of any noun-predicator distinction), and the fact of distribution that both nouns and predicators can "act as predicates on the one hand and as subsidiary elements [usually arguments] on the other, but that there is only one syntactic relationship (that of 'supplementation') between predicates and subsidiary elements (or among subsidiary elements), leaving us with no basis for discriminating among them" (p. 104); at the level of words, the relationship of, say, a predicate and a subject is not syntactically or distributionally distinct from the relationship of a predicate and an adverb modifying that predicate, for instance. But distributional differences are evident at a level of analysis below the word level. Jacobsen argues, from the evidence, that a sentence in a Nootkan language can be divided into two major parts, which he calls "predicate" and "argument," and these parts are marked in the languages; for words with an inflexional ending, different endings appear on predicates and arguments. Words that Jacobsen takes to be nouns occur as subjects and objects (i.e., as arguments), but words he takes to be verbs do so only in nominalised form. He concludes his argument with the following:

. . . My argument basically accepts the premise that major words may all occur as predicates (while still noting gaps in the inflectional possibilities available to some classes), and bases most of its discriminations on differences of occurrence as arguments.

In saying that there are these parts of speech, however, I am not excluding cases of multiple class membership, of sporadic occurrence in atypical roles, and especially, of lexicalization (internally verbal formations used as nouns), all of which seem to occur. (Jacobsen, p. 107).

Given a tendency to view words serving an argument function as nouns, and not as predicators, and to view words for the nonseparable as predicators, and not as nouns, and to view predicates as phrases headed by predicators, the appearance of both kind terms and terms for the nonseparable as both predicates and arguments in different instances could lead to the conclusion that no distinction between nouns and predicators exists in a language. This way of thinking stems from a widespread misunderstanding about the structural characteristics of "normal"

languages such as English. Any noun can be made into a predicable, such as "is a cat" or "is a teacher," and can be predicated of a subject, and most if not all verbs and adjectives can be transformed into nouns, such as "a walk," "the having," "destruction," "construal," "softness," and "tallness," and can appear as the arguments of a predicator. Nouns, verbs and adjectives occur equally readily in predicates, and predicators are freely transformed into nouns. The failure to recognise this fact of language makes the Nootkan and Salish families of languages appear anomalous, but they are not. They differ only in their lack of part-of-speech specific affixation to signal most transformations from one part of speech into another (but languages such as English sometimes fail to mark transformations by affixation, as in the case of the noun "walk"), and in the manner in which a predicator and its argument(s) are formally distinguished: by their co-occurrence patterns with various affixes or inflexions or both, rather than by their co-occurrence patterns with the copula or auxiliary verbs versus determiners – that is, with separate words. Moreover, the standard modern syntactic analysis of a proposition disguises the similarity between "normal" languages such as English and the Nootkan languages because it does not treat an expression such as "is running" as a predicable (containing the predicate "running"), but rather as an auxiliary verb and a verb phrase (with inflexion for present-progressive aspect), where the constituent equivalent to the predicable is conceptualised merely as a higher projection of the auxiliary verb (or rather of its inflexional component). Further, many propositions, such as "Natasha is a cat," do not fit the standard syntactic tree structure for English and related languages, with a subject noun phrase (NP or N") as sister to a higher projection of the inflexional component of the auxiliary (INFL' or I'), with a verb phrase (VP or V') as daughter to INFL' and sister to INFL, and with any object NP as sister to the verb that heads the VP (e.g., van Riemsdijk & Williams, 1986). In phrase-structural notation, Sentence $\rightarrow$ NP INFL', INFL' $\rightarrow$ INFL VP, and VP $\rightarrow$ V NP. Predicates and the possibility of them being created from a verb, an adjective, a noun phrase, or a prepositional phrase are not represented in this structure.

Bickerton (1981) argues that universality is not a good criterion for deciding whether a feature of language is unlearned. Languages can evolve, he argues, in ways that obscure the contribution of the mind to the structure of language; better evidence of what is unlearned can be found in creole languages, which emerge spontaneously through children's efforts to communicate and which are not subject to shaping by linguistic evolution. In creole grammar, one finds nouns and predicators. These categories may even be present in gestural languages that evolved among deaf people, such as American Sign Language and British Sign Language; there is evidence to suggest that such languages contain categories of signs comparable to nouns and predicators (e.g., Klima & Bellugi, 1979; Kyle & Woll, 1985; Valli & Lucas, 1992). The distinction between nouns and predicators becomes particularly clear in these gestural languages when comparing object signs and action signs that are similar in form (and comparable to noun-predicator pairs such as the mass noun "paint" and the verb "paint"); the noun-like sign reduplicates the sequence of movements and holds that characterises the predicator-like sign, while maintaining its handshape, location, and orientation (Supalla & Newport, 1978). Profoundly deaf children of hearing parents who are not exposed to any conventional gestural language invent their own signs, and these can be divided into two types that seem similar to nouns (or noun phrases) and predicators (or predicates): deictic signs (e.g., pointing to an object) that seem to signify members of kinds, and characterising or iconic signs for actions and attributes (e.g., acting out a type of action, or forming a circle with the thumb and index finger to convey the attribute 'round'; see Feldman, Goldin-Meadow, & Gleitman, 1978; Goldin-Meadow, 1979, 1982, 1985; Goldin-Meadow & Feldman, 1977). These two types of signs are combined with one another as if the deictic signs were arguments of the iconic signs. One deaf child of hearing parents who was studied in greater depth expanded the class of "nouns" in his language later in development to include some characterising gestures in addition to deictic signs; Goldin-Meadow, Butcher, Mylander and Dodge (1994) were able to show, through a coding effort that can only be described as heroic, that morphological factors

(such as inflexions and abbreviations) and discourse factors could be used to distinguish nouns from verbs and adjectives (with interrater agreement for 94 percent of the tokens of signs). The class of nouns came to include abbreviated versions of verbs and other non-deictic signs which could appear as arguments of verbs or adjectives.

Must the universality of predicators and nouns rest on the semantic definitions offered here (for predicators) and by Macnamara and his colleagues (for nouns)? Other explanations have been offered. Some argue that the division of words into nouns and predicators (or "verbs") is the minimum distinction necessary for pragmatic purposes: One must have something to talk about and something to say (e.g., Sapir, 1921; see p. 119). The noun specifies the topic, and the predicator specifies the comment on that topic. (Hopper & Thompson, 1984, propose a similar distinction; they argue that prototypical nouns and verbs serve the discourse functions *discourse-manipulable participant* and *reported event* respectively.) But predicators, by themselves, do not say anything about anything. To say something about an individual or set of individuals, one must use a predicate. Perhaps we could regard the predicate of a sentence as a comment upon the subject (e.g., Gruber, 1967). Chomsky (1965) makes this claim:

It might be suggested that Topic-Comment is the basic grammatical relation of surface structure corresponding (roughly) to the fundamental Subject-Predicate relation of deep structure. Thus we might define the Topic-of the Sentence as the leftmost NP immediately dominated by S in the surface structure, and the Comment-of the Sentence as the rest of the string. (p. 221)

Yet there is even something odd about this claim. The subject noun phrase does not always serve just to pick out something to be talked about. In the sentence, "The tall man is lying," the phrase "The tall man" might be viewed just as a means of identifying an individual about which one has something to say; but in the sentence, "That idiot wrecked my car," the noun phrase "That idiot" seems also to make a comment about the character of the individual whom it signifies. (Note also that any noun can be converted to a predicable, such as "is a cat," and so any

noun is tantamount to a comment.) So I reject the view that the universality of nouns and predicators is grounded in the need to have something to talk about and something to say. I also reject the view that the distinction is a functional one, a distinction between logical predicates and their arguments (e.g., Braine, 1987; Keenan, 1979); many types of constituents can be arguments, including verb phrases (as in "She wants to open the door"), adjective phrases (as in "Sherrie likes the red car"), and even complete propositions (as in "Tim believes Jane is a wonderful person"; sometimes the copula appears in infinitive form, as in "Tim believes Jane to be a wonderful person," and sometimes the word "that" introduces the proposition, as in "Tim believes that Jane is a wonderful person"). Also, noun phrases are arguments of predicators, not of predicates (in the grammarian's sense). And further, noun phrases have a semantics much richer than their potential status as arguments; in particular, they are interpreted into kinds or their members (see La Palme Reyes et al., 1994b; Macnamara, 1986, 1991). I have argued, though, that the central characteristic of predicators is their taking of noun-phrase arguments, which reflects their use in signifying properties of individuals (or of sets of individuals) or relations of individuals to other individuals.

While universality is not attributed to the category *adjective*, this part of speech is present in many languages, and it warrants careful consideration. It is possible that there exists a category of adjectives in all languages, but that this category is not formally distinguished from, say, the verb category in every language. The lack of any formal distinction between verbs and adjectives would obviate discovery of the category whenever the usual comparative linguist's procedure was followed.

Particularly relevant to this question is the presence, in many languages that lack a distinct *open* category of adjectives, a small closed class of words for qualities, words that Dixon (1982) calls "adjectives." Swahili has a class of about fifty adjectives, which signify values of dimensions such as speed (fast, slow), size (big, small, long, short, fat, thin, etc.), goodness-badness (good, bad), age (young,

old), and colours. The Bemba language has fewer than 20 adjectives; Luganda has about 36 adjectives; Hausa has only about a dozen, signifying values of age, size, goodness-badness, and colour; Acooli has about 40 adjectives, Hua has about 12, Alamlak has about 40, Kiriwinian has about 50 – to give a few examples (see Dixon). Adjectives in these closed classes tend to fall into a small number of types: They signify values along dimensions of size, age, goodness-badness, speed, physical properties (e.g., hot, cold; hard, soft), or colour. They more rarely signify human propensities (e.g., 'jealous,' 'happy,' 'cruel'). In languages with a closed class of adjectives, many properties signified adjectivally in English are signified verbally (i.e., with verbs). So why do these languages not use verbal signification for all nonseparable phenomena? What drives the formation of a distinct category of adjectives for certain commonly discussed properties? The existence of these closed categories suggests the existence of a distinct adjectival nature that often forces its way into the structure of a language.

Suppose that the category *adjective* is part of the semantic structure of all languages, whether or not it is evident in sentences as a formally distinct part of speech. Perhaps, then, the part of speech *verb* could be viewed as predicators that are not adjectives. I will pursue this line of reasoning no further here.

The speech of young children provides another source of evidence for the category *predicator*. Early speech may be relatively unstructured, or the structure may be idiosyncratic to a given child; for this reason, evidence for a particular part of speech may be difficult to come by. Nonetheless, we can at least inquire as to whether or not any children appear to make any formal distinction between verbs and adjectives, and to distinguish these categories from nouns, prior to learning syntactic and inflexional rules that are specific to these categories (e.g., in the early stages of telegraphic speech).

(I note, in passing, that some researchers regard any discussion of parts of speech in early language as nonsense. Their opinion follows from their belief that all parts of speech are defined formally as distributional patterns or selectional rules that characterise a set of words. Gathercole, 1986, argues that children do

not have, in their grammars, count nouns and mass nouns until they have mastered the meanings and selectional restrictions of all count and mass quantifiers, including "much" and "many," and of all distinguishing inflexions – a mastery that is attained around the age of 5;0. Olguin & Tomasello, 1993, argue that children of age 2;0 do not have the part of speech *verb* in their grammars because they do not generalise newly learned action words to unmodelled verb contexts, such as ones with noun phrases ordered properly with respect to the action word, or with the past-tense marker *-ed*. [An alternative interpretation of their data is that children either failed to identify the actional nonce words as verbs, or that the category *verb* is not constructed from experience, and the data reveal only that the children had not yet mastered English-specific usage of verbs.] Ninio, 1988, argues that no parts of speech can be attributed to young children because category symbols are "shorthand descriptions of the rule system as a whole" [p. 101]. The grammar of a young child is not the end-state grammar, but, she argues, "the use of category symbols N, V, NP or VP, etc., . . . is equivalent to using the whole of endstate grammar to describe child language; and that is unacceptable" [p. 101]. Where a category is presumed to be semantic at the core, these arguments have no purchase. Where a part of speech seems to be defined according to distributional criteria or phonological criteria or both [e.g., gender subcategories of *noun*], a complete lack of evidence in a child's speech of any formal distinction might imply that the part of speech was not yet present in the child's grammar – although the possibility would remain that the child was attentive to the formal properties of the part of speech, but was unable or unwilling to display this knowledge in utterances. The extreme view of Ninio and Gathercole, that the part of speech is not in the grammar until *all* of the rules associated with that part of speech are mastered, seems unproductive. Among linguists, common views about grammar include the idea that a grammar resides in the head of an individual as a form of knowledge; see, for instance, Chomsky, 1980, and van Riemsdijk & Williams, 1986. If a grammar is viewed as a store of knowledge belonging to an individual speaker – knowledge of the rules of a

language – then the complete set of rules for a part of speech in the end-state grammar cannot be specified until the individual speaker has reached a static stage in his or her use of words in that category. Now suppose we were to accept the position of Gathercole and Ninio that parts of speech are present only when the end state of a grammar is reached. This position would lead us to some odd conclusions. Suppose that, at the age of 50, a man acquires a new rule with respect to count nouns – say by learning that "fewer apples" is considered more grammatical than "less apples," and then incorporating this rule into his grammar – then we would be forced to conclude that the man did not have the part of speech *count noun* until the age of 50! And we cannot know ahead of time the final state of the man's grammar, so the man's use of words at any given stage in his life might or might not reflect the end-state grammar – and so we cannot determine, at any stage, whether a part of speech is present in his grammar. A common alternative view of a grammar is that it is a structural account of a language provided by a linguist; see Chomsky, and van Riemsdijk & Williams. Such structural accounts depend on informants' reports of their linguistic intuitions. But individual speakers of a language differ in their use of the language, so the linguist's description of the language will depend on the particular informants providing the linguist with data. Does it make sense to impose upon all speakers of the language the rules present in those informants' linguistic competence as the necessary end point of learning – as the criteria for judging the language to have been learned? Suppose we take yet another view of a grammar, claiming that it is a summary statement about the rules known by the members of a speech community in general; then we must decide from among sets of rules instantiated in the minds of different speakers which is the "end-state" set of rules that determines when a part of speech has been acquired. Is the relevant set of rules for English to be found in the Queen's English? And do only those who use a set of words in the manner of the Queen possess the part of speech in their grammars? It would seem more productive to regard parts of speech as sets or classes of words, rather than sets of rules, so that minimal evidence for a

distinction between classes of words could be taken to imply the presence of a categorical division. Further, such a view would seem to be necessary in creating accounts of learning the rules that are stated over a particular part of speech.)

Examples of child speech from published studies are of limited relevance because researchers tend to present instances of speech that demonstrate a phenomenon that is predicted by their pet theory. Some published examples are relevant, though, to the present theory.

The literature contains several examples of apparent indifference between verbs and adjectives. In Cazden's (1968) study of children's early use of inflexions, she found only four cases of the use of an inflexional morpheme with a word of the wrong part of speech, but of these four errors, three involved the misapplication of a verb inflexion to an adjective (e.g. "That greens"). Carlson and Anisfeld (1969) observed two comparable errors; a two-year-old child used the verb inflexion *-ing* with adjectives ("it's still soring," and "a louding plane"). Braine (1971) describes the case of a child (Andrew) who initially distinguished transitive (two-place) and intransitive (one-place) predicators, but who did not show evidence of a distributional distinction among various kinds of one-place predicators; this class included adjectives (e.g., "hot," "all-wet"), intransitive verbs (e.g., "come," "sit"), and passive participles (e.g., "broken"; passive forms can be verbal, adjectival or ambiguous; see Wasow, 1977). Around 2;4, a distinction emerged in the child's grammar between verbs and other predicators when he learned the inflexion *-ing*. Brown and Fraser (1963) describe a distributional class in the grammar (at age 2;2) of one girl (Eve) that included three adjectives, two intransitive verbs, and one transitive verb. The three words I am calling adjectives ("tired," "broken," and "all-gone") were all participles of verbs, but at least two of them ("tired" and "broken") are adjectival (see Wasow). The words in this class always appeared after a determiner and count noun, after a proper noun or a human count noun, or in isolation (and these three distributional contexts defined the class). Leopold (1949) reports that Hildegard, at age 1;11, said "Meow all wet me" after being licked by a cat. The expression "all wet" is usually used as an

adjective, and Hildegard did use the expression in this way; at 1;11, she said "Papa all wet." The word "open" was used both as a verb (e.g., in "open door" at 1;8) and as an adjective (e.g., in "door open" at 1;11). Hildegard used "break" as an adjective (equivalent to "broken" or "kaputt") at 1;10, and she used the past participles of verbs as adjectives. Other researchers have also reported instances of this phenomenon. Grégoire (1937, 1947), for example, notes that his children used participles such as "parti" and "cassé" as adjectives. Other evidence suggests that young children treat past participles of verbs as adjectives. Antinucci and Miller (1976) report that Italian children initially make the past participles of transitive verbs agree in number and gender with the object of the verb, as if they were adjectives modifying that noun; the past participle is supposed to agree with the object only when it is a pronoun; otherwise, it is supposed to have a fixed ending (-o); for intransitive verbs, the past participle is supposed to agree in number and gender with the subject noun in adult grammar. So the agreement pattern used by Italian children supports the view that verbal past participles are equated with adjectives in children's grammar.

A similar conclusion is suggested by some other data on the use of past participles, data on their use in utterances with the form of passive constructions. Horgan (1975, as cited in Borer & Wexler, 1987) found that children between 2;0 and 4;0 produced passives in truncated form, that is, omitting an agent noun "by" phrase, and they appeared to treat the past participle as a state description of the object, as if it were an adjective; some examples are, "tree is blown down," "tree is broken," "a ball be kicked," "the car's parked," and "the tree's smashed." Even among older children (aged 5 to 13 years), past participles appearing without an explicit agent noun look very much like adjectives (see Horgan, 1978). Truncated passives containing apparently adjectival past participles are much more common at all ages than full passives containing an agent noun phrase (after the preposition "by"). Borer and Wexler conclude, from the evidence they review (from English and Hebrew), that children learning passive (or past) participles first learn only adjectival ones (which are lexical items, as opposed to transformed

verbs; see Wasow, 1977); these participles tend to be the passive (or past) forms of action verbs (and many are ungrammatical from an adult standpoint). Note that verb participles can appear in positions typical of adjectives (i.e., prenominally, and after a form of "be"). Assuming that children recognise some relationship between a verb and its past participle (e.g., between "comb" and "combed"), the appearance of adjectival (i.e., lexical) past participles in a position suitable for adjectives, but not of verbal (i.e., transformationally derived) past participles in the same position, suggests that children define the adjective category primarily in terms of the distributions of adjectives, so that they expect any word appearing in a distributional context appropriate for an adjective to have the distributional privileges of an adjective (i.e., those that characterise lexical or adjectival past participles, such as appearance with the prefix *un-*, after "very," after verbs such as "remained," "became," "seemed" and "appeared," and in prenominal position; see Wasow; an example of an adjectival past participle is "tired" as in "The man remained very tired"); these distributional privileges reflect the stative (versus active) meanings of adjectives. When an inflected verb appears in a position that has come to be associated with adjectives, children seem to assume that it has ceased to be a verb, and thereby lost both its actional meaning and all of the distributional privileges of verbs (e.g., appearance with the verbal degree modifier "very much," with an agent "by" phrase, etc., i.e., the distributions that characterise verbal past participles; see Wasow; an example of a verbal past participle is "given" as in "The teenager was given a car by her mother") – or rather that it has lost those distributional privileges of verbs that are known to the children; adults have learned that the position of a verbal past participle in a passive construction is a context in which a verb can appear, when it is in its past participial form. If these conclusions are correct, then children seem to be defining the distinction between verbs and adjectives in terms of their distributions (and their limited knowledge about the distributions of past participles of verbs prevents them from treating a past participle as a verb when it appears in a known adjective position); even though their use of past participles as words for end states suggests that they

link adjectives with states rather than the actions that lead to those states, it seems that the position of a past participle determines that the word will be given a prototypically adjectival (i.e., stative) interpretation. In other words, it seems that adjectives are *defined* in terms of their distributions.

K. Nelson (1976) found that the earliest use of adjectives tends to be in predicative position – a position that is common to verbs and adjectives (e.g., "It is red"; "It is running") – although her measure may have been biased by her inclusion of isolated adjectives in the predicative class. Over time, the proportion of adjectives appearing in attributive position increases (even when just those adjectives appearing in multi-word utterances are considered).

Martin Braine and his colleagues (Braine, Brooks, Cowan, Samuels, & Tamis-LeMonda, 1993; Braine & Hardy, 1982) have conducted several studies with children and adults which seem to provide evidence for the early existence of a common perceived role for the subject of adjectival predicables (e.g., "is red"), locative predicables (e.g., "is behind the house"), and intransitive-verb predicables (e.g., "is running"). They call this role the "Subject of Attribution." This category is distinct from the surface-structure subject of a sentence, at least among children; five-year-old children do not place the subject noun phrase of a transitive verb in this category. In effect, children treat the subject of all nonrelational predicates alike, which means that they treat the argument of all one-place predicators alike. This finding suggests a failure to make any general semantic distinction between adjectives and one-place verbs. Alternatively, children collapse across types of case or role for predicators with one argument, seeing the taking of arguments as more critical to classification than the roles of those arguments.

Plato and Aristotle treated adjectives as a subcategory of verbs. Lyons (1966b, 1968) argues that this position is correct, and that the differences between verbs and adjectives are surface phenomena of inflexion and distribution – features that are language-specific; in Lyons's view, verbs and adjectives belong to a single category in "deep structure." Case grammarians (e.g., Charles Fillmore; see Fillmore, 1968a, 1968b) and generative semanticists (e.g., George Lakoff; see

G. Lakoff, 1970, 1972), whose concern was the universal semantic base of language, also argued that adjectives are a subset of verbs (or predicators). George Lakoff and Paul Martin Postal constructed a set of arguments for the claim that "adjectives and verbs are members of a single lexical category (which we will call VERB) and that they differ only by a single syntactic feature (which we will call ADJECTIVAL)" (G. Lakoff, 1970, p. 115). Syntactic features are realised by subcategorisations, selectional restrictions, the applicability of rules of inflexion, and so on (e.g., Chomsky, 1965; Radford, 1981), so the Lakoff-Postal doctrine amounts to the assertion that adjectives differ from verbs only in their distributions. I will summarise their nine arguments.

1. There are many pairs of sentences, one with a verb and one with an adjective, that appear to mean the same thing (e.g., "I regret that"; "I am sorry about that"; "I like jazz"; "I am fond of jazz"). Also, with many other pairs of sentences, an adjective and verb seem to be "the same lexical item" (e.g., "I desire that"; "I am desirous of that"; "Cigarettes harm people"; "Cigarettes are harmful to people"). The only significant differences between the verb and adjective uses are the inclusions of a form of "be" and of a preposition when the adjective is used. Lakoff notes that a preposition is also introduced when a verb is nominalised, a fact that leads him to the hypothesis that verbs carry an implicit preposition; compare "I fear rain" with "I have a fear of rain," and "I like jazz" with "I have a liking for jazz." Lakoff argues that this preposition is dropped when a verb is not nominalised, and that the preposition appears with the nominal form of the word as a kind of case marker. He also argues that a form of "be" is introduced with adjectives to permit tense marking, just as "do" is introduced, apparently for this reason, in questions and negative propositions.

(As an aside – modern linguistic theory asserts that the preposition is needed for assignment of a thematic role to the object noun; nouns cannot assign thematic roles, and adjectives can assign just one thematic role, to the subject noun. Adjectives that take an object must therefore appear with a preposition that assigns a role to the object noun, i.e., that indicates the role of the noun relative

to the adjective. This account provides an alternative to Lakoff's hypothesis about the ellipsis of prepositions when verbs are used.)

2. Almost all of the same selectional restrictions apply to both verbs and adjectives. If the appearance of "be" in front of an adjective and the appearance of a preposition after it (e.g., "be fond of") are viewed as superficial phenomena, then we can speak of transitive and intransitive adjectives as well as verbs (i.e., we can view both verbs and adjectives as taking or not taking an object). Further, adjectival and verbal predicators can take subject and object arguments of the same kind (e.g., we can use an animate subject with the predicators "know" and "be aware of," an animate object with "hurt" and "be brutal to," a physical object as subject with "weigh" and "be heavy," and an abstract object such as "idea" with "understand" and "be receptive to"). Also, both types of predicator take the same adverbials (e.g., "They were noisy all night"; "They caroused all night"; "They were being noisy in the living room"; "They were carousing in the living room"; "They were being noisy deliberately"; "They were screaming deliberately").

The next seven arguments show that many rules apply to both verbs and adjectives, suggesting that these rules operate over a category superordinate to the verb and adjective categories (i.e., that verbs and adjectives are part of a single lexical category at some level).

3. Both verbs and adjectives can be classified as stative and submit to rules governing the use of statives. Imperatives, for instance, can be used with nonstative predicators (e.g., "Look at the picture"; "Don't be noisy") but not with stative predicators (e.g., **"Know that Bill went there"; *"*Don't be tall"). Constructions with "do" are also sensitive to the stative-active distinction (e.g., "What I'm doing is looking at the picture," but **"What I'm doing is knowing that Bill went there"; "What I'm doing is being noisy," but *"*What I'm doing is being tall"). Likewise, progressive aspect is restricted to use with nonstative verbs and adjectives (e.g., "I'm looking at the picture," but **"I'm knowing that Bill went there"; "I'm being noisy," but *"*I'm being tall").

(This argument from rules about the use of aspect can be restated without reference to the stative-active distinction by saying that both verbs and adjectives may have inherent aspect, so that some verbs resist the affixation of aspectual markers [e.g., *"I am liking him"; *"I have been knowing that fact for years"] and so that the inherent aspect of most adjectives prevents their use, in grammatical utterances, with auxiliary verbs or copulas marked for aspect [e.g., *"I was being sad yesterday"; *"I am being beautiful, am I not?"]. Adjectives without inherent aspect can be used with aspectually marked auxiliaries: "You are being silly today"; "The boys were being noisy all afternoon." But the notion of inherent aspect may be less defensible than the notion of a stative-active distinction. It is not clear how one could separate the idea of inherent aspect in a predicator from the possibility of progressive aspect in a well-formed predicate containing the predicator. By contrast, the possibility of progressive aspect, and, additionally, the well-formedness of imperatives and "do" constructions, can be predicted through a consideration of the nature of a state or activity; when a phenomenon persists over very long periods and involves no change or movement [e.g., redness], a predicable for it cannot appear with progressive aspect marking; when the phenomenon is transitory [e.g., blushing] or involves change or movement [e.g., breathing], a predicable for it can appear with progressive marking; when the phenomenon is, in addition, under the volitional control of an agent [e.g., kicking], a word for it can appear in all contexts said to be linked with the active or nonstative feature, including imperatives and "do" constructions. This conclusion suggests a three-way classification of stable properties, transitory properties and non-intentional dynamic processes, and actions or activities that arise from intentions, rather than the two-way classification of states and activities.)

In rejecting this argument, Chomsky (1970) asserts that a stative-active distinction is not characteristic of predicators in particular, but rather of lexical categories in general because, he argues, it is characteristic of nouns as well as verbs and adjectives. In support of this claim, he offers the following pairs of contrasting sentences as an illustration: "Be a hero"; *"Be a person"; "He's being a

hero"; *"He's being a person"; "What he's doing is being a hero"; *"What he's doing is being a person." If the stative-active distinction is understood as a distinction between stable properties that are not under one's control, such as being a person or being tall, and transitory properties, dynamic processes, and actions or activities that have their source in intentional states (beliefs and desires), such as being a hero and being noisy, then Chomsky's claim appears to be valid. Such a distinction may affect the use of aspect and mood (e.g., imperative mood) and the well-formedness of constructions with "do" for all predicates headed by an open-class word, regardless of whether they are headed by verbs, adjectives, or nouns. It might be more appropriate, then, to treat the stative-active distinction (or the three-way distinction of stable properties, transitory properties and non-intentional dynamic processes, and intentional actions and activities) as one subcategorising predicates, rather than one subcategorising nouns, verbs, and adjectives.

4. A relative clause containing a verb or an adjective can be converted to an adjectival construction through the application of two rules: WH-deletion and the "adjective shift" that reverses the order of the noun and predicator. By these rules, "The man who is tall" becomes "The tall man," and "The child who is sleeping" becomes "The sleeping child."

5. The same factive, action, and manner nominalisations are undergone by verbs and adjectives, suggesting the possibility of common nominalisation rules for both types of predicator. When (some of) these rules are applied, "John knows that fact" becomes "John's knowledge of that fact . . .," and "John is cognizant of that fact" becomes "John's cognizance of that fact . . ."; "John distrusted Bill" becomes "John's distrust of Bill . . .," and "John was wary of Bill" becomes "John's wariness of Bill"

6. For both adjectives and verbs, there appears to be a transformation that interchanges the subject and object nouns; evidence of this transformation can be seen in the following sentence pairs: "What he did surprised me" and "I was surprised at what he did" (note that "surprised" is adjectival in the second case, so

that the interchange of noun phrases accompanies a transformation of a verb to an adjective; see Wasow, 1977, for tests for the adjectival nature of a past participle, e.g., "very surprised," and "he appeared surprised"); "I enjoy movies" and "Movies are enjoyable to me" (where the interchange of noun phrases accompanies, again, a transformation of a verb into an adjective). Lakoff and Postal claim that this "flip" transformation can be applied in both directions, so that it sometimes involves transforming a verb into an adjective, and sometimes involves transforming an adjective into a verb. Because the interchange of noun phrases or clauses can occur with verbs *or* adjectives, they argue, these words must belong to a single category.

7. The deletion of an indefinite object can occur with both verbs and adjectives. "John is eating something" can become "John is eating," and "The results are suggestive of something" can become "The results are suggestive."

8. Agent nouns can be formed from verbs and from adjectives: By transforming a verb or adjective to a noun, "She is beautiful" becomes "She is a beauty"; "He is idiotic" becomes "He is an idiot"; "John cooks" becomes "John is a cook"; "John destroys houses" becomes "John is a destroyer of houses."

9. Verbs and adjectives take the same variety of complements, and the same rules for complements apply regardless of the type of predicator. Here are some examples: "John wants *to go*"; "John is eager *to go*"; "John knew *that Bill had done it*"; "John was aware *that Bill had done it*"; "John can *hit a ball 400 feet*"; "John is able to *hit a ball 400 feet*."

Chomsky (1970) dismisses the above argument, claiming that nouns take the same complements as verbs and adjectives. By this, he means that they take complements satisfying the same syntactic descriptions, such as *noun phrase* and *sentence*. Lakoff and Postal's claim is that verbs and adjectives with similar meanings can take the very same complements, word for word. Only a small subset of nouns can take the very same complements taken by verbs and adjectives, namely those nouns that are derived from predicators. Consider, for instance, ". . . John's desire *to go* . . . "; ". . . John's eagerness *to go* . . . ";

". . . John's knowledge *that Bill had done it . . .*"; ". . . John's awareness *that Bill had done it . . .*"; and ". . . John's ability to *hit a ball 400 feet . . .*." No general claim can be made that nouns and predicators take the same complements.

G. Lakoff (1970) concludes that the existence of so many rules common to verbs and adjectives can hardly be an accident. The coincidence of rules provides evidence for a unified category (which Lyons, 1966b, and others have called *predicator*).

4.2. Can Children Identify Words?

The classification of a word, or at least its root morpheme, presupposes the ability to identify word (or root morpheme) boundaries. This presupposition is not unique to my theory; any theory of word classification depends upon it. For this reason, I will not review here the evidence in support of the hypothesis that children can locate word boundaries in the speech stream, but the interested reader will find a review of the evidence in Appendix C. The review reveals that children typically extract words as units fairly successfully, although they may sometimes mistake a stressed syllable for the root of a word, and enter that syllable into their lexicons; alternatively, they may enter a complete word into their lexicons, but they may produce just the part of the word that receives stress (due, perhaps, to some production limitation). Whether or not they are able to locate the boundaries of every word, they can, at the very least, extract some portion of the speech stream and treat it as a word. If they happen to extract the wrong portion, the error may not be fatal; sometime during learning, their error may be pointed out to them, and they could then replace the phonological component of their lexical entry without losing any information about the word's part of speech, meaning, and so on.

4.3. Can Children Detect Phrasal Boundaries?

I have argued that the categories verb and adjective are discovered through distributional analyses within phrases, where the status of a phrase as a noun

phrase or a predicator phrase (e.g., a verb phrase) is evident from the noun or predicator status of the stressed word in the phrase (and where the category membership of the stressed word is discerned through semantic means). For this account of learning to work, children must have some means for identifying the boundaries of phrases (e.g., noun phrases and predicator phrases). Phrases occur within clauses, so children must also be able to detect clause boundaries.

There are certainly many prosodic correlates of clause and phrase boundaries available, if a listener could make use of them. Clauses are often separated by a breath (Henderson, Goldman-Eisler, & Skarbek, 1965; Webb, Williams, & Minifie, 1967), and they are associated with prosodic changes such as pausing, segmental lengthening, a fall or rise in the fundamental frequency, stress-marking at a clause boundary, and a blocking of phonological rules (Cooper & Paccia-Cooper, 1980; Cooper & Sorensen, 1981; Garnica, 1977; Klatt, 1975; Kutik, Cooper, & Boyce, 1983; Martin, 1970; Stern, Spieker, Barnett, & MacKain, 1983). (Bolinger, 1978, shows that the "meaning" of a rise and fall in fundamental frequency is nearly universal, such that a fall in frequency almost universally signals the end of a constituent.) Many clues to phrase boundaries are also available. The segments at the end of a phrase are lengthened (Klatt, 1975, 1976; Lindblom & Rapp, 1973, as cited in Klatt, 1975, 1976; Morgan, 1986; Sorensen, Cooper, & Paccia, 1978; Streeter, 1978). A unit called a "foot," equivalent to a stressed syllable and the segments between it and the next stressed syllable, is lengthened when it contains a phrase boundary (Lea, 1980; Lehiste, 1977; Lehiste, Olive, & Streeter, 1976); this lengthening has been found to be attributable to lengthening in the "rhyme" of the final pre-boundary syllable, that is, lengthening in the vowel nucleus and any coda consonants within the final syllable (Wightman, Shattuck-Hufnagel, Ostendorf, & Price, 1992). An increase in intensity often accompanies an increase in duration at a boundary (Streeter). Pauses (i.e., silences) may be inserted between phrases (Lea, 1980; Wightman et al.), and in particular between the subject noun phrase and the predicate phrase (Wilkes & Kennedy, 1970). A fall in fundamental frequency often occurs at the end of a

phrase, followed by a rise at the first stressed word in the next phrase (Lea, 1973; Streeter), although this intonational boundary marker is present at only 33 percent of the boundaries between a subject noun phrase and the auxiliary verb of the predicate phrase (versus 95 percent for boundaries in front of a prepositional phrase; see Lea, 1973).

Additional, non-prosodic clues can signal a phrasal boundary (see Morgan et al., 1987). Words belonging to certain closed classes often occur at the beginning or end of a particular type of phrase. In English, members of the small closed class of determiners appear only at the beginning of a noun phrase (although not all noun phrases begin with a determiner). Predicate phrases begin with an auxiliary verb or the copula. Prepositional phrases begin with a member of the small closed class of prepositions. These "function words" occur with such high frequency (e.g., Kucera & Francis, 1967) that they can serve as boundary markers for phrases, once they have become familiar. Some languages provide another clue to phrase boundaries: concord markers. In Spanish, for example, all the words in a noun phrase may have the same ending, as in "Los niños pequeños hablan" ("The small children are talking"; see Morgan et al., p. 503). Across sentences, syntactic transformations provide information about phrase boundaries because, for many such transformations, all the words in a phrase move together when the sentence is transformed; constituents are never broken up in transformations. And again across sentences, the existence of pro-forms that replace an entire phrase provide information about the boundaries of the phrase (e.g., "I went to the store"; "I went there"; "I have a cat"; "I have one"; "The young man went for a walk"; "He went for a walk"; "She danced all day"; "She did it all day").

All languages have some subset of these clues available to listeners (Morgan et al., 1987), so insofar as these clues are redundant, a child learning any language should have available sufficient clues to phrase boundaries (although it remains to be seen whether the child is able to use them; see below).

Many of these clues may be especially salient in the speech directed at young children. Many studies indicate that adults use steeper contours in

fundamental frequency when speaking to children, and longer pauses (see Fernald & Simon, 1984; Fernald, Taeschner, Dunn, Papousek, de Boysson-Bardies, & Fukui, 1989); both of these prosodic features serve as clues to clause or phrase boundaries. A prosodically distinct register in child-directed speech appears in many languages (e.g., English, French, Italian, Arabic, German, Japanese, Spanish, Marathi, Latvian, Sinhala, and Mandarin; see Fernald et al.). Infants and young children show a preference for this brand of speech (Fernald, 1985; Glenn & Cunningham, 1983; Mehler, Bertoncini, & Barriere, 1978), even when all segmental information is removed, leaving only prosodic information (Fernald, 1984); so young children may be particularly attentive to the prosodic features of speech that signal clause and phrase boundaries. Further, the locations of pauses in child-directed speech are more reliably associated with clause boundaries than in adult-directed speech (Broen, 1972), and the phenomena of clause-final lengthening (Bernstein Ratner, 1985, as cited in Kemler Nelson, Hirsh-Pasek, Jusczyk, & Cassidy, 1989) and phrase-final lengthening (Morgan, 1986) are more characteristic of child-directed than adult-directed speech.

Adults may assist a child's identification of phrase boundaries in another way: recasting sentences. I mentioned above that transformed sentences and replacements of phrases with pro-forms provide information about phrase boundaries. It has been shown that mothers often repeat their own utterances or those of their children, moving or changing or replacing phrases within the sentence (e.g., N. D. Baker & Nelson, 1984; Hoff-Ginsberg, 1985; K. E. Nelson, 1977; K. E. Nelson & Bonvillian, 1978). Some pairs of utterances thus provide clues about the boundaries of phrases. While the effect of recast sentences on learning parts of speech has not been examined, several studies have shown that recast sentences promote vocabulary growth and facilitate the acquisition of syntax. Hoff-Ginsberg found that verb usage by two-year-old children increased in relation to the degree to which their mothers repeated their own utterances, breaking the first utterance at major constituent boundaries (e.g., substituting a different noun phrase or substituting a pronoun for a noun phrase). K. E. Nelson,

Carskaddon, and Bonvillian (1973) had experimenters utter recast sentences to three-year-old children (i.e., recast versions of the children's utterances), focusing mostly on the predicates of the sentences. This intervention facilitated language growth in several ways; the children included more morphemes within a verb phrase, they used auxiliary verbs more often, and they became better at sentence imitation. K. E. Nelson exposed children to recast sentences in the form of questions, or constructions with the verb in a different tense or mood (past, future, or conditional). Recastings as questions facilitated children's acquisition of question forms, and recastings involving verb constructions facilitated the acquisition of those constructions. The acquisition of rules of syntax depends on knowledge of the parts of speech over which the rules are stated, so this sort of evidence suggests that recast sentences may facilitate the discovery of parts of speech (such as verbs and auxiliary verbs), presumably by demarcating phrases within which distributional analysis can efficiently proceed.

Phrasal boundaries are particularly clear when a phrase is presented on its own. Caretakers often utter a phrase in isolation when speaking to their children (Broen, 1972; Newport, 1977; Snow, 1972). These isolated phrases tend to be noun phrases, but learning to identify noun phrases (e.g., as Det + N) will help in the identification of predicate phrases and predicator phrases (e.g., verb phrases), which are bounded by a subject noun phrase in many utterances. In pro-drop languages, isolated phrases may be predicates, such that learners are aided in finding the boundaries of these constituents, which will in turn help them find the boundaries of adjacent noun phrases whenever they appear in an utterance.

It is clear that many clues to clause and phrase boundaries are available to a young learner, but can children make use of these clues? Adults certainly seem able to do so. They have been shown to be able to take advantage of intonational clues to segment speech (e.g., Nooteboom, Brokx, & deRooji, 1976; Wingfield, 1975). Prosodic features of sentences are as useful to adults in locating constituent boundaries as the syntactic structure of the sentence, and have the advantage of being resistant to distortion; prosodic clues are still available even when a

degradation of speech (e.g., the deletion of small segments without leaving silent gaps) makes words unrecognisable, and these clues can be used in segmentation under these circumstances (Wingfield). Adults have trouble understanding and recalling spoken sentences when prosodic clues and syntactic structure suggest different phrase boundary locations (Darwin, 1975; Glanzer, 1976). Adults can use pauses (O'Malley, Kloker, & Dara-Abrams, 1973), phrase-final segmental lengthening, a rise or fall in fundamental frequency at a phrase boundary, and, to a lesser degree, intensity (Streeter, 1978) as clues to phrase boundaries in ambiguous mathematical formulae read aloud, where the ambiguity resides in the possibility of different bracketings of symbols in a string. Other studies show that adults can use pauses and lengthening to disambiguate ambiguous sentences (e.g., Cooper & Paccia-Cooper, 1980; Cooper, Paccia, & Lapointe, 1978; Lehisté, 1973; Lehisté et al., 1976; Macdonald, 1976), when and only when the ambiguity results from different possible locations of phrase boundaries (and not when ambiguity has some other source, such as the existence of homonyms; see Lehisté; Lehisté et al.; Wales & Toner, 1979). Morgan et al. (1987) have shown that adults can learn the syntax of a miniature artificial language far better when the input includes some clue to phrase boundaries; prosodic clues to phrase boundaries (phrase-final lengthening, frequency discontinuities, and pauses), phrase-initial constants comparable to function words, and concord morphology were all shown to facilitate syntax acquisition. All of these clues were also shown directly to facilitate the identification of phrase boundaries.

Older children also appear to be sensitive to prosodic clues to phrase boundaries. Schreiber (1987) showed that, on various tasks, seven-year-olds rely more on prosodic clues than do adults, allowing prosodic clues to override clues present in syntactic structure.

Morgan (1986) found that somewhat younger children (mean age 4;7) were far better able to echo the final words in a spoken string of nonce words when they were asked to model themselves after a puppet who echoed, during some pretrials, all the words in the final phrase; they did far more poorly when the

puppet echoed the word before the phrase boundary plus the words in the phrase. In the latter condition, children almost always echoed the phrase. The only evidence for phrase boundaries available to the children was in prosodic clues (including phrase-final lengthening and pauses), so the children appeared to be processing the strings of nonce words as sets of prosodically signalled phrases (and found it easier to echo a phrase than a set of words not forming a phrase).

Gerken, Landau, and Remez (1990) showed that two-year-olds are sensitive to English function morphemes (e.g., articles and verb inflexions) even though they omit them in their imitations of adult speech, and these authors argue that these morphemes might serve as clues to phrase boundaries for children. They provide no direct evidence, however, for the hypothesis that children take function morphemes to be signals of phrase boundaries.

There are data that indicate that infants are sensitive to prosodic clues to clause and phrase boundaries. When pauses are inserted into samples of speech at clause boundaries or within clauses, seven- to ten-month old infants show a preference for the speech with pauses at clause boundaries (i.e., they orient longer to the speaker over which speech of this nature is played; Hirsh-Pasek, Kemler Nelson, Jusczyk, Cassidy, Druss, & Kennedy, 1987). This preference is present only when the speech samples come from speech directed to children ("motherese") with its exaggerated contours; no preference is shown with samples of adult-directed speech (Kemler Nelson et al., 1989); so the strong clause-boundary clues in child-directed speech appear to facilitate the perception of clauses as units (or *gestalten*). Infants aged 0;4.5 show a preference for clauses uninterrupted by pauses even with samples of foreign speech (Polish speech played to American infants), but they have lost this preference by age 0;6 (Jusczyk, 1989, as cited in Jusczyk, Hirsh-Pasek, Kemler Nelson, Kennedy, Woodward, & Piwoz, 1992). This finding suggests that the perception of prosodic clues to clause boundaries is initially language-independent, but that the perceptual system becomes tailored to the mother tongue, so that it is attuned to just those prosodic features that are relevant to that language's structure. (The same sort of tailoring occurs in the

phonetic domain, where infants lose their sensitivity to phonetic contrasts that are not meaningful in their caretakers' language; see Werker & Tees, 1984).

At the age of 0;9, but not at age 0;6, infants show a preference for speech with pauses inserted at phrase boundaries over speech with pauses within phrases (Jusczyk et al., 1992). These results hold for noun phrases and predicate verb phrases (i.e., when pauses are inserted within those phrases in creating the speech samples in which pauses do not coincide with phrase boundaries), and for both child-directed and adult-directed speech. Moreover, the same preference is exhibited when the speech is low-pass filtered, removing most phonetic information and making words unintelligible; this suggests that the preference is based on prosodic clues to phrase boundaries in particular.

The sensitivity of infants to prosodic clues to clause and phrase boundaries suggests that young children might well be able to use such clues in locating the boundaries of phrases. Direct evidence for this hypothesis awaits further research.

4.4. Can Children Find Part-of-Speech Categories Through Distributional Analyses Within Phrases?

For young children and other language learners to be able to discover the verb-adjective distinction among predicators through analyses of their distributions in and across phrases, they would need to be able to learn contingencies between word classes, and between words and function morphemes.

Several studies have addressed the question of what adults and older children can learn, through distributional analysis, about the structure of phrases and sentences in miniature artificial languages. Let us look at each in turn.

Braine (1963a) conducted five experiments with children ranging in age from 4;2 to 11;1. He found that the children were able to learn the position of a nonce word in a string; if the string contained phrases, they could learn the absolute positions of words within phrases, and the absolute positions of phrases in the string. But learning the absolute positions of words within phrases will not

always facilitate the discovery of classes of words. What about contingencies among sets of words?

Braine (1965) found that teenagers and adults were able to learn the absolute positions in a string consisting of two constants bracketing a member of a set of words; they were able to learn the contingencies between pairs of constants (i.e., that "ane" always appears with "kivil" in a string, and "foo" always appears with "slet"), but they were unable to learn contingencies between the pairs of constants and overlapping subsets of the set of words (i.e., that "ane" and "kivil" can appear bracketing any of 12 words, and "foo" and "slet" can appear bracketing a word from a subset of six of those words, or bracketing any of six other words that never appear with "ane" and "kivil"). This finding suggests that purely distributional analyses might not permit the discovery of contingencies between function morphemes and open classes (but see below regarding Braine, 1966), at least when some of the members of two open classes can appear bracketed by the same function morphemes (e.g., "He is singing **in** the show," "She is red **in** the face").

Segal and Halwes (1965, 1966) presented adult subjects with pairs of letters that conformed with one of two grammars: $[S \rightarrow A + B]$, or $[S \rightarrow A + B \text{ and } S \rightarrow B + C]$, where A, B, and C were small sets of letters. The subjects presented with letter pairs following the first grammar learned the grammar far better than subjects presented with letter pairs following the second grammar. This finding suggests that the subjects were able to learn the absolute position of a set of letters in a two-letter string, but not contingencies between sets of letters (i.e., between A and B and between B and C). K. H. Smith (1966) also showed that, both for adults and for grade-school children, what is learned in such studies is the position in which members of a class can appear (versus paired-associates learning); no co-occurrence restrictions are learned (e.g., such that members of the class N can appear only after members of the class M, and not after members of the class P; K. H. Smith, 1969). Clearly this sort of learning is not adequate for natural language. To discover the category *verb*, for instance, one needs to learn

its position relative to words in the category *auxiliary verb* and relative to noun phrases and prepositional phrases; the absolute position within a predicate phrase is not useful because some predicate phrases begin with an auxiliary verb and some begin with the main verb.

Braine (1966) tested nine-year-old and ten-year-old children's ability to learn a miniature artificial language with two types of phrases, each "marked" by a constant ("function word"). A phrase of one type contained, in addition to the constant, a member of one set of words; a phrase of the other type contained a constant plus two words taken from two sets, with words from the two sets appearing in a fixed order. A sentence could include a phrase of either type alone, or phrases of the two types together, in either order. The children were able to learn the positions of members of sets within a phrase, and they were able to form long sentences, showing that they had learned the two possible phrase combinations. Their ability to learn the positions in phrases suggests that they were able to learn the contingency between a constant and a class, as in Braine's (e.g., 1963b, 1976) theory of a "pivot grammar." It still remained to be shown that children could learn contingencies among classes of words.

Moeser (1969, as cited in Moeser & Bregman, 1972, 1973) and Moeser and Bregman (1972, 1973) argued that contingencies among classes of words could be learned only through an examination of the situation that a sentence described; the relations of properties to entities in the world should reveal to the learner the relations of words for them to one another in the sentence. To test this theory, Moeser and Bregman (1972) taught adult subjects a miniature artificial language, but, unlike those used in the studies described above, their language was associated with a "referent world" of sorts. Strings from a phrase-structure language were paired with shapes that could vary in colour and type of border (single line, double line, or dotted line). In one condition, words alone were presented. In a second condition, a class of words was paired with a class of shapes that seemed to belong together perceptually. In a third condition, the word classes were paired arbitrarily with shapes. In the fourth condition, the classes

were related to one another; the referents of sentences were shapes whose colour and border type were signified by separate words (comparable to "green dotted-border rectangle"). Even the most complex grammar was learned well in the latter condition; less learning occurred in other conditions, with the worst learning in the arbitrary-figures and words-alone conditions. Most importantly, subjects in the condition in which syntax reflected relationships of properties and shapes were able to acquire co-occurrence restrictions. In other conditions, subjects performed near chance level on measures of their learning of rules involving contingencies among classes. Moeser and Bregman (1973) extended their results by showing that teenagers could learn a phrase-structure grammar only with a reference world, and that the grammar so learned could be used to classify words without referents; the grammar, once acquired with the help of semantics, could provide clues to class membership for novel nonce words.

Braine and his colleagues (Braine, 1987; Braine, Brody, Brooks, Sudhalter, Ross, Catalano, & Fisch, 1990) have provided data suggesting that categories and contingencies without any semantic correlate cannot be learned through distributional analyses. In one experiment, Braine, working with Philip Arnsfield, attempted to teach adults subcategories of "nouns" in an artificial language. A "sentence" consisted of a "noun" plus a "number word," and the subcategorisation of the nouns revealed itself in agreement markers on number words (which meant 'one,' 'two,' or 'plural'). When, in the language the subjects were taught, the subcategories were partially correlated with conceptually distinct categories of entities — namely men with "masculine" professions (e.g., soldier, baseball player) and women with "feminine" professions (e.g., nurse, airline stewardess) — the distinction was learned. (Learning was gauged by asking the subjects to describe pictures for which they had learned nouns for the kind of object pictured but had not seen a description of the picture, that is, a noun combined with a number word. If the subjects noticed that one set of number words were used with one half of the nouns, and another set of number words with the other half, they could correctly describe sets of objects of one kind regardless of the cardinality of the

set – that is, even if they had not heard the appropriate number word paired with the appropriate noun.) In the language in which the kinds of professional men and women were distributed equally between the subcategories, the distinction was not learned, despite the presence of number-agreement clues. In another experiment, Braine et al. tried to teach adults and children (aged 7;9 to 10;10) a language in which sentences consisted of pairs of nouns. The referent world consisted of pictures of 24 objects (paired with 24 nouns) and pictures of 72 events. Each event involved a monkey, who was named "Frippy"; the monkey was shown moving toward or away from an object, or in or near the object. A sentence describing an event contained the proper noun "Frippy" followed by the noun for the object. The object words had a suffix attached. One subcategorisation of the suffixes had a semantic correlate, and one subcategorisation did not. For each of the three types of movement/location of the monkey with respect to an object (toward, away from, in/near), there were two "locative" suffixes. One of the suffixes was paired with 18 of the nouns; the other was paired with 6 of the nouns. So the suffixes were typed according to the monkey's movement/location, but they were also split along lines determined by meaningless co-occurrence restrictions with arbitrary subsets of nouns. In general, both children and adults were able to learn the distinction among the three locative suffix types, but they were unable to learn the semantically empty distinction between the two suffixes with co-occurrence restrictions. They tended to generalise the suffix that appeared with the largest number of nouns to all the nouns. The results of these experiments suggest that completely arbitrary co-occurrence restrictions may be difficult to learn, although extremely high frequency of exposure may eventually permit rote learning.

Morgan and Newport (1981) point out that semantics cannot account for many of the syntactic properties of language that children acquire. They argue that another factor, not included in previous studies, may facilitate the acquisition of co-occurrence restrictions. Languages are organised hierarchically, with constituents within constituents, and this structure is not evident in the strings subjects are taught in miniature artificial language studies. Morgan and Newport

suggest that revealing the hierarchical structure of sentences to subjects by providing clues to phrase boundaries will facilitate the acquisition of a phrase structure grammar – including rules involving dependencies among constituents, and even when the dependencies are not associated with relationships of the referents to one another. To test this hypothesis, they ran an experiment very similar to that run by Moeser and Bregman (1972), but they added a condition in which the figures to which words referred were presented in groups, where the figures in groups were in one-to-one correspondence with adjacent words that formed phrases in the artificial language, and where the groups followed the same order from left to right as the phrases. This condition provided, then, an odd sort of clue to phrase boundaries, so that it could potentially reveal the hierarchical structure of the language. They found that subjects run in this condition learned the grammar as well as subjects in the condition in which the relationships of words were signalled by relationships of shapes and properties in the referent world. Subjects in these two conditions did not differ in their rate of success in learning dependencies among words classes, or in their ability to detect constituent boundaries. Morgan et al. (1987; see also Morgan, 1986) ran a study in which strings conforming to a phrase-structure grammar were spoken aloud to subjects with prosody that gave no clues, misleading clues, or valid clues to phrase boundaries. The referent world consisted of nonsense shapes, each paired with one word, and the shapes associated with words in one category were similar in some way. The subjects who received valid prosodic clues to phrase boundaries were far better than subjects in other conditions at learning contingencies among classes of words (and markedly better at detecting phrase boundaries). In a second experiment, Morgan et al. tested the hypothesis that elements similar to function morphemes could serve as phrase-boundary markers and facilitate syntax acquisition. Phrases in the language began with an isolated vowel that was not paired with a nonsense shape; different types of phrases began with different vowels. In another condition, the placement of the "function words" was misleading with respect to phrase boundaries, and in a third condition, no function words

were present. The condition in which function words served as valid phrase-boundary clues facilitated the learning of contingencies among classes (and the ability to detect phrase boundaries in tests of knowledge of constituency). In a third experiment, Morgan et al. obtained the same results when the clue to phrase boundaries was concord morphology (e.g., the word endings in "bifro pelro sogrira facra lumri" signal the presence of three phrases in the string).

It appears, then, that dependencies among word categories in phrase-structure languages can be learned whenever some clue to phrase boundaries is present. This conclusion implies that distributional analyses within prosodically marked phrases should succeed in detecting the distributional regularities characteristic of parts of speech, even when the contingencies among word classes do not correspond to observable relationships in the accompanying scene.

4.5. Does an Assumption of Contrasting Meanings for Words Promote Interpretations Into the Nonseparable?

In the Nonseparability Method of predicator identification, knowledge of a basic-level-kind term (and a proper name, if any) for each individual involved in a relation or bearing a salient property is hypothesised to facilitate relation or property interpretations of phrases headed by novel words (which in turn facilitate predicator identifications for the words because of the need for an argument structure to reveal, in utterances, that which is nonseparable). Is there any evidence in support of the hypothesis that relation or property interpretations of phrases headed by novel words are more common when the participants or bearers belong to familiar kinds for which basic-level nouns are known?

There is evidence suggesting that knowledge of a basic-level noun for an individual facilitates interpretations of a novel word as a word for a non-basic-level kind (a superordinate, subordinate, or situationally restricted kind; see Hall & Waxman, 1993; Mervis & Crisafi, 1982) or for an individual (so that the word is taken to be a rigid designator, or proper noun; Hall, 1991). I know of no published evidence in support of the hypothesis that the familiarity of an

individual's basic-level kind promotes property or relation interpretations. Relevant data are reported in section 6.3.

4.6. Do Actions Provide a Clue About the Part of Speech?

I argued that the nonseparability of actions might lead to the hypothesis that a novel word heading a phrase that is interpreted into an action is a predicator because of the need for an argument structure in signifying the nonseparable. Do novel words heard in the presence of actions, where the phrases they head are interpreted into those actions, tend to be interpreted as predicators?

To date, no study has addressed this question directly. Perhaps the only evidence for a link between predicators and actions is the tendency for verbs (or predicators) acquired early to be words for actions, and for action words to be used as verbs (e.g., Bennett-Kastor, 1986; L. Bloom et al., 1975; L. Bloom, Miller, & Hood, 1975). Also, among verbs with both actional and non-actional senses (e.g., metaphorical meanings, as in "He lifted my spirits"), children only use the word with the actional sense (Gallivan, 1988). But a possibility exists that the high proportion of action words in children's verb vocabulary and their use of action words as verbs are a function of the words they hear. Rondal and Cession (1990) studied samples of mothers' speech to their young children, and found that 62 percent of the verbs used by the mothers were action words. (The rest were words for states or mental functions.) Of the action words used, 100 percent were verbs.

Despite the preponderance of action words among early verbs, and the preponderance among early action words of verbs, there does not appear to be any one-to-one correspondence between actions words and verbs in early vocabularies. A child studied by Brown, Fraser, and Bellugi (1964) knew 11 verbs at the time of study, and five of these did not signify actions: "get," "need," "want," "see," and "find." Macnamara (1982) reported that somewhere between 8 and 12 percent of the verbs in the vocabulary of one two-year-old girl (Sarah) were non-activity verbs. Further, an action word can easily fall outside the verb category. Weir (1970), for instance, found that an infant used the words "dance," "bite,"

"jump," "take" and "broke" as verbs and nouns interchangeably. K. Nelson, Hampson, and Kessler Shaw (1993) observed that children aged 1;1 to 1;8 used a number of actions words in clear noun contexts; these words included "bath," "bite," and "call" (i.e., 'telephone call'). In section 4.8, I report that Olguin and Tomasello's (1993) child subjects sometimes interpreted a nonce word as a word for action of the type observed, but used the word in noun contexts. Braine (1971) taught his daughter a made-up action word; she subsequently used the word both as a verb and as a noun. Braine also noted that she used the Hebrew word "nafal," which is the third person masculine singular past tense form of the verb meaning 'fall,' in a verb context ("Naomi nafal"), and, in the next breath, in a noun context ("Nafal didn't hurt"). While these findings present a problem for the "semantic bootstrapping" theory, they are compatible with a theory in which any sort of relation or property signals a lexical part of speech (*predicator*), but in which transformations from predicators to nouns are permitted under the appropriate change in meaning. They suggest that actions may indeed be related to the part of speech (although we cannot know the word contexts in the adult utterances that permitted learning), but that they have no special status except, perhaps, insofar as they are more readily observable and salient than other types of relations and properties.

A child's use of an action word as a verb does not, in itself, provide evidence in support of the hypothesis that an action provides a clue to verb status for a novel word. Without knowing the contexts in which the action word appeared in parental utterances, one cannot determine if the mere presence of an action led to part-of-speech classification as a verb or predicator, or if such classification was mediated by the presence of noun-phrase arguments in the utterances.

4.7. Do Noun Phrases Provide a Clue to Meaning?

I have argued that the presence, in an utterance, of familiar nouns in phrases, where the referents of the noun phrases are involved in some observable

relation, or where the referent of a single noun phrase has some salient property or is involved in some salient activity, leads children to the hypothesis that the remaining, unfamiliar, stressed word in the utterance is a predicator heading a phrase that signifies a relation, property, or activity of the type observed. I will here review the evidence that supports my claim that the surface-structure realisation of arguments will influence children's hypotheses about word meaning for novel words.

Consistent with my thesis is the fact that children learning most languages acquire many names for individuals and for kinds of objects – which investigators usually take to be nouns (proper nouns and common nouns) – before they learn many action and attribute words – which investigators usually take to be verbs and adjectives (e.g., Anglin, 1977; Benedict, 1979; Gentner, 1978; Goldfield & Reznick, 1990; Goldin-Meadow, Seligman, & Gelman, 1976; Huttenlocher, 1974; K. Nelson, 1973; Schwartz & Leonard, 1984; Weir, 1970; for Spanish, see Jackson-Maldonado, Thal, Marchman, Bates, Gutierrez-Clellen, 1993; for Russian, see Chukovsky, 1925/1968; for conflicting evidence in Japanese, see Clancy, 1985). If predicator learning and the concomitant learning of words for properties and actions (and so on) is facilitated by the presence in an utterance of familiar nouns as the heads of noun phrases that transparently signify individuals present in the situation, then children must come to recognise some nouns before they can readily learn predicators (i.e., before they can use the Interpreted Noun Phrase Method of predicator identification, which was argued to be more effective than the Nonseparability Method, although the latter also presupposes a knowledge of nouns, i.e., of basic-level nouns for the bearers of properties and the participants in relations).

Gentner (1978) argues that verbs are learned more slowly than nouns because, (1) verbs are used to signify relations of individuals to other individuals (and here, she seems to have in mind transitive verbs in particular), such that their meanings are more "abstract" than the interpretations of nouns (i.e., visible objects) and less constrained by perception (or "the physical world," to use

Gentner's words); (2) verbs are used more "broadly" than nouns – that is, they have a greater number of (related) meanings, depending on the nouns with which they are used; the variability in their usage necessitates greater experience with them to master their meanings, and the breadth of their usage may permit children to get away with learning a few verbs which can be used in many situations (although Gentner provides no evidence in support of the assumption that children's word acquisition is subject to considerations of parsimony); and (3) verb meanings are componential, and must be learned bit by bit. Gentner's first two explanations, if they are correct, would provide support for my theory. Noun phrases would be necessary both to signal the relational nature of what phrases headed by verbs signify and to permit learning of the different meanings of a verb, which are linked with its typing by different nouns. (Gentner's third explanation – i.e., that verb meanings are componential – is independent of the assumptions and predictions of my theory. A word could be identified as a member of the category *predicator* or *verb* without all aspects of its meaning having been mastered.)

There are anecdotal reports of children's errors in the classification of words that indirectly support the hypothesis that explicit evidence of argument structure promotes predicator identification. Leopold (1949) reports that one child took the adjective "white" to be a noun meaning 'snow,' presumably because the child had heard the snow called white with the noun "snow" absent from the utterance. The same child thought that "hot" meant 'radiator.' It is likely that such errors will occur whenever an unfamiliar adjective is applied to an object or mass of stuff whose kind name is unknown (see also Macnamara, 1972).

Several studies demonstrate that young children are able to interpret a novel word as a word for a property of the type observed (e.g., a colour, a texture, or a shape) when it appears with the pronoun "one" (e.g., "the zav one" or "This is a zav one"; Carey & Bartlett, 1978; Heibeck & Markman, 1987), and that they are more likely to make a property interpretation when the word appears with "one" than when the word appears in a noun context or in a context that is compatible with any of three parts of speech, *adjective*, *mass noun*, and *proper name*, namely

"This is zav" (e.g., S. A. Gelman & Markman, 1985; M. Taylor & Gelman, 1988); this is especially the case when the property is perceptually salient (L. B. Smith, Jones, & Landau, 1992). In the absence of the pronoun "one" (e.g., "This is a zav," or "This is zav"), children tend to interpret a novel word into a kind; if the object paired with the utterance belongs to a familiar basic-level kind, they interpret the word into a subordinate kind, or else they interpret the word as a proper noun (Hall, 1991; M. Taylor & Gelman); subordinate kind interpretations are also facilitated when the basic-level noun for the object is mentioned in surrounding sentences (Waxman, Shipley, & Shepperson, 1991; the context of the nonce word also included a noun clue, namely the indefinite article). M. Taylor and Gelman point out that Markman and Wachtel (1988) did not manage to produce an adjectival (i.e., material kind) interpretation of a phrase headed by a nonce word, in a task similar to that used by Taylor and Gelman, when the kind of object was unfamiliar (see Markman & Wachtel, Studies 4-6); children interpreted the word into a kind when presented with an object of an unfamiliar kind, whereas, in Taylor and Gelman's study, children often made a property interpretation even when the kind of the object was unfamiliar; Taylor and Gelman attribute these different findings to the nature of the stimulus sentences used by Markman and Wachtel, which did not include the pronoun "one"; the context was of the form "It's X." The inclusion of the argument "thing" (e.g., "the zav thing") also permits interpretations of novel words as words for properties (Au & Laframboise, 1990). For adjectives already acquired, the inclusion of the pronoun "one" is not necessary to get a property interpretation; the effect of including the pronoun is specific to novel words (S. A. Gelman & Markman).

Hall et al. (1993) found that four-year-olds were more likely to interpret a nonce word as a name for the kind of stuff out of which an object is made if the word appeared before "one" than if it appeared in a noun context; note that the name of a material kind can appear in adjective positions when the material is understood as a property of an object (e.g., "This ring is gold"; "This gold ring . . ."). There was no difference in the frequency of material-kind

interpretations for the two contexts "This is a zav one" and "This is a very zav-ish one," suggesting that the distributional clues to adjectival status (i.e., "very" in front of the word, and the ending *-ish*) were less influential than the presence of the pronominal argument "one." (Two-year-olds tended not to make material kind interpretations in any of the conditions.) Waxman (1990) found that the inclusion of the argument "one" (and of the adjective suffix *-ish*) facilitated a subordinate-kind (versus a superordinate-kind or a basic-level-kind) interpretation, suggesting that the nonce word was interpreted as an adjective modifying "one" (and providing support for the idea that adjective-noun combinations pick out subkinds). Prasada (1993) found that contexts for adjectives derived from mass nouns, such as, "This is a plastic plate," permitted material-kind interpretations for words such as "plastic", suggesting that the inclusion of the basic-level count noun for the object may have facilitated a property interpretation (where being made of stuff of a certain kind is considered a property) – although Prasada included another type of context in the same trials, one exemplified by "This plate is made of plastic," and this context might have been critical to learning.

In one particularly interesting study, Hall (1994) taught three- and four-year-old children nonce words in the context, "This Y is X," where "Y" was a familiar basic-level count noun for the kind of the object that was paired with the sentence, and "X" was a nonce term. This syntactic context is suitable for an adjective or a proper name. (The nonce word always ended in *-y*, an ending that appears on many adjectives and proper names.) When the object was an artifact, the majority of children favoured a property interpretation of the phrase headed by the word (i.e., an interpretation of the word's phrase into a salient property of the teaching stimulus) over an interpretation of the word into a basic-level kind, into a subordinate kind, or into one individual (i.e., an interpretation of the word as a proper name). (When the object was an animal, and particularly when it was an animal of a kind that people commonly take in as a pet, or when the experimenter said that the animal belonged to him, children tended to interpret the word into the teaching object, that is, they appeared to interpret the word as a

proper name.) Hall did not manipulate the word's context, but the inclusion of the basic-level count noun for the teaching object in the sentence may well have facilitated a property interpretation (at least when the object was an artifact so that it would resist taking a proper name). This study is particularly important in its provision for responses showing various sorts of interpretations. The fact that property interpretations appear to have been favoured is therefore all the more striking.

Hovell, Schumaker, and Sherman (1978) found that when a mother and child were looking at pictures together and the child's mother "expanded" the child's utterances containing isolated nouns (e.g., "chair") to adjective-noun combinations (e.g., "blue chair"), the children began using the adjective-noun combinations spontaneously in appropriate contexts (without any evidence of previous spontaneous use). No such facilitation occurred when mothers modelled adjective-noun combinations, that is, when they said something like "blue chair" (while looking at a picture of a blue chair) without the child having said "chair." It is possible that the children did not have full comprehension of the modelled nouns, whereas they surely did understand the nouns they had produced while looking at pictures of the referents. This study thus provides suggestive evidence in support of the hypothesis that combining a predicator with an interpretable noun facilitates its acquisition.

The evidence with actions and activities is more slim and less direct. Gillette and Gleitman (as cited in Fisher, Hall, Rakowitz, & Gleitman, 1994) had adults watch a video in which a mother interacted with her child. The audio remained off throughout the viewing period. When the mother in the video uttered a particular word, subjects heard a beep. Their task was to guess which noun or else which verb was being uttered by the mother at that instant. Subjects did extremely well with nouns; the scene itself and the direction of the mother's and child's attention seemed to provide enough information to determine the referent of the word. The task proved to be virtually impossible for verbs. Success rates varied between 0 and 7 percent. But telling the subjects which nouns

appeared in the utterance containing the verb allowed for much greater success in guessing the verb uttered. Lederer, Gleitman, and Gleitman (1991, as cited in Fisher et al.) found that knowing the nouns permitted subjects to guess correctly which verb was uttered for about 28 percent of the verbs used by the mothers. These findings imply that adults can frequently guess the meaning of a predicator if they know its noun phrase arguments in a given utterance. Children might be able to do the same; upon hearing a novel, stressed word in an utterance containing noun phrases that can be interpreted, at that moment, into particular individuals, they may be able to guess the meaning of the novel word, realising that its phrase signifies a particular relation of one individual to another, or a particular property such as an activity.

Fisher (1993, as cited in Fisher et al., 1994) showed that children between 3 and 5 years of age can use the number of noun-phrase arguments in an utterance to decide between a transitive and an intransitive action as the interpretation of a verb phrase. The children watched one woman making another woman swivel on a stool by pulling on the ends of a scarf that was around the rotating woman's waist. Half of the children heard the sentence, "She's blicking around," and the other half heard, "She's blicking her around." The pronoun arguments are ambiguous as to their referents, so the only clues available regarding the meaning of the nonce verb are the number of arguments and the syntactic structure of the utterance; the major clue is the number of arguments, because the transitive sentence differs from the intransitive one only in the addition of a second pronoun with the same person and gender as the first one, leaving the referents of the pronouns ambiguous, and thereby preventing the use of word order to work out which noun signifies the agent and which the patient. Children who heard the transitive context for the word concluded that its phrase signified the causative action of the one woman on the other. Children hearing the intransitive context thought the word's phrase signified the motion of the patient (i.e., the rotating woman). The presence of two noun phrases accompanied by a scene in which two women, transparently the referents of the noun phrases "she" and "her," are involved in

some observable relation, provided sufficient information for deducing the type of relation or activity associated with the verb.

Most actions that produce some change can be interpreted in two ways: As a causative action, with one object acting upon another to produce the change, or as an intransitive action, with the change produced by the action being incidental. Olguin and Tomasello found that with actions of this type (e.g., Cookie Monster jumps on one end of a seesaw, sending Big Bird, who is standing on the other end, flying into the air), children's interpretation of the event, as evident in their use of a nonce verb for the event, was influenced by the number of noun arguments present in an utterance. If children were taught a nonce verb with two noun-phrase arguments, they interpreted the predicate headed by the nonce word into a causative action (i.e., they sometimes used two arguments with the word in their own utterances); if they learned the word with one noun-phrase argument (a subject noun phrase), they interpreted the word's phrase into an intransitive action (i.e., they never used the word with two arguments). This evidence indicates that children can use the presence of noun-phrase arguments not only to deduce that a phrase headed by a novel word signifies a relation or property, but also to guide their choice among relations and properties according to the number of arguments present.

Shipley, Smith and Gleitman (1969) asked young children (aged 1;6 to 2;9) to perform actions. Among several conditions was one in which a noun, the object of the requested action, was uttered in isolation (e.g., "Ball!"); in another condition, a nonce word was included with the object noun (e.g., "Gor ball!"). Children were more likely to perform the expected action (e.g., throwing the ball) when the object noun was uttered alone than when a nonce word appeared with it. This result suggests that the children felt that the nonce word should be interpreted as an action word, with the noun as its object argument, but that they were unable to discern its intended meaning (because they could not view an instance of the type of action); they were therefore stumped as to what action they

should perform (whereas in the noun-alone condition, they could perform an action typical of actions performed with objects of the kind present).

McShane, Whittaker and Dockrell (1986) report that the children they tested did not interpret a nonce word as an action word on the basis of inflexional clues alone (e.g., "This is X-ing"). The children did interpret the word as an action word when the indefinite pronoun "someone" was added to the sentence (e.g., "This is someone X-ing"). This study provides some of the clearest evidence available that children are sensitive to argument structure. I suspect that action interpretations would be even more readily obtained if a definite noun was inserted in place of the indefinite pronoun "someone" (and, likewise, in the adjective-learning studies, if a definite noun appeared in the utterance instead of "one").

Experiments designed to test the hypothesis directly are reported in sections 6.2 and 6.3.

4.8. Do Noun Phrases Provide a Clue About the Part of Speech?

Very few studies of young children's interpretation or use of predicators include any measure of part of speech, and for an obvious reason: It is very difficult to determine the part of speech of a word in a young child's grammar. This problem is especially acute with predicators; the aspects of language that distinguish them (e.g., tense and aspect marking, agreement) are absent in early speech production, even after some noun markers (e.g., plural and possessive markers) appear in a child's speech. But a couple of studies have attempted to determine the part of speech of children's words for relations.

Kean and Yamamoto (1965) obtained data that are suggestive regarding the role of noun phrases in determining the part of speech. They presented young children (the youngest being in kindergarten) with six low-frequency English words that can be transitive verbs or count nouns, depending on their contexts. The words were paired with pictures of someone thinking, so that the pictures gave no clues about the words' meanings. In each of three trials, one of the words was

presented in a count-noun context: "Do you know what a *censor* is? This is a picture of a little girl thinking about a *censor*. Can you guess what this might mean?" In each of three trials, one of the remaining words was presented in a transitive-verb context: "Do you know what it means to *censor* something? This is a picture of a little girl who wants to *censor* something. Can you guess what that might mean?" The children's task was to guess the meaning of the unfamiliar word. If their suggested translation of the word was a verb, they were assumed to have identified the word as a verb; if it was a noun, they were assumed to have identified the word as a noun. The children showed a fairly strong tendency to choose the part of speech for the word that was compatible with the syntactic context. The authors interpret the results as an effect of syntactic clues. In the case of the verb contexts, the possibility exists that children were aided in their part-of-speech identifications by the presence of the direct object noun phrase "something." The context of the word lacked certain other distinctive verb clues, such as tense and aspect markers (e.g., *-ing* or *-ed*). It is possible, though, that the children responded primarily to the presence of the preposition "to" in front of the word; this preposition forms part of the infinitive of a verb in English. One would expect infinitives to be learned rather late, but the data showed an age trend consistent with such late learning: For verbs but not for nouns, older children were more responsive to the word's context. To gauge the effect of noun-phrase arguments alone, all other possible verb clues, such as verb endings, "to" in front of the verb, and English word order, would have to be absent from a word's context.

One other study provides data that address the relationship of noun-phrase arguments to parts of speech. Olguin and Tomasello (1993) taught children nonce words for novel (causative) actions using word contexts containing zero, one, or two noun-phrase arguments in a within-subjects design. The experimenters then observed the children's use of the words. All of the eight children studied used the nonce word in noun contexts on some occasions (e.g., "That's dacking") – if the word in isolation (e.g., "Dacking") is counted as a noun use. All of the noun uses

occurred when the word had appeared, during training, with zero arguments (e.g., "Dacking") or with just the agent argument (e.g., "Big Bird's dacking"; note that this context is equivocal; it could be interpreted as a contraction of the noun phrase "Big Bird" and the auxiliary verb "is" followed by a verb in present progressive form; alternatively, it could be interpreted as the possessive form of the proper noun "Big Bird" followed by a noun describing the activity of the subject; but prosody may have disambiguated the utterance, favouring the former interpretation, because the experimenters intended the word to be a verb). Of the 51 clear noun uses occurring in these two conditions (i.e., excluding cases in which the word was uttered by itself), 36 (or 71 percent) occurred in the zero-argument condition (M. Tomasello, personal communication, July 27, 1994). Of the five children using the word in clear noun contexts in this condition, three used it exclusively as a noun (and sometimes in isolation as well – an equivocal usage). In the agent-argument condition, four of the five children using the word as a noun on some occasions were also observed to use the word in verb contexts (M. Tomasello, personal communication, July 27, 1994). So the zero-argument condition seemed to favour noun interpretations of the word much more strongly than the other conditions, whereas the other conditions, in which arguments were included in the word's context, favoured verb interpretations (i.e., they facilitated the use of the word with arguments and in verb contexts – though not in a full range of verb contexts). No noun uses occurred when the word had appeared with the object argument alone (e.g., "Dacking Cookie Monster") or with both arguments (e.g., "Big Bird's Dacking Cookie Monster"). When children used the word as a noun, it appeared with the ending *-ing*, which had been attached to the word in all instances of use during training. This present-progressive or present-participial marker appears to have been interpreted, in these cases, as part of the root morpheme (as it is in "herring"). The children showed no evidence of having failed to interpret the word as an action word when they identified it as a noun; they seemed, rather, to have taken the absence of arguments as an indication that the word was to be interpreted into a kind consisting of instances of action of the

type observed (comparable to the kind named by "dancing" in the sentence, "Her dancing is thrilling"). When no arguments appeared with the word, the children's knowledge of proper names and basic-level kinds for the participants may have ruled out the most salient possible kind interpretations, leading them to consider the action, which was made especially salient during training through repeated participation of the child in making the characters (e.g., Big Bird and Cookie Monster) perform the actions. The failure of the ending *-ing* to signal, on its own, verb status for the word is interesting in light of Brown's (1957) finding that children interpreted a nonce word as an action word when it ended in *-ing*, which Brown took as evidence for an interpretive link between verbs and actions. Olguin and Tomasello's findings suggest that an interpretation of a word as an action word is, to some degree, independent of its identification as a verb, and that the ending *-ing* does not serve as a verb signal per se. As Braine (1971) has pointed out, Brown's "verb contexts" in which the inflexion *-ing* was attached to the word were actually noun contexts; the word had the form of a gerund (i.e., "In this picture, you can see sibbing," and "Now show me another picture of sibbing"). (Brown's remaining context, in which an apparent infinitive of a verb appeared, was also not a genuine verb context, because the position of the infinitive indicated that it was being used as a noun: "Do you know what it means to sib?" That "to sib" is a nominal infinitive in this context is revealed by the fact that an answer to the question would begin with "to sib" in subject position: "To sib means . . .," or "To sib is to . . .") So Brown's data do not provide strong evidence for any link between actions and verbs per se (but perhaps they provide evidence for a link between actions and actional nouns derived from verbs). Olguin and Tomasello's data show that action words tend to be interpreted as verbs (or predicators) when and only when they appear in sentences with explicit noun-phrase arguments. This finding highlights the importance of argument structure in identifying predicators; actions seem to play a lesser role, suggesting that they have no special link with verbs or predicators.

5. PROSPECTS AND PREDICTIONS

The nonseparability hypothesis states that a novel word will be identified as a predicator when the discerned meaning of the phrase it heads is something that exists only by virtue of one or more individuals (e.g., the agent, etc., of an action, or the bearer of a property). I argued that two types of circumstance would facilitate the identification of a predicator: (1) when a novel word is uttered while the listener's and speaker's attention are focused on an individual or a set of individuals involved in some salient relation or possessing some salient property, and when the listener knows a basic-level-kind term for each individual, and its proper name (if any), but the listener does not know a word for the type of relation or property; under such conditions, the listener might form the hypothesis that the phrase headed by the word signifies the salient property or relation; the nonseparability of the property or relation would in turn lead to the hypothesis that the word takes one or more arguments (whether or not they are realised in the utterance) and is thus a predicator. I called this the Nonseparability Method of identifying a predicator. This set of circumstances is not ideal for learning; predicators heading phrases that signify the nonseparable can be transformed to nouns so that they name kinds (e.g., kinds with instances of a type of action as their members), and so that they no longer take arguments (or at least they no longer take explicit arguments by necessity in a language that is not pro-drop). The second type of circumstance is more favourable for learning: (2) If the utterance in which a novel predicator appears contains one or more noun phrases that are its arguments, and the listener is able to interpret those noun phrases into one or more individuals (because of familiarity with the nouns that head the phrases), and the individuals possess, as part of their being, something nonseparable that is observable and salient (e.g., they are involved in an action, or they are the bearers of a perceptible and salient property), then the listener should realise that the novel word is a predicator; in this set of circumstances, the argument structure of the word is explicit, so the listener should not be tempted to

interpret the word as a noun derived from a predicator. I called this type of learning the Interpreted Noun Phrase Method.

I furthered refined the theory by describing three possible sequences of interpretive events. In two of them, the learner realises that a phrase headed by a novel word in an utterance signifies a relation or property (e.g., an action or some other nonseparable phenomenon), perhaps for the reasons provided in the description of the Nonseparability Method. The learner then (1) identifies the word as a predicator because of the nonseparability of that which its phrase signifies, and then interprets any noun phrases in the utterance as the predicator's arguments, or (2) realises that each noun phrase in the utterance signifies a participant in the relation or a bearer of the property, interprets the noun phrases as arguments, and identifies the novel word as a predicator. In the third possible sequence of events, the learner interprets the noun phrases into individuals, notices that those individuals are involved in some relation or that they bear some salient property, interprets the phrase headed by the word into that relation or property, and then identifies the word as a predicator because that which its phrase signifies is nonseparable (and because its arguments are explicit).

To identify a predicator as a verb in particular, a learner will have first to learn the distributional differences between verbs and adjectives (through analyses within phrases) so that the predicator's context can provide effective clues to its predicator subcategory.

Does the evidence I have reviewed provide support for the theory? Let us look first at the Nonseparability Method.

To see whether relation or property interpretations and concomitant predicator identification are facilitated when the participants in a relation or the bearers of a property belong to kinds for which the learner knows common nouns (and when their proper nouns, if any exist, are known), the familiarity of an individual and its kind would have to be manipulated directly, and, for a novel word paired with the relation or property, both the word's interpretation and its part of speech would have to be determined. Some evidence exists to suggest that

the familiarity of an individual facilitates interpretations other than basic-level-kind ones (e.g., interpretations into other sorts of kinds, or interpretations as a rigid designator), but no relevant evidence exists regarding actions or other relations, or regarding properties, and no evidence exists regarding the role of familiarity in part-of-speech decisions. A study examining, among other things, the effect of familiarity on action interpretations and part-of-speech classification is reported in section 6.3.

In the Nonseparability Method, the identification of a predicator depends on the nonseparability of what the phrase headed by the word is taken to signify. No direct evidence exists for such a link between predicators and words for relations (e.g., actions) or properties. The relationship of action words to parts of speech is examined experimentally in sections 6.1 and 6.3.

For the Interpreted Noun Phrase Method, there exists some supportive evidence, which was reviewed above. I discussed evidence in support of the hypothesis that noun phrases facilitate interpretations into the nonseparable, at least for properties. I also reviewed some findings that suggest that noun phrases may promote predicator (or verb) interpretations of action words. The prospects for the success of these hypotheses look fairly good, but no study has tested them directly. Direct tests are reported in sections 6.2 and 6.3.

Stronger evidence exists for learners' capacity to discover subcategories of predicators through distributional analyses of the phrases in which they appear. Even infants appear to be sensitive to clues to phrase boundaries, and people seem able to discover, through analyses within phrases, the contingencies among word classes that characterise the distributions of parts of speech such as *verb* and *adjective*. I know of no evidence in support of the hypothesis that predicator subcategories are actually discovered through distributional analyses in the normal course of language learning, and I will not attempt to provide evidence in support of this hypothesis in this dissertation.

The various accounts of learning sketched above generate several specific and testable predictions about the pairing of an utterance with a situation of which an action is a constituent:

(1) Given the presence of a salient action of unfamiliar type which is paired with a novel word, the word will be interpreted as an action word more frequently when the agent (and the object) belongs to a familiar kind for which a basic-level-kind term is known – and especially if the agent's proper name (if any exists) is also known.

(2) When the word is interpreted as an action word, it should often be identified as a predicator because of the nonseparability of actions.

(3) When a word is taken to be an action word, it will not always be interpreted as a predicator when its context lacks noun-phrase arguments, despite the nonseparability of actions; while actions can serve as a guide to predicator identification, they do not have any essential connection with predicators or verbs (e.g., there is no one-to-one correspondence between action words and verbs); action words can be nouns used to signify instances of a type of action; nothing in the theory bars young children from accepting and using action words as nouns.

(4) In an utterance containing a novel predicator, the presence of noun phrases that signify the participants in an ongoing action should (i) increase the probability of an action-word interpretation, and (ii) increase the probability of predicator identification.

(5) For learners who have learned the correlations between predicator subcategories and morphosyntactic environments, the presence of syntactic or morphological clues to the part of speech (e.g., in well-formed utterances) should facilitate the identification of a predicator as well as its specific subcategory.

The theory generates other predictions, but these ones are particularly central. The next section provides experimental evidence regarding these predictions.

6. EXPERIMENTAL TESTS OF SOME PREDICTIONS OF THE THEORY

6.1. Experiment 1

I have argued that actions may play a special role in predicator (and verb) learning because (1) they are prototypical of phenomena that exist only by virtue of individuals (i.e., the participants in the action), and (2) they are observable and salient. But I have also argued that the category *predicator* has no special relationship with words for actions in particular, as in Grimshaw's (1981) and Pinker's (1982, 1984, 1987) "semantic bootstrapping" theory, according to which action words are mapped into the verb category. The existence of such a map would create the expectation that any action word should be a verb, at least prior to any shift to a distributionally based procedure for part-of-speech identification. As Pinker (1984) puts it, "the child tentatively assumes [the] syntax-semantics correspondences [such as verb-action/change of state] to hold" (p. 39); he also points out that the theory implies that, early in learning a language, "all the child's nouns are object words, all his or her verbs are action words, and so on" (p. 53); it also implies that all the child's object words are nouns, and all the action words are verbs. In rejecting the bootstrapping approach, I leave open the possibility that children will be willing to accept and use an action word in its nominal form wherever the possibility exists for a transformation of the word from a predicator to a noun. When a predicator is transformed into a noun, each argument is "absorbed" (in the linguist's jargon), and the word's phrase comes to be interpreted into a kind or one or more of its members. For instance, when the action word "jump" is transformed from a verb to a noun (e.g., "That jump was really high"), it gains an extension consisting of individual acts of jumping. If young children are willing to allow action words to undergo such transformations, they cannot be said to expect a one-to-one correspondence between predicators (or verbs) and action words.

An experiment was designed to test the hypothesis that children, at a young age, are indifferent to the part of speech, verb or noun, of an action word.

Children were asked to perform actions, and the requests contained action words that appeared, on different trials, in verb or noun contexts. The children were also asked to describe their actions after performing them so that their use of the action words as verbs or nouns could be observed.

6.1.1. Method

6.1.1.1. Subjects

The subjects were 21 children (13 boys and 8 girls) recruited through day-care centres in the Montréal area. Their mean age was 3;5 ($SD = 0;7$; ages ranged from 2;2 to 4;3). Most children were bilingual (speaking both English and French) with English as a first language; 3 children had some other language as a first language (Cantonese, Italian, or Spanish) but had extensive exposure to English.

6.1.1.2. Materials

The toys used in the study were: a rubber ball, a toy vehicle with large wheels, a small drum and drumstick, a toy monkey, a toy bear, a toy piggy, a toy dog, a baby doll, a push-button toy telephone, a doll (similar to a Barbie doll), a toy bunny, and a rubber mouse that makes a noise when it is squeezed.

6.1.1.3. Procedure

Children were tested individually in a room or hallway separate from their classroom in a day-care centre. Each child was told, "I'm going to ask you to do some things with some toys, okay? And if you don't know what I want you to do, you just tell me, okay? And after I ask you to do something, I'm going to ask you to tell me what you did, okay?"

The experimenter (E) pulled 12 toys out of the bag one at a time, and for each toy she asked the child to perform an action on it. The actions to be performed on each toy were: to punch the ball, to spin the wheel (on the car), to hit the drum, to kick the monkey, to slap the bear, to tickle the piggy, to rub the

dog, to kiss the baby (doll), to push the button (on the telephone), to smile at the doll, to hug the bunny, and to squeeze the mouse. The order of these actions was randomised for each child.

The word for an action used in the request to perform the action was an imperative verb as in "Kiss the baby" for 4 trials. This is the *Verb* condition. The action word was a noun as in "Give the baby a kiss" for 4 trials. This is the *Noun* condition. For the remaining 4 trials, which served as the *Control* trials, the action word was a noun but the order of the noun phrases was ungrammatical and the nouns were paired with the wrong determiners: "Give the kiss a baby." These trials were included to control for the possibility that children listen primarily to the stressed words in the sentence and work out the meaning of the sentence from those words alone, ignoring unstressed elements including determiners that signal noun status for the action word, and ignoring word order. In other words, these trials controlled for the possibility that children could interpret the sentence and perform the action without ever noticing the part of speech of the action word.

If a child succeeded in performing the action, he or she was then asked to tell E what he or she had done. In the Verb condition, E asked, "What did you just do?" In the Noun condition, E asked, "What did you just give the (ball, wheel, drum, etc.)?" In the Control condition, E asked both of these questions, asking the "do" question first.

An observer recorded whether the child performed each action, and what responses the child gave to the question(s). The sessions were audiotaped and children's responses were later checked by reviewing the audiotapes.

6.1.2. Results

The children's responses to questions were encoded as (1) verb use of the action word, (2) noun use of the action word, or (3) use of the action word by itself. Failures to respond or failures to use the action word in the response were coded as missing values. A "verb use" of the word included the word with a subject noun (e.g., "I spin"), the word with an object noun (e.g., "spin it" or "spinned it"),

and the word with both a subject and an object noun (e.g., "I spin it"). The utterances were not required to be fully grammatical. A "noun use" of the word always took the following form: "a spin" (indefinite article plus noun). Two apparent noun uses of the word by one child were excluded because they were elicited after failure to respond in the desired way to the question. The child responded by saying, "I went like that." E then asked, "What do you call that?" to which the child replied, on one occasion, "hugging" and, on another trial, "kissing." These appear to be mass-noun uses of the action word, but because they are not completely unambiguous and because they were elicited by a question that was not asked of all the children, these were not included as noun uses of the word.

For the Verb trials, a verb use was coded as *Appropriate* and a noun use was coded as *Inappropriate* (because the question asked was, "What did you just do?"). For the Noun trials, a noun use was coded as *Appropriate* and a verb use was coded as *Inappropriate* (because the question asked was, "What did you just give the . . . ?"). For the Control trials, a verb use was coded as *Appropriate* and a noun use as *Inappropriate* for the "What did you just do" question; the coding was reversed for the "What did you just give the . . ." question.

On many trials, the child responded with the action word alone. The percentages of trials, overall and in each condition, on which children responded with the action word by itself follow. Across all trials, 26.0 percent of the responses were the action word by itself. For the Verb and Noun trials, the percentages were 33.9 and 22.8 respectively. For the Control trials, the word alone was given as a response to the "do" question on 26.2 percent of the trials and it was given as a response to the "give" question on 17.5 percent of the trials. When the action word was used by itself, the lack of context precluded discernment of its part of speech. Given the high proportion of responses of this type, excluding these responses altogether would have created too many missing values, reducing drastically the power of the statistical analyses. To keep the number of missing values to a minimum, it was decided to code isolated-word responses in two ways, one way for each of two separate analyses: as *Appropriate* regardless of the

condition, or as Inappropriate regardless of the condition. This coding scheme should not bias the results in any particular direction; it should just reduce the size of any effects.

For statistical analyses, the α criterion for significance (i.e., the nominal probability of type I error) was set at .05. The experiment's design necessitated the use of a repeated measures (or within-subjects) analysis. For the analysis of variance (ANOVA), a repeated measures analysis with more than two levels rests on an assumption of compound symmetry (i.e., equal pooled within-treatment variances and across-subjects covariances of the repeated measures) and an assumption of sphericity (i.e., independence of the differences between levels of the repeated-measures factor, so that the differences are not correlated across subjects, and so that all the differences have the same variance; see Huynh & Feldt, 1970) in addition to the usual ANOVA assumptions. Because of suspected violations of the sphericity and compound symmetry assumptions, a multivariate approach to repeated-measures analysis was used (see Davidson, 1972, and Romaniuk, Levin, & Hubert, 1977); this approach does not presuppose compound symmetry or sphericity. Because the assumptions of normality and homogeneity of variances and covariances for all pairs of repeated measures were violated in the data, the Pillai-Bartlett Trace Criterion, V (Bartlett, 1939; Pillai, 1955), was used in evaluating significance; among the commonly used criteria, this one is the most robust in the face of violations of the normality and the homogeneity of variance and covariance assumptions (see Olson, 1974).

Let us look first at children's tendency to perform the requested action. The measure is the mean proportion of trials on which the child performed the action. The mean proportion differed significantly across the three conditions in a multivariate repeated-measures analysis of variance: $V(2, 19) = 8.70, p < .05$. Tukey's Honestly Significant Difference (HSD) post hoc tests indicated that the mean proportion for the Control condition, in which the noun phrases were in the wrong order (e.g., "Give the kiss a baby"), was significantly lower than the means for the other two conditions; the means for the latter conditions did not differ

significantly from one another. Children virtually always performed the action in the two conditions in which the request was grammatical; for the proportion of trials on which the child performed the action, $M = 0.98$ ($SD = 0.08$) for the Verb condition, and $M = 0.92$ ($SD = 0.16$) for the Noun condition. When the request was ungrammatical, the mean proportion of trials on which the children performed the action ($M = 0.79$; $SD = 0.24$) was substantially lower, but still fairly large. So even though children sometimes failed to perform the action during a Control trial, presumably because they could not understand the request, the large proportion of trials on which they did perform the action in this condition suggests that children often may have attended just to the stressed words and worked out what the request meant from the combination of the action word and the object noun. They may not even have noticed whether the action word was a verb or a noun on all trials; alternatively, they may have been unconcerned about the grammatical structure of the sentence, and they may have assumed that E intended to request of the child the action associated with the action word, with the named object as the object of the action. If children were oblivious to grammatical structure, their performance of the action may have been independent of the perceived part of speech of the action word. If so, their tendency to perform the action on any given trial may not be the ideal measure of their willingness to accept an action word as either a noun or a verb. The use of the word as a noun did not prevent them from understanding the request, but the possibility remains that they could deduce the intended request whether or not they took notice of how the word was used. Their own use of the action word as a noun or verb may be more revealing.

For the responses to the questions, children were equally likely to use the word as a verb when asked what they had done on the Verb trials and as a noun when asked what they had just given the toy on the Noun trials, according to t tests for dependent samples; this result obtained for both analyses: With action words alone coded as Appropriate responses, $t(19) = 0.21$, $p = .834$ for the difference in the mean proportion of trials on which an Appropriate response was

made; the mean is .96 ($SD = .13$) for the Verb condition and .95 ($SD = .23$) for the Noun condition. With isolated action words coded as Inappropriate responses, $t(19) = 0.34$, $p = .736$; the mean for the Verb condition is .65 ($SD = .40$); the mean for the Noun condition is .61 ($SD = .45$).

The responses from the Control trials are somewhat more interesting because the request to perform the action contained neither word use that would serve as an Appropriate response to either question (i.e., neither "spin" as a verb nor "a spin"). For the Control condition, children were equally likely to use the word as a verb when asked what they had just done and to use the word as a noun when asked what they had just given the toy, according to t tests for dependent samples. This finding obtains whether the action word by itself is coded as an Appropriate response or as an Inappropriate response. In the former case, $t(14) = 0.67$, $p = .513$; the mean for the "What did you just do" question is .85 ($SD = .28$) and the mean for the "What did you just give the . . ." question is .76 ($SD = .36$); in the latter case, $t(14) = 0.31$, $p = .761$; for the "do" question, the mean is .53 ($SD = .45$); for the "give" question, the mean is .57 ($SD = .38$).

Note that responses I have called "inappropriate" can themselves be taken as evidence in support of the hypothesis that the children were equally willing to use the action word as a noun or as a verb. When asked to supply a noun, they sometimes supplied a verb. When asked to supply a verb, they sometimes supplied a noun. The children seemed content to allow the action word to move freely between the noun and verb categories.

6.1.3. Discussion

The children in this study did not appear to pay much attention to the contexts of open-class action words. They were willing to perform the requested actions regardless of the syntax of the request, and even when the request was ungrammatical (although the ungrammaticality did reduce their tendency to respond somewhat). They appeared to interpret the action word in the request as a potential relation of themselves to the object for which a noun appeared in the

request. Their apparent lack of serious concern for the grammaticality of the request suggests that these children were not, in general, dominated by syntactic concerns in their comprehension of language. It might be argued that their failure to attend closely to syntax weakens any claims about learning that have the child basing part-of-speech identification on details of syntactic structure (i.e., on distributional criteria) – assuming that discerning meaning and determining the parts of speech of words both follow from a single processing of a sentence. Otherwise, if we assume that children do attend to syntax, and use it for part-of-speech identification, then we must conclude that they place less value on syntax when interpreting an utterance; in this, they would differ from adults, whom we would expect to look bewildered when asked to "give the kiss a baby." Adults might be able to discern the intended meaning of such an utterance, but they would expect a tighter relation between syntax and meaning than the children appeared to expect. So perhaps young children also expect no tight relation between syntax and parts of speech.

When the children were asked to describe their actions, they were equally willing to use the action word as a verb or as a noun (although the part of speech of the word was indeterminate when the action word was uttered by itself, as it was on about one quarter of the trials). They showed no hesitation whatsoever to use a noun in describing their action. This finding suggests that action words are not associated strictly with verbs in early language use, as the "semantic bootstrapping" theory would seem to predict. Young children seem perfectly willing to allow action words to undergo transformations from verbs to nouns. Their willingness to do so supports the hypothesis that while actions may sometimes promote predicator identification, no essential connection exists between actions and predicators or verbs; actions are merely prototypical of that which is both nonseparable and observable.

A possibility exists that semantic bootstrapping occurs at a stage in language learning that had been passed by the children in this study; that is, the children participating in this study may already have begun to identify nouns and

verbs entirely on the basis of their distributions – although the children's apparent lack of attention to details of the syntax of the action requests militates against such a conclusion. Pinker (1984) points out that,

. . . there is nothing in the [semantic-bootstrapping] theory . . . that specifies when in development the distributional procedures could begin to operate, other than that there must be enough semantically induced rules in the child's grammar to specify the phrase structure position of the unknown word. Distributional learning could even proceed on the second input sentence . . . (p. 53)

If distributional procedures for part-of-speech identification supersede semantic-bootstrapping procedures almost immediately, and do so completely, so that the child's assumptions about syntax-semantics correspondences are utterly abandoned, then the data from this experiment do not create a problem for the semantic-bootstrapping theory. But nearly immediate and complete supersession by distributional procedures would seem to be incompatible with the fact that the vast majority of children's words for a long time fall rather neatly into ontologically based categories, with verbs, for instance, typically being words for actions. Further, McPherson (1991) showed that some children of an age similar to those tested in this study (1;9 to 3;10, with a mean age of 2;10) failed, for the most part, to make use of distributional clues in identifying count nouns and mass nouns, basing their part-of-speech identifications instead on the object- or stuff-like appearance of a noun phrase's referent.

6.2. Experiment 2

I argued that, under favourable conditions for learning, the presence of noun phrases in an utterance that signify the participants in an action would facilitate an action interpretation for a phrase headed by a novel word in the utterance (and would promote identification of the word as a predicator by the Interpreted Noun Phrase Method). This experiment is aimed at providing evidence in support of the hypothesis that young children are more likely to interpret a phrase headed by a novel word into an action when the utterance in which it

appears contains noun phrases that are interpretable into the participants in an ongoing action.

In describing the possible relationships among actions, predicators, and noun-phrase arguments in learning, I argued that three scenarios were relatively plausible: (1) The presence of an action when a novel word is uttered may lead directly to the hypothesis that the word is a predicator – because of the nonseparability of actions – from which the child can deduce that any noun phrases are the predicator's arguments; (2) observing an action might lead to the hypothesis that the noun phrases in an accompanying utterance are the arguments of a word for the action; the presence of arguments in surface structure may then lead to the conclusion that the novel word in the utterance is a predicator; (3) the appearance, in an utterance, of noun phrases that obviously signify the participants in an ongoing action will lead to the hypothesis that the novel word in the utterance is an action word, which will in turn suggest that the word is a predicator (because actions necessarily involve participants and action words must therefore take arguments, and also because the word's arguments are explicit). The third account leads to the prediction that noun-phrase arguments appearing in the surface structure of a sentence will increase the likelihood of a novel word being interpreted as an action word. The other two accounts predict that the presence of noun phrases that signify participants in an action should have no influence on the word's interpretation; the presence of a salient action should, by itself, suggest that a novel word is an action word. If children are found to be more likely to interpret a novel word as an action word when the utterance in which it appears contains noun phrases, then support will have been obtained for the third sequence of interpretive events; but if children sometimes make action word interpretations when the novel word appears without noun phrases in an utterance, then the first two sequences of interpretive events will remain plausible as accounts of learning covering some instances. The data from this experiment can be used to help decide among these various learning scenarios.

The experiment also includes conditions in which the word's context contains distributional clues to verbal status for the word. By comparing the data from these conditions with the data from conditions in which the word appears with arguments but not with distributional clues, the role of noun phrases independently of verb clues can be gauged; it will be possible to determine whether children of the age included in this study use verbal distributional clues in interpreting a novel word, or if their interpretation is influenced only by the presence or absence of noun phrases that could be the arguments of the word.

6.2.1. Method

6.2.1.1. Subjects

The subjects were recruited through day-care centres in Montréal. All subjects spoke English as a first language. The sample included 13 boys and 8 girls. The mean age was 3;4 ($SD = 0;7$), and ages ranged between 2;2 and 4;3.

6.2.1.2. Materials

Six wooden toys that could be made to perform an action were used as the visual stimuli: A toy rat, dressed in a prince outfit, who brandished a sword; a bunny who flapped its arms up and down in unison; a bear who beat with sticks both sides of a drum suspended from its waist; a clown who shinnied up a string; a bird who pecked its way down the wire trunk of a tree; and a man who tipped his stove-pipe hat. These toys were chosen because (1) the children were unlikely to know a word for the specific type of action performed by the toy, and (2) the toys represent animals of kinds familiar to young children, kinds for which they are likely to know a basic-level count noun. For these reasons, children might be biased to interpret as an action word a novel word uttered while one of the toy animals was in action – assuming that their interpretations of words are guided by a principle of contrast such that new words require new meanings, and assuming that the action was more salient than any other nonseparable aspect of the toy's

being and than any subordinate or superordinate kind to which the toy animal belonged.

To determine the children's interpretation of the nonce word, five drawings were created for each toy. One drawing showed the agent of the action (e.g., the rat) in a static pose. A second picture showed the object of the action (e.g., the sword). A third picture showed another member of the same basic-level kind as the agent, and a fourth picture showed another member of the basic-level kind to which the object of the action belonged. The fifth picture showed the action being performed by the other member of the kind to which the agent belonged on the other member of the object's kind. Choice of the fifth picture alone would indicate an interpretation of the word as a word for the type of action. Choice of the first, third, and fifth picture would suggest that the word had been interpreted as a word for the basic-level kind to which the agent of the action belonged. Choice of the second, fourth and fifth pictures would indicate that the child thought the word was a word for the basic-level kind to which the object of the action belonged. Choice of the first picture alone would suggest that the child interpreted the word as a proper noun for the individual performing the action. The set of five pictures for each toy was mounted on a single sheet of cardboard, and the relative positions of the pictures varied for each set.

6.2.1.3. Word Contexts

For each toy, a nonce word was uttered while the toy performed the action. The set of nonce words used was: "keef," "teg," "kag," "dake," "bick," and "kib." The nonce word paired with a toy appeared in one of six contexts, with a different context for each of the six toys. Three contexts for the nonce word contained noun phrases that signified the agent and object of the action, and three contexts lacked such noun phrases. The six Word Context conditions were as follows:

1. No noun phrases. The word was presented in isolation. (E.g., "Bick.") This condition will be called *Isolated*.

2. No noun phrases. Before the toy performed the action, the child was taught a proper name for the agent of the action and the child was reminded of the basic-level count nouns for the kinds to which the agent and object of the action belonged. This condition was included to test Clark's contrastive hypothesis (Clark, 1980, 1983a, 1983b, 1987, 1988), which states that children assume different words have different meanings. If the child knew count nouns for the kinds of objects and knew a proper noun for the agent of the action, the child might be forced to conclude that the new word signified some property or attribute of one of the objects or, possibly, the action. In other words, this condition was aimed at eliminating certain psychologically privileged hypotheses about the meaning of the word. (E.g., "This is Tweety. That's his name. So your name is <child's name>, my name is Leslie, and his name is Tweety. Tweety is a bird. See? He's a bird. And this is a tree. Okay?" [Action begins.] "Look: Bick.") This condition will be called the *Contrastive* condition.

3. No noun phrases. The word was presented with the ending *-ing* as if it were a present participle. This inflexion can be attached to verb roots alone (but there are cases in which the same morph is part of a noun root, e.g., in "herring"). This condition provided, for children knowledgeable about this inflexion, a distributional clue that the root form of the word was a verb. (E.g., "Bicking.") Note that the inflexion *-ing* was dropped during testing, providing a contrast between the root and the present participle, so that the ending could, in actuality, serve as a verb clue. This ending is the first verb inflexion that children learn, or among the first (e.g., Berko, 1958; Bickerton, 1981; Brown, 1973; Cazden, 1968; de Villiers & de Villiers, 1973a), so it is as good a verb clue as can be included in a single-word utterance. This condition will be called *Word + -ing*.

4. Noun phrases present in utterance. If the new word were interpreted as a verb and the noun phrases were interpreted as its arguments, then the noun phrases are in non-English word order, in particular, SUBJECT-OBJECT-VERB (SOV). (e.g., "The bird the tree bick.") This condition will be called *SOV*.

5. Noun phrases present in utterance. If the new word were interpreted as a verb and the noun phrases were interpreted as its arguments, then the noun phrases are in English word order, that is, SUBJECT-VERB-OBJECT (SVO). (e.g., "The bird bick the tree.") This condition will be called *SVO*.
6. Noun phrases present in utterance. The word was presented as if it was a transitive verb in a complete, well-formed utterance. (e.g., "The bird is bickng the tree.") This condition will be called *Verb*.

6.2.1.4. Procedure

The experiment was preceded by a training session. The child was shown two sets of five pictures. The first set contained pictures of a dog, a second dog, an apple, a second apple, and the first dog eating the first apple. The second set included pictures of a girl, a second girl, a ball, a second ball, and the first girl bouncing the first ball. Before viewing the first set of pictures, the child was shown a picture of one of the dogs (the one other than the one that is shown eating an apple) and taught its name ("This is Fido. His name is Fido. My name is Leslie, and your name is <child's name>, and his name is Fido. Okay?"). Before presentation of the second set of pictures, the child was shown a drawing of one of the girls (the one other than the one who is shown bouncing a ball), and taught her name (Mary). While viewing a set of pictures, the child was asked to point out (1) the individual signified by the proper noun just taught (Fido or Mary), (2) an instance of a property (roundness or a colour), (3) an instance of the basic-level kind to which the agent of the action belonged (DOG or GIRL), (4) an instance of the basic-level kind to which the object of the action belonged (APPLE or BALL), and (5) an instance of an action of a certain type (the type shown in one picture: eating or bouncing). Each time the child pointed to one picture, he or she was asked if there were any more pictures showing what the child had been asked to locate. The form of the question addressed to the children was: "Are there any pictures that show what _____ means?" (e.g., "Are there any pictures that show what Mary/girl/ball/round/bounce means?"). This question does not contain any

clues to the syntactic category of the word that fills the blank, and so this question could be used in the experiment without contaminating the results. During the training session, children were corrected if they did not respond appropriately, and E made sure the children understood the corrections and could respond appropriately when asked again. When a child was asked to point out an instance of a type of action, E explained in detail how the picture portrayed the action (i.e., because the apple is in the dog's mouth, and the little lines in the picture around the dog's jaws indicate that he is chewing the apple); this explanation was given whether or not the child succeeded in choosing that picture. Young children sometimes have difficulty recognising action in a static picture, and may not be familiar with marks used by illustrators to indicate action (Amen, 1941; Cocking & McHale, 1981; Friedman & Stevenson, 1975; Leonard, 1975), so every effort was made to facilitate a child's recognition of action in the picture.

When the training session was complete, and E felt the child understood the task, the experiment began. For each of six trials, E, seated by the child's side, held a wooden toy in front of the child and made it perform an action while she fixed her gaze upon it. As she did so, she uttered a nonce word in some context as if she was commenting on what the child viewed. She repeated the word in its context four times. For example, in the condition in which the word appeared with the ending *-ing*, she said, "Look: Bicking. Can you say bick?" (Child repeats word.) "Good! Look: Bicking. See? Bicking. Bicking." E was careful to ensure that the child's attention was focused on the toy while she uttered the word string. The order of presentation of the toys, the pairings of toys with Word Contexts, and the pairings of nonce words with Word Contexts were randomised across subjects.

After viewing the action and hearing the word string, the child was shown a set of five pictures showing the agent of the action, a member of the same kind, the object of the action, another member of the object's kind, and the action being performed by the other member of the kind to which the agent belonged on the other member of the kind to which the object belonged. As in the training session, the child was asked, "Are there any pictures that show what _____ means?" with

the nonce word filling in the blank. If the child pointed to one picture, the child was asked, "Are there any more?" A research assistant noted on paper the numbers (from 1 to 5) of the pictures chosen by the child, which were spoken aloud by E. Audiotape recordings of the experiment were used to later confirm the child's responses.

6.2.2. Results

Six subjects responded in the same way on each trial, and just one of these children chose the picture of the action alone on each trial; the remaining 5 always interpreted the word as a word for the kind to which the agent belonged. This response bias may have reflected a failure to understand the task, or, for 5 of the 6 children, an inability to recognise an action in a static picture. Data for these subjects were dropped prior to running the analyses, leaving data from 15 children.

For evaluating the significance of effects in statistical analyses, I used .05 as the level of α (i.e., the nominal probability of type I error).

Children's responses were often less than clear-cut. For example, on 20 trials (22 percent of the 90 trials – 6 trials per child for 15 children), children pointed to a different picture every time E asked "Are there any more?" so that ultimately the complete set of pictures was chosen. In such cases, the order in which the pictures were chosen may provide a better clue to the child's interpretation of the word than the set of pictures chosen.

In an attempt to work around this response problem, three separate measures of the word's interpretation were computed for each child. For the first measure, the complete set of responses was interpreted, and categorised as follows: picked the action picture, picked the picture of the agent, picked the three pictures showing instances of the agent's kind, picked the three pictures showing instances of the object's kind, picked no pictures, or other (e.g., picked all pictures or some subset with nothing obvious in common).

For the second measure, just the first picture chosen was considered. For this measure, the response categories are: action, agent, other member of the agent's kind, object, other member of the object's kind, and none.

The third measure summarised a different number of responses depending on the pictures chosen. If the first three pictures chosen all showed members of a single kind (the kind to which belonged the agent or the object of the action), then the child was taken to have interpreted the word as a word for that kind. In all other cases, just the first response was taken into account, as with the second measure. The categories are as follows for this measure: action, agent's kind, object's kind, agent, object, other member of the agent's kind, other member of the object's kind, and none.

Tables 1, 2, and 3 show the percentage of children in each condition receiving the possible values of each of the three measures. With the first and third measures, the most common interpretation appears to have been one in which the word was taken to be a word for the kind to which the agent of the action belonged. This result is a bit puzzling because the children should have known the basic-level count nouns for the kinds of animals the toys represented, but perhaps they interpreted the word as a noun for the kind of toy. Bears and toy bears do not belong to the same kind, so perhaps children expect a separate word for toy bears, or at least for toy bears dressed in clown costumes and beating drums. Another possibility is that the children were simply biased toward basic-level kinds so strongly that they rarely considered the action as a possible interpretation of the word or its phrase. (See the Discussion, section 6.2.3, for other possible explanations.)

Oddly enough, children were slightly (but, in tests of proportions, nonsignificantly) more likely to think the word signified a specific individual, the agent of the action, in the Contrastive condition as compared to the other conditions. Teaching the children a proper name for the agent of the action did not deter them from interpreting the word into a specific individual. Alternatively, children who chose the picture of the agent but not the picture of the other

Table 1

Percentage of children in each condition making each type of interpretation according to the first measure in Experiment 2.

Word Context	Action	Agent	A-Kind	O-Kind	None	Other
Isolated	13.33	6.67	33.33	6.67	0.00	40.00
Contrastive	6.67	20.00	33.33	0.00	6.67	33.33
Word + -ing	6.67	13.33	60.00	6.67	0.00	13.33
SOV	33.33	0.00	33.33	0.00	0.00	33.33
SVO	20.00	13.33	20.00	13.33	0.00	33.33
Verb	20.00	13.33	40.00	6.67	0.00	20.00

Key: A-Kind=kind to which the agent belongs; O-Kind=kind to which the object belongs.

Table 2

Percentage of children in each condition making each type of interpretation according to the second measure in Experiment 2.

Word Context	Action	Agent	Other-A	Object	Other-O	None
Isolated	53.33	20.00	20.00	6.67	0.00	0.00
Contrastive	26.67	46.67	13.33	0.00	6.67	6.67
Word + -ing	33.33	33.33	26.67	6.67	0.00	0.00
SOV	73.33	20.00	6.67	0.00	0.00	0.00
SVO	46.67	26.67	6.67	13.33	6.67	0.00
Verb	60.00	33.33	0.00	6.67	0.00	0.00

Key: Other-A=other member of the agent's kind; Other-O=other member of the object's kind.

Table 3

Percentage of children in each condition making each type of interpretation according to the third measure in Experiment 2.

Word Context	Action	A-Kind	O-Kind	Agent	Object	Othr-A	Othr-O	None
Isolated	33.33	40.00	6.67	13.33	6.67	0.00	0.00	0.00
Contrastive	20.00	40.00	0.00	26.67	0.00	0.00	6.67	6.67
Word + -ing	6.67	66.67	6.67	20.00	0.00	0.00	0.00	0.00
SOV	40.00	40.00	0.00	13.33	0.00	6.67	0.00	0.00
SVO	53.33	13.33	13.33	13.33	6.67	0.00	0.00	0.00
Verb	26.67	53.33	6.67	13.33	0.00	0.00	0.00	0.00

Key: A-Kind=kind to which agent belongs; O-Kind=kind to which object belongs; Othr-A=other member of agent's kind; Othr-O=other member of object's kind.

member of the same kind may have interpreted the word as a name for a subordinate kind to which the agent belongs, but to which the other individual of the agent's basic-level kind does not belong.

Let us examine now interpretations of the word as an action word. Note first that the measured proportion of action interpretations is much higher for the second measure than for the other two measures; this is because children often chose the action picture first (i.e., the picture of the other individual of the agent's kind performing the action on the other individual of the object's kind), but when asked if there were any more pictures that showed what the word meant, they continued to point at other pictures. If they pointed to all of them in turn, such a response pattern would be classified under "other" with the first measure. If they pointed to the two other pictures showing a member of the agent's kind, the response pattern would be classified under "agent's kind" with the first and third

measures. But because the second measure is based on just the first picture chosen, action interpretations are much more common with this measure.

A measure of whether or not the word was interpreted as an action word was constructed such that an action response received a score of 1 and all other responses received a score of 0. Cochran's Q statistic (a nonparametric test; see Cochran, 1950; Marascuilo & McSweeney, 1977; Siegel & Castellan, 1988) was computed to determine if the frequencies of action responses differed across the six Word Context conditions. For the first measure (where all pictures chosen are considered), the statistic was not significant: $Q(5) = 6.05, p = .301$. For the second and third measures, the statistics did not reach significance, but they did indicate a weak trend: $Q(5) = 8.93, p = .112$ for the second measure; $Q(5) = 9.52, p = .090$ for the third measure.

To examine the effects of Word Context on action interpretations, the proportion of children interpreting the word (or its phrase) into an action was compared for each pair of conditions. In computing the proportions, subjects who chose none of the pictures in a given condition (never more than one subject) were dropped for the computation for that condition. No tests of proportions were significant for pairs taken from among the conditions in which noun phrases were part of the word context or for pairs taken from among the conditions in which no noun phrases were present. Some of the proportions differed significantly when comparing conditions with and without noun phrases, and in the direction predicted by the theory. Using the first measure (for which all pictures chosen are considered), the SOV condition produced a significantly higher proportion of action interpretations (.33) than the Word + *-ing* condition (.07) and the Contrastive condition (.07; $Z = 1.83, p < .05$, one-tailed test, in each case; the direction of the effect was predicted, justifying the use of a one-tailed test, because the inclusion of noun phrases should favour an action interpretation according to the theory). With the second measure (which is based on just the first picture chosen), the SOV condition (.73) again differed from the Word + *-ing* condition (.33) and from the Contrastive condition (.29; $Z = 2.20, p < .05$, and $Z = 2.41, p$

< .05, one tailed, respectively). For the third measure (where just the first picture chosen was considered unless the first three chosen showed instances of the same kind), the proportion in the Word + *-ing* condition (.07) was significantly lower than in both the SOV condition (.40) and the SVO condition (.53; $Z = 2.16$, $p < .05$, and $Z = 2.79$, $p < .05$, one tailed, respectively). The proportion in the SVO condition (.53) also differed significantly from the proportion in the Contrastive condition (.21; $Z = 1.77$, $p < .05$, one tailed).

To gauge the overall effect of the presence of noun-phrase arguments in the word's context, additional dependent variables were constructed as follows. For the three conditions with noun phrases in the context and again for the three conditions without noun phrases, the number of times each child interpreted the word as an action word was counted, yielding two ratio variables for which values can range between 0 and 3. Values of these two variables were computed for each of the three measures of the word's interpretation.

When mean values of the two variables based upon the first measure were compared in a t test for dependent samples, the difference (i.e., the effect of the presence versus absence of noun phrases) was significant: $t(14) = 2.17$, $p < .05$ (one-tailed test; the direction of the effect was predicted because the theory states that the presence of noun phrases will increase the frequency of action interpretations). For the second measure, the mean difference between the conditions with and without noun phrases was significant: $t(14) = 1.92$, $p < .05$ (one tailed). Using the third measure, the effect of the presence or absence of noun phrases was again significant: $t(14) = 2.20$, $p < .05$ (one tailed). The presence of noun phrases in the word's context seems to have promoted action interpretations in this study.

The means and standard deviations for the number of action responses in the two sets of conditions appear in Table 4.

Although actions interpretations were more common when the word's context contained noun phrases, such interpretations were occasionally made when no noun phrases accompanied the word (see Table 1). The mere presence of an

Table 4

Mean number of action responses for the conditions including and lacking noun-phrase arguments, for the three measures in Experiment 2.

Measure	Noun Phrases?	Mean	Standard Deviation
1	Absent	0.27	0.46
1	Present	0.73	0.88
2	Absent	1.13	0.92
2	Present	1.80	0.94
3	Absent	0.60	0.74
3	Present	1.20	0.86

action was sometimes sufficient to suggest that the word signified the type of action.

The children did not appear to be sensitive to syntax. There was no tendency for children to interpret the word (or its phrase) into an action more often when distributional verb clues were present (i.e., in the Word + *-ing* condition and in the Verb condition). Perhaps the children had not yet learned the correlations between verbs and these clues, or perhaps they did not expect a verb or verb phrase to signify an action. In any case, their failure to be influenced by verb clues suggests that a young child's action interpretation when hearing a grammatical utterance containing a novel verb is largely a function of the presence of interpretable noun phrases in the utterance, and not a function of the word's distributionally determined verb status.

The most salient alternatives to an interpretation of the word as an action word were its interpretation as a word for a kind or for a specific individual (usually the agent of the action), and one might expect that these sorts of interpretation would be associated with contexts that lack noun-phrase arguments. To permit an examination of such interpretations, a measure was constructed that was equal to 1 whenever the child interpreted the word as a word for a kind or for the agent alone, and equal to 0 for other types of responses. This variable could be constructed for the first and third measures (but not for the second measure, which provides no indication of kind interpretations per se). Cochran's Q test was performed to determine whether the frequencies of kind/agent interpretations differed across conditions. For the first measure, the results of the test were not significant: $Q(5) = 7.78, p = .169$. For the third measure, the frequencies across conditions were found to differ significantly: $Q(5) = 11.20, p < .05$.

For each pair of Word Context conditions, a test was made of the difference in the proportion of kind or agent responses, excluding cases in which the criteria were not met for any of the response types. For the first measure, no differences were significant, in two-tailed tests, for pairs of conditions from among those in which the word was uttered without noun phrases. No differences were significant for pairs of conditions from among those that included noun phrases in the utterance. In comparing conditions without noun phrases and conditions with noun phrases, two pairs of conditions differed significantly: the Word + *-ing* condition and the SOV condition differed significantly ($Z = 2.58, p < .05$, one tailed), and the Word + *-ing* condition and the SVO condition differed significantly ($Z = 1.89, p < .05$, one tailed). In both cases, the proportion was higher for the Word + *-ing* condition (.80 versus .33 and .47 for the SOV and SVO conditions, respectively).

Using the third measure, the only significant difference among the conditions without noun phrases was the difference between the Isolated condition and the Word + *-ing* condition: $Z = 2.16, p < .05$, two tailed; the proportion was higher for the Word + *-ing* condition (.93) than for the Isolated condition (.60).

Among the conditions with noun phrases, no differences in proportions were significant in two-tailed tests. In comparing conditions without and with noun phrases, three differences were found to be significant. The proportion in the Contrastive condition (.71) was significantly higher than the proportion in the SVO condition (.40; $Z = 1.70$, $p < .05$, one tailed). For the Word + *-ing* condition, the proportion (.93) was significantly higher than the proportions for the SOV and SVO conditions (.53 and .40 respectively; $Z = 2.48$, $p < .05$, and $Z = 3.10$, $p < .05$, one tailed in each case, in comparing the Word + *-ing* condition with the SOV and SVO conditions). So the absence of noun phrases seemed to favour interpretations of a word as a word for a kind or individual.

As an alternative way of gauging the effect of noun phrases on kind and individual interpretations, another measure was constructed. For the three conditions in which no noun phrases appeared in the word's context, and again for the three conditions including noun-phrase arguments, a count was made of the number of kind or agent responses, creating a ratio variable ranging between 0 and 3. The two counts were compared in a t test for dependent samples. For the first measure, the difference did not quite reach significance: $t(14) = 1.57$, $p = .069$ (one tailed). For the third measure, the difference in the number of kind/agent responses for the two sets of conditions was significant: $t(14) = 2.26$, $p < .05$ (one tailed). The means and standard deviations appear in Table 5. These data strengthen the conclusion that noun phrases in an utterance containing a novel word reduce the likelihood of interpretations of the phrase headed by the word into a kind or individual (favouring, instead, an interpretation into the nonseparable).

6.2.3. Discussion

The children in this study were more likely to interpret a novel word as an action word and less likely to interpret it as a word for a kind or an individual when the word appeared with noun phrases that signified the agent and object of the action. The tendency to interpret the word as an action word was not

Table 5

Mean number of kind/agent responses for the conditions including and lacking noun-phrase arguments, for two measures in Experiment 2.

Measure	Noun Phrases?	Mean	Standard Deviation
1	Absent	1.80	0.78
1	Present	1.40	0.91
3	Absent	2.20	0.78
3	Present	1.67	0.82

increased by the presence of the verb ending *-ing* or by the multiple verb clues present in a complete, grammatical utterance (e.g., "The bird is bickering the tree"). The presence or absence of noun phrases appears to have been critical, but the presence or absence of distributional clues per se (e.g., word order, or a verb ending attached to the novel word) seemed not to make any difference.

When no noun phrases appeared in the utterance, children sometimes interpreted the novel word as an action word anyway. An action interpretation may have been made because other salient hypotheses about meaning, such as the basic-level kind of the agent and object, were ruled out by familiarity with the kinds involved. This conclusion would be compatible with assumptions underlying the Nonseparability Method of predicator identification. Notice, though, that among conditions in which the word appeared without noun phrases, action interpretations were not especially favoured in the Contrastive condition, in which the child was reminded of the basic-level-kind terms for the agent and object and taught a proper name for the agent. For all of the measures computed, children interpreted the word as an action word less frequently on the Contrastive trial than on the other trial in which the word was presented in isolation (without the

verb ending *-ing*), although the difference was not significant. But the familiarity of the basic-level kinds may have precluded an observable effect of contrast; the provision of kind names may have been redundant because the children already knew their names.

The fact that children's responses sometimes reflected action interpretations both when the word appeared with noun phrases and when it appeared without them (though such responses were more common when the word appeared with noun phrases) precludes the elimination of any of the three possible learning scenarios described in section 3.4 and in the introduction to this section: The presence of an action may lead directly to the hypothesis that a novel word is an action word, leading to its identification as a predicator and the interpretation of any noun phrases present as its arguments; an action word interpretation to which the presence of an action gives rise may, instead, suggest that the noun phrases in the accompanying utterance are arguments, which in turn suggests that the word is a predicator; and, finally, in some instances of learning the presence of noun phrases that are interpreted into the participants in an action may lead to the hypothesis that the phrase headed by a novel word signifies an action, and that the word must therefore be a predicator. Any or all of these series of deductions may describe learning in various instances. Data from this experiment do not favour one over the other, although they do suggest that the third account may describe learning in some instances, because the presence of noun-phrase arguments did increase the frequency of action interpretations (although without a measure of the word's part of speech, we cannot determine whether an action interpretation led to predicator identification, that is, whether learning did indeed follow the third account); the data also suggest that learning follows either the first or the second account, or both, in at least some instances because noun phrases are not necessary to get action interpretations (although they do increase their frequency).

The addition of the inflexion *-ing* to an isolated word increased the frequency of kind or rigid-designator interpretations over that observed in the

Isolated condition. In particular, it increased the frequency of interpretations into the kind to which the agent or object belonged (from 6 in the Isolated condition to 10 in the Word + *-ing* condition by the first measure, or from 7 to 11 by the third measure). Nouns for actions or activities can be derived from verbs by adding *-ing*, but knowledge of this derivational rule might increase the frequency of action interpretations, but not the frequency of interpretations of a word as a word for a kind of individual. Perhaps the children were sensitive to the statistical tendency for English nouns to have more syllables than English verbs (Cassidy & Kelly, 1991), so that the two-syllable word formed by adding *-ing* suggested a noun, which in turn suggested an interpretation as a word for a kind.

The high frequency of non-action responses, even when the word appeared with noun phrases, requires an explanation. I suggested earlier (in section 6.2.2) that the children might have often taken the nonce word to be a word for the kind of toy, so that their knowledge of a basic-level noun for the kind of animal the toy represented did not block a kind interpretation; alternatively, children may be so strongly biased toward kind interpretations that they rarely consider alternatives. But other possible explanations can be offered. Young children sometimes have trouble recognising action in static pictures (Amen, 1941; Cocking & McHale, 1981; Friedman & Stevenson, 1975; Leonard, 1975). Children may have been unable, in many cases, to find a picture that corresponded to the action because they failed to perceive any action in any of the pictures. In such a circumstance, children may have fallen back onto a response strategy of choosing pictures of members of the agent's kind (for instance). One boy who was slow to respond was asked again what the novel word meant; he replied by performing the action. But when he finally chose a set of pictures, his choices suggested an agent-kind interpretation! The frequency of action interpretations might be better revealed in a task where the child was asked to demonstrate the meaning of the word, or where the child was presented with a moving picture of the action as one response option.

The preponderance of apparent kind interpretations may be partly explained by another factor. The event of looking at pictures may have called into play an action schema acquired while looking at picture books with adults. When parents look at books with their children, limited evidence suggests that the vast majority of words they use in commenting upon the pictures are common nouns for kinds. One study showed that only about 4 percent of a mother's labels for pictures named actions, attributes, or properties (Ninio & Bruner, 1978). In the same study, over 75 percent of the mother's instances of labelling objects were found to occur while the mother and child were looking at pictures. It is possible, then, that parents teach their children common nouns primarily during picture-looking episodes (at least in the West). The event of looking at pictures in this study may have primed the children to think in terms of kinds (versus actions or attributes); in some cases, children may have assumed that they were being asked to link a kind with a noun – regardless of what interpretation of the word they may have favoured prior to looking at the pictures. They may have abandoned the interpretation that came to mind while viewing the action, and changed their interpretation of the word to fit their expectations associated with picture-looking.

6.3. Experiment 3

The results of Experiment 2 showed that the presence of an action of unfamiliar type when a novel word is uttered, especially when the word coupled with the action appears in an utterance containing noun phrases for the participants, facilitates an action interpretation of the novel word. That experiment did not speak to the issue of parts of speech in particular. I was unable to devise a measure of the part of speech for predicator categories (i.e., *predicator*, *verb*, and *adjective*) that could be employed successfully with children of a sufficiently young age – that is, children who might still be identifying words as members of the major part-of-speech categories on some semantic basis because they still lacked the knowledge of syntax necessary for identification on a distributional basis. (One measure was devised, but young children proved unable to perform the task.) I

decided to run an experiment on adult subjects so that I could determine both the interpretation of a novel word and its identified part-of-speech membership under various conditions. There is no reason to believe that early learning methods are not available to adults; if adults did not retain the interpretive strategies and presuppositions that characterise early learning methods (e.g., the tendency to interpret noun phrases for the participants in an action as the arguments of a predicator), they might be less able to teach language to young children, misleading them because of a mismatch between the adults' intent and the children's expectations. The primary way in which adults differ from children is that they have available to them additional learning methods, such as those making use of language-specific information about the distributions of words in different semantically defined part-of-speech categories. By making such language-specific information unavailable in certain conditions, I hoped to tap into learning methods that dominate the earliest part-of-speech identifications.

Adults also differ from children in that they have learned language-specific divisions of unlearned categories such as noun and predicator (e.g., gender subcategories of nouns, and the subcategories *verb* and *adjective*). It is doubtful that adults can set aside this knowledge, and classify words according to semantically defined categories alone, as a child might do. Nonetheless, if verbs and adjectives are indeed subcategories of *predicator*, the adults' identification of members of the predicator category can be inferred from their identification of verbs and adjectives, and wherever inflexional and syntactic clues to a subcategory are absent in a learning situation, the identification can be inferred to have a semantic basis; moreover, one of the response tasks used in this experiment required the subjects to indicate that a word was a predicator (versus a noun) before they were given an opportunity to indicate that it was a verb or adjective in particular.

The design of the experiment was similar to the design of Experiment 2, so the results of the two experiments can be compared. If the adults in this experiment are influenced by the presence of noun phrases in making action

interpretations, as the children in Experiment 2 were, then their response tendencies on the part-of-speech tasks might be more safely generalised to children on a tentative basis. Also, this experiment will allow a more detailed evaluation of the three learning scenarios I described earlier, which are characterised by different sequences of interpretive events (see section 3.4). If action interpretations and predicator identifications occur when the word is presented without noun phrase arguments, then the first scenario described in section 3.4 will have found support: The interpretation of a word's phrase into an action may lead directly to predicator identification, which in turn leads to an interpretation of any noun phrases as arguments of the predicator. If observing an action of a novel type leads to action interpretations, and no more frequently when the word appears with noun phrases, but if action interpretations lead to predicator identifications more frequently when the word is presented with noun phrase arguments, support for the second learning scenario will have been found: An interpretation into the action may lead to an interpretation of the noun phrases as the arguments of the novel word, which leads to identification of the word as a predicator. If the presence of explicit arguments increases the frequency of action interpretations and of predicator identifications, then support will have been found for the third learning scenario: The interpretation of noun phrases into individuals involved in a relation or possessing a salient property may lead to the interpretation of the novel word's phrase into the relation or property, and to identification of the word as a predicator (both because of its association with the nonseparable, and because of the explicit arguments).

This experiment also examined the identification of the count and mass subcategories of common nouns by including trials in which a novel word was paired with an object or stuff of an unfamiliar kind. By comparing the results for noun categories and predicator categories, it was possible to compare the strengths of links between types of being (i.e., objects, stuff, and actions) and parts of speech (i.e., count nouns, mass nouns, and predicators or verbs) for nouns versus predicators (e.g., to compare the strength of the link between objects and count

nouns on the one hand, and between actions and verbs on the other hand). The inclusion of object and stuff trials served another purpose. Research has shown that young children can identify count nouns and mass nouns on a purely perceptual basis, interpreting a word used to label an object or stuff of an unfamiliar kind as a count noun or mass noun, respectively; they need no distributional evidence to make these identifications (Gordon, 1985; McPherson, 1991; Soja, 1992; Soja et al., 1991). If it can be shown that adults are able to identify count nouns and mass nouns through the same means as young children, we can be more confident that they can identify predicators through the same means as young children. In other words, if adults can be shown to use a perceptually based learning method when classifying words for novel kinds of objects and stuff without the benefit of distributional clues, despite their having learned additional, distributionally based, methods for identifying count nouns and mass nouns, then our confidence will increase that they can also use the predictor-identification methods employed by young children acquiring a first language – for this would suggest that distributionally based methods do not completely supersede the early methods of learning; we could conclude that at least some of the methods available early in learning remain available.

The experiment also includes conditions that permit an evaluation of the Nonseparability Method of predictor identification, according to which action and predictor interpretations should be favoured when the participants in an action belong to familiar basic-level kinds for which common nouns are known (and, with an animate participant, for whom his or her proper name is known).

6.3.1. Method

6.3.1.1. Subjects

Forty-two graduate and undergraduate students and technicians from McGill University volunteered for the study. Each subject was paid \$5.00 for

participation. All those who served as subjects in this experiment speak English as a first language or are fluently bilingual.

6.3.1.2. Stimuli

The video stimuli were extracted from television programmes and concatenated on a single videotape. The stimuli varied from 2 to 11 seconds in length, and they were separated by 15 seconds of blackness.

There were 5 types of video, producing 5 levels of a factor I will call *Video Type*; the 5 types are listed in Table 6.

Table 6

Video Types used in Experiment 3.

Intransitive Action:

Intransitive action of unfamiliar type (agent of a familiar kind)

Transitive Action:

Transitive action of unfamiliar type (agent and object of familiar kinds)

Object:

Atomic object of an unfamiliar kind

Stuff:

Stuff of an unfamiliar kind

Unfamiliar Agent/Object:

Agent or object of action of unfamiliar kind; action of unfamiliar type

The most salient feature of the video for eight trials was an intransitive action (i.e., one lacking an object) for which most subjects would not have a name (i.e., the action was of a type likely to be unfamiliar); the action was performed by

an individual of a familiar basic-level kind; these trials will be called the *Intransitive-Action* trials. The videos showed: a baboon hopping on its hind legs; a girl spinning in a circle while holding one foot in her hand with her leg in the air; two storks bending their heads backwards and forwards as part of a courting ritual; two ducks "dabbling down," that is, repeatedly tipping over so that their heads are underwater and their rear ends are in the air; a man sitting on a bicycle and making it "hop" without turning its wheels ("rock-hopping"); a Thompson gazelle bounding along with its front legs kept together and its rear legs kept together throughout; two albatrosses bouncing their heads up and down in unison; and an old woman performing a gentle exercise that resembles a series of deep bows with the arms outstretched.

For seven trials, the video showed a transitive action (i.e., one involving both an agent and an object of the action) of an unfamiliar type; the agent and object belonged to familiar kinds; these trials will be called the *Transitive-Action* trials: a woman crumpling up a towel by repeatedly bending her toes while pushing them against the towel; a salmon slapping the rocks on a riverbed with her tail in preparation for spawning; a turkey spreading and folding its tail; a woman passing an orange to a child while holding it under her chin; a cockroach passing an antenna slowly through its mouth with its front legs; a gymnast performing movements on the floor that cause a large ball to roll up and down her body without the use of her hands; and a bear scraping the surface of a pond in search of fish.

For four trials, the most salient feature in the video was an object of an unfamiliar kind, but some action was being performed on the object; these are the *Object* trials. The objects were: a Victorian "posy-holder," a horn-shaped object made of gold filigree, which was being lifted out of a box; a mushroom-cap jellyfish swimming by folding and unfolding the upper part of its body; a snuff box with a built-in miniature gun barrel that can fire a bullet when the box is opened, and this action was performed in the video (without any resulting firing of a

bullet); and an Indian musical instrument loosely resembling an accordion, which was being played.

For another four trials, stuff of an unfamiliar kind was featured; as in the Object trials, some action was being performed on it; these are the *Stuff* trials. The four kinds of stuff were: a kind of building material consisting of small white pellets, which a man was letting run through his fingers; blue putty used to fill dents in car bodies, which a man was mixing with a spatula-like implement; a coarse mealy dough prepared by South American natives, which was being pressed against a large square sieve by a native woman; and green copper ore, which was being pulled from a rock wall and manipulated in a man's hand.

For three trials, either the agent or object of an action was of an unfamiliar kind; the action was of an unfamiliar type as well; these are the *Unfamiliar Agent/Object* trials. One trial showed an agent of an unfamiliar kind performing an intransitive action of unfamiliar type: a "mud-skipper", a kind of fish that propels itself across muddy land by pushing its fins against the ground. One trial showed an agent of an unfamiliar kind performing a transitive action of unfamiliar type on an object of a familiar kind: a spoon-bill (a water bird) skimming the surface of a lake with its bill to search for food. One trial featured an agent of a familiar kind performing a transitive action of unfamiliar type involving an object of the action of an unfamiliar kind: a woman performing a type of Chinese martial art in which a large baton-like object with tassels on the ends is rolled across the body rapidly as the person spins in circles.

The verbal stimuli providing contexts for the nonce words were printed on a piece of paper, with the response area printed on the other side of the sheet. The nonce word used on a given trial was chosen from among 26 nonce words, and the order of the words used was randomised across subjects prior to the experiment using a random-number generator. The order in which the various word contexts were presented was also randomised across subjects in this way. (The order of the videos was fixed because the technology used did not allow this order to vary.)

For Intransitive-Action and Transitive-Action trials, the word contexts sometimes included one or two noun phrases, each containing a familiar noun, that could be interpreted as arguments of the unfamiliar word if it was interpreted as a predicator. In other words, the one or more noun phrases could be interpreted into the object(s) involved in an action in the video. An attempt was made to choose nouns that would be at the basic level for most subjects, although the basic level may vary from person to person.

Some of the contexts containing English noun-phrase arguments also provided distributional clues to the category of the word. Some contained no such clues and were not well-formed formulae in English. Sometimes a distributional clue to verb status was provided when no noun-phrase arguments were included: the inflexion *-ing* on the word; this inflexion can only be conjoined with verb roots. (NB: In the word "herring," *-ing* is not an inflexion. Also note that the subjects always classified the root form of the word, which was printed at the top of the response sheet, and that the contrast between the form with *-ing* and the root form should have ensured that the inflexion did indeed serve as a verb clue.)

A couple of trials tested the contrastive hypothesis of Eve Clark (1980, 1983a, 1983b, 1987, 1988) by reducing the plausibility of a basic-level-noun or proper-noun interpretation of the word, which might increase the likelihood of a predicator interpretation. Prior to reading the nonce word (which appeared without any additional context), the subject read a proper name for the agent of the action in the video, and a familiar count noun for the agent's basic-level kind. This manipulation does not rule out the possibility of some noun interpretation for the word, for example its interpretation as a noun subordinate or superordinate to the count noun presented.

The context in which a word appeared will be considered a level of a factor I will call *Word Context*.

For the Intransitive-Action trials, one nonce word appeared in each of the contexts shown below on a separate trial; "NP" is an abbreviation for "noun

phrase"; the noun phrases consisted of the article "the" followed by a common noun.

- 1) *Intransitive-Verb context*: <NP signifying agent> IS <nonce word>-ING
- 2) *Predicative-Adjective context*: <NP signifying agent> IS <nonce word>
- 3) *Attributive-Adjective context*: LOOK AT THE <nonce word> <noun signifying agent's kind>
- 4) *Word + NP context*: <nonce word> <NP signifying agent>
- 5) *NP + Word context*: <NP signifying agent> <nonce word>
- 6) *Word + -ing context*: <nonce word>-ING
- 7) *Contrastive context*: The <noun signifying agent's kind> in the video is named <nonce word #1>. <nonce word #2>
- 8) *Isolated context*: <nonce word>

To summarise, the 8 levels of Word Context are called: *Intransitive Verb*, *Predicative Adjective*, *Attributive Adjective*, *Word + NP*, *NP + Word*, *Word + -ing*, *Contrastive*, and *Isolated*.

On the Transitive-Action trials, a word appeared in each of these contexts on separate trials:

- 1) *Transitive-Verb context*: <NP signifying agent> IS <nonce word>-ING <NP signifying object>
- 2) *SVO context*: <NP signifying agent> <nonce word> <NP signifying object>
- 3) *SOV context*: <NP signifying agent> <NP signifying object> <nonce word>
- 4) *VSO context*: <nonce word> <NP signifying agent> <NP signifying object>
- 5) *Word + -ing context*: <nonce word>-ING
- 6) *Contrastive context*: The <noun signifying agent's kind> in the video is named <nonce word #1>. <nonce word #2>
- 7) *Isolated context*: <nonce word>

If the nonce word is interpreted as a verb, then the contexts numbered 2 to 4 represent the three word orders for a transitive verb and its arguments that are found most commonly among the world's languages: SVO, SOV, and VSO (where

"S" is the subject noun phrase, "O" is the object noun phrase, and "V" is the verb; see, e.g., Comrie, 1981; Greenberg, 1963; Mallinson & Blake, 1981). To recapitulate, the seven levels of Word Context for the Transitive-Action trials are called: *Transitive Verb*, *SVO*, *SOV*, *VSO*, *Word + -ing*, *Contrastive*, and *Isolated*.

On trials showing an object or stuff of an unfamiliar kind (i.e., the Object and Stuff trials), the nonce word appeared in one of these four contexts:

- 1) *Count-Noun context*: IT'S A <nonce word>
- 2) *Mass-Noun context*: IT'S SOME <nonce word>
- 3) *Neutral-Noun context*: LOOK AT THE <nonce word>
- 4) *Isolated context*: <nonce word>

The four levels of Word Context for these trials are thus called: *Count Noun*, *Mass Noun*, *Neutral Noun*, and *Isolated*.

For the three trials involving an action of unfamiliar type and an agent or object of the action of an unfamiliar kind, the nonce word was always presented by itself.

The words and their contexts were always printed in capital letters with no punctuation to avoid providing any clues not available to someone hearing spoken speech (e.g., a capital letter at the beginning of a word could signal that it is a proper name). The nonce word was also printed in capital letters at the top of the response sheet for that trial. It was decided to use written word strings rather than spoken ones to reduce the chances of an experimenter effect due to the experimenter's unconscious use of prosodic or other subtle clues in her voice and demeanour that might signal the part of speech that conformed to her hypotheses most closely. Since prosodic and nonverbal clues to the word's part of speech were not relevant to the hypotheses being tested, they could introduce confounding factors into the experiment unless varied systematically.

6.3.1.3. Procedure

The subject read a set of instructions which described the nature of the study (see Appendix D). The instruction sheet explained that the study was

designed to gain insight into young children's learning of words, and that the experimental situation would mimic a child's experience in several ways. First, because children sometimes know the meaning of some but not all of the words in a sentence they hear, the strings of words presented as stimuli in the experiment would sometimes contain familiar English words, but one word would always be unfamiliar. Second, children have a limited knowledge of language, and so they cannot always use clues provided by morphology and syntax in determining the grammatical category of a word. The experiment mimics this situation by sometimes presenting the subject with word strings that do not form grammatical utterances in English. These explanations were designed to prepare the subjects for the weird nature of the verbal stimuli, and to encourage them to interpret the word strings whether or not they were grammatical. Third, subjects were told, children have relatively little experience of the world, and they often lack words for certain aspects of situations. The instructions explained that in the experiment, the videos may involve the unfamiliar. The instructions then warned the subject not to rely on a knowledge of grammar learned in school. They were advised instead to pay attention to their intuitions or "gut" feelings. The instructions then explained the three response tasks in detail.

The subjects learned the response tasks with a set of 8 practice trials involving familiar English words: "cat" (a count noun), "previous" (an attributive adjective), "slap" (a transitive verb), "flour" (a mass noun), "funny" (an adjective), "sob" (an intransitive verb), "Robert" (a proper noun), and "ablaze" (a predicative adjective).

In the experiment proper, the subject read a word string containing a nonce word and then immediately viewed one of the video stimuli. The subject then flipped over the sheet of paper on which the word string was printed, read the root form of the nonce word at the top of the sheet, and completed the three response tasks on that sheet. When the subject was finished, the next trial began.

6.3.1.4. Response Tasks

6.3.1.4.1. Meaning Task. The first response task was designed to determine the approximate meaning of the word for the subject. The subject was asked to decide if the word signified:

- 1) a specific individual (as a name),
- 2) a type of animate bounded object,
- 3) a type of inanimate bounded object,
- 4) a type of stuff or substance,
- 5) a type of activity, action, process, or change of state,
- 6) a type of property, quality, attribute, or state, or
- 7) other (please specify).

The instructions explained that a bounded object was one with fixed boundaries, such as a cup: "If a cup is broken into pieces or cut in two, the pieces cannot be called cups, and the collection of pieces, fitted together appropriately, constitute a cup. Also, if two cups are glued together (say bottom to bottom), the result is not a cup. Two small cups do not form one larger cup. This shows that cups have boundaries that cannot be arbitrarily changed without the objects ceasing to be cups. Contrast cups with clay. A lump of clay can be divided into any number of lumps, and each lump is equally a lump of clay. And two lumps of clay can be put together to form one larger lump of clay. So a lump of clay is not a 'bounded object,' but a cup is a bounded object. A puddle is not a bounded object because its boundaries can change as rain increases its size or the water in it evaporates, and yet it still remains a puddle. Examples of bounded objects are chairs, people, apples, televisions, and books."

The second and third response tasks permitted a determination of the part of speech of the word.

6.3.1.4.2. List-Matching Task. In the second task, subjects made a series of decisions in which they matched the word to one of two or three lists of English

words on the basis of its part of speech. The word lists appeared on a separate sheet (see Appendix E). By having subjects match the word to a list, the task did not require any *explicit* (i.e., conscious) knowledge about the names or even the existence of specific parts of speech.

The subject's first choice in this task was between a list of nouns (common nouns and proper nouns) and a list of predicators (verbs and adjectives).

If the subject matched the word to the list of nouns, then the next choice was between a list of proper nouns and common nouns. If the subject chose the list of common nouns, the next choice was between a list of count nouns and a list of mass nouns.

If the subject first matched the word to the list of predicators, the next choice was between a list of verbs and a list of adjectives. If the subject chose the verb list, the next choice was between a list of intransitive verbs and a list of transitive verbs. If the subject chose the adjective list, the next choice was among a list of adjectives that can appear both attributively and predicatively, a list of adjectives that can only appear in predicative position, and a list of adjectives that can only appear in attributive position (i.e., in front of a noun).

After each choice, the subject was asked to rate his or her level of confidence in the decision on a five-point scale (with the extremes of the scale coded as "wild guess" and "highly confident").

This response task forced the subject to choose one part of speech for the word. It was hoped that this choice would reflect the "lexical" or "default" category. Words can and do change their part of speech when placed in appropriate linguistic contexts, but most words have one part-of-speech category that is the default or the lexical part of speech. For example, if someone is asked what is the part of speech of the word "run," he or she will typically say "verb." But when the word is placed in a meaningful noun context (e.g., "He went for a run around the park"), the listener can readily accept the utterance as grammatical. The list-matching task has the advantage of tapping into the lexical or default category of the word. Its disadvantage is that people's intuitions about the category of a word

outside a sentential context might be somewhat weak, and the matching task might therefore be quite difficult. In addition, this task produces many missing values because a given choice eliminates other ones that follow from the choice not made (i.e., a choice of the noun list at one stage eliminates the verb/adjective choice and choices among verbal and adjectival subcategories); as a result, one cannot analyse the data for all measures while retaining statistical power.

6.3.1.4.3. Grammaticality Task. The third response task complements the second one. Its advantages are that, first, it asks subjects to make judgements about which they have strong intuitions and, second, it provides data for all trials and all subjects for each part of speech. Its disadvantage is that it allows the word to change categories depending on the context, preventing a determination of the default or lexical category. In this task, subjects were asked to judge the grammatical appropriateness, or grammaticality, of placing the word in various contexts. Each context was appropriate for a word belonging to a specific part of speech. Here are the contexts:

<i>Count Noun:</i>	"I am thinking of another ____."
<i>Mass Noun:</i>	"There is too much ____."
<i>Proper Noun:</i>	"Ask ____ to do it."
<i>Transitive Verb:</i>	"She/it was ____-ing it/her."
<i>Intransitive Verb:</i>	"He/it was ____-ing."
<i>Predicative Adjective₁:</i>	"He/it remains ____."
<i>Predicative Adjective₂:</i>	"He/it is really ____."
<i>Attributive Adjective:</i>	"Let's talk about the ____ one."

Subjects were asked to fill in the blank mentally with the nonce word (as it appeared at the top of the response sheet, i.e., in root form) and to decide if the sentence was grammatically appropriate. They responded on a five-point scale with the extremes of the scale coded as "inappropriate" and "appropriate." They were asked to concentrate on grammaticality rather than meaning, although a grammatical sentence was usually meaningful. (Two contexts for predicative

adjectives were included because not all such adjectives fit well in either of these contexts, but most fit well in one or the other.)

6.3.2. Results

Of the 42 subjects, 4 were unable to adequately learn the response tasks as evidenced by many errors on the practice trials. Data for these subjects were not included in the analyses. The resulting sample size is 38.

For tests of significance, the nominal level of probability α used as the criterion for significance was set at .01 because of the large number of tests conducted (i.e., to reduce somewhat the probability of making a type I error). Because of the necessity of performing repeated-measures analyses, and because violations of the repeated-measures ANOVA's assumptions of compound symmetry and sphericity were suspected, a multivariate approach to repeated-measures analysis was taken (see Davidson, 1972; Romaniuk et al., 1977). Because the assumptions of normality and homogeneity of variance and covariance were violated, a criterion that is robust against these violations (see Olson, 1974), the Pillai-Bartlett Trace Criterion V (Bartlett, 1939; Pillai, 1955), was used whenever possible. For a few analyses, a singular or nearly singular matrix prevented the use of the multivariate technique. In those instances, a univariate repeated-measures ANOVA was run, but significance of the F statistic was determined using degrees of freedom adjusted according to the Greenhouse-Geisser method of correction (see Geisser & Greenhouse, 1958; Greenhouse & Geisser, 1959). For planned comparisons and for main effects, in multi-way analyses, of factors with only 2 levels, the F values reported are the square of the t value for dependent samples. Note that the t test is robust against violations of its assumptions of normality and homogeneity of variance when the treatment groups are of equal size and the sample size exceeds 25 or 30 (e.g., Boneau, 1960).

6.3.2.1. Measures

For the List-Matching task, a measure was constructed for each choice to reflect both the decision made and the level of confidence in that decision. The highest level of confidence was coded as "1" if the subject chose the list on the left, and as "10" if the subject chose the list on the right. The lowest level of confidence was coded as "5" for the list on the left and "6" for the list on the right. The numbers from 2 to 4 represent intermediate levels of confidence for a choice of the list on the left, and the numbers from 7 to 9 represent intermediate levels of confidence for the choice of the right-hand list.

For the Grammaticality task, the scores range between 1 and 5 where "1" indicates that the subject felt the context was inappropriate and "5" indicates that the context seemed appropriate.

For the Meaning task, the data are nominal, with seven possible values, one for each category of meaning.

6.3.2.2. List-Matching Task

The first choice in this task was between a list of nouns and a list of predicators. This is the key choice for a test of the learning theory presented in this dissertation. The means for all trials appear in Table 7.

Inspection of the table shows a strong effect of Video Type: For trials on which subjects viewed a video of an object or stuff of an unfamiliar kind, the means are all well below 5.5, indicating that the word was matched to the noun list. For all but one trial on which subjects viewed a video of an action of unfamiliar type, the means are above 5.5, indicating that the word was usually matched to the predicator list. The one exception is the condition in which an entity of an unfamiliar kind (a mud-skipper) was shown performing an intransitive action of unfamiliar type. Here, the unfamiliarity of the agent's kind seemed to favour a noun interpretation for the novel word.

For almost every type of video, a significant effect of Word Context was obtained; for Stuff trials, the effect was nearly significant ($p = .017$). (See the V values in Table 7.)

Table 7

Means (and standard deviations) for the noun/predicator choice on the List-Matching task for all trials in Experiment 3. (Means in the ranges 1-5.5 and 5.5-10 show a tendency to match the word to the noun list and to the predicator list respectively.)

Video Type	Word Context	Mean (Standard Deviation)
Object		
	Count Noun	1.21 (0.70)
	Mass Noun	1.89 (1.61)
	Neutral Noun	1.26 (0.69)
	Isolated	2.11 (1.97)
	$V(df)$	5.01 (3, 35)*
Stuff		
	Count Noun	1.95 (1.79)
	Mass Noun	1.21 (0.53)
	Neutral Noun	1.29 (0.57)
	Isolated	2.18 (2.44)
	$V(df)$	3.87 (3, 35)
Intransitive Action		
	Intransitive Verb	9.92 (0.27)
	Predicative Adjective	9.39 (1.00)
	Attributive Adjective	9.21 (2.03)
	Word + NP	6.42 (3.82)
	NP + Word	8.92 (2.10)
	Word + <i>-ing</i>	9.78 (0.50)
	Contrastive	7.89 (2.75)
	Isolated	6.32 (3.72)
	$V(df)$	16.93 (7, 30)*
Transitive Action		
	Transitive Verb	9.87 (0.41)
	SVO	9.87 (0.34)
	SOV	8.89 (1.77)
	VSO	7.84 (3.03)
	Word + <i>-ing</i>	9.55 (1.18)
	Contrastive	7.87 (2.91)
	Isolated	6.74 (3.70)
	$V(df)$	9.06 (6, 32)*
Unfamiliar Agent or Object (Isolated Word)		
	-Intransitive Action/Agent Unfamiliar	2.61 (2.75)
	-Transitive Action/Agent Unfamiliar	5.89 (3.77)
	-Transitive Action/Object Unfamiliar	6.39 (3.59)
	$V(df)$	21.72 (2, 36)*

*Significant at $\alpha = .01$.

6.3.2.2.1. Object and Stuff Trials. For these trials, the results for Word Context can be summarised as follows: In the Isolated condition (in which the word appeared by itself), subjects were less confident that the word was a noun than in the three conditions in which the word appeared in a noun context of some sort – although none of the means was found to differ significantly from any other at the $\alpha = .01$ level in Tukey HSD post hoc tests.

On 94 percent of the Object and Stuff trials, the subject indicated in the List-Matching task that the word was a common noun (versus a proper noun or a predicator). The results presented below are for the choice between the list of count nouns and the list of mass nouns.

An ANOVA was run using two within-subjects factors and their interaction. The first factor was Video Type: Object or Stuff. The second factor was Word Context: Count Noun ("IT'S A <nonce word>"), Mass Noun ("IT'S SOME <nonce word>"), Neutral Noun ("LOOK AT THE <nonce word>"), or Isolated (i.e., the nonce word alone). A multivariate technique was used for the second factor and for the interaction effect.

The main effects for both factors were significant, and the interaction was also significant. For Video Type, $F(1, 23) = 251.45, p < .01$. For Word Context, $V(3, 21) = 24.77, p < .01$. For the interaction, $V(3, 21) = 16.99, p < .01$. The largest effect was the main effect of Video Type. The values of the dependent variable can range from 1 to 10, where "1" indicates high confidence that the word is a count noun and "10" indicates high confidence that the word is a mass noun. The mean for the Object trials was 2.54 ($SD = 1.13$); the mean for the Stuff trials was 8.13 ($SD = 0.97$).

The effect of syntax was apparent only when the linguistic context and the stimulus were such as to favour competing hypotheses about the word's noun subcategory. In two planned comparisons, one for each Video Type, the trials in which the syntax and the stimulus were incongruent in this way were found to differ significantly from the other trials; for Object trials, $F(1, 23) = 28.79, p < .01$; for Stuff trials, $F(1, 23) = 54.90, p < .01$. When there was an incongruence

between the syntax and the stimulus, subjects tended to make choices consistent with the syntax, but they did so, on average, with very low confidence in their decisions; see Table 8.

Table 8

Means (and standard deviations) for the count-noun/mass-noun choice on the List-Matching task for combinations of object or stuff trials with the subcategory-specific Word Contexts in Experiment 3. (Means in the range 1-5.5 indicate a tendency to choose the count-noun list, and means in the range 5.5-10 indicate a tendency to choose the list of mass nouns.)

Word Context	Video Type	
	Object	Stuff
Count Noun	1.50 (1.70)	4.47 (3.84)
Mass Noun	5.54 (4.05)	9.76 (0.49)

In Tukey HSD post hoc tests, it was found that on Object trials, the means for the Count-Noun context, the Neutral-Noun context, and the Isolated condition did not differ significantly. Similarly, on Stuff trials the means did not differ for the Mass-Noun context, the Neutral-Noun context, and the Isolated condition. These findings suggest that when an object of an unfamiliar kind is presented, no distributional clues are necessary to determine that the word is a count noun. When stuff of an unfamiliar kind is presented, no positive evidence from syntax is required to classify the word as a mass noun. McPherson (1991), Gordon (1985), and Soja (1992; Soja et al., 1991) obtained similar results with young children. The

results for the Object and Stuff trials indicate that adults have access to a learning method used early in learning a first language, that is, the method that McPherson showed to be operative in one- to three-year-olds lacking sufficient knowledge of syntax to identify count nouns and mass nouns on a distributional basis. The adults' access to this early learning method increases one's optimism that adults also have access to early learning methods for identifying predicators, methods used prior to acquiring extensive knowledge about the distributional privileges of verbs and adjectives. If such optimism is well-founded, then the data for the action trials of this experiment may tell us something about young children's predicator-identification methods, as hoped. Let us now examine those data.

6.3.2.2. Intransitive-Action Trials. For these trials, means tended to be higher for the noun/predicator measure when the word's context contained noun-phrase arguments, reflecting a higher proportion of matches to the predicator list. A planned contrast compared the means for the conditions in which the word appeared with an explicit argument (with or without distributional clues) and the conditions in which no argument was present in the word context. The contrast was not quite significant at $\alpha = .01$: $F(1, 36) = 4.64$, $p = .019$ (one tailed; the direction of the difference was predicted from the theory). The failure to obtain a significant contrast might be due to the large mean for the Word + *-ing* condition relative to the means for the other two contexts in which no argument appeared, and, as well, to the small mean in the Word + NP condition relative to the means for the other contexts containing arguments. In Tukey HSD post hoc tests, the mean for the Word + *-ing* condition was found to differ significantly from the mean for the Isolated condition; the difference with the mean for the Contrastive condition, the remaining context in which no argument appeared, was nearly significant ($p = .019$). The mean for the Word + NP condition was found to differ significantly from all of the means for other conditions with an argument in the context. The low mean in the Word + NP condition reflects a large number of decisions to categorise the word as a proper noun. In English, a phrase such as

"Fido the dog" is common, and subjects may have assumed that the word in front of the NP was a proper noun in a phrase such as this one.

Distributional clues associated with the categories *verb* and *adjective* increased subjects' tendency to identify the word as a predicator with a high level of confidence. When the word appeared with an NP, means were higher if the context was a grammatical sentence in English (i.e., in the Intransitive-Verb condition or in one of the two adjective conditions): $F(1, 36) = 27.54, p < .01$. When no NPs appeared in the word's context, a verb clue still promoted predicator identification; in a contrast, the mean for the Word + *-ing* condition was found to be significantly higher than the mean for the other two conditions in which the word appeared without noun phrases (i.e., Contrastive and Isolated): $F(1, 36) = 42.11, p < .01$.

A principle of contrast did not seem to play any significant role in part-of-speech decisions in this task, or at least knowledge of a proper name for the agent did not promote an action interpretation. (The subjects likely already knew a basic-level noun for the agent, so reminding them of this noun by presenting it might have no effect in blocking a basic-level noun interpretation over and above the effect of their knowledge of the noun.) In the Contrastive condition, the mean response was lower than in most conditions (although it was only significantly lower than one mean, the mean for the Intransitive-Verb condition, according to Tukey HSD post hoc tests), and the mean was not significantly higher than the mean in the Isolated condition. So when the novel word appeared alone, the ruling out of a proper-noun interpretation did not make predicator interpretations significantly more frequent.

For trials on which the subject interpreted the word as a predicator according to the List-Matching task, the choice of the verb list or the adjective list varied across conditions: $F(7, 49) = 10.33, p < .01$. One factor affecting decisions was the presence of distributional clues for a specific subcategory of predicator. In a planned contrast comparing the conditions in which the word appeared with verb syntax (Intransitive-Verb context or Word + *-ing*) and adjective syntax

(Predicative Adjective or Attributive Adjective), mean responses were found to differ significantly: $F(1, 7) = 36.85, p < .01$. The presence of a noun-phrase argument without distributional clues seemed to favour verb interpretations; when the word appeared with an argument, it tended to be interpreted as a verb unless it appeared in an adjective context. A contrast between the adjective conditions and the two conditions with an argument but lacking verb syntax was significant: $F(1, 7) = 20.78, p < .01$. This result may indicate that the adults in this study had learned a correlation between actions and verbs, or they may have had an (unlearned) expectation that actions, which are prototypical of the nonseparable, will be associated with verbs, which are prototypical of predicators (see section 6.3.3). Verb syntax did not increase greatly the tendency to classify the word as a verb beyond the level attained with the presence of arguments alone. A contrast between the two verb-syntax conditions and the two argument-without-syntax conditions was not significant at $\alpha = .01$: $F(1, 7) = 8.41, p = .023$.

When subjects indicated that the word was a verb on the List-Matching task, they almost always judged the word to be an intransitive (versus a transitive) verb (see Table 9), except in the Word + NP condition. Perhaps the placement of the argument after the word suggested to these English speakers that the NP was the object of the verb, even though it signified the agent of the action.

Most subjects have a missing value for the choice between the intransitive-verb and transitive-verb lists in the adjective conditions, so these two conditions were dropped in comparing means across conditions. The effect of condition was not significant: $F(2, 8) = 3.63, p = .076$ (a repeated-measures ANOVA with Greenhouse-Geisser corrected degrees of freedom was used because the small number of data prevented any meaningful use of a multivariate procedure). The means for all conditions are presented in Table 9.

It is interesting that the lowest mean is for the Intransitive-Verb condition. This is the only condition in which a lack of transitivity is absolutely clear from the word's context (although the presence of one and only one noun phrase in the

Table 9

Mean response for the intransitive/transitive verb choice on the List-Matching task for Intransitive-Action trials in Experiment 3. (Means in the range 1-5.5 indicate a tendency to choose the intransitive-verb list, and means in the range 5.5-10 indicate a tendency to choose the transitive-verb list.)

Word Context	Mean (Standard Deviation)	
Intransitive Verb	1.53	(1.56)
Predicative Adjective	1.60	(0.70)
Attributive Adjective	2.20	(1.30)
Word + NP	6.17	(3.76)
NP + Word	2.12	(1.90)
Word + <i>-ing</i>	1.97	(2.05)
Contrastive	2.79	(2.72)
Isolated	2.75	(2.10)

Word + NP and NP + Word contexts, and in the adjective contexts, would tend to suggest that the word was not a transitive verb). Despite the lack of any object of the action, subjects were less sure that the verb was intransitive when clear evidence about its argument structure was lacking, although not significantly so in post hoc tests.

6.3.2.2.3. Transitive-Action Trials. Results for the Transitive-Action trials were similar to those for the Intransitive-Action trials. In choosing between the lists of nouns and predicators, the presence of noun-phrase arguments increased the subjects' level of confidence in their choice of the predicator list. In a planned contrast, the mean for the conditions in which the word appeared with NP

arguments was found to differ significantly from the mean for trials on which no NPs appeared with the word: $F(1, 37) = 11.64, p < .01$ (one tailed). In the Isolated condition and in the Contrastive condition, a number of subjects (13 and 7) interpreted the word as a noun, and most of these (11 and 6) interpreted the word as a common noun in particular (usually a count noun). In tests of proportions comparing pairs of Word Context conditions, it was found that the proportion of subjects interpreting the word as a noun in the Isolated condition (.34) was significantly higher than in three of the conditions in which the word appeared with noun phrases (SVO, SOV, and Transitive Verb; the proportions were .00, .05, and .00 respectively; for these three proportions, $Z = 3.96, 3.17$, and $3.96, p < .01$, one tailed, in each case), and it was also higher than the proportion in the Word + *-ing* condition (.03; $Z = 3.55, p < .01$, one tailed); the proportion in the Contrastive condition (.18) was significantly higher than in two of the conditions with noun-phrase arguments (SVO and Transitive Verb; the proportion was .00 for both of these conditions; $Z = 2.78$ in each case, $p < .01$, one tailed). These results provide support for the hypothesis that the presence of noun-phrase arguments will increase the likelihood of a predicator interpretation (versus a noun interpretation).

Verbal distributional clues also favoured a match with the predicator list. Among the conditions including arguments in the word context, the mean for the Transitive-Verb context was significantly higher than for the other three contexts combined; the latter contained arguments but no distributional clues (SVO, SOV, and VSO): $F(1, 37) = 17.72, p < .01$. It should be noted, though, that the means for the Transitive-Verb context and the SVO condition were identical. Among the conditions in which no NPs appeared, the condition providing a distributional clue (Word + *-ing*) yielded a higher mean than the other two conditions (Isolated and Contrastive): $F(1, 37) = 28.83, p < .01$.

No effect of contrast was evident in these trials for the noun/predicator choice in the List-Matching task. The mean for the Contrastive condition was not significantly higher than the mean for the Isolated condition, according to a Tukey

HSD post hoc test, suggesting that knowledge of a proper noun for the agent does not promote predicator identification. (The basic-level count noun for the agent's kind was likely familiar, so the only effectively new information in this condition is the proper name.)

In the VSO condition, subjects often assumed the word was a proper name, as they did during an Intransitive-Action trial in the Word + NP condition. Of the 38 subjects, 7 (18.4 percent) interpreted the word as a proper noun. This type of response lowered the overall mean for this condition.

In the choice between a list of verbs and a list of adjectives, virtually all subjects who interpreted the word as a predicator chose the list of verbs in all conditions. In choosing between the intransitive-verb and transitive-verb categories, mean responses differed across conditions: $F(4, 45) = 7.18, p < .01$ (from a repeated-measures ANOVA with Greenhouse-Geisser corrected degrees of freedom; there were too few data for a multivariate analysis). When no arguments appeared in the word's context, subjects displayed a greater tendency to match the word to the Intransitive-Verb list: $F(1, 12) = 34.29, p < .01$. In other words, positive evidence of transitivity was often needed to classify the word as a transitive verb, even though the action was transitive. This result shows that for the distinction between transitive and intransitive verbs, a more tenuous link exists between meaning and part of speech than was observed in the Object and Stuff trials for the distinction between count nouns and mass nouns; in those trials, the presence in the video of an object or stuff of an unfamiliar kind was sufficient for determining the subcategory of noun (count or mass). The means for the intransitive/transitive choice are shown in Table 10.

6.3.2.2.4. Unfamiliar Agent or Object Trials. When the agent or object of an action of unfamiliar type was of an unfamiliar kind, predicator interpretations were less frequent when the agent's kind was unfamiliar, for one of two such trials, but not when the object's kind was unfamiliar; for the intransitive action with an agent of an unfamiliar kind, the mean on the noun/predicator measure

Table 10

Mean response for the intransitive/transitive verb choice on the List-Matching task for Transitive-Action trials in Experiment 3. (Means below and above 5.5 indicate a tendency to choose the intransitive-verb list and the transitive-verb list respectively.)

Word Context	Mean (Standard Deviation)
Transitive verb	9.21 (2.03)
SVO	9.17 (1.98)
SOV	7.81 (3.06)
VSO	9.00 (1.63)
Word + <i>-ing</i>	5.57 (3.94)
Contrastive	4.32 (3.35)
Isolated	5.04 (3.30)

was significantly lower than the means for the other two conditions, according to Tukey HSD post hoc tests. Subjects choosing the noun list in this condition matched the word to the list of count nouns on 91 percent of the trials; otherwise, they matched it to the list of proper names. When we look at the results for the meaning task, it will become clear that this finding is due to an effect of contrasting meanings, so that action and predicator interpretations are considered only when a basic-level-kind hypothesis about meaning is ruled out by prior learning of a basic-level noun for the kind of object, as required in the Nonseparability Method of predicator identification. The absence of any strong effect in this direction for the transitive actions with an agent or object of an unfamiliar kind is discussed later, when the results for the Grammaticality Task and the Meaning Task are presented.

6.3.2.3. Grammaticality Task

The results for this task were similar to those obtained in the List-Matching task. The mean responses for all trials are shown in Table 11. Note that means near 1 indicate that the word context was generally judged inappropriate for the word, whereas means near 5 indicate a preponderance of judgements that the context was appropriate.

The pattern of means shows a strong effect of Video Type: Words presented during an Object trial were judged to fit well in the Count-Noun context; in the Stuff trials, the word was judged grammatical in the Mass-Noun context; in the Intransitive-Action trials, the Intransitive-Verb context was judged appropriate for the word in most conditions; on Transitive-Action trials, both the verb contexts were judged suitable for the word (reflecting, perhaps, the grammaticality in English of dropping an object argument); for the three conditions involving an agent or object of an unfamiliar kind involved in an action of unfamiliar type, one of the verb contexts (the Intransitive-Verb context) was judged appropriate for the word in two conditions (and the Count-Noun context was judged appropriate in one condition – Intransitive Action, Unfamiliar Agent). For all other combinations of Video Type, Word Context, and Task, the means tend to be below the value of the neutral point in the 5-point rating scale (i.e., 3).

6.3.2.3.1. Object and Stuff Trials. Significant effects of Word Context (see the V and F values in Table 11) were found for means in the Count-Noun and Mass-Noun grammaticality tasks. (The significant effects for the Predicative-Adjective contexts are due to the fact that mass nouns, but not count nouns, fit fairly well in these contexts; e.g., "It is really butter," and "It remains ice.") In addition to these analyses, a two-way ANOVA was run for each of the two common-noun grammaticality tasks, with Video Type (Object or Stuff) and Word Context (Count Noun, Mass Noun, Neutral Noun, or Isolated) as repeated measures. For means from the Count-Noun grammaticality task, the main effects

Table 11. Means (and standard deviations) in the Grammaticality tasks for all trials in Experiment 3.

Video Type Word Context	Grammaticality Task							
	Count Noun	Mass Noun	Proper Noun	Intrans. Verb	Trans. Verb	Pred. Adj.,	Pred. Adj.,	Attrib. Adj.
Object								
Count Noun	4.82 (0.69)	1.13 (0.41)	1.18 (0.51)	1.11 (0.52)	1.05 (0.32)	1.37 (1.02)	1.50 (1.27)	1.55 (1.20)
Mass Noun	3.18 (1.84)	3.26 (1.90)	1.29 (0.73)	1.19 (0.70)	1.16 (0.68)	2.18 (1.75)	2.34 (1.77)	1.55 (1.16)
Neutral Noun	4.61 (1.03)	1.37 (1.00)	1.45 (1.08)	1.16 (0.69)	1.08 (0.36)	1.37 (1.00)	1.55 (1.25)	1.45 (1.03)
Isolated	4.34 (1.38)	1.47 (1.03)	1.32 (0.90)	1.35 (1.06)	1.29 (0.96)	1.68 (1.32)	1.89 (1.54)	1.34 (0.97)
$\bar{y}$ (df)	11.09 (3, 35)*	19.84 (3, 35)*	0.93 (3, 35)	1.36 (3, 34)	2.05 (3, 35)	3.25 (3, 35)*	3.47 (3, 35)*	0.53 (3, 35)
Stuff								
Count Noun	3.89 (1.69)	2.76 (1.79)	1.11 (0.39)	1.32 (0.96)	1.16 (0.68)	1.95 (1.56)	2.05 (1.63)	1.47 (1.01)
Mass Noun	1.82 (1.47)	4.89 (0.39)	1.08 (0.36)	1.34 (1.05)	1.29 (1.01)	3.03 (1.85)	2.95 (1.86)	1.45 (0.98)
Neutral Noun	1.68 (1.28)	4.79 (0.91)	1.08 (0.36)	1.21 (0.81)	1.21 (0.81)	3.05 (1.84)	3.00 (1.87)	1.21 (0.74)
Isolated	1.84 (1.39)	4.66 (1.02)	1.14 (0.67)	1.42 (1.11)	1.55 (1.27)	2.84 (1.82)	3.03 (1.92)	1.32 (0.93)
$\bar{y}$ (F) (df)	14.13 (3, 35)*	18.74 (3, 35)*	0.73 (1, 50)	0.44 (3, 35)	1.04 (3, 35)	4.19 (3, 35)*	3.54 (3, 35)*	1.88 (3, 35)
Intransitive Action								
Intrans. V	1.26 (0.92)	1.92 (1.51)	1.00 (0.00)	4.82 (0.69)	2.16 (1.52)	1.84 (1.52)	2.18 (1.74)	1.82 (1.44)
Pred. Adj.	1.18 (0.69)	1.37 (1.05)	1.00 (0.00)	2.34 (1.85)	1.37 (0.94)	3.68 (1.47)	3.89 (1.57)	3.92 (1.60)
Attrib. Adj.	1.26 (0.86)	1.39 (1.05)	1.03 (0.16)	2.08 (1.60)	1.24 (0.63)	3.47 (1.77)	4.00 (1.51)	4.16 (1.37)
Word+NP	2.37 (1.78)	1.13 (0.66)	2.53 (1.94)	2.92 (1.94)	2.37 (1.85)	1.89 (1.57)	2.11 (1.77)	1.34 (1.02)
NP+Word	1.32 (0.77)	1.45 (1.13)	1.21 (0.91)	4.29 (1.47)	2.11 (1.57)	1.58 (1.29)	1.58 (1.31)	1.45 (1.11)
Word+-ing	1.30 (0.91)	1.83 (1.46)	1.03 (0.16)	4.81 (0.74)	2.22 (1.51)	1.59 (1.12)	1.76 (1.40)	1.76 (1.40)
Contrastive	1.97 (1.62)	1.29 (1.01)	1.11 (0.65)	3.74 (1.80)	2.11 (1.67)	1.92 (1.44)	2.08 (1.58)	1.95 (1.52)
Isolated	2.32 (1.77)	1.55 (1.22)	1.39 (1.03)	3.29 (1.86)	1.89 (1.47)	1.79 (1.51)	1.84 (1.55)	1.76 (1.42)
$\bar{y}$ (F) (df)	4.94 (7, 30)*	2.02 (7, 29)	14.23 (2, 76)*	18.39 (7, 30)*	7.32 (7, 30)*	15.13 (6, 207)*	16.32 (5, 188)*	22.35 (7, 30)*
Transitive Action								
Trans. Verb	1.11 (0.51)	1.58 (1.27)	1.00 (0.00)	3.00 (1.59)	4.82 (0.73)	1.39 (1.00)	1.68 (1.36)	1.37 (0.97)
SVO	1.16 (0.72)	1.08 (0.36)	1.05 (0.32)	3.34 (1.74)	4.61 (1.03)	1.47 (1.20)	1.47 (1.20)	1.45 (1.13)
SOV	1.21 (0.91)	1.53 (1.16)	1.05 (0.32)	3.11 (1.77)	3.53 (1.83)	2.03 (1.67)	2.11 (1.66)	1.53 (1.22)
VSO	1.82 (1.52)	1.37 (1.05)	1.66 (1.44)	3.08 (1.76)	3.95 (1.61)	1.95 (1.59)	1.95 (1.56)	1.37 (1.00)
Word+-ing	1.13 (0.67)	1.71 (1.43)	1.00 (0.00)	4.00 (1.47)	3.72 (1.67)	1.58 (1.08)	2.24 (1.57)	1.74 (1.37)
Contrastive	1.61 (1.31)	1.34 (0.94)	1.13 (0.66)	3.89 (1.69)	2.42 (1.70)	1.50 (1.16)	1.55 (1.29)	1.45 (1.18)
Isolated	2.08 (1.67)	1.42 (1.13)	1.13 (0.66)	2.87 (1.68)	2.76 (1.82)	1.39 (0.97)	1.82 (1.49)	1.21 (0.70)
$\bar{y}$ (F) (df)	3.82 (6, 32)*	2.24 (6, 32)	14.11 (2, 86)*	2.85 (6, 32)	19.39 (6, 30)*	1.48 (6, 32)	2.20 (6, 32)	1.29 (6, 32)
Unfamiliar Agent or Object (Isolated Word)								
-Intransitive	4.18 (1.49)	1.18 (0.65)	1.61 (1.28)	1.50 (1.27)	1.05 (0.23)	1.55 (1.31)	1.71 (1.47)	1.53 (1.08)
-Trans. Agent	2.84 (1.92)	1.21 (0.66)	1.50 (1.22)	3.05 (1.94)	1.84 (1.48)	1.71 (1.39)	1.84 (1.57)	1.39 (0.92)
-Trans. Object	2.50 (1.80)	1.55 (1.29)	1.26 (0.86)	3.34 (1.82)	2.37 (1.79)	1.82 (1.47)	1.79 (1.53)	1.71 (1.33)
$\bar{y}$ (df)	13.93 (2, 36)*	1.89 (2, 36)	1.49 (2, 36)	17.16 (2, 36)*	11.40 (2, 36)*	1.46 (2, 36)	0.49 (2, 36)	1.47 (2, 36)

Significant at $\alpha = .01$.

of Video Type and Word Context were significant: For Video Type, $F(1, 37) = 111.48$, $p < .01$; for Word Context, $V(3, 35) = 19.38$, $p < .01$. The interaction was also significant: $V(3, 35) = 9.76$, $p < .01$. For the Mass-Noun grammaticality task, the main effects of Video Type and Word Context were also significant, as was the interaction of these factors: For Video Type, $F(1, 37) = 302.70$, $p < .01$; for Word Context, $V(3, 35) = 21.42$, $p < .01$; and for the interaction, $V(3, 35) = 9.13$, $p < .01$. These results can be interpreted as follows: Words paired with objects were usually interpreted as count nouns, and words paired with stuff were usually interpreted as mass nouns. Responses deviated from this pattern if the Word Context was incongruent with the Video Type; when the word was presented in a Mass-Noun context on an Object trial, or in a Count-Noun context on a Stuff trial, it was judged to fit better in a context appropriate for the type of noun implied by the distributional clues in its context during presentation. Post hoc Tukey HSD tests indicated that for the Object trials, the mean responses on the Count-Noun grammaticality task differed only for the trial on which an object was paired with the Mass-Noun context for the word. For the Stuff trials, the mean differed only when stuff was paired with the Count-Noun word context. This same pattern of mean differences obtained in the Mass-Noun grammaticality task, with the direction of the mean differences reversed. In the absence of an incongruence between Video Type and Word Context, the subjects were no more likely to classify the word as a count noun or mass noun when the word appeared in a Count-Noun or Mass-Noun context respectively than they were on the trials in which the word appeared by itself (the Isolated condition) or in the Neutral-Noun context. These findings confirm the findings with adults in the List-Matching task, as well as earlier findings with children (Gordon, 1985; McPherson, 1991; Soja, 1992; Soja et al., 1991): The presence of an object or some stuff of an unfamiliar kind is sufficient for classifying a novel word as a count noun or mass noun; no positive evidence from syntax is required for such classification to occur. These data also support my earlier conclusion that adults have access to a learning method used early in language learning for identifying count nouns and mass

nouns; their ability to use this one early learning method suggests that they might also be able to use other early learning methods, such as those used in identifying predators.

6.3.2.3.2. Intransitive-Action Trials. Subjects judged the word to fit best in the Intransitive-Verb context in all but the adjective-context conditions. An effect of the presence or absence of noun-phrase arguments in the word's context on subject's judgements of the appropriateness of the Intransitive-Verb context was obscured by a large effect of distributional clues to verb or adjective status, and a low mean for the Word + NP condition in which many subjects interpreted the nonce word as a proper noun (because of the familiarity of strings such as "Fido the dog"); according to a planned comparison, the mean for all conditions with an NP argument excluding the adjective conditions did not differ significantly from the mean for all conditions in which no argument was present: $F(1, 36) = 0.00$, $p = .959$. The presence of distributional clues to verb status played a strong role in subjects' judgements. Among the conditions in which the word appeared with NP arguments, the mean for the condition providing verb clues (Intransitive Verb) was found to be significantly higher than the mean for the two conditions with no distinctive verb clues (Word + NP and NP + Word) in a planned contrast: $F(1, 36) = 34.14$, $p < .01$. (Note, though, that the mean for the Word + NP condition was lowered because of frequent proper-noun interpretations.) Among the conditions in which the word's context lacked NP arguments, the mean for the condition providing a verb clue (Word + *-ing*) was found to be significantly higher than the means for the conditions providing no verb clues (Isolated and Contrastive): $F(1, 36) = 26.93$, $p < .01$.

A principle of contrast did not seem to influence subjects' judgements in the Intransitive-Verb task, or at least ruling out a proper noun did not affect judgements. (A basic-level count noun would presumably be ruled out by the subject's knowledge of such a noun, so providing the common noun for the agent might not be expected to affect the decision about the nonce word's part of

speech, i.e., the Contrastive condition would not provide any information about the agent's kind that was not available also in the Isolated condition because of the subject's familiarity with the agent's kind.) The mean for the Contrastive condition was not significantly higher than the mean for the Isolated condition (according to a Tukey HSD post hoc test).

The generally low scores for the Transitive-Verb context task on Intransitive-Action trials indicate that subjects tend not to generalise an intransitive verb to transitive-verb contexts when the associated action does not have an object.

The means differed significantly across Word-Context conditions for all three adjective grammaticality tasks (see the V values in the table). For the Predicative-Adjective context tasks, post hoc tests indicated that the means for the two adjective-context conditions differed significantly from all other means, but not from one another. This finding suggests that the subjects generalised a word appearing in an attributive-adjective context to predicative position. Likewise, in the Attributive-Adjective context task, the means for the two adjective conditions differed significantly from all other means in post hoc tests, but they did not differ significantly from one another. So the subjects appeared also to generalise a word appearing in a predicative-adjective context to attributive position.

6.3.2.3.3. Transitive-Action Trials. For these trials, the presence of NP arguments clearly favoured a verb interpretation for the word; according to the results of a planned contrast, subjects were less likely to find the Transitive-Verb context appropriate when the word context lacked NP arguments: $F(1, 35) = 43.93, p < .01$ (one tailed). This effect of arguments was not present for the Intransitive-Verb context task, though; for this task, there was no significant difference between the conditions including arguments in the word's context and the conditions with no arguments, although a trend in the predicted direction was present: $F(1, 37) = 3.73, p = .031$ (one tailed).

Distributional clues again had an effect on responses. For the conditions in which the word was presented with NP arguments, the condition providing verb clues (Transitive Verb) produced a mean significantly higher than the mean for the conditions lacking verb clues (SVO, SOV, and VSO): For a planned contrast, $F(1, 35) = 17.86, p < .01$. For the conditions without NP arguments, a planned contrast indicated that the mean for the condition providing a verb clue (Word + *-ing*) was significantly higher than the mean for the conditions providing no verb clues (Isolated and Contrastive): $F(1, 35) = 7.97, p < .01$.

No evidence emerged from this task for an effect of contrast due to ruling out a proper name. The mean score for judgements of the appropriateness of the Transitive-Verb context was not significantly higher for the Contrastive word context than for the Isolated word context according to a post hoc test.

All but one of the means for the Intransitive-Verb context task are above 3. It appears that subjects found the intransitive context appropriate for the word despite the presence of an object of the action, and despite its signification by an object noun phrase. In English, the dropping of a transitive verb's object argument is quite common (e.g., "I was eating," "He was shooting," "I am pushing"), and subjects may have come to treat object arguments as optional. Inspection of the means in Table 11 reveals, though, that the presence of an object argument in the word's context was associated with a slight (though nonsignificant) reduction in the tendency to accept an intransitive context for the word.

6.3.2.3.4. Unfamiliar Agent or Object Trials. For trials showing an action of unfamiliar type with an agent or object of an unfamiliar kind, the presence of the action seems to have been associated with less facilitation of verb identification than in the other action trials. The presence of an agent of an unfamiliar kind, but not of an object of an unfamiliar kind, seems to have promoted noun identification, at least for the Intransitive-Action trial. For the Count-Noun grammaticality task, the mean for the Intransitive-Action/Unfamiliar-Agent condition was found to be significantly higher than the other two means in post

hoc tests. For the Transitive-Verb grammaticality task, the mean for the Intransitive-Action trial was found to be significantly lower than the mean for the Transitive-Action/Unfamiliar-Object trial; and for the Intransitive-Verb grammaticality task, the mean for the Intransitive-Action trial was significantly lower than the means for the two Transitive-Action trials; these results reflect the stronger tendency to interpret the word as a noun on this trial. The tendency to identify the word as a noun when the agent of the action was of an unfamiliar kind when and only when the action was intransitive calls for an explanation. In the Transitive-Action/Unfamiliar-Agent condition, the tendency of subjects to interpret the word as a verb for a type of action (see the results for the Meaning Task in section 6.3.2.4.4) may be an artifact of the choice of visual stimulus. The video showed a spoon-bill (a kind of water bird), but for many subjects the bird may have been identified as a duck, and the kind DUCK may be at the basic level, and so the subjects may not have been seeking a name for the kind of animal. In contrast, the mud-skipper shown in the video for the Intransitive-Action/Unfamiliar-Agent trial could not easily be placed in the kind FISH because of its ability to manoeuvre across land and the disguising of its scales by mud covering its body; subjects probably felt a much stronger need for a basic-level count noun naming the species in this case. (In fact, some subjects could not resist asking out loud, "What is that?")

The results for the action trials involving an agent or object of an unfamiliar kind provide support for an assumption of the Nonseparability Method of predicator identification; the data presented here show that noun interpretations are often made, even in the presence of a salient action of an unfamiliar type, when the agent of the observed action is of an unfamiliar kind.

6.3.2.4. Meaning Task

The subjects' choices of categories of meaning for all trials are shown in Table 12 as the percentages of subjects choosing each category, where the animate- and inanimate-object categories have been merged. (The "other" category

Table 12

Percentages of subjects choosing each category of meaning for all trials in Experiment 3.

Video Type	Category of Meaning					
	Word Context	Individual	Object	Stuff	Action	Property
Object						
	Count Noun	2.63	97.37	0.00	0.00	0.00
	Mass Noun	2.63	57.36	34.21	7.89	2.63
	Neutral Noun	5.26	81.58	2.63	0.00	2.63
	Isolated	0.00	84.21	2.63	7.89	2.63
Stuff						
	Count Noun	2.63	57.90	34.21	2.63	2.63
	Mass Noun	0.00	2.63	97.37	0.00	0.00
	Neutral Noun	0.00	10.81	89.19	0.00	0.00
	Isolated	2.63	7.89	81.58	7.89	0.00
Intransitive Action						
	Intransitive Verb	0.00	0.00	0.00	97.37	2.63
	Predicative Adjective	0.00	0.00	0.00	35.14	64.86
	Attributive Adjective	2.63	2.63	0.00	13.16	81.53
	Word + NP	39.47	0.00	0.00	60.53	0.00
	NP + Word	5.26	2.63	0.00	86.84	5.26
	Word + <i>-ing</i>	0.00	0.00	0.00	100.0	0.00
	Contrastive	0.00	13.16	0.00	73.68	13.16
	Isolated	7.89	18.42	0.00	65.79	7.89
Transitive Action						
	Transitive Verb	0.00	0.00	0.00	100.0	0.00
	SVO	0.00	0.00	0.00	100.0	0.00
	SOV	0.00	2.63	2.63	84.21	10.53
	VSO	18.42	0.00	0.00	76.32	5.26
	Word + <i>-ing</i>	0.00	2.63	0.00	97.37	0.00
	Contrastive	0.00	15.79	0.00	78.95	5.26
	Isolated	5.26	21.05	0.00	73.68	0.00
Unfamiliar Agent or Object (Isolated Word)						
	-Intransitive Action/Agent	7.89	78.95	0.00	10.53	2.63
	-Transitive Action/Agent	5.26	42.11	0.00	52.63	0.00
	-Transitive Action/Object	2.70	18.92	0.00	75.68	2.70

of meaning is not included in Table 12 because it was rarely chosen. It was chosen in just 6 instances, all during Object trials: It was chosen twice, or 5.26 percent of the time, when an object was paired with the Mass-Noun context, three times, or 7.89 percent of the time, when an object was paired with the Neutral-Noun context, and once, or 2.63 percent of the time, when an object was paired with the Isolated context.) I will comment on the subjects' choices for each Video Type separately.

6.3.2.4.1. Object and Stuff Trials. A strong effect of Video Type can be observed in the table. On Object trials, subjects usually chose an object category of meaning. On Stuff trials, subjects usually chose the stuff category. But this tendency was attenuated greatly when the distributional clues present in a word's context suggested that a word paired with an object was a mass noun, or that a word paired with some stuff was a count noun. Subjects concluded the word signified a kind of object (animate or inanimate) on almost every trial in which an object was paired with Count-Noun syntax, and only one subject thought the word signified a kind of object when stuff was paired with a Mass-Noun context; but when the Word Context and the Video Type were incongruent, about half of the subjects chose a category of meaning that fit the word's distributionally evident part of speech, namely the stuff/substance category for an apparent mass noun paired with an object, and an object category for an apparent count noun paired with some stuff.

The relationship of choices of part-of-speech categories to choices of meaning categories was strong. In 92 percent of the cases in which a subject indicated that the word was a count noun on the List-Matching task, the subject thought the word signified a kind of animate or inanimate object. For the trials on which a subject matched the word to the list of mass nouns, the subject indicated that the word signified a kind of stuff or substance on 85 percent of the trials.

This relationship is of particular interest for the trials on which the Word Context was incongruent with the Video Type. When subjects saw an object but

categorised the word as a mass noun because it appeared in a context most appropriate for mass nouns (as 47 percent of the subjects did), they said the word signified a kind of stuff or substance 61 percent of the time. When they chose count-noun status for a word after viewing some stuff because the word appeared in a count-noun context (as 61 percent of the subjects did), they indicated that the word signified a kind of object on 87 percent of those trials. So in most cases in which the incongruent syntax led to a change away from the most salient, perceptually based hypothesis about the word's part of speech, it led to a change away from the most salient hypothesis about the meaning of the word as well. When distributional clues promoted an interpretation as a count noun or mass noun, the hypothesised meaning usually changed to match the part of speech (i.e., a kind of object for count nouns and, for mass nouns, a kind of stuff, or at least a kind with nonatomic members; see below).

The choice of an object category for a word appearing in a count-noun context when the video showed stuff of an unfamiliar kind seemed to depend upon the availability in the video of some object that could plausibly be the referent of the noun phrase. Upon viewing the video showing a bag full of small white pellets which were being manipulated in the hand of a man not fully visible, interpretations of the word other than a stuff-kind interpretation would be difficult to make; as a result, over half of the subjects chose the stuff/substance category of meaning, with 83 percent of those subjects identifying the word as a mass noun (in the List-Matching task), in spite of its count-noun context. Of the remaining subjects, 40 percent interpreted the word into a kind of animate object (presumably some kind to which the partially visible man belonged) or into the individual who was manipulating the pellets (as his name); the other 60 percent chose the inanimate-object category (interpreting the word, perhaps, into the water heater next to the bag of pellets, or perhaps into a kind comparable to PEBBLE or PELLET with single pellets as its members, or into the bag containing the pellets). Similarly, the video showing chunks of copper ore being pulled from a rock wall by the hand of a man not fully visible did not lend itself

readily to anything other than stuff-kind interpretations; just under half of the subjects chose the stuff/substance category of meaning, with 75 percent of these subjects classifying the word as a mass noun, apparently ignoring the distributional clues. But over half of the subjects were able to make an object-kind interpretation with this video, as evident in their choice of the inanimate-object category of meaning; so perhaps they took the word to mean something like "rock" or "nugget." When subjects viewed the video of some blue putty being mixed on a palette with a spatula-like mixing implement by a man not fully visible, three quarters of them identified the word as a count noun and chose an object category of meaning; of these, 83 percent chose the inanimate object category (versus the animate object category, which would imply some kind to which the man belonged); they probably interpreted the word into the mixing implement's kind, for this was the most visually salient object in the video. For the video showing a native woman manipulating some coarse dough on a large sieve, only 10 percent of the subjects chose the stuff category of meaning. Half identified the word as a count noun and chose the inanimate-object category, perhaps interpreting the word as a word for the sieve. One fifth of the subjects identified the word as a count noun, but chose the animate-object category of meaning, presumably interpreting the word into some kind to which the woman belonged (e.g., the kind of tribe to which she belonged). Another fifth of the subjects ignored the word's context and chose the activity/action category (apparently linking the word's meaning to the woman's action upon the dough) and identified the word as a verb, or else chose the property/quality category and identified the word as an adjective. It seems, then, that the pairing of what appears to be a count noun with a scene including some stuff of an unfamiliar kind sends the learner on a search for an object for which the word could plausibly be a name; if no such object is present, the learner will often ignore the distributional clues to count-noun status for the word, and interpret it as a mass noun for the kind of stuff.

A parallel effect was evident when the word appeared in a mass-noun context, but was paired with a video featuring an object of an unfamiliar kind; the

plausibility of a stuff/substance interpretation affected subjects' choices among meaning categories. Possible sources of plausibility include this one: An interpretation into the stuff of which something is made seems much more natural for inanimate objects (e.g., artifacts) than for living things. For the one Object video showing an animate being, namely an exotic jellyfish, only 36 percent of the subjects chose the stuff/substance category of meaning. The remaining subjects chose the animate-object category, and of these subjects 71 percent identified the word as a count noun, in spite of the word's appearance in a mass-noun context. (It is possible, though, that the mass-noun context, "IT'S SOME _____," could be interpreted as a context appropriate for common nouns in general if "some" were taken to be, not an indefinite quantifier, but rather an adjective meaning 'a certain,' as in "Some dog followed me around in the park," or an adjective meaning 'quite a,' as in "This is some rainstorm.") Choice of the stuff/substance category was most common for the video showing a musical instrument of a kind unfamiliar to most Westerners, which was being played by a member of a band of Indian musicians; but the subjects choosing the stuff/substance category (40 percent) may have interpreted the word, not into a kind of material, but into the musical sound produced by the musicians, which might be conceptualised as stuff-like; 13 percent of the subjects chose either the stuff/substance or the "other" category of meaning and described the meaning as music or sound¹⁵ (even though the video was not accompanied by sound), so perhaps the same interpretation was made by some of the other subjects choosing the stuff/substance category. One fifth of the subjects interpreted the word into the activity of playing the music, and of these subjects, two thirds took the word to be a mass noun, with the other third identifying the word as a verb. A few subjects (13 percent) interpreted the word into a kind of inanimate object (presumably the musical instrument) and identified it as a count noun, apparently ignoring the

¹⁵Subjects were not asked to describe the word's meaning unless they chose the "other" category of meaning, but they sometimes supplied specific information about their interpretation of the word nonetheless.

word's context. Other, less common, interpretations (each of which was made by 7 percent of the subjects) were: the group of musicians, for which the word was taken to be a common noun (comparable, perhaps, to "mariachi band" or "orchestra"), a quality or property, and a kind of animate object. When the video showed a Victorian posy-holder, the stuff/substance category was chosen by one quarter of the subjects, who interpreted the word into the gold of which the object was made. The remaining subjects interpreted the word into a kind of inanimate object (presumably the posy-holder) and identified the word as a count noun in spite of its mass-noun context. For the video showing an unusual snuff box, one quarter chose the stuff/substance category (perhaps interpreting the word into the kind of stuff out of which the box was made). Half the subjects chose the inanimate-object category, and these subjects were equally divided in identifying the word as a count noun and as a mass noun. The remaining subjects (25 percent) interpreted the word into the partially visible person who was opening the box (as the person's proper name), or into some kind to which that person belonged (as a count noun for that kind). It appears that the subjects, having read a word in a context that is most natural for mass nouns, looked for something nonatomic of some kind — if not the stuff out of which the object was made, then sound of some kind or an instance of activity of some kind; if they were unable to find any suitable referent for a mass noun, then they typically identified the word as a count noun and interpreted it into the kind of object of which an instance was featured in the video.

These results show a strong link between meaning and part of speech for nouns. Presentation of an object of a novel kind leads to an interpretation of a novel word into the kind of object and to its classification as a count noun unless distributional clues lead the learner to conclude that the word is a mass noun. In the latter case, the word is taken to be a stuff-kind word over half the time. Presentation of stuff of a novel kind leads to an interpretation of a novel word into the kind of stuff and to its classification as a mass noun unless the linguistic

context of the word suggests to the learner that it is a count noun. In this case, the word is taken to be an object-kind word most of the time.

The strong link between meaning and part of speech demonstrated in the Object and Stuff trials provides a "baseline" against which the results for the action trials can be compared.

6.3.2.4.2. Intransitive-Action Trials. In these trials, subjects were most likely to think the word signified a type of action in all conditions except the two adjective conditions. This result suggests that the actions shown in the videos were indeed salient, as they were intended to be. It also suggests that the mere presence of a salient action of an unfamiliar type is sufficient, in the absence of incongruent distributional clues, to lead to an interpretation of a novel word as a word for action of the type observed.

Subjects were more likely to decide that the word signified a kind of object or an individual in the Isolated condition than in all other conditions, but they were also quite likely to think the word signified a kind of object in the Contrastive condition. So in the presence of an action, subjects displayed a strong tendency to interpret the word as a word for action of the type observed, but when no arguments or distributional clues were present in the word context, they sometimes interpreted the word as a word for objects of the kind present in the video or as a rigid designator (i.e., a proper name). The proportion of activity/action choices in the presence of arguments without distributional clues or in the presence of verb clues (.92) was significantly higher than the proportion of activity/action choices in the two conditions in which the word appeared alone without the verb ending *-ing* (.70; $Z = 4.39$, $p < .01$, one tailed). Likewise, the proportion of object choices when the word's context contained noun phrases or verb clues (.01) was significantly lower than for the two conditions with a context lacking noun phrases or verb clues (.16; $Z = 4.63$, $p < .01$, one tailed).

Subjects were somewhat more likely to think the word signified a type of activity or action in the Predicative-Adjective than in the Attributive-Adjective

condition, although this difference did not satisfy the .01 criterion for significance ($Z = 2.23$, $p = .026$, two tailed). Some subjects may have thought that the string "THE <noun> IS <word>" (the Predicative-Adjective context) was an ungrammatical verb use, with the word missing the inflexion *-ing*; an interpretation as an ungrammatical verb use is less plausible for the context "LOOK AT THE <word> <noun>" (the Attributive-Adjective context).

The links between meaning and part of speech were strong. Table 13 shows the percentages of choices of various grammatical categories in the List-Matching task on those trials on which subjects indicated that the word signified a type of action.

The intransitive actions were almost always associated with an intransitive verb, or a transitive verb in the Word + NP condition (in which the NP may have been interpreted as the object of the verb). Non-verb categories were chosen with some frequency in a few conditions. In the Predicative-Adjective condition, a word for an action was frequently interpreted as a predicative adjective or, less frequently, a general adjective (that can appear both attributively and predicatively). A word taken to signify the action was interpreted as a common noun only in the two conditions in which the word was presented by itself: the Isolated condition and the Contrastive condition. (Tests of proportions showed that the proportion of subjects interpreting an action word as a common noun was significantly higher in the Isolated condition [.16] than in three conditions: Intransitive Verb, NP + Word, and Word + *-ing*; the proportion was .00 in each of these three conditions; $Z = 2.52$, 2.38 , and 2.52 for these conditions, $p < .01$, one tailed, in each case.) This finding shows that an absence of arguments and distributional verb clues sometimes leads to the interpretation of a word for an action as a common noun. (The category proper noun was never chosen.)

When the meaning category *activity/action* was not chosen, the correspondence between meaning and part of speech was still close during Intransitive-Action trials. In the Isolated condition, all 7 subjects who thought the word signified a kind of object also thought that the word was a count noun. Of

Table 13

For Intransitive-Action trials on which the subject thought the word signified a type of action or activity, the percentages of choices of various parts of speech for the word on the List-Matching task in Experiment 3.

Word Context	Part of Speech						
	CN	MN	IV	TV	Adj	AttA	PrA
Intransitive Verb	0.0	0.0	94.6	2.7	2.7	0.0	0.0
Predicative Adjective	0.0	0.0	69.2	0.0	7.7	0.0	23.1
Attributive Adjective	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Word + NP	0.0	0.0	43.5	56.5	0.0	0.0	0.0
NP + Word	0.0	0.0	93.9	6.1	0.0	0.0	0.0
Word + -ing	0.0	0.0	91.9	5.4	0.0	0.0	2.7
Contrastive	0.0	7.1	75.0	10.7	3.6	0.0	3.6
Isolated	12.0	4.0	72.0	8.0	0.0	0.0	4.0

Key: CN = count noun; MN = mass noun; IV = intransitive verb; TV = transitive verb; Adj = adjective; AttA = attributive adjective; PrA = predicative adjective.

the 3 subjects who thought the word signified a specific individual, 2 indicated that the word was a proper noun and 1 that it was a count noun. In the Contrastive condition, 5 subjects indicated that the word signified a kind of object, and of these subjects 4 concluded that the word was a count noun and 1 chose the proper-noun category. In the Word + NP condition, all 15 subjects who thought the word signified a specific individual also thought the word was a proper noun. In the Attributive-Adjective condition, of the 31 subjects who chose *property/quality* as the word's meaning, 22 (71.0 percent) indicated that the word

was a general adjective, 6 (19.4 percent) said it was an attributive adjective in particular, and 1 (3.2 percent) said it was a predicative adjective; 2 others (6.5 percent) chose the category adjective (versus verb), but failed to indicate which subcategory of adjective best fit the word. In the Predicative-Adjective condition, 19 (79.2 percent) of the 24 subjects who chose *property/quality* in the meaning task also chose the general adjective category; 1 subject (4.2 percent) chose the category attributive adjective, and 3 (12.5 percent) chose the category predicative adjective; just 1 subject indicated that the word was a verb (an intransitive verb).

6.3.2.4.3. Transitive-Action Trials. In these trials, the subjects displayed a strong tendency, in all conditions, to interpret the word as a word for action of the type observed. When the word appeared without arguments or distributional clues, though, many subjects thought the word signified a kind of object, and some thought it signified an individual. For Word Contexts including noun phrases or verb clues, the proportion of action choices (.92) was significantly higher than for the two Word Contexts with no noun phrases and no verb clues (.76; $Z = 3.37$, $p < .01$, one tailed); the proportion of object-kind choices was significantly lower when noun phrases or verb clues were present (.01) than when none were present (.18; $Z = 5.38$, $p < .01$, one tailed).

In the VSO condition, the word was interpreted as a rigid designator for a specific individual by almost one fifth of the subjects. The interpretation of the word as a word for a property of some sort occurred with any frequency in just one condition: the SOV condition.

As with the other Video Types, meaning and part of speech went hand in hand. Table 14 shows the percentage of subjects choosing various parts of speech in the List-Matching task for those trials on which they indicated that the word signified a type of action.

When subjects thought the word or its phrase signified action of the type observed, they almost always interpreted the word as a verb. When NP arguments appeared with the word, they usually chose the transitive-verb category, and when

Table 14

For Transitive-Action trials on which the subject thought the word signified a type of action or activity, the percentages of choices of various parts of speech for the word on the List-Matching task in Experiment 3.

Word Context	Part of Speech						
	CN	MN	IV	TV	Adj	AttA	PrA
Transitive verb	0.0	0.0	5.3	94.7	0.0	0.0	0.0
SVO	0.0	0.0	5.3	89.5	2.6	0.0	2.6
SOV	0.0	0.0	15.6	78.1	3.1	0.0	3.1
VSO	0.0	0.0	6.9	93.1	0.0	0.0	0.0
Word + <i>-ing</i>	0.0	0.0	43.2	51.4	2.7	0.0	2.7
Contrastive	0.0	3.3	63.3	30.0	0.0	0.0	3.3
Isolated word	3.6	7.1	50.0	39.3	0.0	0.0	0.0

Key: CN = count noun; MN = mass noun; IV = intransitive verb; TV = transitive verb; Adj = adjective; AttA = attributive adjective; PrA = predicative adjective.

no arguments were included in the word context, they were about equally likely to choose the transitive-verb and intransitive-verb categories. When the word appeared without arguments, a few subjects interpreted the action word as a common noun, although the proportion doing so did not differ significantly from zero (in one-tailed tests of proportions), that is, from the proportion doing so when noun phrases were present.

In the two Word Context conditions with no arguments and no distributional clues, the subjects often interpreted the word into a kind of object (see Table 12). When they did so, they almost always identified the word as a

count noun; in the Contrastive condition, 5 of the 6 subjects who chose an object category of meaning matched the word to the list of count nouns, and 1 matched it to the list of proper nouns. In the Isolated condition, all 8 subjects who chose an object category identified the word as a count noun.

In the VSO condition, all 7 subjects who thought the word signified a specific individual matched the word to a list of proper nouns.

In the SOV condition, 4 subjects indicated that the word signified a type of property or quality, and 3 of these 4 matched the word to an adjective category. The fourth subject identified the word as a transitive verb.

6.3.2.4.4. Unfamiliar Agent or Object Trials. For the Intransitive-Action/Unfamiliar-Agent trial, the vast majority of subjects chose the animate-object category of meaning. For the Transitive-Action/Unfamiliar-Agent trial, subjects were almost equally divided in choosing the animate-object and the activity/action categories of meaning. These results contrast quite sharply with those for the Isolated condition in the Intransitive- and Transitive-Action trials, in which the agent of the action was always of a familiar kind. For those trials, about two thirds of the subjects chose the activity/action category of meaning. This difference shows that action interpretations are more likely when the agent belongs to a familiar basic-level kind for which a noun is known, providing support for the contrastive component of the Nonseparability Method of predicator identification.

For the Transitive-Action/Unfamiliar-Object trial, most subjects chose the activity/action category. This choice might reflect the conjoint operation of two forces: a bias toward the agent (versus the object) of an action so that subjects would not entertain the hypothesis that the word signified the object's kind, and a tendency to associate new meanings with new words (following Clark's principle of contrast).

As noted above, the tendency to interpret the word as a word for action of the type observed is much weaker during these trials than during the other action

trials in which an action was paired with an uninflected isolated word, presumably because of the presence of an object of an unfamiliar kind for which the subjects would be seeking a name. It appears that a principle of contrast guides learners in the direction of an action interpretation when a participant in an action is of a familiar kind; with a participant of an unfamiliar kind, learners seek a basic-level count noun for it. This effect seems limited to the kind of the agent of the action. With an agent of an unfamiliar kind performing an intransitive action, the proportion of action interpretations (.11) was significantly lower than with agents of familiar kinds performing intransitive actions during trials discussed in section 6.3.2.4.2 (.66, for the Isolated condition; $Z = 4.96$, $p < .01$, one tailed; .74, for the Contrastive condition; $Z = 5.58$, $p < .01$, one tailed), or with agents of familiar kinds performing transitive actions during trials discussed in section 6.3.2.4.3 (.74, for the Isolated condition; $Z = 5.58$, $p < .01$, one tailed; .79, for the Contrastive condition; $Z = 6.00$, $p < .01$, one tailed; the use of one-tailed tests is justified because the direction of the effect was predicted; see the description of the Nonseparability Method in section 3.2.5.1). When the agent of a transitive action was a member of an unfamiliar kind, the proportion of action interpretations (.53) was significantly lower than in one of the conditions in which an agent of a familiar kind performed an action (a transitive action, in the Contrastive condition; the proportion was .79; $Z = 2.42$, $p < .01$, one tailed). No such differences obtained when the agent was of a familiar kind, but the object was of an unfamiliar kind, suggesting that learners do not feel a need for a basic-level noun for the object of an action as strongly as they do for the agent of the action.

No general claim about an agent bias can be made on the basis of the results for the three trials involving an agent or object of an unfamiliar kind. Only one trial showed an object of the action from an unfamiliar kind, and the possibility exists that this object, a long decorated stick, fell naturally into a familiar kind such as BATON for most subjects. Evidence from other researchers, though, backs up the claim that people seek basic-level count nouns for the agents of actions, but not for their objects (Grace & Suci, 1985). Data from Experiment 2

also support this claim: When the nonce word was taken to be a word for a kind, it was taken to be a word for the kind to which the agent belonged in the vast majority of instances (see Tables 1 and 3).

Meaning and part of speech were tightly linked during these trials. When subjects took the word to be a word for action of the type observed, they usually matched the word to the list of verbs. Of the 4 subjects choosing the activity/action category on the Intransitive-Action trial, 100 percent classified the word as an intransitive verb. For the Transitive-Action/Unfamiliar-Agent trial, 80.0 percent of the 20 subjects interpreting the word as an action word matched it to the list of intransitive verbs, and 20.0 percent matched it to the list of transitive verbs. In the Transitive-Action/Unfamiliar-Object condition, of the 28 subjects choosing the activity/action category, 60.7 percent matched the word to the intransitive-verb list, and 17.9 percent matched it to the transitive-verb list. (This result shows, again, the bias against an interpretation of a verb as a transitive verb in the absence of positive evidence regarding the possibility that the word takes an object argument.) Another 10.7 percent matched the word to the list of count nouns, 7.1 percent to the list of mass nouns, and 3.6 percent to the list of adjectives.

In the Intransitive-Action/Unfamiliar-Agent trial, 30 subjects chose an object category of meaning, and all of them matched the word to the list of count nouns. In the Transitive-Action/Unfamiliar-Agent trial, 16 subjects chose an object category of meaning. Of those subjects, 87.5 percent matched the word to the list of count nouns, 6.3 percent matched it to the mass-noun list, and 6.3 percent interpreted the word as a proper noun. On the Transitive-Action/Unfamiliar-Object trial, 100 percent of the 7 subjects who took the word to be a word for a kind of object classified the word as a count noun.

6.3.3. Discussion

The effect observed in Experiment 2 of noun-phrase arguments on a word's interpretation was replicated with adults in Experiment 3. The presence of an

action of unfamiliar type performed by an agent of a familiar kind was associated with a strong tendency to interpret the word as a word for action of the type observed, and this tendency was strengthened when the word's context included one or more noun phrases that signified the participant(s) in the action. Action interpretations in the presence of an action of unfamiliar type were more common in this experiment than in Experiment 2. This may simply be due to the response bias associated with the picture-pointing task in Experiment 2. If children are like adults in their interpretive tendencies, then the children participating in Experiment 2 may have made more action interpretations than their responses revealed.

The presence of a salient action was also associated with a strong tendency to identify the word as a predicator, and as a verb in particular. The appearance of noun-phrase arguments in the word's context increased the tendency to identify it as a member of the predicator category, and of the verb subcategory. It seems that the nonseparability of actions was usually sufficient for predicator identification, but, because action words can be nouns (and some subjects did interpret some words both as action words and as nouns), the presence of explicit noun-phrase arguments increased the level of confidence that an action word was a predicator.

The results provide strong support for the use of the Nonseparability Method of predicator identification. The presence of an action of unfamiliar type performed by an agent of a familiar kind was sufficient for an action-word interpretation in most instances. When the word appeared without noun phrases or verb clues, it was taken to be an action word about three quarters of the time. This interpretation almost inevitably led to the word's being identified as a predicator (e.g., in the List-Matching task, 92.9 and 84.0 percent of the choices in the Contrastive and Isolated conditions on Intransitive-Action trials, and 96.6 and 89.3 percent of the choices in the Contrastive and Isolated conditions during Transitive-Action trials, were choices of the predicator list). Subjects did

sometimes take the action word to be a noun, though, presumably because of the lack of explicit arguments.

When the word appeared without noun-phrase arguments and without any distributional verb clues on action trials, it was taken to be an action word far more frequently when the agent (and the object) of the action was a member of a familiar basic-level kind. When an unfamiliar kind was involved, and especially when the agent was of an unfamiliar kind, the word tended to be interpreted as a word for a kind of atomic object. This finding regarding actions is in line with Hall's findings regarding proper names (Hall, 1991) and the findings of Hall and of other researchers regarding non-basic-level common nouns (i.e., superordinate and subordinate nouns, or nouns for situationally restricted kinds; e.g., Hall & Waxman, 1993; Mervis & Crisafi, 1982); the familiarity of an object's basic-level kind tends to favour interpretations of a word other than a basic-level-kind interpretation (but not interpretations into a part of a basic-level object; see Mervis, Golinkoff, & Bertrand, 1994). The present findings show that an assumption of contrasting meanings for words can help a learner discover that the phrase headed by a novel word signifies an action of some type, as required for the Nonseparability Method of predicator identification. (Explicitly naming the basic-level kind of the agent of an action in the Contrastive conditions did not seem to promote action interpretations or predicator identifications, but the subjects were familiar with the kind, and knew a count noun for it, so the explicit naming did not contribute any information not already available to the learners.) Learning a proper name for an individual did not seem to have the same effect as knowledge of a basic-level-kind term. When the word was presented alone after teaching the subject a proper name for the action's agent, action interpretations were no more likely than when the word was presented alone without any such teaching. Perhaps the satisfaction of a learner's need for a basic-level-kind term for an individual belonging to an unfamiliar kind is sufficient to open the door to an action interpretation for a novel word when the individual is performing an action of unfamiliar type. It is possible, though, that the nature of the situation

prevented subjects from seeking proper names for the actions' agents. People may only expect to be taught a proper name and may only feel a need for a proper name when they anticipate having future social or business interactions with the bearer of the name. In the experiment, the videos showed people that the subjects were unlikely ever to meet. People may be more likely to take a novel word as a proper name in situations in which they expect the bearer to play some role in their lives – situations in which they are more likely to be told the bearer's name.

The results also provide evidence for use of the Interpreted Noun Phrase Method of identifying predicators. The presence in a word's context of noun phrases that could be interpreted into the individuals participating in the action increased the frequency of action interpretations, and whenever an action interpretation was made, the novel word was identified as a predicator. This finding is very striking. The presence of noun phrases, even without verb clues, led to predicator classification whenever the word was understood to be an action word (i.e., a word for a relation or property of some type) so that the noun phrases could be interpreted as its arguments. The nonseparability of actions, by itself, led to predicator identification 90.7 percent of the time (according to the results for the List-Matching task), but nonseparability coupled with explicit arguments led to predicator identification 100 percent of the time.

Because explicit arguments were not always necessary for the word or its phrase to be interpreted into the action, or for the word to be identified as a predicator, but because their presence increased the frequency of action interpretations and predicator identifications, all three possible learning scenarios described in section 3.4 remain as possibilities. In different instances, learning may follow any one of the three different sequences of interpretive events: (1) An action interpretation may lead to predicator identification, which may in turn lead to an interpretation of any noun phrases as arguments, (2) an action interpretation may lead to an interpretation of noun phrases as arguments, which may in turn lead to predicator identification, or (3) an interpretation of noun phrases into

individuals may lead to an action interpretation, which may in turn lead to predicator identification.

Unlike the children in Experiment 2, the adults in this study were strongly influenced by distributional clues. The presence of verb clues (and even of just the verb inflexion *-ing*) increased their confidence in their decision to identify a word as a predicator and as a verb. When adjective clues were present, they often identified the word as a member of an adjective category. When they did so, they frequently took the word to be a word for a property rather than an action.

When distributional clues were absent, the default interpretations reflected what was salient in the videos: objects, stuff, or actions. Syntax and morphology could override these default interpretations because of expectations about links between types of being and parts of speech. An apparent mass noun paired with an object video could lead to a conceptualisation of the object as a mass of stuff – the stuff out of which the object was made – or else the learner would search for an instance of some other kind with nonatomic members, such as a kind of sound or a kind of activity. An apparent count noun paired with a video showing stuff of an unfamiliar kind often led to the hypothesis that the word was for an object kind (e.g., for the kind of some object fully or partially visible in the video, or for a kind comparable to PELLET, ROCK or NUGGET). If the word's context suggested that it was an adjective but the video featured an action, many subjects concluded that the word must signify some property or quality of an object shown in the video.

For all of the parts of speech investigated, meaning was closely linked to decisions about part-of-speech membership. The subjects in this study showed a strong tendency to associate categories of meaning with parts of speech as follows: individuals with proper nouns, object kinds with count nouns, stuff kinds with mass nouns, activity or actions with verbs, and qualities or properties with adjectives. These associations were so strong that a shift away from a perceptually driven hypothesis about the part of speech was often accompanied by a shift away from a perceptually driven hypothesis about the word's meaning. One wonders if some of

these correlations are learned, or if they all follow from unlearned interpretive biases. Research with young children suggests that the link between objects and count nouns and the link between stuff and mass nouns are unlearned and attributable to intuitions that arise from the perception of objects and stuff (Gordon, 1985; McPherson, 1991; Soja, 1992; Soja et al., 1991); children make use of these links before they learn the distributional regularities associated with the noun subcategories, regularities that will later allow noun subcategorisation on a distributional basis. Knowledge of the link between individuals and proper nouns appears so early that it could very plausibly be unlearned as well (N. Katz et al., 1974). Actions have a natural relationship with verbs because actions are prototypical of what phrases headed by predicators signify – something nonseparable that exists by virtue of one or more individuals – and verbs are prototypical of predicators. We need not, therefore, entertain seriously the hypothesis that the correlation between actions and verbs is learned; the correlation follows naturally from the definition of predicators. For properties to be naturally linked with adjectives, people would have to possess certain unlearned expectations about adjectives in particular, such as the expectation that the phrases they head will signify dimensional qualities. The alternative remains that people learn the correlation between properties and adjectives from experience with a language. This question cannot be decided without further research.

The links between objects and count nouns and between stuff and mass nouns appear to be much stronger than the link between actions and verbs. An interpretation of a word into an unfamiliar kind of object or stuff led readily to count-noun or mass-noun identification unless distributional clues signalled a different part of speech. In contrast, a word taken to be a word for an unfamiliar type of action was not always identified as a verb. The subjects were more willing to classify the word as a verb in the presence of noun-phrase arguments, and they were even more willing to do so in the presence of distributional verb clues. This result fits well with my thesis: The presence of noun phrases makes the predicator

status of the word more obvious, and the presence of distributional clues makes clear the predicator subcategory of the word.

6.4. General Discussion

All of the theory's five predictions that were stated in section 5 found support in the combined results of the three experiments.

(1) Data from Experiment 3 indicate that interpretations of novel words as action words when the words have been paired with actions of unfamiliar types are more common when the agents belong to familiar kinds for which basic-level nouns are known. (A knowledge of the agent's proper name did not facilitate action interpretations, though.)

(2) Words taken to be action words were almost always identified as predicators by the adult subjects in Experiment 3.

These results provide strong evidence for the use of the Nonseparability Method of identifying predicators.

(3) The adults in Experiment 3 did not always identify a word as a predicator when they interpreted it as an action word; when its context did not contain any noun phrases, they sometimes identified it as a noun. The children in Experiment 1 displayed a willingness to allow an action word to move freely between the noun and verb categories. So, despite the fact that actions are prototypical of the nonseparable, words for actions do not stand in one-to-one correspondence with verbs in the minds of children or adults.

(4) Both among young children (Experiment 2) and adults (Experiment 3), the presence, in words' contexts, of noun phrases signifying the participants in actions increased the frequency of interpretations of the words as action words. In Experiment 3, the adults also more frequently chose the predicator category for words when the words' contexts contained noun phrases.

These effects of explicit arguments provide empirical evidence for the use of the Interpreted Noun Phrase Method of predicator identification.

(5) The adults in Experiment 3 were able to interpret verb clues and adjective contexts as evidence for a predicator, and for its specific subcategory (verb or adjective).

The nonseparability hypothesis, which encompasses the two methods of predicator identification described herein, has received strong support from the results of these experiments. The remaining part of the learning theory, which describes the discovery of predicator subcategories through distributional analyses within phrases, and the subsequent identification of verbs through analyses of words' contexts, finds some support from data obtained in Experiment 3: Adults can discern the subcategory of a predicator from its context whenever it appears in a grammatical string of words. No evidence is available regarding the hypothesis that learners discover the verb and adjective categories through distributional analyses, but I presented evidence from other researchers in sections 4.3 and 4.4 showing that people can detect the boundaries of phrases, and that they can discover classes of words through analyses within phrases; so the discovery of the verb and adjective categories through distributional analysis at least seems plausible.

7. SUMMARY AND CONCLUSIONS

I reviewed theories of part-of-speech identification, finding that most of them appeared to be motivated by certain facts of language acquisition and language, namely the characteristic preponderance of words belonging to simple conceptual or ontological categories, such as action words, in early vocabularies, and the fact that such categories fail to encompass all the words in mature part-of-speech categories. I presented a theory that accounts for these facts by assuming a definition of the category *predicator* that is sufficiently general to encompass all predicators in a mature vocabulary, and that entails a preponderance of action words among early predicators. I defined a predicator as a word (i.e., a lexical unit) that takes arguments because of the nonseparability of what the phrase it heads signifies, namely a property or relation that comes to be and exists only by virtue of those individuals in which the quality or activity (for instance) arises, or because of which the relation comes into being. The individuals upon which a property or relation depends are the referents of a predicator's noun-phrase arguments. Actions are prototypical of the nonseparable, because they involve one or more participants upon which they depend for their being; further, they are observable, and their dynamic nature makes them perceptually salient. For these reasons, the earliest predicators acquired are likely to be words for actions.

The thesis presented herein can be briefly restated as follows: If a learner realises that a word's meaning implies the involvement of one or more individuals because the phrase it heads signifies a property or relation of a certain type, the learner will realise that the word must take arguments, and will identify it as a predicator. (I called this the "nonseparability hypothesis.") The realisation that the word has an argument structure can occur because (1) the most salient hypothesis about the signification of the phrase headed by the word is that it signifies a nonseparable phenomenon, such as an action, where relative salience is determined partially by knowledge of words for other aspects of the situation, such as the agent's basic-level kind (the Nonseparability Method), or because (2) the utterance in which the word appears contains one or more noun phrases that are

interpretable into the participants in a relation or the bearers of a salient property, suggesting that the noun phrases are the arguments of a predicator for the relation or property (the Interpreted Noun Phrase Method). In order to determine the specific part of speech of the word, the learner will first have to discover the subcategories of predicators in the language being learned, if any exist. Such discovery will depend on distributional analyses within phrases. Once the language-specific categories are discovered, the learner can use distributional evidence to determine the part of speech of a particular word in a given use. If learners are predisposed to identify a predicator as a member of the adjective category (whether or not that category is realised in the surface structure of the language) when the word (1) takes just one noun-phrase argument in all its uses, (2) picks out a subkind when conjoined with a noun in a noun phrase, and (3) signifies a dimension of quality, then learners can identify a word as a verb without making use of distributional evidence: If a word's meaning implies the involvement of individuals, but it does not meet the criteria to be an adjective, then the word must be a verb.

The theory of verb identification found strong support in this dissertation. Evidence from comparative linguistics, creole grammars, gestural languages created by deaf children of hearing parents, children's early speech, and linguistic comparisons of verbs and adjectives converges in support of the conclusion that the categories *noun* and *predicator* are universal, but that the verb-adjective distinction is not. The category *predicator* seems available to learners, including young children, in the sense that they appear sensitive to the nonseparability of relations and properties that creates a need for an argument structure, that is, for the taking of noun-phrase arguments; the presence of such noun-phrase arguments in an utterance containing a novel word seems to lead both children and adults to interpret the phrase headed by the word into the most salient nonseparable aspect of a situation (e.g., an action; see Experiments 2 and 3).

In line with the hypothesised Nonseparability Method of predicator identification, the nonseparability of that which is most salient in a situation can

promote predicator identification (at least among adults; see Experiment 3) even when explicit arguments are absent from a word's context. Moreover, in support of the contrastive component of the Nonseparability Method of identification, evidence was obtained (in Experiment 3) in favour of the hypothesis that familiarity with the basic-level kind of each individual engaged in an action, and familiarity with the associated noun, promotes interpretations of phrases headed by novel words into the nonseparable, and promotes predicator identification.

In keeping with the Interpreted Noun Phrase Method of predicator identification, adult learners observing an action tend to identify a word appearing in an utterance with its noun-phrase arguments as a member of the predicator category – and, in the absence of contradictory distributional evidence, as a member of its prototypical subcategory (*verb*; see Experiment 3); more research is needed to determine if young children do the same, but I reviewed some evidence from studies of property-word and verb learning in young children that showed that predicator (e.g., verb) identifications and interpretations into the nonseparable are facilitated by the presence of predicators' noun-phrase arguments in utterances (see sections 4.7 and 4.8).

Evidence for the thesis also comes from the fact that nouns, which are presupposed in predicator learning, according to the theory, are learned in great quantity before many predicators are learned.

In support of a distributionally based identification of verbs as members of a subcategory of *predicator*, learners seem able to identify the boundaries of phrases (or at least adults have this ability; infants show evidence of sensitivity to correlates of those boundaries such as pauses, and children seem able to use those correlates to identify phrase boundaries at an older age – so their identification of the boundaries at a younger age appears plausible; see section 4.3). Moreover, at least among older children and adults, learners can discover distributional regularities within phrases in the form of contingencies between word classes, an ability that would permit them to discover the parts of speech, including *verb* and

adjective, that are specific to the language they are learning (and that are subcategories of categories identified through semantic means).

And finally, I showed that adults are able to use distributional evidence for a word's part of speech to identify verbs (see Experiment 3), so children must acquire this capacity at some stage in learning their first language. They may or may not be able to identify verbs, *per se*, before then, depending on the existence of unlearned semantic criteria for the part of speech *adjective*.

More direct evidence about the identification of words as predicators by young children in particular awaits the development of a procedure for detecting instances of the parts of speech *verb* and *adjective* and of the category *predicator* in a young child's grammar – a procedure that can be applied reliably with very young children, children who have not yet learned the distributions of verbs and adjectives. With such a measure in hand, one could determine whether salient actions of an unfamiliar type promote, by themselves, predicator identification, or whether explicit arguments are necessary for such identification. One could also determine whether action words, with or without noun-phrase arguments realised in surface structure, are initially identified as predicators, or as verbs in particular – or if verb identification requires the presence of language-specific verb clues available in morphological and syntactic structure and must await a child's learning about them.

APPENDIX A

Historical Change in the Concept of a Relation

How did the classical understanding of relations get lost? To answer this question, we must look to mathematics. Because the concept of a relation entered into so many modern psychological, philosophical and linguistic theories, and is so central to the theory presented here, and because the change in the concept has never, to my knowledge, been documented, I will examine the change and the forces behind it in some detail.

Perhaps the major historical event contributing to a changed understanding of relations was the reconceptualisation of a ratio of one magnitude or number to another as a *common fraction*, that is, as a number. Among mathematicians, the ratio was the prototypical relation, so any change in their understanding of a ratio would tend to change their understanding of a relation.

In early Greek mathematics, ratios were never equated with a numerical quantity, and they were clearly distinguished from the closest thing the Greeks had to a fraction in the modern sense, namely what we would call a proper fraction, a part (*meros* in the Greek) or parts of a unit (Fowler, 1987). The word "fraction" is derived from the Latin *frāctiō(nem)*, a noun of action from the perfect passive participle (*frāctus*) of the verb *frangō*, 'break,' 'fracture,' 'break off,' 'break in pieces,' such that a fraction is the result of breaking off of part of a unit, a product of the fracturing of a unit. For the Greeks, a fraction was always a piece or pieces of the unit. The Greeks did not use common fractions in the modern sense, that is, *numbers* (versus ratios) that can be expressed as p/q (where p and q are integers, and where the number may exceed one); modern scholars sometimes claim that the Greeks used such fractions in their calculations (e.g., Heath, 1921), but Fowler makes a convincing argument that such claims are based on

misinterpretations of their notation.¹⁶ As the use of common fractions developed, the distinction between ratios and fractions dissolved so that ratios lost their relational nature.

When the ratio came to be interpreted as a common fraction, what consequences followed for the notion of a relation? A common fraction is itself a number, an individual distinct from the two individual numbers that make up the fraction (e.g., the fraction $3/6$, equal to 0.5, is distinct from 3 and from 6, as is the fraction $6/3$, equal to 2); we call the numbers equivalent to fractions that are stated over integers "rational numbers," where "rational" is related to "ratio" (which is from the Latin equivalent of the Greek *logos*). Because the ratio was the prototypical relation in mathematics, the reconceptualisation of a ratio as a common fraction – as a number – and thus as a third thing with being separate from the two individuals involved in the relation, may have influenced the

¹⁶ Fowler (1987) argues that,

. . . We have no evidence for any conception of common fractions p/q and their manipulations such as, for example, $p/q \times r/s = pr/qs$ and $p/q + r/s = (ps + qr)/qs$, in Greek mathematical, scientific, financial, or pedagogical texts before the time of Heron and Diophantus; and even the fractional notations and manipulations found in the Byzantine manuscripts of these late authors may have been revised and introduced during the medieval modernisation of their minuscule script. (p. 226)

Fowler (pp. 248-268) shows that apparent fractional notation is used only where the scribe would, in all likelihood, lack access to a mathematical table that would give him the value of a division of one number into another, where division was conceptualised as the dividing of one number into as many parts as there are units in the other number, and where the result of division was expressed as the conjunction of parts of the unit (e.g., in a mathematical table from Fowler, p. 235, we read that "of the 4 [the $1/9$ is] $1/3$ [and] $1/9$," where the "fractions" are to be interpreted as parts of the unit):

The very few instances [in the papyri] that can be cited as illustrating [notations] for common fractions appear, on closer scrutiny, more probably to be abbreviations of unresolved descriptions of divisions that are still conceived as sums of unit fractions, and all can be more naturally explained as relaxations of stylistic conventions about how these divisions should be evaluated and expressed. Possibly the abbreviations did then evolve into our conceptions of common fractions, and certainly the practice and popularity of common fractions developed, particularly among Italian mathematicians, from the ninth or tenth centuries onwards. These new fractional notations and conceptions may then have been adopted by the scribes and readers of the medieval manuscripts [containing the text of Greek scientific treatises], and so infiltrated and corrupted the evidence [regarding fractional notation] to be found there . . . (p. 264)

mathematician's view of relations in general. Relations would then come to be viewed as things separate from their subjects and objects.

The reconceptualisation of the ratio as a number may have begun in the late medieval period, when mathematicians assigned to ratios *denominations*. The denomination of a ratio is the ratio of the lowest numbers that are in the same relation, such that the denomination of 14:6 is 7:3;¹⁷ this ratio was expressed as the parts of the greater number that the lesser number was (when the lesser number was the antecedent), or as the wholes and parts of the lesser number in the greater number (when the greater number was the antecedent). As we will see, denominations came to be understood as *numbers*. What motivated their adoption? Murdoch (1963) argues that "the manner in which the denomination idea became connected with the theory of proportionality [i.e., of ratios] . . . is . . . involved" (p. 257), but may be tied to a change in the accepted definition of equal ratios. Mathematicians such as Roger Bacon (1214-1294) and

¹⁷The notion of a denomination can be traced back to the Greek notion of a "root number," or *puthmên*, of a ratio (see Murdoch, 1963). This word was used by the Pythagoreans for the smallest number of a given species of number (see J. Klein, 1939/1985). In the context of ratios, it meant the ratio having the same relation of the two numbers as a given ratio, but with the smallest possible numbers related in the ratio. In the series 2:1, 4:2, 6:3, 8:4 . . . , 2:1 is the *puthmên*. Theon of Smyrna (c. 100-150) gave the following definition:

Of all the ratios grouped in one species (e.g., double sesquialter, etc.) those that are expressed in the smallest numbers and numbers prime to one another are called primary among those bearing the same ratio, and roots (*puthmenes*) of those of the same species. (Nicomachus of Gerasa, 120/1926, p. 216, fn 1)

In Greek mathematics, the *puthmên* of a species of ratio was itself clearly a ratio, and not a number. That is not to say that the Greeks never associated ratios with numbers or magnitudes. J. Klein (1934-1936/1968) provides an excerpt from a commentary of Eutocius of Ascalon that gives evidence for an ancient tradition of using numbers to speak about the "sizes" of ratios (*pêlikotêtes logôn*):

Let it not upset those who happen to notice it that this is demonstrated through numbers; for the ancients used such demonstrations rather as being mathematical [in the sense of involving a *general* theory] than [specifically] as arithmetical, *because of the proportions* and because the thing sought is [actually] arithmetical. *For ratios and sizes of ratios and multiplications primarily exist in numbers* and through these in magnitudes, as he says [namely Archytus . . .]; for these mathematical objects seem to be cognate. (p. 279, fn 268)

Thomas of Bradwardine (1290-1349) defined equal ratios¹⁸ as those "whose *denominations* are the same, or equal" (Crosby, 1955, p. 77; see also Murdoch, p. 257), and this definition became the standard one. According to Murdoch, the idea that equal ratios are those with equal denominations may have become conventional because of a substitution, in one popular medieval version of Euclid's *Elements* – that of Campanus Da Novara (d. 1296), of this sort of definition for Euclid's definition of equal ratios for numbers (in Book 7, Definition 20);¹⁹ the substituted definition came from Jordanus Nemorarius's (12th-13th century) *Arithmetica Decem Libris Demonstrata*.²⁰ Murdoch claims that "once thus firmly established in Book VII, 'denominaciones' seeped back into the more general

¹⁸The medieval writers used the word *proportio*, or 'proportion,' for both 'ratio' and 'proportion,' that is, for both: *logos* and *analogia*. I have substituted the word "ratio" wherever they meant *logos* rather than *analogia*; the latter is the relation of one ratio to another, whereas *logos* or ratio is the relation of one number to another, or the relation of one magnitude to another.

¹⁹The story behind this substitution is complicated. Medieval mathematicians were unable to understand Euclid's definition of equal ratios for geometric magnitudes (Book 5, Definition 5), taken from Eudoxus, a definition that worked even for incommensurable magnitudes. (Murdoch, 1963, restates the definition symbolically as follows: " $A/B = C/D$ if, and only if, for all positive integers m, n when $nA \geq mB$ then, correspondingly $nC \geq mD$ "; p. 239.) As a result, they sought other means of defining equality for ratios, and the means they favoured were arithmetical, according to Murdoch. They adopted the arithmetical definition based on denominations, first for arithmetical ratios, and then for all ratios. Unfortunately, the definition fails for ratios of incommensurable magnitudes, as Murdoch shows.

²⁰The definition borrowed from Jordanus and given by Campanus (as his definition 21) in place of Euclid's Definition 20 of Book 7, as well as a definition of a denomination that is inserted before it (from a 1506 copy of the manuscript in the Houghton library at Harvard), are as follows:

20. Denominatio dicitur proportionis minoris quidem numeri ad maiorem, pars uel partes ipsius minoris quae in maiore sunt. Maioris autem ad minorem, totum uel totum & pars uel partes, prout maior superfluit. ['Denomination is said of the ratio of the lesser number to the greater (number about) the part or parts of this lesser (number) that are in the greater (number). However (denomination is said of the ratio) of the greater to the lesser (about) the whole, or the whole and the part or parts, according as the greater exceeds (the lesser).']

21. Similes siue una alii eadem dicuntur proportionones, quae eandem denominationem recipiunt. Maior uero, quae maiorem. Minor autem, quae minorem. ['Similar or the same one to another are said (about) ratios that receive the same denomination. But the greater (is said about the ratio) that (receives) the greater (denomination). And the lesser (is said about the ratio) that (receives) the lesser (denomination).']

theory of proportionality of Book V" (p. 258) – that is, into the interpretation of Euclid's theory of ratios of geometric magnitudes. Denominations were probably originally conceptualised as signs for ratios, but they came to be viewed as numbers. For a prototypical ratio known as a "multiple," such as double or triple (examples of which are 8:4 and 9:3), the denomination is a sign for a ratio to the unit (i.e., 2:1 or 3:1), but it was given as the numeral for the antecedent alone (i.e., as 2 or 3). The term "denomination" suggests that the numeral is acting as a *name* of a ratio, and not as a sign for a multitude (i.e., a number). But these numerals appear to have been conceptualised as numbers, and not just as names for ratios to the unit; Bradwardine says, for instance, that a first order (i.e., in lowest terms) ratio of commensurables 'is that which is immediately denominated by some *number* ["est illa quae immediate denominatur ab aliquo numero"], just as in the case of the ratio double, and triple, even so in the cases of the others' (Crosby, p. 66; the translation is mine), meaning that the denomination of 2:1 is the *number* 2. He also says that, 'However great one quantity is relative to another, so great is the ratio of this one relative to that one' ("Et quanta est una quantitas ad aliam, tanta est proportio eius ad illam"; Crosby, p. 70; the translation is mine), implying that a ratio has a magnitude. He thus appears to have reinterpreted a denomination consisting of a numeral, which presumably was used originally as a name for a ratio, as a number. As a further impetus to the reinterpretation of ratios as numbers, denominations, integer and otherwise, were used as numbers in thirteenth-century algebraic computations (e.g., multiplication and division; for examples, see Jordanus de Nemore, 1225/1981²¹). (For Nicole

²¹Here is one example from Jordanus de Nemore (1225/1981):

SI PRIMUM AD SECUNDUM DATUM, ET AD QUOD SECUNDUM HABET
 PROPORTIONEM ERIT DATUM. QUOD SI AD ILLUD FUERIT DATUM, ET AD
 SECUNDUM DATUM ERIT. Denominatio enim proportionis primi ad secundum, in
 denominationem proportionis secundi ad tertium ducatur, et fiet proportio primi ad
 tertium. Item proportio secundi ad tertium dividat proportionem primi ad tertium,
 et exibat proportio primi ad secundum. Verbi gratia: Primum continet secundum et
 eius tres septimas, et secundus tertium et eius duas quintas. Ducatur ergo unum et

(continued...)

Oresme's [c. 1320-1382] fourteenth-century discussion of the multiplication and division of denominations in "algorism" [*algorismus*] to solve problems with ratios, see Oresme, 1355/1966, p. 143, p. 145, and p. 155.) With the relations of double, triple, etcetera, denominated by the numerals 2, 3, etcetera – which apparently came to be interpreted as numbers – and with denominations in general used like numbers in computations, the stage was set for the ultimate identification of ratios with numbers.

The generality with which denominations were applied to ratios may have had consequences for the concept of number, for denominations were not restricted (except, perhaps, by Campanus; see Murdoch, 1963) to ratios of integers, that is, arithmetic ratios; they were applied also to ratios of the continuous magnitudes of geometry, even when the magnitudes in a ratio were incommensurable – that is, even when one of the magnitudes was irrational (e.g., in the ratio of the length of the diagonal to the length of a side in a right isosceles triangle). Bradwardine, or earlier mathematicians from whom he took the idea, extended the term "denomination" to what he called "irrational proportion" (*proportione irrationali*), that is, ratios of incommensurable quantities;²² later scholastics, including Albert of Saxony, followed him, according to Murdoch. The incommensurable quantities were not yet numbers in Bradwardine; he was explicit in denying them the status of numbers and thereby restricting them to branches of

²¹(...continued)

tres septimae in unum et duas quintas, et provenient duo, quare primum est duplum tertie. Item duo dividantur per unum et duas quintas, et exhibunt unum et tres septimae. Itaque aliis positis primum continebit secundum et eius tres septimas. (p. 72)

The third sentence can be translated as follows: 'For the denomination of the proportion [i.e., ratio] of the first in relation to the second, is led into [i.e., is multiplied by] the denomination of the proportion of the second in relation to the third, and the proportion of the first in relation to the third is made [i.e., found].'

²²For ratios of incommensurables, Bradwardine said they were *mediately* denominated by a given number, whereas ratios of commensurables were *immediately* denominated by a given number. For ratios of incommensurables, immediate denomination was by a given ratio, which was immediately denominated by a given number. See Murdoch (1963, pp. 258-260) and Grant's introduction to Oresme (1355/1966, pp. 31-35) for a full explanation of the idea.

mathematics other than arithmetic (see Crosby, 1955, p. 67). But since denominations came to be viewed as numbers, the assignment of denominations to ratios of incommensurables was a first step in the direction of irrational numbers; a fully conscious acceptance of irrational magnitudes as numbers awaited a complete reconceptualisation of the concept of number. It is to this that I now turn, for this event seems to have provided impetus to a reinterpretation of the ratio – even the geometric ratio – as a number.

A new concept of number arose in the late 16th century, one that served to promote the identification of a ratio of two numbers with the fraction or whole number that represented the multiple that one number was of the other. The rise of an explicit conceptualisation of number as continuous rather than discrete (i.e., as magnitude rather than multitude) permitted an identification of the ratio (a relational concept) and the common fraction (a new number concept) because the multiple that one magnitude was of another could now be assigned a number whether or not the multiple was an integer.

How did number come to be viewed as continuous, removed from multitudes? The continuous magnitudes of geometry came to be reconceptualised as numbers, which necessitated a new concept of number that took on the continuous character of such magnitudes. Among the numbers along the new number continuum were common fractions, which are equated with ratios in modern mathematics and which correspond to what we have come to call "rational numbers." Fractions were originally conceptualised, in the classical period, as parts of a unit, and so they were always proper fractions. Further, they were not conceptualised as numbers. The closest thing to a common fraction in Greek thought was the notion of a part (*meros*) or parts of a number, where a part was a submultiple that could measure the number, that is, that could fit into the number an exact number of times (e.g., see Euclid, *Elements* 7, Definitions 3 and 4, in Heath, 1956). So the Greeks could speak of 3 as a part of 6, 4 as parts of 6 (where each part is 2 or 1), and so on; but they did not conceive of the part of 6 that is 3 as the *number* one half. Further, any number of parts of a number could

not exceed the number of parts that could fit exactly into the number, whereas a common fraction can be equivalent to a number greater than one (i.e., the numerator can exceed the denominator).

The reconceptualisation of number as continuous is usually attributed to Simon Stevin (1548-1620). Part of his reconceptualisation was an interpretation of proper fractions as numbers. He described a part or parts of a unit as a "broken number" (or *nombre rompu*; see J. Klein, 1934-1936/1968, p. 195, and Stevin, 1585/1958a, p. 506); he reasoned that, by analogy with the fact that the parts of a line are themselves lines, the parts of a number should themselves be numbers (J. Klein, 1939/1985). With proper fractions reconceptualised in this way, it was a small step to conclude that common fractions are also numbers, and Stevin did include them among his "broken numbers."²³ Stevin saw no reason to keep number distinct from continuous magnitudes, and he even accepted irrational magnitudes as numbers, so that numbers could be viewed as filling up a continuum. In fact, he regarded all numbers as continua, including whole numbers, and argued against the idea of discontinuous or discrete quantities; he felt that the division of a number such as 60, which was in his mind a continuous magnitude, into 60 units, was an act of the imagination that did nothing to make the number itself discontinuous; for, he argued, one could equally well divide 60 into 30 couples or 20 triples (see Stevin, pp. 501-502). If the division into unit measures seemed meaningless to Stevin, it must have been because number was not viewed by him (or those of his contemporaries who accepted his views on number) as the number of *something*, that is, as the cardinality of a set of individuals. He expressed the correspondence between numbers and continuous magnitudes as follows:

²³Under his definition of "nombre rompu," he says,

Comme étant un divisé en trois parties égales, une des mêmes est nombre rompu, qu'on décrit ainsi $1/3$ & s'appelle un tiers. . . . Ou étant 1 parti en trois parties égales, sept de telles parties est nombre rompu qu'on décrit ainsi $7/3$ & s'appelle sept troisièmes. ['Take one divided into three equal parts, one of the same is a broken number that one describes thus, $1/3$, and that is called a third. . . . Or given one divided up into three equal parts, seven of such parts is a broken number that one describes thus, $7/3$, and that is called seven thirds.'] (Stevin, 1585/1958a, p. 506)

... Le nombre est quelque chose telle en grandeur, comme l'humidité en l'eau, car comme cette ci s'étend par tout et en chaque partie de l'eau; Ainsi le nombre destiné à quelque grandeur s'étend par tout et en chaque partie de sa grandeur: Item comme à une continue eau correspond une continue humidité, ainsi à une continue grandeur correspond un continue nombre: Item comme la continue humidité de l'entière eau, souffre la même division et disjonction que son eau; Ainsi le continue nombre souffre la même division et disjonction que sa grandeur. ['... Number is something in magnitude comparable to humidity in water, for as this extends everywhere and in each part of the water; even so, number tied to some magnitude extends everywhere and in each part of its magnitude: Just as to a water continuum there corresponds a humidity continuum, even so to a magnitude continuum there corresponds a number continuum. Just as the humidity continuum of the entirety of the water undergoes the same division and separation as its water, so the number continuum undergoes the same division and separation as its magnitude.'] (Stevin, 1585/1958a, p. 502)

Stevin's views may have been influenced by his adoption of decimal fractions for expressing numbers (see Stevin, 1585/1958b), a system he favoured because of its great practical utility; this system does not preclude the numerical expression of irrational numbers, and it might, if accepted as a valid means of number expression, be taken to imply the existence of indenumerably many such numbers, one for each possible infinite decimal expansion. The introduction into general use in the West of the Hindu-Arabic number notation in the 12th century had already set the stage for the new view of number by de-emphasising the tie between number and multitude. In the previously used Roman numeral system, the numerals were collections of individuals, namely collections of marks on paper (i.e., the numbers 1 through 4 were originally symbolised by I, II, III, and IIII; the latter later became IV), or else they were signs for such collections (i.e., V stood for IIII). These collections stood in for, or represented, collections of objects or monads. Manipulations of these collections of marks produced results that could be applied to collections of individuals of any kind whatsoever. Schmidt (1986) calls these numerals *counterparts*. They are not signs for numbers, but rather representations of collections. Schmidt gives as an example of a counterpart a

nautical chart. One can plot a course on such a chart, which is a representation of a region, and then follow that course in the place represented. Similarly, one can combine 2 marks with 3 marks to obtain 5 marks, and then apply the result to collections of objects of any kind (e.g., 2 cats aggregated with 3 cats will yield 5 cats). When the Hindu-Arabic numerals were first introduced, mathematicians understood them much as they understood the Roman numerals V and X, according to Schmidt, namely as signs for collections of marks on paper – or perhaps as signs for Roman numerals which were, in turn, collections of marks or signs for such collections. Eventually, though (perhaps during or after the Renaissance), mathematicians forgot that the symbols had this (indirect) counterpart function, which was no longer immediately available in the forms of the numerals themselves. In forgetting that the symbols were supposed to function as signs for counterparts, they forgot that the numerals were supposed to be interpreted in terms of collections of individuals. So the newly accepted notation permitted a reconceptualisation of number as something independent of multitude.

The geometric algebra created by René Descartes (1596-1650) may have furthered the dissolution of the boundary between geometric magnitudes and numbers, even if Descartes was an unwitting party to the dissolution. Having possibly been a student or disciple of Stevin in the years 1618-1619, and being familiar with at least some of Stevin's writings (see J. Klein, 1934-1936/1968, pp. 292-293, fn 306), Descartes was probably no stranger to the idea of number as continuous, although he did not, perhaps, understand number as Stevin did.

Descartes used lines or plane figures, or letters that stood for particular lines or figures, as representations or stand-ins or counterparts for particular magnitudes (Schmidt, 1986), using these extended things as a means of studying the relations of any magnitudes or quantities one pleases (Descartes, 1701/1970). In this way, his geometric algebra was comparable to a numerical calculus that operates on Roman numerals or some similarly iconic set of symbols, where the symbols are themselves collections of individuals, so that a manipulation of the symbols is a manipulation of collections. The lines and figures that Descartes used

to represent magnitudes were directly manipulable, but the results of the manipulations could be applied to any magnitudes, just as the result of an arithmetic calculation manipulating marks on paper can be applied to any collections of individuals one pleases. Whatever could be learned about the magnitudes of the lines or the relations of those magnitudes to one another could be generalised to any domain in which the same relations held for magnitudes that were comparable under some abstraction:

When . . . we have freed the terms of the problem from any reference to a particular subject, we shall discover that all we have left to deal with consists of magnitudes in general [or 'in a genus'; *in genere*²⁴].

We shall, however, even in this case make use of our imagination, employing not the naked understanding but the intellect as aided by images of particulars [or 'species' or 'individuals of a particular species'; *speciebus*²⁵] depicted on the fancy. Finally we must note that nothing can be asserted of magnitudes in general [or 'magnitudes in a genus'] that cannot also be ascribed to any particular instance [or 'magnitudes in a species'; (*magnitudinibus*) *in specie*].

This lets us easily conclude that there will be no slight profit in transferring whatsoever we find asserted of magnitudes in general [or 'in a genus'] to that particular species of magnitude which is most easily and distinctly depicted in our imagination. . . . This must be

²⁴I doubt that Descartes meant "magnitudes in general," as the translator apparently believed. He almost certainly meant precisely what he wrote, namely 'magnitudes in a genus' (for the Latin word that Descartes used, *genere*, is the ablative case of the noun *genus*; the word meaning 'general' is *generalis*). He was likely thinking in terms of the tradition in mathematics of distinguishing different genera of magnitudes, such as magnitudes in one dimension, two dimensions (i.e., plane magnitudes, or the areas of plane figures), and three dimensions (i.e., solid magnitudes, or the volumes of solids). For an example of a discussion of the genera of magnitudes, see Viète's *Introduction to the Analytical Art* in the appendix of J. Klein (1934-1936/1968; see Chapter 3, pp. 324-328).

²⁵The Greek mathematician Diophantus, who in his *Arithmetic* described an analytic art that was a precursor to algebra, distinguished different species (*eidē*) of number (a tradition adapted by Viète for his analysis of geometric magnitudes, such that he distinguished species of magnitudes within genera; see the appendix in J. Klein, 1934-1936/1968). Descartes may have been using the term "species" in this way. The translation of *species* as "particular" in keeping with the most common modern meaning of "specific" (i.e., 'definite') may therefore be slightly misleading. Given the counterpart function of Descartes's lines and figures, and the fact that they could be held in the imagination, he likely was thinking of particular, or specific, magnitudes, but as individual magnitudes belonging to species of magnitudes (as when we think of a cat *as* a cat, and not just as an animal, i.e., not as a member of a genus).

the real extension of body abstracted from everything else except the fact that it has figure This is also itself evident; for no other subject displays more distinctly differences in ratio of whatsoever kind. Though one thing can be said to be more or less white than another, or a sound sharper or flatter, and so on, it is yet impossible to determine exactly whether the greater exceeds the less in the proportion two to one, or three to one, etc., unless we treat the quantity as being in a certain way analogous to the extension of a body possessing figure. Let us then take it as fixed and certain that perfectly definite 'questions' are almost free from difficulty other than that of transmuting ratios so that they may be stated as equations. Let us agree too that everything in which we discover precisely this difficulty, can be easily, and ought to be, disengaged from reference to every other subject, and immediately stated in terms of extension and figure. (Descartes, 1701/1970, pp. 56-57)

. . . We need retain nothing but rectilinear and rectangular superficies, or else straight lines, which we also call figures, because they serve quite as well as surfaces in aiding us to imagine an object which actually has extension Human ingenuity can devise nothing simpler for the complete expression of differences of relation. (Descartes, 1701/1970, p. 65)

. . . When the problems are determinate and fully comprehended, we may abstract them from their subject matter and so transform them that nothing remains to be investigated save how to discover certain magnitudes, from the fact that they bear such and such a relation to certain other magnitudes already given. (Descartes, 1701/1970, p. 70)

The generality of solutions obtained with his geometric algebra implied a use for it in the solution of purely arithmetic problems (i.e., problems in the realm of number). Even though Descartes's lines and figures were intended solely as counterparts or representations for any sort of magnitude or quantity whatsoever, their manifest geometric character may have served to blur the distinction between geometry and number science for those who were influenced by his algebra. The use of a line to represent any quantity one pleases might tend to dissolve the conceptual boundary between the continuous magnitudes of geometry and the discrete counts of individuals that were once the entire domain of number science. Because Descartes's geometric symbols were intended to be counterparts for any sort of quantities, he himself sometimes described the lines and figures in

terms of numbers and number relations. He stated, for instance, that the geometric figures he used in his calculations "have to represent for us now continuous magnitudes, again a plurality of units or number also" (Descartes, 1701/1970, p. 65). Descartes represented the magnitudes of lines as multiples of the length of one line taken as the unit, and in so doing brought continuous magnitudes into the realm of number: ". . . By the help of the unit we have assumed, continuous magnitudes can sometimes be reduced in their entirety to [multitude]" (Descartes, 1701/1970, p. 64; his Latin reads, ". . . Magnitudines continuas beneficio unitatis assumptitiae posse totas interdum ad multitudinem reduci . . ."; Descartes, 1701/1966, pp. 451-452). He described number as "a species of dimension" and stated that the "division of the whole into a number of parts of identical nature, whether it exists in the real order of things or be merely the work of the understanding, gives us exactly that dimension in terms of which we apply number to objects" (Descartes, 1701/1970, p. 61); Descartes listed dimension as one feature of extension, and from this he may have concluded that the extended beings (i.e., lines or other figures) used in his algebra, and held in the imagination as representations, could represent numbers: "Thus, if number be the question, we imagine an object [i.e., a figure] which we can measure by summing a plurality of units" (Descartes, 1701/1970, p. 60). Further, Descartes was explicit about bringing geometry and arithmetic together by introducing arithmetic ideas into geometry. At the beginning of *La Géométrie*, he stated that,

Just as arithmetic consists of only four or five operations, namely, addition, subtraction, multiplication, division and the extraction of roots, which may be considered a kind of division, so in geometry, to find required lines it is merely necessary to add or subtract other lines; or else, taking one line which I shall call unity in order to relate it as closely as possible to numbers, and which can in general be chosen arbitrarily, and having given two other lines, to find a fourth line which shall be to one of the given lines as the other is to unity (which is the same as multiplication); or, again, to find a fourth line which is to one of the given lines as unity is to the other (which is equivalent to division) I shall not hesitate to introduce these arithmetical terms into geometry, for the sake of greater clearness. (Descartes, 1637/1925, pp. 2-5)

In his *Rules for the Direction of the Mind*, he asserted that arithmeticians and geometers talk about the same things in different ways:

. . . 'Extract the square root of a^2 , i.e. 25' or 'extract the cube root of a^3 , i.e. 125,' and so in other cases. This then is the way in which Arithmeticians commonly put the matter. But alternatively we may explain the problems in the terms employed by Geometers: it comes to the same thing if we say, 'find a mean proportional between that assumed magnitude, which we call unity, and that indicated by a^2 ,' or 'find two mean proportionals between unity and a^3 ,' and so in other cases. (Descartes, 1701/1970, p. 73)

Descartes freely used arithmetic concepts and operations in his geometric algebra, and the geometric concept of a ratio of continuous magnitudes came to take on the appearance of an arithmetic operation, namely division. He described the solving of equations for an unknown magnitude as "a simplification [or reduction] of ratios . . . such that we may discover some equation between what is unknown and something known" (Descartes, 1701/1970, p. 61). He spoke also of "transmuting ratios so that they may be stated as equations" (Descartes, 1701/1970, p. 56). An example of such transmutation from *La Géométrie* follows:

Puis à cause que tous les angles du triangle ARB sont donnés, la proportion, qui est entre les côtés AB, & BR, est aussi donnée, & je la pose comme de z à b , de façon qu'AB étant x , RB sera bx/z , & la toute CR sera $y = bx/z$, à cause que le point B tombe entre C & R ['Now because all the angles of the triangle ARB are given, the ratio, that is between the sides AB and BR, is also given, and I set it down as (that) of z to b , so that as AB is x (where x is the name given to the line segment between A and B), RB will be bx/z , and the whole CR will be $y + bx/z$, because the point B falls between C and R (and because the line segment between B and C is named y)'] (Descartes, 1637/1925, p. 28; the translation is mine)

In forming equations in this way, a ratio of one magnitude to another effectively becomes a division of the one magnitude by the other, since the two magnitudes enter freely into multiplications and divisions within the equations (and this conclusion holds despite Descartes's geometric conceptualisation of division and multiplication; see Descartes, 1701/1970, pp. 74-76; the geometric and the arithmetic formulations were equivalent in his eyes). His algebraic treatment of

magnitudes may thus have helped erode the conceptual barrier between ratios and numbers.

The reinterpretation of ratios as numbers is seen explicitly in the writings of John Wallis (1616-1703).²⁶ In the following passage, the new view of ratios is seen to have led to a reinterpretation of part of Euclid's geometry as arithmetic:

For this fifth book of the Elements is, like the whole theory of proportions, arithmetical rather than geometric. *And so also the whole of arithmetic itself seems, on closer inspection, to be nothing other than a theory of ratios*, and the numbers themselves nothing but the 'indices' of all the possible ratios whose common consequent is 1, the unit. For when 1 or the unit is taken as the [unique] *reference quantum*, all the rest of the numbers (be they whole, or broken or even irrational) are the 'indices' or 'exponents' of all the different ratios possible in relation to the reference quantum. (J. Klein, 1934-1936/1968, p. 220)

By this, he means that any number is really the ratio of that number to the number one, making numbers identical with ratios and vice versa – or at least making numbers signs for ratios (like the denominations of multiples). This way of thinking moves numbers and ratios uncomfortably close together. But given the new view of number as continuous, the move is logical: A continuous magnitude can have no value except relative to some other magnitude. When continuous magnitudes moved from geometry into number science, they did so independently of figures such as triangles and rectangles. With no possibility of comparing the length of one side of a figure to the length of another side, some other standard for comparison had to be established. Wallis chose a unit magnitude, which he took to be signified by the numeral 1, as that standard for comparison.

The importation of the geometric concept of a ratio of magnitudes into number science, that is, into arithmetic²⁷ (and the reinterpretation of certain

²⁶I am grateful to Robert Schmidt for alerting me to the relevance of the works of Wallis and Leibniz to the transformation of the concept of a relation.

²⁷The word "arithmetic" is derived from the Greek *hê arithmētikê*, which means 'the art of counting' (where this noun is derived from the verb *arithmeō*, 'count' or 'number,' which is itself derived from the word for number, *arithmos*).

areas of Greek geometry as arithmetic), went hand in hand with changing views about number. For the Greeks, number was multitude, and it was not separate from a collection of atoms; further, an atom could not be divided. (This is unequivocally true of the Greek ideal or abstract unit of counting, or monad, called a *monas* [plural *monades*], used in pure mathematics. If the units of counting were sensible entities such as vases, they could be divided in the sense of broken up; but such fracturing of the unit of counting implied a change in the unit of counting, say from vases to vase-parts. See J. Klein, 1934-1936/1968, 1939/1985.) Further, the atoms that yielded a count had to be of one kind. Aristotle explained it this way:

"Number" . . . means a measured multitude and a multitude of measures. . . . The measure must always be something that is attributed to all alike, as for instance if [we take] horses, the measure is a horse, and if men, a man. If man and horse and god, perhaps [the measure will be] living thing, and the number of them will be [the number of] living things. If [we take] man and white and walking, scarcely can there be a number of these, which all come to be in dependency through that which is one according to number [i.e., the man], however the number of these will be [the number of] genera, or some other such appellation. (*Metaphysics* N.1, 1088^a5-14; the translation is mine)

In the Greek mind, number was not separate from extramental being; it existed by virtue of collections of individuals of some kind. But number lost this tie with extramental being, and moved entirely into the conceptual realm, so that its nature was free to change. Under Stevin's influence, mathematicians came to accept as numbers fractional numbers and irrational numbers, so that numbers could be conceptualised as places on a continuum (as in the modern concept of a "number line" upon which points are supposed to correspond to numbers), or as continua or continuous magnitudes (even in the case of whole numbers); in classical Greek mathematics, continuous magnitudes were in the domain of geometry alone, where they were tied to particular lines (e.g., the sides of a figure). As the number concept changed to include numbers between integers, the distinction between magnitudes and multitudes, and thus between geometry and

arithmetic, became blurred. As Murdoch (1963) puts it, in the medieval period, "the Greek distinction between the continuous and the discrete was beginning to undergo erosion" (p. 270), an erosion that became complete in the Renaissance. Murdoch suggests that,

. . . the Middle Ages, both Arabic and Latin, were something of a halfway-house between the guarded Greek separation of general magnitudes from the discrete multitudes which were number and, on the other hand, the confident declaration of John Wallis that "the whole fifth book of Euclid's *Elements* is Arithmetic." If the medievals were historically no stimulus for Wallis's determined position, still their speculations pointed in his direction. (p. 271)

The new understanding of a ratio as a number likely contributed to a new understanding of relations as things separate from their subjects and objects. If so, the new view of relations that emerged and that remains with us was motivated by (largely unconscious) shifts in the interpretations of mathematical symbols that were concomitant with a changing view of number in mathematics, making the modern view of relations meaningless in the unrelated domains of natural language and cognition.

Mathematicians' conscious understanding of relations may have been influenced by Gottfried Wilhelm Leibniz (1646-1716), who was perhaps the first to explicitly describe a relation as something separate from the individuals related and independent of any subject. He did so in the context of a critique of Newton's view that space and time are absolute frameworks in which events occur, making space and time real existing things in addition to the individuals that populate the universe. This view was in conflict with Leibniz's view that individuals are monads, and that monads alone (plus God) constitute the universe; he sought, therefore, to conceptualise space and time as relations of some kind, and in particular as relations without subjects (to keep space and time outside of the monads themselves in order to account for their apparently objective nature). In a letter to Newton's disciple Samuel Clarke (which was published in 1717), Leibniz describes a type of relation that is an ideal entity, which implies that it is an idea in the mind of God:

The ratio or proportion between two lines L and M, may be conceived three several ways; as a ratio of the greater L, to the lesser M; as a ratio of the lesser M, to the greater L; and lastly, as something abstracted from both, that is, as the ratio between L and M, without considering which is the antecedent, or which the consequent; which the subject, and which the object. And thus it is, that proportions are considered in music. In the first way of considering them, L the greater [is the subject]; in the second, M the lesser, is the subject of that accident, which philosophers call relation. But, which of them will be the subject, in the third way of considering them? It cannot be said that both of them, L and M together, are the subject of such an accident; for if so, we should have an accident in two subjects, with one leg in one, and the other [leg] in the other; which is contrary to the notion of accidents. Therefore we must say, that this relation, in this third way of considering it, is indeed out of the subjects; but being neither a substance, nor an accident, it must be a mere ideal thing, the consideration of which is nevertheless useful. (Alexander, 1956, p. 71)

Leibniz here introduces a relation that is independent of a subject, such that in addition to the relation of half that characterises 2 relative to 4, and the relation of double that characterises 4 relative to 2, there is a third relation of proportion, existing as "a purely ideal thing" (i.e., in the mind of God) between 2 and 4. But what might this relation be, if not half and not double? Both half and double simultaneously? Or the disjunction of half and double? Both of these "relations" involve two separate relations. Moreover, the conjunction or disjunction of the two relations implies taking the point of view of one individual or the other, perhaps in alternation, since each of the two relations is an aspect of one individual's being with regard to the other. Another possibility can be ruled out: The "ideal" relation cannot be a fraction formed by the two numbers, because $2/4 (= 0.5)$ is not equal to $4/2 (= 2.0)$. We cannot conceptualise a relation except from the point of view of a subject; no relation exists that is subject-independent and separate from both of the individuals related – or present equally in both of them. We may imagine that we can take a bird's-eye or God's-eye or "objective" view of a relation, understanding it as an aspect of the being of both individuals, or of neither, but if we attempt to conceptualise clearly the relation so viewed, it will either evaporate

before the mind's eye, or we will find ourselves implicitly taking the point of view of one individual (as when we conceptualise a relation associated with "hit" as an action rather than the suffering of an action, implicitly taking the point of view of the hitter rather than the hittee). The ideal or subject-independent relation of Leibniz is an illusion. And yet the view expressed by Leibniz appears to have become the standard one among mathematicians, at least in explicit discussions of relations; in that view, a relation between two individuals is some third thing that is blind as to which individual is the subject.²⁸ In this way, it resembles a mathematical formula stated over multiple individuals, and it seems that the notion of a relation did, in fact, come to include the notion of a formula, which then came to be called a "predicate" (see Appendix B regarding Hilbert's notion of a predicate). I reject this view, favouring instead the view that a relation is not *between* two individuals, or a formula stated over them; it is, rather, an aspect of being of one individual relative to or with regard to another.

Leibniz was able to conceptualise a relation with no subject by including among "relations" things not previously considered to be relations, such as orders. His "relational" conception of space and time was that of an order: ". . . Space is nothing else but an order of the existence of things, observed as existing together"

²⁸A related idea appears in the writings of Frege:

If from a judgement-content which deals with an object *a* and an object *b* we subtract *a* and *b*, we obtain as remainder a relation-concept which is, accordingly, incomplete at two points. If from the proposition "the Earth is more massive than the Moon" we subtract "the Earth," we obtain the concept "more massive than the Moon." If, alternatively, we subtract the object, "the Moon," we get the concept "less massive than the Earth." But if we subtract them both at once, then we are left with a relation-concept, which taken by itself has no . . . sense any more than a simple concept has: it has always to be completed in order to make up a judgement-content. It can however be completed in different ways: instead of Earth and Moon I can put, for example, Sun and Earth, and this *eo ipso* effects the subtraction. (Frege, 1893/1980, p. 82)

Notice that he changed the "concept" when he "subtracted" the noun phrase embedded in the predicate; the concept (or relation) changed from "more massive than" to "less massive than." The necessity for this change demonstrates the incoherence of his approach; the nature of the relation depends upon the subject relative to the object, so it cannot be conceptualised independently of them.

(Alexander, 1956, p. 63); ". . . Time does only co-exist with creatures, and is only conceived by the order and quantity of their changes" (Alexander, p. 75).

Elsewhere, he includes among relations genealogical trees and geometrical figures:

There are . . . examples of relation between several things at once, as that of order or that of a genealogical tree, which expresses the rank and connection of all the terms or members, and even a figure like that of a polygon includes the relation of all the sides. (Leibniz, 1765/1949, p. 236)

Here, Leibniz not only abstracts a relation away from any subject, but he also allows an unlimited number of individuals to be related to one another by virtue of a single relation. The idea of a relation is replaced by the idea of co-existence in some arrangement of things. Any arrangement that has implicit within it relations of pairs of individuals to one another is treated as a relation itself.

Leibniz's view of relations may have been shaped by the interpretation of a ratio as a number that was becoming common in his time. In his correspondence with Clarke, and in an attempt to refute Clarke's claim that space is not relative but absolute because it can be quantified, Leibniz argues as follows:

. . . Order also has its quantity; there is in it, that which goes before, and that which follows; there is distance or interval. Relative things have their quantity, as well as absolute ones. For instance, ratios or proportions in mathematics, have their quantity, and are measured by logarithms; and yet they are relations. And therefore though time and space consist in relations, yet they have their quantity. (Alexander, 1956, p. 75)

Part of Clarke's reply to Leibniz's argument consisted of a description of the classical, relational notion of a ratio, and a rejection of the view that a ratio has or is a quantity, showing that the identification of ratios with numbers was not universally accepted at the beginning of the 18th century.²⁹ But it appears to

²⁹Clarke wrote,

This learned author . . . replies, that ratios or proportions . . . have their quantity; and therefore so may time and space, though they be nothing but relations. I answer . . . [that] proportions are not quantities, but the proportions of quantities. If they were quantities, they would be the quantities of quantities; which is absurd. . . . That which mathematicians sometimes inaccurately call the quantity of

(continued...)

have been sufficiently prevalent to make a stamp upon Leibniz's mind. It certainly seems to have affected the thinking of later mathematicians as well. Whether or not Leibniz's explicit description of an "ideal" relation influenced mathematicians, Leibniz's understanding of a relation is the modern understanding of a relation.

²⁹(...continued)

proportion, is (accurately and strictly speaking), only the quantity of the relative or comparative magnitude of one thing with regard to another: and proportion is not the comparative magnitude itself, but the comparison or relation of the magnitude to another. The proportion of 6 to 1, with regard to that of 3 to 1, is not a double quantity of proportion, but the proportion of a double quantity. And in general, what they call bearing a greater or less proportion, is not bearing a greater or less quantity of proportion or relation, but, bearing the proportion or relation of a greater or less quantity to another: 'tis not a greater or less quantity of comparison, but the comparison of a greater or less quantity. The . . . logarithmic expression of a proportion, is not (as this learned author styles it) a measure, but only an artificial index or sign of proportion: 'tis not the expressing a quantity of proportion, but barely a denoting the number of times that any proportion is repeated or complicated. The logarithm of the proportion of equality, is 0; and yet 'tis as real and as much a proportion, as any other: and when the logarithm is negative, as -1; yet the proportion of which it is the sign or index, is itself affirmative. Duplicate or triplicate proportion, does not denote a double or triple quantity of proportion, but the number of times that the proportion is repeated. The tripling of any magnitude or quantity once, produces a magnitude or quantity, which to the former bears the proportion of 3 to 1. The tripling it a second time, produces (not a double quantity of proportion, but) a magnitude or quantity, which to the former bears the proportion (called duplicate) of 9 to 1. The tripling it a third time, produces (not a triple quantity of proportion, but) a magnitude or quantity, which to the former bears the proportion (called triplicate) of 27 to 1: and so on. (Alexander, 1956, pp. 105-107)

APPENDIX B

Predication: Aristotle and Beyond

Predication in Aristotle

Once . . . in the beginning of Western thinking, the essence of language flashed in the light of Being. . . . But the lightning abruptly vanished. No one held onto its streak of light and the nearness of what it illuminated.

We see this lightning only when we station ourselves in the storm of Being. Yet everything today betrays the fact that we bestir ourselves only to drive storms away. We organize all available means for cloud-seeding and storm dispersal in order to have calm in the face of the storm. But this calm is no tranquility. It is only anesthesia; more precisely, the narcotization of anxiety in the face of thinking. (Heidegger, 1951/1975a, p. 78)

Aristotle's theory of predication has never been properly explicated. Because his logic was known to only a few until after the development of Stoic logic, those who came after him never saw his logical ideas untainted by their knowledge of Stoic logic or later systems of logic. But a careful study of his texts accompanied by careful attention to the core meanings of the words he used brings his ideas clearly into the light. The ideas that become clear in the course of such study are radically different from those embraced in any modern conception of predication, and one hopes that the reader can resist a modernistic urge to reject ancient ideas as primitive – as insightful only insofar as they anticipate modern ideas. The Aristotelian idea of predication seems to me to be meaningful and useful, but to arrive at this conclusion, one must get past the foreignness of it. In order to understand what predication meant for Aristotle, one must set aside one's belief in any modern idea about predication, and attempt to step inside the mind of this Greek. Heidegger describes the frame of mind necessary for understanding ancient Greek material:

. . . All later thinking which seeks dialogue with ancient thinking should listen continually from within its own standpoint, and should thereby bring the silence of ancient thinking to expression. In this

process, of course, the earlier thinking is inevitably accommodated to the later dialogue, into whose frame of reference and ways of hearing it is transposed. The earlier thinking is thus, as it were, deprived of its own freedom of speech. But this accommodation in no way restricts one to an interpretation completely dedicated to reinterpreting the to-be-thought at the beginning of Western thinking exclusively in terms of subsequent modes of representation. All depends on whether the dialogue we have undertaken first of all and continually allows itself to respond to the questioning address of early thinking, or whether it simply closes itself off to such an address and cloaks early thought with the mantle of more recent doctrines. This happens as soon as subsequent thinking neglects to *inquire properly* into the ways of hearing and frames of reference of early thinking.

An effort at proper inquiry should not end in a historical investigation which merely establishes the unexpressed presuppositions underlying early thought; that is, proper inquiry is not an investigation in which these presuppositions are taken into account solely with respect to whatever subsequent interpretation either validates as already posited truth or invalidates as having been superseded by further developments. Unlike this type of investigation, proper inquiry must be a dialogue in which the ways of hearing and points of view of ancient thinking are contemplated according to their essential origin, so that the call [*Geheiss*] under which past, present, and future thinking – each in its own way – all stand, might begin to announce itself. An attempt at such inquiry should first direct its attention to the obscure passages of the ancient text, and should not settle upon those which give the appearance of easy intelligibility. To focus on the latter would end the dialogue before it has begun. (Heidegger, 1954/1975b, pp. 85-86)

What was predication for Aristotle? When Aristotle talks about speech, there is no one set of terms he uses to write about the relation of what we would call the grammatical predicate of a sentence to the grammatical subject. For Aristotle, predication was not syntactic in nature; nor was it morphological (i.e., tied to the case marking that signals which noun is the subject of predication, namely the one marked for nominative case) – although the subject of predication does coincide, in Greek, with a noun or noun phrase with nominative case (but such a noun phrase is not necessarily a true subject of predication, as we will see). Translators of his writings have used the terms "subject" and "predicate" whenever

Aristotle wrote about those parts of a sentence that we have come to label in this manner. But for Aristotle, the words properly translated as "subject" and "predicate" were applicable only when the subject noun phrase (i.e., the phrase distinguished by marking for nominative case) and the rest of the sentence were related to one another in a very particular way – in the way discussed in his *Categories*.

Aristotle's word for predication is *katēgoria*. The tendency among translators of Aristotle's writing has been to translate words with the same root as *katēgoria* as "predicate" or "predication," but they have typically used the word "category" for items appearing in lists that Aristotle gives, lists including quality, quantity, location, time, and so on; in those instances, translators usually translate *katēgoria* as "category" rather than "predicate" or "predication" even when they elsewhere translate *katēgoria* as "predicate" or "predication." By contrast, early translations of the *Categories* into Latin rendered *katēgoriai* as *praedicamenta* (see Brentano, 1862/1975; the categories came to be known as "predicaments" in English). The odd policy of the modern translators has led to confused and confusing debates among scholars about what on earth Aristotle intended with his "categories" (e.g., Moravcsik, 1967), with few modern scholars (e.g., Anscombe & Geach, 1961; Cobb-Stevens, 1990; Ryle, 1955) noticing that they are types of predicates, in keeping with the linguistic nature of all of the books in Aristotle's *Organon*, including his *Categories* (i.e., all of these books are about *logos*, which encompasses propositions and arguments consisting of conjoined propositions – and so they are sometimes called his "logical" treatises). (The categories are types of predicates in the sense that they are types of things that can be predicated of a subject; see below; they are not necessarily types of things that are signified by the grammatical predicate.) Most scholars conclude that the categories cannot possibly be linguistic in any sense, but must be categories of being and nothing else. In truth, they are both (although the categories do not exhaust the genera of being; they are just those genera of being that can be predicated of a subject, in a sense

of predication to be described).³⁰ That the categories correspond to genera of being can be seen in a number of passages in which Aristotle says that *being* and thus the copula or auxiliary verb meaning 'be' has a different meaning for each of the categories (*Metaphysics* Δ.7, 1017^a22-30; Z.1, 1028^a10-20; Z.4, 1030^a17-27). But these same passages reveal the concomitant linguistic nature of the categories. The word for being (*einai*) is the present infinitive of the verb meaning 'be' (*eimi*) or, for being as 'that which is' (*to on*), the nominal form of the neuter present participle of 'be' – that is, of the copula; different genera of being (i.e., those that correspond to the categories) necessitate different senses of 'be' in propositions by virtue of which the different genera of being are predicated of subjects. (The derivation of the word for being from the copula or auxiliary 'be' reveals a deep link between ontology [from *onto-* plus *-logia*, where the former means 'being'] and propositional utterances, with a predicate revealing some aspect of a subject's being when something is truly predicated of a subject, in a sense to be given.) The Neoplatonist Porphyry (232-309), in his commentary on the *Categories*, describes the subject of this book as "significant expressions differing in genus, insofar as they signify" (58, 16; see Porphyry, 265/1992, p. 35):

Question: . . . If the treatise is about significant expressions, how is it that the whole of his subsequent discussion was about things?

Answer: Because words are like messengers that report to us about things, and they get their generic differentiae from the things about which they report. Hence it is necessary to begin the consideration of them from what makes their use necessary, so that they may receive their difference in genus from the generic differentiae of the things about which they report. So our inquiry is incidentally concerned with the generic differentiae of beings, while primarily it

³⁰This double nature of the categories must elude modern scholars because modern semantics does not generally allow for any direct relation (e.g., reference) of an utterance to that about which the speaker is speaking, and so the relation of utterances to being is hidden in modern scholarship (with a very few exceptions; see Macnamara & Reyes, 1994, for a theory of natural-language semantics that has reference at its core).

In contrast, the Greeks thought that language, as *logos*, can reveal being, and in a way that is true to its nature (e.g., Plato, *Republic* 6, 510-511, and 7, 533-534; see also Heidegger, 1927/1962, pp. 56-57).

is about significant expressions . . . (58, 21-29; see Porphyry, 265/1992, p. 35)

The confusion about Aristotle's categories cannot be attributed entirely to English translations of his works. The same confusion has existed from ancient times to the present. Porphyry reports in some detail on the history of this confusion, using his question and answer style of dialectic:

Question: Has everyone who has written about the *Categories* been aware of [the] distinction [between expressions qua signifying expressions versus expressions qua expressions, e.g., types of words such as nouns and verbs]?

Answer: Certainly not. Otherwise there would not have been those who took the investigation to be primarily about the genera of being, nor those who attacked the work and rejected the division of categories as being insufficiently comprehensive and as failing to include certain items, or again as containing extraneous ones.

Question: Who were the latter?

Answer: The followers of Athenodorus and Cornutus [i.e., Stoic philosophers of the first centuries B.C.E. and C.E.], who took the objects of the investigation to be expressions *qua* expressions, that is, expressions as used properly and figuratively and so forth, for these are differentiae of expressions *qua* expressions. Fixing upon these, they raised the question of what category they belonged to, and finding none, they complained that the division was incomplete, since it fails to include every sort of significant expression.

Question: Have all the commentators been mistaken about the subject matter of the *Categories*?

Answer: Certainly not. Boethius, in his commentary on the *Categories*, said what we have said, and so did Herminus [a teacher of the Aristotelian Alexander of Aphrodisias], though briefly.

Question: Tell us what Herminus says, since you say he spoke briefly.

Answer: Herminus says that the subject of the work is not the primary and highest genera in nature, for instruction in these is not suitable for young persons, nor the issue of what the primary and fundamental differentiae of things said are, since in that case the discussion would seem to be about the parts of speech. Rather it is about the sort of predication that will properly belong to what is said in each of the genera of being. Hence it also became necessary to touch in some way upon the genera to which the predications in question correspond, for it is impossible to recognise the kind of signification that is proper to each genus without some preconception of it. This also accounts for the title *Category* [*sic*], which indicates the proper mode of signification connected with each

genus. The discussion will reveal as it proceeds that these genera are ten in number, so that the number of predications is also ten. But it would not be unreasonable for one to give the work the title *On the Ten Genera*, provided this title is taken to refer to the correspondence between the predications and the genera, and one does not think that the book is primarily concerned with the ten genera. (59, 4-34; see Porphyry, 265/1992, pp. 36-37)

Porphyry's teacher, Plotinus, the founder of Neoplatonism, himself interpreted the categories as genera of being, and attacked them on that basis (see *Enneads* 6, 1-3). The Neoplatonist Ammonius (435/445-517/526), a student of Proclus, writing at the end of the fifth century, also briefly described the differing views of earlier commentators:

Et d'abord, la question du propos [of Aristotle's *Categories*, les *Attributions*]. Il faut savoir que les commentateurs ont différé d'opinion à ce sujet. Certains ont cru que le Philosophe détermine des mots, d'autres des choses, d'autres, encore, des concepts. ['First of all, the question of the purpose (of Aristotle's *Categories*). It is necessary to be aware that the commentators differed in their opinions on this subject. Certain ones among them believed that the Philosopher characterises words, others things, and still others concepts.'] (*Prolégomènes aux Attributions* 9, 1-3; see Pelletier, 1983, p. 77)

It is noteworthy that the best known of Aristotle's commentators in the Aristotelian tradition, Alexander of Aphrodisias, took the position later taken by Porphyry, namely that the ten categories are types of predicates signifying ten types of being (see a fragment of his lost writing in Simplicius's commentary on the *Categories*, at 10, 11-19; see Simplicius, 540/1971, p. 13).

Brentano (1862/1975) described the views about "the actual nature and meaning of the categories" that were prevalent in his time (i.e., the middle of the last century):

The first of these opinions holds that the categories are not real concepts, but only the framework in which all real concepts are to be placed, that they merely generate points of view, according to which concepts are to be classified when the objects of thought are discriminated.

... The second opinion describes categories not as forms of statement, as manners of predicating concepts, but *as concepts*,

though not as regarded in and by themselves and as describing simple mental representations, but as concepts envisaged in their relation to a judgment, i.e., insofar as they are part of the judgment, viz. the *predicate*. According to this view the categories arose from a dissolution of the propositional context; they are isolated predicates, most general predicates. Their classification derives not from real observation, but from the differences between grammatical relations where a corresponding difference of logical relations seems to be presupposed.

. . . The third view, finally, agrees with the second by taking the categories to be not a mere framework for concepts, but real concepts; it denies, however, more decisively than the first, that they are merely predicates or that the table of categories was designed merely in view of logical and grammatical relations. It takes the categories to be the various highest concepts which are designated by the common name being. (pp. 51-53)

Let us conclude, from Aristotle's choice of terminology, that the ten categories are first and foremost types of predication (albeit ones borrowing their genera from types of being), and let us now examine predication itself. The literal meaning of *katēgoria*, and the Aristotelian idea of predication, is 'accusation'.³¹ The word derives from the verb *katēgoreō*, which means 'accuse,' but more literally to speak out against, or denounce, someone publically; it is equivalent to *kata*, 'against,' conjoined with *agoreuō*, which means to speak before the Agora (i.e., before an assembly of the people). This word was used for the speech of the prosecution in front of a tribunal (where the speech of the defendant was called the *apologia*).

Another expression often used by Aristotle for predication is *legein kata tinōs*, 'to speak (out) against someone (or something)' (see Liddell & Scott, 1968); this expression carries the same notion of accusing someone of something – of holding someone responsible for a thing (i.e., for some wrongdoing). It is synonymous with *katēgoreō*, and Aristotle uses the two expressions interchangeably.

³¹I am very grateful to Robert Schmidt for pointing out to me the meaning of Aristotle's word for predication, as well as the meanings of some other Greek words relevant to language, and for his corrections of my errors in translation. His thoughts on Aristotle's idea of predication and my discussions with him have greatly influenced the views presented in this section.

The core meaning of the verb *legō*, for which *legein* is the infinitive, is ‘determine’ or ‘bring to a limit’ (R. Schmidt, personal communication, April 4, 1995); Plato, in the *Sophist*, uses this verb interchangeably with *parainō*, which has the same meaning. All of the other meanings of *legō* are related to this one. It means ‘speak’ in the sense of *logos* because *logos*, as *logos apophantikos*, ‘a revelatory, or appearance-permitting, utterance,’ or a proposition, results from *determining* a predicator with a noun (see Aristotle, *On Interpretation* 1, 16^a9-18, 4, 16^b28 - 5, 17^a12); the referent of the subject noun phrase, namely a particular or set of particulars, provides the substrate for that which a predicate headed by (and sometimes coincident with) a predicator signifies, namely something nonseparable, and thereby gives the nonseparable phenomenon a determination, allowing it to come to be out of the limitless. (The word *logos* also applies to syllogistic argument and dialectic; see footnote 45 for a description of the way in which the former involves a determination or bringing to a limit. *Legō* as ‘reason’ comes from the idea that reasoning is talking to oneself; see Plato, *Sophist* 263e, 264a.) *Legō* also means ‘lay’ or ‘gather.’ Heidegger (e.g., 1951/1975a) takes this word to mean letting something lie before one or letting something be seen. In this case, what is laid before someone or something is an accusation or charge – something for which the subject is claimed responsible. A true accusation allows to be seen (in the mind’s eye) that for which a subject is responsible. I will translate *legein kata tinos* as ‘to lay against someone/something’ to give the sense of laying a charge against someone or something.

Why does Aristotle describe predication as accusation? Porphyry explains it this way:

Question: Why, given that in ordinary usage the term *katēgoria* denotes the speech of the prosecution against someone at a trial, which is opposed by the defendant’s speech (*apologia*), and that Aristotle’s intention was not to instruct us about how to argue accusations against opponents in lawcourts, but about something else, for which this word is not used in ordinary Greek, did he choose to violate accepted usage by giving his book the title *Categories*?

Answer: Because ordinary language is for communicating about everyday things, and employs the expressions that are commonly used to indicate such things, but philosophers are interpreters of things that are unknown to most people and need new words to communicate the things they have discovered. Hence either they have invented new and unfamiliar expressions or they have used established ones in extended senses in order to indicate the things they have discovered. (55, 3-14; see Porphyry, 265/1992, p. 29)

What was it that Aristotle discovered about predication? His choice of terms and his examples of predication and non-predication seem to indicate that he had come to view predication as an attribution of responsibility to a subject for a predicate. If one accuses someone of a misdeed, then one holds that person responsible for it; the deed came into being through that person. By analogy, if one can accuse a thing of having a property or being in a certain relation to something else, then one holds the thing responsible for the property or relation; the property or relation came to be in or by virtue of that thing. So predication is an attribution of responsibility to a subject for the coming to be and the being of whatever the predicate signifies.³² The act of predication yields a proposition that

³²An accusation implies wrongdoing. In this context, the wrongdoing follows from the fact that responsibility for something implies having let it or made it come into being. The Greeks may have believed that any form of being, in coming to be, commits an injustice. The idea of injustice created in coming to be seems inherent in Anaximander's famous fragment from the sixth century B.C.E.:

It is neither water nor any other of the so-called elements, but some different, boundless nature, from which all the heavens arise and the *kosmoi* within them; out of those things whence is the generation for existing things, into these again does their destruction take place, according to what must needs be; for they make amends and give reparation to one another for their offense, according to the ordinance of time . . . (Kahn, 1985, p. 166)

For a quality with a contrary, perhaps the injustice is in the form of denying being to one's contrary, because contraries cannot exist simultaneously in the same individual (see Jones, 1956, p. 40). The Greeks may have believed that when hotness comes to be within its substrate, it commits an injustice to coldness, for which it must give reparation through its own destruction in that same place. Applying the same idea to the four elements as Aristotle conceived them, each with two qualities, and for which transformations into one another occur by virtue of at least one of the two qualities changing to its contrary, one might conclude that the being of one element would prevent the being of all other elements in the same substrate – again, because contraries cannot coincide in the same substrate (see Aristotle's *Generation and Corruption*; Aristotle did not, himself, discuss the injustice associated with the coming to be of an element). When earth, which is cold and dry, comes to be, it may commit an injustice to fire, which is hot and dry, because the hot and dry cannot exist where the

(continued...)

reveals to the mind's eye being that comes to be or *is* by virtue of the subject such that it is some aspect of the subject's being.

Predication as an attribution of responsibility for the being of what the predicate signifies is foreshadowed in some of Plato's writings. In the *Sophist* (262d), with reference to a man's utterance "a man learns" as an example of a proposition, Plato says, ". . . He thereby reveals something about that which is or is becoming or has become or is to be . . ." (the translation is mine); by this, he means that something is revealed about the being of the subject (whether it be past, present, or future being; see *Sophist* 262e).

Aristotle's idea is partially captured in our modern usage of words concerning predication. The verb "predicate" is derived from the Latin verb *praedicō*, which means 'cry in public' or 'proclaim'; as such, it captures the idea of speaking in public, but not of speaking out *against someone* in public. Nonetheless, we sometimes use the verb "predicate" in the sense of basing or founding something on something (e.g., "He predicated his argument on the existence of . . ."); this usage gives some sense of one thing being responsible for another, as its source. We sometimes talk about predication in terms of *attribution*. This word, from the Latin verb *attribuō* ('allot, assign, or impute to'), is more closely related to "accusation" in meaning; in fact, we even attribute crimes and misdeeds to people – but we also attribute to people or things qualities and properties and deeds of whatever nature; by "attribution" we mean that something is said to belong to someone or something, perhaps because it came to be within that person or thing, or because it is the creation of the person to whom it is attributed, or we mean that the one to whom it is attributed is responsible for it as its source or basis. (A fairly recent translation of Aristotle's *Categories* into French uses the word "attribution" for *katēgoria* consistently throughout; see Pelletier, 1983.) But the modern use of this word is almost completely restricted to the

³²(...continued)

cold and dry exists. Earth could likewise be seen to commit an injustice against the other elements, for neither cold and wet (water) nor hot and wet (air) can exist where cold and dry (earth) exists.

modification of a noun by an adjective within the same phrase, with the adjective viewed only as a device for limiting the extension of the noun. Aristotle's view of predication is also partially captured when we say that a predicate signifies a *property* of the subject. A property of someone is something that belongs to the person. In this case, the belonging is not due to the person's having purchased something. That which the predicate signifies belongs to the subject because it came to be within that individual, or by virtue of that individual. To say that it belongs to the subject is to say that the subject allowed it to or made it come to be – and so the subject is responsible for its being, in that sense. We also sometimes say that a statement containing a subject and a predicate is an *assertion*. The verb "assert" comes from the Latin verb *asserō*, which is equivalent to 'to' plus 'join, put' and which means 'lay hands on' or 'grasp,' but also 'claim (as one's own).' This word was used for putting one's hand on the head of a slave, either to set him free or to claim him for servitude. The latter seems the most relevant, for if we assert a predicate of a subject, we claim that the predicate belongs to the subject; the predicate is subservient to the subject because it depends upon the subject for its existence. (Aristotle often wrote of the significations of predicates 'coming to be in dependency,' *huparchon*, upon a subject; one literal meaning of the word *huparchon* is 'being under the power of a supreme ruler.')

Our use of the term "copula" for the "be" in a proposition also hints at Aristotle's idea of predication. This word has the same root as "copulate," and implies a union of the subject and the predicate. If the union is taken to be a union of what they signify, rather than a union of the expressions per se, such a union implies that one is not separate from the other, implying in turn that one came to be within the other and by virtue of the other. Finally, certain of our terms for cases tacitly carry Aristotle's idea of predication. A noun in the predicate naming a direct object is usually said to be in accusative case in languages that have case marking for common nouns. The adjective "accusative" derives from the Greek *aitiatikē* through the intermediary of the Latin *accūsātīvus*, both of which mean 'belonging to or connected with accusation'

(because the Greek noun *aitia*, in one of its senses, means 'accusation,' or the imputation of guilt, blame, or responsibility, and the Latin verb *accūsō* means 'blame,' 'accuse,' or 'hold responsible'; the suffixes mean 'belonging to' or 'connected with'); this fits well with the fact that a noun in accusative case is part of the predicate, that is, part of the accusation against the subject; the act of which the subject is accused is an act upon an object named in accusative case. The name for the case of the noun in the subject phrase is "nominative"; this comes from the Latin *nōminātīvus*, itself from the verb *nōminō*, meaning 'name,' 'denounce,' or 'accuse'; so *nōminātīvus* means 'belonging to or connected with naming or denouncing or accusing,' and it signifies the case of the one named (as in a law suit), denounced, or accused.

The notion of accusation as an analogy for predication works better in the context of Greek society than in the context of modern society. In modern times, accusations and attributions of responsibility for misdeeds are made against people, but not against other kinds of things that can be named as the subject of predication in propositions. But in classical Greece, a death by unnatural causes could be attributed to a person, but alternatively to an animal or an inanimate object. Such attributions were determined by the tribal kings in a court in the Prytaneion (e.g., Andocides, *On The Mysteries*, 78; Aristotle, *Constitution of Athens*, 57; Demosthenes, *Against Aristocrates*, 76; Pausanias, *Attica* 28, 10; Plutarch, *Solon* 19, 3; Pollux 8, 120). The trial of inanimate objects shows that responsibility did not always have its source in an intention; in fact, a death could be attributed to a person whether the death was caused intentionally or accidentally, and the same severe punishment (death or exile) applied in either case (see, e.g., Antiphon, *Second Tetralogy*). When the death was attributed to an inanimate object, the object was sometimes the instrument of an unknown or absent murderer (as in the first case of a trial against an object, according to Pausanias, in which an axe was acquitted for the slaying of an ox at the altar of Zeus Polieus; see Pausanias, *Attica* 28, 10-11; see also Demosthenes, *Against Aristocrates*, 76), but it was sometimes judged to have acted of its own accord, as it were (and Pausanias gives

the example of the scimitar of Cambyses, which was said to have come free of its cap and pierced his thigh as he leapt onto his horse, leading to his death; see Herodotus 3, 64); an attribution of responsibility for a death could be made to an object that had simply fallen on someone (Pollux 8, 120). When a death was deemed to be caused by a person, the person was exiled or killed. The reason for these types of punishment is revealed in Antiphon's description of the consequences of a killing:

. . . The whole city is defiled by the criminal until he is brought to justice. . . . It is against all your interests that this polluted wretch should profane the sanctity of the divine precincts by setting foot within them, or pass on his defilement to the innocent by sitting at the same tables as they. It is this that causes dearth and public calamity. And so you must hold the avenging of the dead a personal duty; you must visit the defendant with retribution for the sin which was his alone; you must see that none but he suffers, and that the stain of guilt is removed from the city. (*First Tetralogy* 1, 3-11)

A killing always implied "blood-guilt"; that guilt must rest on someone or something, whether the killing was accidental or wilful, and whether the killer was a person, an animal, or an object. The guilty party must be punished to avenge the death, and the punishment must rid the land of the killer, by death or by exile, or else the killer's presence will bring misfortune to the entire community, and especially to those closely connected with the killer. If blood-guilt is taken to imply responsibility for the death, then one can infer that responsibility was attributed to inanimate objects and animals just as surely as it was to human murderers; just as people were exiled for murder, inanimate objects and animals were removed beyond the borders of the land if found guilty for a death (Pollux 8, 120). It is clear, then, that in the context of Greek society an accusation in a court of law serves well as an analogy for an attribution of responsibility for something's coming to pass (or coming to be).

Other Greek terms in the domain of language bring this analogy to bear. The Greeks often used the word *phasis* for an utterance. The noun *phasis*, when derived from the verb *phēmi*, means 'utterance' or 'proposition,' but also

‘judgement’ or ‘sentence.’ When the noun *phasis* is derived from the verb *phainō*, it can mean ‘a becoming visible’ or ‘appearance,’ but also ‘denunciation’ or ‘information laid’ (see Liddell & Scott’s, 1968, *A Greek-English Lexicon*). More specifically, a *phasis* was an accusation or denunciation that could be brought forward by any citizen of Athens (and not just by the wronged party). The accuser was called a *phainōn* (see Harrison, 1968), which means ‘one who brings to light,’ ‘one who makes appear,’ or ‘one who makes known.’³³ *Phasis* was a legal procedure for making accusations regarding matters of property and ownership (e.g., MacDowell, 1991; Osborne, 1985). It was also used in cases of maltreatment of an orphan, but was restricted to maltreatment in the form of improper handling of the orphan’s property (i.e., the orphan’s estate; see Harrison). MacDowell (1991) shows that the procedure of *phasis* was primarily a bringing to light of goods or other property as belonging to someone, and only secondarily a bringing into the light of a person who was in wrongful possession of the property or misusing it. Among MacDowell’s examples is a passage from Aristophanes showing the use of the procedure in a case of the illegal import of goods from a state with which the Athenians were at war; in this case, the enemy goods are piglets that a Megarian is attempting to sell; the passage reads “Ta choiridia toinun egō phanō tadi polemia kai se,” ‘The piglets, then, I will bring to light as that which belongs to the enemy, and also you’; in other words, the accuser brings to light the property as belonging to the enemy, and also brings to light the person who illegally imported it, but only secondarily. When the wrongdoer alone was brought to light, and not firstly the goods wrongly used or wrongly possessed, a different word was used for the legal action: *endeixis*. MacDowell (1991) sums up the difference between the two procedures as follows:

Phainō is used for pointing out objects, goods or property,
endeiknumi for pointing out persons. . . . In *phasis* the denouncer

³³This word was also an epithet for the planet we call Saturn, known to the Greeks as Kronos, which was considered to be the body of the god governing, among other things, accusations (see Valens, 150/1993).

points out some goods, which ought not to be there; so the goods are confiscated and shared out between the denouncer and the state. In *endeixis* there are no goods to be seen [i.e., the goods are not present]; the denouncer merely points out the offender, and the penalty has to take a different form. (p. 189)

So a *phasis* is an accusation primarily regarding property and its ownership. If the accusation was judged true, the accuser received one half of the fine raised; if it was judged false by 80 percent or more of the jurors, the accuser had to pay a fine (see, e.g., Osborne; Todd, 1993) and was subject to public disgrace and a partial loss of civil rights (*atimia*; see Harrison). In other words, a false accusation inculcates the accuser – an idea that fits nicely with the fact that the Greek word for falsity, *pseudos*, means ‘a lie’ or ‘a deceit.’ When a *phasis* was made, the charge was inscribed on a wax-covered tablet and displayed in public (in the Agora, the place of public assembly; see MacDowell, 1990). The public display of the accusation in the form of a sign is analogous to the bringing to light of something that a subject is accused of possessing as an attribute, a bringing to light in the form of an affirmation that “gives a sign” (*semainei*) of the attribution.

In the Greek vocabulary, propositions in the form of affirmations are instances of *kataphasis*, and denials are instances of *apophasis*. The prefix *kata-* means ‘against,’ ‘toward,’ ‘down,’ or ‘in accordance with,’ so a *kataphasis* may be a statement that is in accordance with denunciation or bringing to light. The prefix *apo-* means ‘away from,’ so an instance of *apophasis* may be a statement that departs from denunciation by saying that an accusation would be false (or a lie, since the Greek word for falsity means ‘a lie’ or ‘a deceit’). In the context of an accusation, *apo-* can mean the *removal* of the accusation (e.g., in the word *apologeomai*; see Liddell & Scott, 1968), so an *apophasis* can be interpreted as a removal of a charge against the subject.

A *kataphasis* may also take us toward a *phasis* in the sense of ‘appearance’; the Greek word for truth, *alêtheia*, means ‘taken out of hiding,’ ‘unconcealed,’ ‘made manifest,’ and especially being’s having been made manifest to the mind’s eye (see Heidegger, 1975/1988, p. 215; Krell, 1975). According to Aristotle, a true

affirmation reveals to us some aspect of being, and so truth, or the "unconcealed," is equivalent to being (i.e., it is being that is unconcealed); moreover, truth and falsity are associated with combinations of nouns (read noun phrases) and predicators (read predicates) – that is, with affirmations and denials, for only such combinations have the capacity to unconceal being (see *Metaphysics* Δ.7, 1017^a31-32 and Θ.9, 1051^a34 - Θ.10, 1051^b2, and *On Interpretation* 1, 16^a9-18 and 4, 16^b28-17^a12).

The Greek word for an utterance that is either a *kataphasis* or an *apophasis* (i.e., a proposition) is *apophansis*. This noun is derived from the verb *apophainō*, which means 'show forth' or 'display,' as well as 'make known' or 'declare,' but also 'denounce' or 'inform against.' The verb *apophainō*, in turn, derives from the verb *phainō* from which the noun *phasis* is formed. This verb, *phainō*, means 'bring to light,' 'bring into sight,' 'make to appear,' 'show by baring,' 'uncover,' 'show forth,' 'display,' and other related meanings. As the source of *apophainō* and *apophansis*, it reveals the power of speech to bring the being of things into the light – to make their being appear to the mind's eye. Recall that the nominalisation of this verb, *phainōn*, means 'accuser.' In the passive form, this verb can mean 'be denounced' or 'be informed against.' In the context of *apophainō* and *apophansis*, the prefix *apo-* seems to signify the source or origin of the bringing to light or the denunciation, the thing *from* which the uncovering originates, or *by* which an appearance arises – or *from* which a denunciation comes to be laid on someone, bringing to light some deed that may have been done. This origin is a proposition, an *apophansis*. Affirmations and denials of predicates are to be understood in terms of their power to bring something to light – to make something appear to the mind's eye – or to make known something for which a subject can be held responsible if the utterance is a true affirmation.

Aristotle's list of "categories" gives types of expressions signifying those types of being for which a subject can be held responsible.³⁴ In the *Categories* (4, 1^b25-2^a4), the following list of predicate types³⁵ appears: *ousia*, 'beingness' (of a particular kind, e.g., "man," "horse"), *posos*, 'a quantity or numerical value' (e.g., "two cubits [long or broad]," "three cubits [long or broad]"), *poios*, 'a quality' (e.g., "white," "well-versed in grammar"), *pros ti*, 'a proportion or relation to something' (e.g., "double," "half," "greater"), *pou*, 'at some place' (e.g., "in the Lyceum," "in the market-place"), *pote*, 'at some time' (e.g., "yesterday," "last year"), *keisthai*, 'to be situated' (in a certain way, e.g., "to be laid up," "to be seated"), *echein*, 'to have' as 'to wear,' 'to bear,' 'to be contained by,' 'to be held in or up by,' or 'to possess'³⁶ (e.g., "to be bound into sandals," "to be in warrior dress"), *poiein*, 'to do, make, bring about, or cause something' (e.g., "to cut," "to set on fire"), and *paschein*, 'to suffer or undergo' (e.g., "to be cut," "to take fire"; the translations are mine). In the *Topics* (A.9, 103^b22-23), Aristotle lists essentially the same ten *genē tōn katēgoriōn*, or 'genera of accusations,' except that the first is given as *ti esti* ('what [it] is') instead of *ousia* ('beingness'). Elsewhere while speaking explicitly of predicates or the being they signify, he also calls this category *ti esti*, or else *to ti*,

³⁴As mentioned earlier, the categories came to be called "predicaments," from the Latin *praedicamenta*; the modern English word "predicament" still carries with it the idea of a bad situation, as did the Greek idea of predication, in which the subject is accused of wrongdoing -- in the form of bringing something into being.

³⁵The expression Aristotle uses to describe them is "[Ta] kata mēdēman sumplōkēn legomenōn . . .," which means 'Those which are getting laid against no interweaving . . .,' that is, those expressions that are predicated, not of interweavings of words, but of simple expressions. For instance, "quality" can be predicated of white (e.g., "White is a quality"), but not of a white rabbit ("A white rabbit is a quality"). Elsewhere, these same expressions are called schemata of accusation or genera of accusation.

³⁶Aristotle gives a detailed description of this category, *echein*, in *Metaphysics* Δ.23, and another in *Categories* 15.

'the what' (see *Metaphysics* Δ.28, 1024^b14, E.2, 1026^a37, and E.4, 1027^b33.)³⁷ This is the category of kinds (i.e., "secondary substances"). It is that which provides an answer to the question, "What is it?" (See *Categories* 5, 2^b8-14, 29-37.) The category includes basic-level kinds (or species, what the Greeks called *eidē*) and genera (for one supplies the basic-level-kind term for a basic-level individual when asked "What is it?" but the term for the genus when asked this about a basic-level kind, e.g., "An animal" when asked "What is an aardvark?"; *Categories* 5, 2^a14-19). In the context of predication, this category does not include individuals (i.e., primary substances), which cannot, as we will see, be predicated of anything (other than themselves). For the category of kinds, the intension or form associated with a kind seems to be the meaning when the noun for the kind heads the predicate: Aristotle says that a noun for a kind in a nominal predicate signifies a certain quality or nature or sort, but not in the sense of a quality like whiteness that is *in* a substance; the quality signified by a nominal predicate *defines* a substance or atom, determining that to which the name for the kind can be applied (*Categories* 5, 3^b13-16, 19-23).

³⁷It is likely that Aristotle used terms other than *ousia* for this first category in later works because this word signifies substance in general, when his intent regarding predication was secondary substance alone. Many scholars have been confused by his use of *ousia* for the first category, inferring that a primary substance can be predicated of subjects (in contradiction to Aristotle's own statements in *Categories* 2, 1^b6-7, 5, 3^a8-9, 36-37, and *Prior Analytics* A.27, 43^a32-40), or concluding that the categories cannot be genera of predicates, but only genera of being or genera of concepts (see, for e.g., Brentano, 1862/1975). Whenever Aristotle is explicitly discussing predication, he never uses any expression for this category, other than *ousia*, that would suggest primary substance; for instance, he never speaks of "this something" (*tode ti*) or "the this" (*to tode*) with reference to this category in such contexts. But when he is discussing something other than predication, such as the genera of being that correspond to the categories, he does use expressions such as *tode ti* ('this something') and *to tode* ('the this') that suggest more strongly the inclusion of primary substance (e.g., in *Metaphysics* Z.1, 1028^a11-12, Z.4, 1030^b11-12, and H.6, 1045^b2). (In a discussion of the first principles of being, Aristotle calls *ousia* 'one genus of being': "hē gar ousia hen ti genos esti tou ontos"; *Physics* A.6, 189^b23-24.) It is likely that Aristotle used the more general term for substance in his list in *Categories* 4 because this list does not give the genera of predicates per se, but the genera of expressions that are not combinations of other expressions (i.e., the list gives expressions that are predicable of uncombined expressions only, expressions that name the genera of the significations of such uncombined expressions in subject position). When the same list, or part of it, appears elsewhere in his writings, and the list is said to be of genera of accusation, or schemata of accusation, the first item is not *ousia*, but some expression that more clearly indicates secondary substance and that more clearly excludes primary substance (such as *ti esti* or *to ti*).

Not just any "subject" can be held responsible for any of these predicates, but just that sort that Aristotle calls a *hupokeimenon*.³⁸ The prefix of this word, ὑπο- — from which we have derived the prefix that appears in English words such as "hypothesis" and "hypothermia" — means 'under.' The remainder of the word derives from the verb meaning 'lie,' and the entire word is a noun from the present middle or passive participle of the verb meaning 'underlie' (*hupokeimai*); as such, it means literally 'the thing that is getting lain under (something)' or 'that which is getting lain under (something),' or 'that which is getting itself to underlie (something).'³⁹

To see what the word *hupokeimenon* implies, consider the following sentence: "That dancer is beautiful." This sentence predicates being beautiful, not of a dancer, but of the woman who underlies the dancer. Aristotle would call a woman, but not a dancer, a substance (*ousia*, 'beingness'). He argued, in many places, that substances are the substrates for qualities (e.g., in the *Categories*, and in *Metaphysics Z*). The substrate is usually characterised by the form, not the matter, of an individual; in modern psychological language, it is characterised by its basic-level kind, that through which we trace identity over the longest period of existence for an individual (e.g., we trace identity over a longer period for a passenger qua person than for a passenger qua passenger). Beauty can be attributed to a dancer qua dancer, but typically not when the noun "dancer" appears in the subject phrase and the predicator "beautiful" appears in the predicate; for beauty to be attributed to a dancer, versus a woman that underlies a

³⁸Aristotle also uses, occasionally, the expression *(to) hou katēgoreitai* ('that of which [something] is accused' or 'that which gets [something] accused of itself') for the subject of predication (e.g., in *Posterior Analytics* A.22, 83^a18).

³⁹Perhaps the best English translation for *hupokeimenon* is "substrate" from the Latin *substratus* (although this word implies that that which lies underneath is a spread-out layer or cover of some sort), or possibly "subject," from the Latin *subjectus* (although this word implies a *throwing* or *projecting* upwards or a *sending forth* from underneath, which may or may not be an appropriate addition to the meaning); this word can suggest that that which is underneath provides support; the word "substance," from the Latin *substantia*, 'the condition of coming to a standstill under, or of standing under' (or 'understandingness'), should imply a standing under, which is similar to a lying under, but this word's meaning has been polluted.

dancer, the noun and the predicator must appear in the same phrase (e.g., "That beautiful dancer is the toast of the town"; "That woman is a beautiful dancer"). When a non-basic-level noun appears in the subject noun phrase, we almost always "map" into an underlying individual of a basic-level kind before we apply the predicate (see La Palme Reyes et al., 1994b, for a discussion of such mappings). Such a mapping is blocked only when (1) a predicator in the predicate can be typed by the surface noun in the subject noun phrase, but not typically by the basic-level noun for the substance underlying the individual that is explicitly named, as in the sentence "That blackjack player is green," or (2) extrinsic information from within or without the sentence points to a predicator that is typed by the surface noun, as in the sentence "That politician is running in the election" or in the sentence "That politician is running" when the preceding discussion has focused on politicians running in a particular election; in the absence of this extrinsic information, "That politician is running" means that the underlying person is running in the sense of moving his or her legs rapidly in a coordinated fashion. But this typing of predicators was not Aristotle's concern when he discussed predication; his interest was in attributing responsibility for being. In Aristotle's view, the underlying substance (*ousia*) is always ultimately responsible for the predicate, and in this he seems to have been correct. If a politician runs in an election, the responsibility for the running lies ultimately in the person underlying the politician, for that person must have formed an intention to run; he or she must have made a decision to run (and also to become a politician, at some point). So, regardless of whether the predicator is typed by the surface noun or by an underlying noun for substance of some kind, once the nature of the predicate is known (and despite the fact that that nature depends on the noun that types the predicator within the predicate), responsibility for the predicate is attributed to the substance underlying the individual signified by the surface noun phrase; that individual is held responsible for the coming to be (and thus the being) of whatever the predicate signifies. Even if we attribute being beautiful to a dancer qua dancer, the underlying woman is nonetheless responsible

for the beautiful dancing she does – for that which leads us to call her a beautiful dancer. (But below, we will see that a dancer can be held responsible for the being of something that can come to be by virtue of a dancer qua dancer, such as dancing, the wearing of ballet shoes, etc. In other words, a proposition such as "The dancer is executing a pirouette" is an instance of proper predication; but because the dancer arose out of a person, the predication can also be made against the person who underlies the dancer, who is the ultimate subject.)

Primary substances (i.e., members of basic-level count kinds) are not the only things that can be true subjects of predication. In *Metaphysics* Δ.18, Aristotle lists the kinds of things that can give rise to being (and so be held responsible for a predicate). The first is the basic-level kind (or species, or secondary substance; *to eidos*) of an individual, and the second is the beingness (or the substance; *hē ousia*) of an individual. Third is that in which something is immediately generated, such as the surface of an object in which colour comes to be. Being can arise also by virtue of the material out of which objects are made. In summary, a true subject of predication can be a basic-level kind, a basic-level atom, a surface or other bearer of properties, or a portion of material or stuff.

Aristotle also seems to allow for other sorts of subjects as proper subjects of predication, when the predicate is something that could come to be from their nature. For instance, "The carpenter built the house" would be an instance of proper predication, but "The carpenter graded the papers" would not; "The teacher built the house" is not proper predication, but "The teacher graded the papers" is an instance of proper predication. (See Aristotle, *Metaphysics* Δ.7, E.2.) We can attribute responsibility for building a house to a carpenter qua carpenter, but not to a teacher qua teacher. When we say, "The teacher built the house," we mean that the teacher is concomitant with that which built the house; we do not mean to imply that the teacher built the house qua teacher. For such utterances, it seems most natural to map from the named subject into its underlying substance (e.g., a person) before attributing the predicate to the subject.

Aristotle's categories describe those things that can be said to come into being (and thus to have being) because of a subject. Qualities, for instance, come to be within substances from which they cannot be separated. Being in a place comes to be by virtue of a beingness (a "substance," *ousia*) that moves or is moved into that place. The being of causing something (e.g., cutting) exists by virtue of an agent who performs the action. And so on. In the case of the category of substance or the "what" (i.e., kinds), the subject brings into being an instance of the form of a person, for example, by itself coming into being. The form of a person does not exist except as the form of a particular person. Notice that the attribution of responsibility that is equivalent to predication is separate from the notion of a cause. The cause of a person is his or her parents, who conceive a child. But the responsibility for the being of a person, or rather for the being of his or her form, in the predicative sense of responsibility, where responsibility is attributed to that which underlies being – that responsibility belongs to a person so conceived.

Not all propositions involve predication in the Aristotelian sense. Aristotle describes combinations of nouns and predicators that, while forming well-formed propositional utterances (i.e., ones containing a grammatical "subject" and a grammatical "predicate"), do not yet constitute instances of genuine (or natural) predication because responsibility cannot be attributed to the individual named as subject for that which is signified by the predicate. One example, given above, is "The teacher built the house," where we cannot attribute building the house to the teacher qua teacher. In addition, a rigid designator (i.e., proper noun) for an individual signifies something (i.e., a primary substance, a member of a basic-level kind, or rather its form when the name appears in the predicate) for which no other individual can be held responsible:

Things that are individual [*ta atoma*, i.e., atoms] and numerically one are, without exception, not said of any subject [*kat' oudenos*

hupokeimenou legetai, 'do not get laid against any substrate']
(*Categories* 2, 1^b6-7)⁴⁰

. . . A primary substance [or primary beingness; *prôtē ousia*] is [not] said of a subject [*oute kath' hupokeimenou legetai*, 'does not get laid against a substrate'] (*Categories* 5, 3^a8-9)

. . . From a primary substance there is no predicate [*oudemia esti katēgoria*, 'none is an accusation'], since it is said of no subject [*kat' oudenos . . . hupokeimenou legetai*, 'does not get laid against any substrate'] (*Categories* 5, 3^a36-37)

(I gather, though, from *Metaphysics* Δ.18, that an individual, or rather its form, can be predicated of itself.⁴¹) In the *Prior Analytics*, Aristotle claims that the

⁴⁰Where I have not given my own translation of Aristotle's text, as in this instance, the translations are from the Oxford English editions of the texts. I have sometimes used published translations in order to contrast the standard interpretations of Aristotle's words with more literal interpretations, to bring to light the chasm between what Aristotle said and what he has been taken to have said.

⁴¹In the *Metaphysics* (e.g., Θ.7) and *Physics* (e.g., A.7), Aristotle argues that everything must come to be from something, and calls that something "matter" (*hylē*); even an instance of primary substance (i.e., an individual member of a basic-level kind) can be predicated of its "matter."

. . . Original causes . . . are spoken of in four senses. . . . [The second is] the matter or substratum (*Metaphysics* A.3, 983^a24-30)

Things are said to come to be in different ways. In some cases we do not use the expression 'come to be,' but 'come to be so-and-so.' Only substances are said to come to be without qualification. Now in all cases other than substance it is plain that there must be something underlying, namely, that which becomes. For when a thing comes to be of such a quantity or quality or in such a relation, time, or place, a subject is always presupposed, since substance alone is not predicated of another subject, but everything else of substance. But that substances too, and anything that can be said to be without qualification, come to be from some underlying thing, will appear on examination. For we find in every case something that underlies from which proceeds that which comes to be; for instance, animals and plants from seed. Things which come to be without qualification, come to be in different ways: by change of shape, as a statue; by addition, as things which grow; by taking away, as the Hermes from the stone; by putting together, as a house; by alteration, as things which turn in respect of their matter. It is plain that these are all cases of coming to be from some underlying thing. Thus, from what has been said, whatever comes to be is always complex. There is, on the one hand, something which comes to be, and again something which becomes that – the latter in two senses, either the subject or the opposite. By the opposite I mean the unmusical, by the subject, man; and similarly I call the absence of shape or form or order the opposite, and the bronze or stone or gold the subject. (*Physics* A.7, 190^a31-190^b17)

(continued...)

⁴¹(...continued)

We have now stated the number of the principles of natural objects which are subject to generation, and how the number is reached; and it is clear that there must be something underlying the contraries, and that the contraries must be two. . . . The underlying nature can be known by analogy. For as the bronze is to the statue, the wood to the bed, or the matter and the formless before receiving form to any thing which has form, so is the underlying nature to substance, i.e. the 'this' or existent. (*Physics* A.7, 191^a3-12)

. . . The substratum of *accidents* is an individual such as a man, i.e. body and soul, while the accident [*pathos*] is something like musical or white. . . . Wherever this is so, then, the ultimate subject is a substance; but when this is not so but the predicate is a form or a 'this,' the ultimate subject is matter and material substance. (*Metaphysics* Θ.7, 1049^a29-37)

For living things, the material substrate may be that which is the source of being, as the seed to the plant. Presumably Aristotle has in mind a predication such as this: "That seed will be a plant." For artifacts, he seems to have in mind propositions such as "That portion of bronze is (or is becoming) a statue." It is true that for artifacts such as statues, the material substrate may coincide with the object throughout its existence as that kind of object; but such a coincidence is not always necessary. As in the famous example of the ship of Theseus, one can sometimes replace every portion of matter making up the body of an object without the object losing its identity under the kind description for the object. A ship remains the same ship as long as it satisfies the principle of application for a ship, that is, as long as it does not *cease to be* as a member of the kind SHIP. If removing and then replacing one part of the ship with new material does not, at any point, destroy the integrity of the ship to such a degree that it ceases to be a ship, then the ship can retain its identity even if every part of it is replaced, part by part, over a period of time. (See La Palme Reyes et al., 1994b, for this solution to the question of the ship's identity.) This analysis makes suspect Aristotle's thesis that matter is the substrate for individual artifacts.

Aristotle also discusses the possibility of an ultimate substrate from which even kinds of stuff could arise – "matter" that has the potential to become any kind of matter:

The matter comes to be and ceases to be in one sense, while in another it does not. As that which contains the privation, it ceases to be in its own nature; for what ceases to be – the privation – is contained within it. But as potentiality it does not cease to be in its own nature, but is necessarily outside the sphere of becoming and ceasing to be. For if it came to be, something must have existed as a primary substratum from which it should come and which should persist in it; but this is its own very nature, so that it will be before coming to be. (For my definition of matter is just this – the primary substratum of each thing, from which it comes to be, and which persists in the result, not accidentally.) And if it ceases to be it will pass into that at the last, so it will have ceased to be before ceasing to be. (*Physics* A.9, 192^a25-34)

. . . A single matter must always be assumed as underlying the contraries in any change – whether change of place, or growth and diminution, or alteration; further, that the being of this matter and the being of alteration must stand and fall together. For if the change is alteration, then the *substratum* is a single element; i.e., all things which admit of change into one another have a single matter. And, conversely, if the *substratum* is one, there is alteration. (*On Generation and*

(continued...)

following sentences do not involve predication in any real sense: "That white object is Socrates," and "That which approaches is Callias." In general, an individual substance cannot be predicated of something that is concomitant with it:

It is clear then that some things are naturally not said of anything; for as a rule each sensible thing is such that it cannot be predicated of anything, save incidentally – for we sometimes say [*phamen*] that that white object is Socrates, or that that which approaches is Callias. . . . Of these it is not possible to demonstrate another predicate, save as a matter of opinion, but these may be predicated of other things. Neither can individuals be predicated of other things, though other things can be predicated of them. (A.27, 43^a32-40)

The words "some things are naturally not said of anything" (from the Oxford translation by A. J. Jenkinson) disguise Aristotle's meaning; he uses a version of *legein kata*, and a more literal translation is 'some of the individual things that *are* [i.e., primary substances] are, by nature, to be laid against nothing' (i.e., in an accusation of responsibility for their being). The word translated as "incidentally" is *sumbebēkos*. This is the neuter singular perfect participle of the verb *sumbainō*. This verb is composed of *sum-*, 'together,' and *bainō*, 'go,' 'walk,' 'step,' or 'tread,' and so *sumbainō* means literally 'go together' or 'walk together.' The perfect participle has a meaning close to '(that which is) in a state of having gone along (with something)' or '(that which is) in a state of having walked together (with something)'; the participle suggests something that has come to exist alongside of something else – something that has come to be a companion to something else.

⁴¹(...continued)

Corruption A.1, 314^b27-315^a3)

Our own doctrine is that although there is a matter of the perceptible bodies (a matter out of which the so-called elements come-to-be), it has no separate existence, but is always bound up with a contrariety. . . . We must reckon as a principle and as primary the matter which underlies, though it is inseparable from, the contrary qualities; for the hot is not matter for the cold nor the cold for the hot, but the *substratum* is matter for them both. Thus as principles we have *firstly* that which is potentially perceptible body, *secondly* the contrarieties (I mean, e.g., heat and cold), and *thirdly* Fire, Water, and the like. For these bodies change into one another . . . , whereas the contrarieties do not change. (*On Generation and Corruption* B.1, 329^a25-329^b3)

This word is thus very close in meaning to the word "concomitant," from the Latin *concomitāns*, which is the present participle of *concomitō*, 'accompany, go with.' (A more literal translation of the end of the sentence containing *sumbebēkos* is 'for nearly every perceivable thing is of the sort that it is not to be accused against anything, except as against a concomitant.') An approaching thing, an individual that comes to be as someone begins to approach (in this case Callias) and ceases to be as the person ceases to approach – that individual can be concomitant with the person Callias for a time. So we can say that that which is approaching is concomitant with the individual we call Callias, but we cannot truly attribute responsibility to the approaching thing for Callias; responsibility must be attributed the other way around, such that Callias is held responsible for approaching (or for being an approaching thing). Aristotle says, ". . . To . . . *sumbebēkos* ouk einai hupokeimenon ti," ' . . . The concomitant (or the concomitant thing) is not to be the thing that is getting lain under something' (*Posterior Analytics* A.22, 83^b21-22).

Note that nothing bars us from combining words in such a way as to suggest predication. But if an attribution of responsibility cannot be made to the subject for the predicate, then no real predication takes place (i.e., the predicate is not attributed to the individual named as subject in surface structure). The words translated as "Of these it is not possible to demonstrate another predicate, save as a matter of opinion . . ." are "kata men oun toutōn ouk estin apodeixai katēgoroumenon heteron, plēn ei mē kata doxan"; a fairly literal translation is 'On the contrary, against these another thing being accused [of them] is not to be proven [or demonstrated], not except against an illusion.' In other words, something that is concomitant with a substance for a time cannot be held responsible for any predicate; to make such a predication is to accuse something of an illusion – of something that does not really exist (in the way that a primary substance exists; in *Metaphysics* E.2, 1026^b22-23, Aristotle says that that which is concomitant, *to sumbebēkos*, is closely akin to nonbeing or the nonexistent, *to mē on*). Aristotle does not go so far as to say that such a predication yields a false

sentence. The notion of truth (*alêtheia*) is tied up with the notion of being (*einai*), such that that which *is* grounds the truth of an affirmation, and that which *is not* grounds the truth of a denial. So the truth of an utterance depends on the "is" (or "was" or "will be") or the "is not" (or "was not" or "will not be") in an utterance. When the subject or the predicate is a concomitant thing, the "is" of the utterance still has an interpretation (in terms of the beingness, or *ousia*, of the substrate for the concomitant thing; see *Metaphysics* Δ.7). So predicating the form of a substance of something that is not substance, or improperly predicating something of an individual that is not a substance (e.g., "The teacher built the house"), may not be directly meaningful (i.e., it may require mapping from the individual named in surface structure into an underlying substance), but the resulting utterance can be true nonetheless.

In the *Posterior Analytics* A.22, Aristotle is most explicit about the status of different types of statements with respect to predication. He says,

. . . One can say truly that the white thing is walking, and that that large thing is a log, and again that the log is large and that the man is walking. Well, speaking in the latter and in the former ways are different. For when I say that the white thing is a log, then I say that that which is accidentally white is a log; and not that the white thing is the underlying subject for the log; for it is not the case that, being white or just what is some white, it came to be a log, so that it is not a log except accidentally. But when I say that the log is white, I do not say that something else is white and that that is accidentally a log, as when I say that the musical thing is white (for then I say that the man, who is accidentally musical, is white); but the log is the underlying subject which *did* come to be white without being something other than just what is a log or a particular log. Well, if we must legislate, let speaking in the latter way be predicating, and in the former way either no predicating at all, or else not predicating *simpliciter* but predicating accidentally. (What is predicated is like the white, and that of which it is predicated is like the log.) Thus let it be supposed that what is predicated is always predicated *simpliciter* of what it is predicated of, and not accidentally; for this is the way in which demonstrations demonstrate. Hence when one thing is predicated of one, either it is predicated in what a thing is [i.e., its kind] or it says that it has some quality or quantity or relation or is

doing something or undergoing something or is at some place or time. (83^a1-23)

At 83^a14-17 (which corresponds, in the above passage, to the sentence beginning with "Well, if we must legislate . . ."), Aristotle says that when the grammatical subject is a concomitant thing (e.g., a white thing or an approaching thing), either no predication takes place, or the predication is against a concomitant, that is, against something that cannot truly be held responsible for the predicate's being. Here is the Greek: "ei dē dei nomothetēsai, estō to houtō legein katēgorein, to d' ekeinōs ētoi mēdamōs katēgorein, ē katēgorein men mē haplōs, kata sumbebēkos de katēgorein." This means, 'If indeed it is necessary to lay down a law, as for the latter [e.g., "the log is large"] [let's make it] be to accuse [i.e., to predicate], [whereas] the former [e.g., "that large thing is a log"] is either not to accuse at all, or to accuse not simply, but to accuse against a concomitant.' Because a concomitant is not real in the way that its substrate is real, an attribution of responsibility for being to a concomitant is not meaningful; in that sense, it is not predication at all. Note that whenever we map from the external noun phrase that appears in surface structure (i.e., the one that is external to the grammatical predicate) to a noun phrase for the underlying individual, as when we interpret the sentence "That dancer is beautiful," predicating "beautiful" of the woman that underlies the dancer, the predication is, in effect, a predication against a substance – against something real, and not just a concomitant thing – and so the predication is, in that sense, a genuine predication. Aristotle would likely caution us to be careful in demonstrations, though, so that we recognise the real subject of predication, and not attempt to predicate anything of the individual named in surface structure if that individual is not a substance (i.e., either a basic-level kind or a member of such a kind); such an error could lead to false demonstrations (e.g., "If that running thing is a man, and if a man is an animal, then that running thing is an animal"; there is no kind of animal corresponding to running things; of course the man that *underlies* the running thing is an animal).

An attribution of responsibility for a predicate to a subject implies that the predicate has come to be in dependency upon the subject (i.e., in dependency for its being). It also implies that something about the subject (i.e., some aspect of its being) is revealed or brought to light in the act of predication. In the *Prior Analytics*, Aristotle says that, "To d' huparchein tode tōide kai to alētheuesthai tode kata toude tosaútachōs lēpteon hosachōs hai katēgoriai diēirēntai . . ." (A.37, 49^a6-7), or 'That thing which comes to be in dependency upon that other thing, and that thing which is unconcealed about [i.e., is true of] that other thing, one must take [these] in as many ways as there are ways in which the accusations are divided' (the translation is mine). That is, each category of accusation defines one type of thing that can come to be in dependency upon some other thing, and each category of accusation defines one type of thing that can be true (*alēthēs*) of something else; because truth (*alētheia*) is literally the unconcealed or the revealed, the latter implies that each category of accusation defines one type of thing that can be brought to light or unconcealed about a subject.

Aristotle's idea of predication has implications regarding the nature of being that is revealed in *logos apophantikos*, or a propositional utterance, with different implications for the interpretation of utterances involving proper predication than for those that do not involve proper (or simple) predication (i.e., utterances with the form of propositions but for which the named subject cannot be held responsible for the predicate as given). It is worthwhile to consider what Aristotle says about being, particularly because his discussion of being reveals a pattern of terminology in keeping with my interpretation of his writings on predication. Consider first what Aristotle's modern translators and commentators call "accidental being," or what Aristotle calls *to on . . . to kata sumbebēkos*, 'the being [laid] against the concomitant,' that is, being for which a substance is not held (directly) responsible, but which is attributed to (i.e., laid against) a concomitant, so that no real attribution of responsibility to the named subject for the predicate's being can take place. When Aristotle discusses this being, he does not use terms with the same root as *katēgoria* throughout the discussion, nor does

he use the expression *legein kata tinos* (see *Metaphysics* Δ.7, 1017^a8-22). He uses the term *katēgoreitai* once at the very end of the passage on accidental being, when he explains what is meant by "is" in the sentence "the artist is a man" in terms of the beingness of the man (a primary substance) in whom comes to be in dependency (for its being) an artist; he says, ". . . auto estin hōi huparchei hou auto katēgoreitai" (1017^a22), or ' . . . it is [i.e., is an underlying substance] that in which comes to be in dependency that of which it itself [i.e., the substance] gets accused.' The context shows that by 'gets accused,' he means 'gets accused against a concomitant,' so that no real predication takes place. Earlier, he says, "To . . . mousikon anthrōpon [legōmen], hoti toutōi to mousikon sumbebēken" (1017^a17-18), or '[We say] "the artist is a man" because the artist is concomitant with (or concomitates) this [i.e., the man].' When two things are concomitant (i.e., when one concomitates the other, to revive an obsolete verb), the one that is a substance can be held responsible for the being of the other one, but not vice versa; so being laid against the concomitant is attributable to that which serves as a substrate for the concomitant thing. This conclusion implies that in interpreting a proposition into extramental being, we must map from the individual named in surface structure into the substance that underlies it whenever the individual named as the subject is a concomitant thing. It is only through such mappings that being can be revealed to the mind and the truth of a propositional utterance can be understood.

In the very next section of the *Metaphysics*, Aristotle speaks of the being associated with the categories, and immediately switches to the language of predication – using the term *katēgoroumenōn*, and the expression *kath' hauta . . . einai legetai*, which is related to *legein kata*. This expression means 'against itself to be [i.e., being] gets laid'; Aristotle says that being ('to be,' *einai*) gets laid against itself, that is, gets attributed to itself (i.e., to the substance that is its substrate), in as many ways as there are schemata of accusation (or 'ways of

accusation,' *schēmata tēs katēgorias*) – or "categories." This being⁴² – the being that gets laid against itself – is contrasted with the being that gets laid against the concomitant, implying that these are the only two ways of accounting for being (but not the only two *types* of being; see *Metaphysics* E.2): "To on legetai to men kata sumbebēkos, to de kath' hautō . . ." (*Metaphysics* Δ.7, 1017^a8), 'That which is being gets laid [or said] against the concomitant, or else against itself' (the translation is mine). Aristotle's categories give the different ways in which that which *is* can be because of itself or as itself (i.e., as a substance, and not as a concomitant thing). For instance, with the category of quality, that which is green is green by virtue of itself in the case of a frog, but not in the case of a hopping thing (i.e., a concomitant thing), for greenness comes to be in a frog, but not in a hopping thing qua hopping thing. So when being gets laid against its substrate ("itself"), we need not map from the individual named in surface structure into that which underlies it; the proposition reveals being simply and directly due to the nature of what the subject and the predicate signify, so that the truth of the proposition is directly understood.

The idea that being that gets laid against itself is attributed directly to its substrate is almost expressed in W. D. Ross's translation (in the Oxford English edition, entitled *The Complete Works of Aristotle*) of the expressions for being that gets laid against itself as "things said to be . . . by their own nature" or "things . . . said in their own right to be"; but these translations suggest, not just that being arises in dependency upon a subject as a substance, but that responsibility for being can be attributed only by virtue of the nature of a thing, such that its nature gives rise to the being for which it is held responsible. The responsibility for being might have a source that is more specific than the nature

⁴²Translators usually call this type of being "essential being" or "absolute being" as a contrast to "accidental being." This translation is misleading. It loses the sense of that which *is*, a real existent thing, being held responsible for being, and implies that Aristotle is speaking of a *type* of being, as opposed to the way in which being is attributed, that is, what sort of subject is a proper subject of predication. Further, nine of the ten categories define types of being that are not in the definition or "essence" of a subject (where the "essence" is usually equated with the "what," i.e., the kind).

of a thing; for instance, in the affirmation, "The man kicked the ball," it seems most natural to assign responsibility to the man because he acted upon an intention he formed to kick the ball, and not simply because it is in his nature to have the capacity to kick balls (for he is not *always* kicking balls, even when balls are around).

In What Senses Can a Subject be Held Responsible for a Predicate?

One's intuitions lead to the conclusion that there are stronger and weaker senses of responsibility for the being signified by a predicate, the strongest sense being responsibility by virtue of acting upon an intention to do something – or, for propositions in future tense, by virtue of intending to act. This sense of responsibility seems to be psychologically privileged; perhaps for this reason, we find it odd to attribute responsibility for a relation such as killing someone to an inanimate object such as a scimitar. Intentional responsibility is marked in English propositions by the use of forms of "do" and "will."⁴³ Any proposition involving the attribution of a predicate to a subject by virtue of the subject's intentional action or intent to act can be rephrased so as to include a form of "do" or "will." For example, "Alice runs" can be restated as "Alice does run," and "Marcus hit the ball" as "Marcus did hit the ball." The use of the word "will" in propositions in future tense most clearly indicates the presence of an intention or will in the subject to carry out the action that is predicated of him or her (although "will" has come to be used to signal simply the attributability of the predicate in the future, regardless of the way in which the subject will be responsible for the predicate's

⁴³A predicate by itself in an utterance in the imperative mood signifies that which the addressee would be responsible for by virtue of intentional action if he or she were to act upon the demand or command (i.e., it signifies some aspect of a counterfactual situation, without predicating that counterfactual being of any subject, but the speaker hopes or expects that the utterance will bring into being a situation that would permit predication of the corresponding actual being to take place). If a woman acted on the demand "Close the door," then the proposition "She closed the door" (or "She did close the door") would be true, and she could be held responsible for the closing of the door by virtue of her acting upon an intention to do so. So, like the possibility of the use of forms of "do" and "will," the possibility of the use of a predicate in imperative utterances is linked with the possibility of holding subjects responsible for the predicate by virtue of their intentional actions.

being, e.g., "The leaves will fall off the trees soon"); but the notion of responsibility in general for the action is inherent in "do." This word is derivationally related to the root of the Greek verb *tithēmi* or *tidhēmi* (τίθημι), which has the general sense of 'set, put, place,' but which can mean 'put in a certain condition'; one meaning of this verb is 'make, cause, bring to pass' (perhaps because these mean 'set in motion' or 'put into action'). The root and verb-stem of this verb is *dhe-* (θε-) or *dhē-* (θη-), a stem related to the Indo-European *dhō-*, the Old English *dōn*, and the modern English "do." The intentional implication of a form of "do" is perhaps most clear when purely passive constructions, that is, passives containing a form of "be" (e.g., "Wilfred was kicked"), are compared with constructions that are comparable to Greek constructions in the middle voice with respect to their implications about responsibility, that is, "passive" constructions containing a form of "get" with or without a reflexive pronoun to make it clear that the subject somehow brought the predicate upon himself or herself (e.g., "Wilfred got [himself] kicked"; see footnote 44, below). "Do" forms cannot appear in purely passive constructions, where the subject is not to any degree responsible for the predicate by virtue of acting upon an intention; we cannot say, for instance, **"Wilfred did be kicked,"* but we can say *"Wilfred did get kicked"* or *"Wilfred did get himself kicked"* because these last two propositions imply that Wilfred somehow intended to be kicked, and intentionally brought about the kicking of himself by some other individual. ("Get" does not always imply intentional responsibility; in some propositions, such as "The house gets cold in the wintertime," it means 'become'; in others, such as "He got to the theatre too late," "get to" means 'arrive at'; and in still others, such as "We got to eat ice cream," "get to" means 'have the privilege to'.) Forms of "do" are not restricted to use with verbal predicates. When an adjectival predicate signifies something that the subject brought into being through intentions, a form of "do" can be included in the proposition; we can say, *"Wilfred does be silly from time to time,"* but not **"Wilfred does be tall"* because being silly is under one's intentional control, but being tall is not. Similarly, when a nominal predicate signifies

something the subject has brought into being through intentions, forms of "do" can be used; we can say, "Wilfred did be a hero during the crisis," "Wilfred does be a nuisance when I'm working," and "Wilfred does be a mensch in times of trouble," but not *"Wilfred does be a person" or *"Wilfred did (or does) be an orphan since his mother died."

Second in strength, it seems, is responsibility by virtue of the nature of the subject, whether the specific nature, the generic nature, or its nature as a physical object (for instance). Responsibility, in this sense, can be attributed to the object of an action for the undergoing of the action, as in the passive construction "The tree was hit by the car," where being hit by the car is a part of the tree's being, and where responsibility for that being is attributable to the tree because it is in the nature of a tree, as a physical object, that it can be hit.⁴⁴

An individual is responsible for a predicate in the weakest sense when a relation or property that the predicate signifies is merely nonseparable from the individual, as when, for instance, a woman is green because her skin was tinted that colour by a tattoo artist (although this sense of responsibility could be subsumed under the second; something cannot have a property or relation present in it unless it is in the nature of the thing to be capable of having that property or relation as a nonseparable aspect of its being; so even though it is not in the nature of a person qua person to be green, it is in the nature of a physical object with a porous surface that it can be tinted).

⁴⁴R. Schmidt (personal communication, February 15, 1995) pointed out that the passive voice in Attic Greek developed from the middle voice (see also Smyth, 1956), and may have retained a middle flavour. If so, the object of an action named as subject in a Greek "passive" would seem to be responsible by virtue of intentions, to some degree, for the undergoing of the action because in the middle voice, the object of an action has itself acted upon. A rough English equivalent to a middle construction is "I got myself driven downtown"; this proposition implies some intentional responsibility for the predicate "driven downtown," whereas the corresponding passive construction, "I was driven downtown," does not. (In English, passives formed with "be" seem to have purely passive connotations, whereas those formed with "get" seem to be more middle-like in their connotations; see R. Lakoff, 1971.) For Aristotle, then, the responsibility of the object of an action for its undergoing of the action may have been more psychologically salient because the subject would seem to be responsible for the predicate in the strongest sense.

The three types of responsibility, in the order presented, are not successively more inclusive. Responsibility by virtue of intentional action might be viewed as a species of responsibility by virtue of one's nature. But responsibility by virtue of one's nature is not a species of responsibility by virtue of nonseparability; that which a predicate signifies can be attributed to a subject by virtue of its nature without being something nonseparable from the subject, as in the cases of nominal and locative predicates (see section 3.2.5.6).

The ideas of responsibility by virtue of acting upon an intention and by virtue of nonseparability are straightforward enough. But what do I mean by responsibility by virtue of one's nature? Aristotle described this type of responsibility as *kath' hauto*, 'against itself' (i.e., against the subject or substrate) or 'because of itself,' and contrasted it with concomitance:

... On the one hand, that which is because of it [i.e., because of the subject – because of its own nature, the nature of its subject] coming to be in dependency [*huparchon*] in each [thing is] against itself [*kath' hauto*], and on the other hand, that which is not because of it [is] concomitant [or, literally, it is in a state of having walked with it; *sumbebēkos*], as for instance if it was lightening [because of a lightning flash] while [one was] walking, it is concomitant; for it was not because of the walking that it was lightening, but rather, we say, this [was] concomitant. But if [something happens] because of it, [it is] against itself, as for instance if something being slaughtered died and [it died] because of the slaughtering, [we say that] because [it died] on account of being slaughtered, then it is not concomitant, to die [while] being slaughtered. Thus concerning those things that are [or can be] understood⁴⁵ simply [i.e., substances, or basic-level

⁴⁵The word I have translated as "understood" is a version of the verb *epistamai* from which comes the noun *epistēmē*, which is often translated as "science" or "knowledge." The verb *epistamai* means literally 'come to a standstill upon (something).' Aristotle called a syllogism, for instance, *epistēmē* because a premiss, or *protasis* ('stretching forward'), such as "If man is an animal . . ." stretches the mind forward, leaving it waiting for what is yet to come, but when the concluding proposition of a syllogism is uttered, the mind comes to rest (i.e., the tension is relaxed; R. Schmidt, personal communication, February 15, 1995). This coming to rest, an *epistēmē*, is symptomatic of the fact that a syllogism is an instance of *logos*, a 'determination,' for a syllogism is completed or determined when the final proposition is uttered; so, like a proposition (which combines, at a minimum, a noun and a predicator to achieve a determination), a syllogism is *logos* (see *On Interpretation* 5, 17^a8-9; *Prior Analytics* A.1, 24^b18); as such, it unconceals being; this is why Aristotle (continued...)

kinds and individuals of such kinds], the things laid [as accusations, i.e., predicates] against themselves [are such] on the ground that to come to be in dependency in [*enuparchein*] the accusations [e.g., as dying comes to be in dependency in the being slaughtered] or to get [something] brought to be in dependency in [them, i.e., the substrates] are both because of them [i.e., because of the nature of the subjects] and from necessity. For [it] is not possible [for

⁴⁵(...continued)

considered the syllogism to be a tool of science. The unconcealment of being is equivalent to the mind intending, and thus coming to rest upon, something that *is*. (Aristotle used the coming to rest of the mind as a criterion for determining when an utterance or expression is signifying, although a coming to rest of the mind is only a coming to rest *upon* something, or *epistēmē*, and thus a coming to rest that unconceals being, when the coming to rest is brought about by *logos*; see *On Interpretation* 3, 16^b20-22.) When Aristotle, in this passage, writes of those things that are (or can be) understood simply (*tōn haplōs epistētōn*), he means those things that the mind can come to rest upon directly. Each of those things is a beingness (or "substance"; *ousia*), a basic-level kind or an individual of such a kind. (Note that the usual translation of *ousia*, "sub-stance," from the Latin *substantia*, means, literally, 'standing under' or 'coming to a standstill under' just like the English "under-standing," which is itself comparable in meaning to the Greek *epistēmē* or 'over-standing'; interestingly, the Latin equivalent to this word is *superstitiō* from which we get "superstition." Note also the linguistic connection between "substances" and the words used in bringing our minds to rest upon them, words called "substantives.") Elsewhere (*Metaphysics* E.4, 1027^b28), Aristotle speaks of "ta hapla kai ta ti estin," 'those which are simple and those which are what is,' where he seems to be talking about primary substances and secondary substances, that is, about basic-level individuals and basic-level kinds; his use of the term 'simple' apparently for primary substance (*prōtē ousia*) suggests that by 'those things that are (or can be) understood simply,' Aristotle means especially primary substances, or basic-level individuals. Aristotle calls a basic-level individual "simply separate" (*chōriston haplōs*; see *Metaphysics* H.1, 1042^a30-31) to contrast it with that which is nonseparable; the fact that such beingness is simply separate, depending upon no other thing for its being, means that the mind can come to rest upon it simply or directly. But the mind comes to rest, simply and directly, upon its basic-level kind (a secondary substance) as well; in perceiving a basic-level individual, the mind comes to rest upon both the individual and its kind, according to Aristotle (*Posterior Analytics* B.19, 100^a15-100^b2). (Macnamara and his colleagues have argued too that an individual and its basic-level kind are understood in a single apprehension, for an individual is necessarily individuated by some kind, and so some kind must be apprehended for any individual to be apprehended; moreover, the "default" kind is the basic-level one, which the mind intends in perceiving a thing because it is the kind associated with the perceptual type, that is, the kind given in perception by the thing's shape and general appearance; see La Palme Reyes et al., 1994b; La Palme Reyes et al., 1993; Macnamara, 1986, 1994; Macnamara & Reyes, 1994.) Basic-level kinds and, especially, individuals of such kinds are ultimately responsible for the being signified by all predicates (see *Categories* 5, 2^a34-2^b6, 15-22, 37-3^a6, 4^a29-4^b19; *Metaphysics* Z.1, 1028^a18-36), being which arises in dependency upon them (*Posterior Analytics* A.4, 73^b18-24). One's mind can come to rest upon them (i.e., can intend them, or be aimed toward them) without having to come to rest first upon any intermediary (in contrast to an individual such as a walking thing or a teacher, or to a genus such as ANIMAL; when one's mind is aimed at such things, it must continue to stretch beyond them to that which underlies them – say a person in the case of a walking thing or a teacher, or the kind CAT, for instance, in the case of ANIMAL – something with autarchical being upon which the mind can come to rest).

accusations, i.e., predicates] not to come to be in dependency [huparchein], either simply or [in the manner of] the opposites, as for instance the straight or the curved in a line, and the odd or the even in a number. . . . Consequently if it is necessary to affirm or to deny [i.e., to predicate], [then] it is necessary also [for] the against itself [which is affirmed or denied] to come to be in dependency. (*Posterior Analytics* A.4, 73^b10-24; the translation is mine)

In other words, dying can be attributed to an animal that is being slaughtered because it is by its own nature that an animal dies in the slaughter; we can attribute dying in the slaughter to the animal itself (*kath' hauto*).⁴⁶ But one cannot attribute to a walking person the lighting up of the sky that concomitates the walking; it is not in the nature of a person that the sky should light up when the person is walking. It is in the nature of a line to be straight or curved, so these properties come to be in dependency upon a line (and by necessity, for a line is either straight or curved by its very nature). That which a predicate signifies necessarily comes to be in dependency upon a subject, because it is only by virtue of the subject's nature that it can come to be. And it is only by virtue of this fact that it can be affirmed or predicated of the subject.

An example may help illuminate responsibility by virtue of one's nature. Suppose we say, for instance, that a rock falls. I believe that such a predication is

⁴⁶In the above passage, Aristotle asserts that the signification of one predicate can come to be in dependency in (or be inherent in) the signification of another predicate, which itself comes to be in dependency upon a substance. Elsewhere, he says,

Whenever one thing is predicated of another as of a subject, all things said of what is predicated will be said of the subject also ["hosa kata tou katēgoroumenou legetai, panta kai kata tou hupokeimenou rhēthēsetai," 'whatever gets laid against that which is getting accused, all (of those accusations) will also be spoken (or verbalised, or, literally, strung together, as words) against that which is getting underlain']. For example, man is predicated of the individual man, and animal of man; so animal will be predicated of the individual man also – for the individual man is both a man and an animal. (*Categories* 3, 1^b10-15)

This passage deals with nominal predicates. In the passage above (from *Posterior Analytics*), though, he claims that the signification of a verbal predicate, such as "died" can come to be in dependency in (or be inherent in) the signification of another verbal predicate, such as "slaughtered." This may be the case whenever the one predicate is inherent in the definition of the other (as dying is inherent in the definition of being slaughtered, namely "being killed for food," where "being killed" is defined as "being caused to die," or as animal is inherent in the definition of man as "a rational animal").

to be understood in the following way. It is in the nature of a rock that it is capable of falling (because it is a massive body, heavier than air, that is subject to gravitational force). We can predicate falling of anything that has, by virtue of its nature, the capacity to fall. Suppose somebody bats a fully inflated helium balloon in a downward direction so that it moves to the ground at the rate of a body in the earth's gravitational field. We cannot truly predicate falling of the balloon – that is, we cannot say, in a true affirmation, that the balloon fell to the ground – because it is not in the nature of a helium balloon to fall; fully inflated helium balloons do not have the capacity to fall by virtue of their nature. A property or relation can be attributed to a subject if it is in the nature of the subject to be capable of having that property (whether it be permanent or temporary) or of being in a relation of the type signified by the predicate.

Responsibility by virtue of one's nature is perhaps most obvious when one's specific nature is the source of responsibility. We can easily attribute furriness to a rabbit (e.g., "That rabbit is furry") because it is in the nature of a rabbit to have fur. Attributions based on generic nature also seem natural. The capacity for self-induced locomotion is easily attributed to a rabbit by virtue of its nature as an animal (i.e., by virtue of its genus; e.g., "That rabbit is moving"). Responsibility is less easily attributed, perhaps, when a relation or property comes to be by virtue of one's nature as a physical entity. If a rabbit is blown off a ledge by a strong wind, we tend to attribute responsibility for the rabbit's fate to the wind, rather than to the rabbit; and yet the rabbit could not be blown over if it was not a physical object that provides resistance to the wind. In that sense, it can be held responsible for being blown off the ledge. This intuition grounds the meaningfulness of the proposition, "The rabbit was blown off the ledge."⁴⁷

⁴⁷Aristotle gives several senses of "nature" in the *Metaphysics* Δ.4. They are: the genesis of a growing thing, that which makes a growing thing come to be, the source of primary motion in a naturally existing thing, the stuff or material out of which something is made, and the beingness (*ousia*) or "substance" of naturally existing things. I also allow that artifacts have natures that can give rise to being of various types (natures with sources other than just the stuff of which they are made). A ball, for instance, has a nature that permits rolling to come into being.

Responsibility and Verb Learning

The three senses of responsibility – by virtue of acting upon an intention (or by virtue of an intention to act for propositions in future tense), by virtue of one's nature, and by virtue of nonseparability – these three seem to guide our attributions of responsibility in an ordered way, such that we attempt to attribute responsibility by virtue of an agent's acting upon an intention wherever possible; when no such attribution is possible (e.g., because no creature is involved), we attempt to find the source of the signification of a predicate in the nature of the entity that is the referent of the subject noun phrase (i.e., in its natural capacity to give rise to that which the predicate signifies); as a last resort, we look to nonseparability. If all attempts to attribute responsibility fail, then no intuition of predication (as accusation) can arise.

This ordering of senses of responsibility may account for certain facts of child language acquisition. Because being that comes to be by virtue of intentional action permits an attribution to the subject of responsibility in the strongest sense, actions, which arise from the beliefs and intentions of actors, are prototypical of the sort of thing we can predicate of a subject. This source of prototypicality may contribute to an explanation for the common observation that children learn action words before they learn words for properties such as colour, which are equally observable (though possibly not as salient because they are less transient and dynamic). As I argued in section 3.2.5.6, it may simply be easier to notice the relationship of a noun phrase to the predicator of which the noun phrase is an argument when the noun phrase is a subject of predication being held responsible for an action. The perceived link between the two words may be strengthened by the predicative relationship – one in which the subject is held responsible for the predicate headed by the predicator in the strongest possible sense. (Of possible relevance is the fact that young children have a greater capacity for learning basic-level-kind terms for the agents, versus the objects, of observed actions, which would be the subjects of predications of the actions; see Grace & Suci, 1985.)

The ordering of senses of responsibility may account for another fact of language learning, namely misinterpretations of novel verbs as words for properties or relations that come to be by virtue of intentional action. Some such misinterpretations are called "transitivity errors" because the child interprets a verb as transitive when it is not, or as taking both a direct and an indirect object when it only takes a direct object (e.g., the child interprets "stay" as 'keep,' "die" as 'kill,' "eat" as 'feed,' or "learn" as 'teach'). Young children (and even infants) exhibit a bias toward interpreting situations in terms of interactions that occur as the result of the beliefs and desires of one or more of the participants (e.g., Fisher et al., 1994; Fritz & Suci, 1981; Leslie, 1982; Leslie & Keeble, 1987; Mandler, 1991; Michotte, 1954); this bias leads them to interpret a predicate headed by a predicator, wherever possible, into a causal relation of an animate agent to an affected object (e.g., Berman, 1982; Bowerman, 1974, 1977, 1982; Corrigan & Ody-Weis, 1985; Figueira, 1984; Hochberg, 1986; Lord, 1979; MacWhinney, Pleh, & Bates, 1985). The bias may also explain their initial tendency to associate subject noun phrases with animate agents of actions (e.g., Bever, 1970; L. Bloom, 1970; Bock, 1986; Bowerman, 1973; Brown, 1973; Brown, Cazden, & Bellugi, 1969; Dewart, 1979; M. Harris, 1978; Jarvella & Sinnott, 1972; Lempert, 1985, 1988; Marantz, 1982; Matthei, 1987).

A growing body of evidence suggests that young children have intuitions relevant to the two strongest senses of responsibility associated with predication. It has been demonstrated that young children are aware that actions have their source in the intentions of the actors (Shultz, Wells, & Sarda, 1980; Wellman, 1990); more generally, infants, by the end of their first year, expect actions and activity to issue from animate beings, but not from inanimate objects (Golinkoff, Harding, Carlson, & Sexton, 1984; Poulin-Dubois & Shultz, 1990). The idea of an object being responsible for a property or relation by virtue of its nature also appears to be available to young language learners. Preschool children understand that stable properties are attributable to the nature of an object, and that

behaviours are made possible by an object's inner structure or nature (see R. Gelman, 1990; S. A. Gelman & Kremer, 1991).

Implications for the Psychology of Language, Linguistics, and Logic

An interpretation of predication as an attribution of responsibility, coupled with an ordering of senses of responsibility, implies that acting, for which an agent is responsible by virtue of an intention to act, is psychologically privileged relative to being acted upon, for which the object of an action is responsible by virtue of its nature as a physical object. For this reason, agents appear as subjects of predication more frequently than do objects of actions; that is, "active" sentences are psychologically privileged relative to "passive" sentences.

The predicate, upon careful examination, shows itself to be of such a nature that only one of a predicator's arguments can be held responsible for it. Compare "Ian kicked the dog," and "The dog was kicked by Ian." In the former sentence, an *action* is predicated of Ian; he is said to have kicked the dog. In the latter sentence, an *undergoing* or *suffering* of action is predicated of the dog; it is said to have been kicked (by Ian). The subject noun phrase, which is a referring expression, identifies a particular as the domain of being under consideration. That particular is an extended being, a being that extends (or stretches) outward across space. The predicate identifies an *intension* of the particular that is the subject of predication (see footnote 10 in section 3.2.5.6). This is most obvious when the predicate names a quality of the subject, such as its colour or warmth. When we say "The stove is hot," we understand that hotness has come to be within the stove, as something nonseparable from it, and that its coming to be was in the form of intensification; as the warmth of the stove increased or intensified, it came to be hot. Whereas an extended body stretches out across space, and its magnitude is equivalent to its extension, that which "intends" (i.e., an "intension") is stretched toward higher intensive magnitude, or else it relaxes into lower intensity; it intensifies during its generation, and recedes into lower intensive magnitude (e.g., dissipates or fades) during its destruction or ceasing to be. But the term

"intension," as used here, does not signify only qualities. Anything that can be truly predicated of a subject, or attributed to a subject, in the Aristotelian sense, is an intension of the subject in the sense that it is an aspect of the subject's being. (See footnote 10 in section 3.2.5.6 regarding another sense in which non-quality predicates, including nominal and locative predicates, are intensions of subjects.) "Ian kicked the dog" implies that kicking the dog was an aspect of Ian's being. "The dog was kicked by Ian" implies that undergoing kicking from Ian was an aspect of the dog's being. (This distinction is absent in modern mathematical logic, in which "hit" is treated as a "two-place predicate," with no distinction in meaning for active and passive constructions. See the history of predication that appears below regarding Frege's view that these two constructions are conceptually equivalent. The distinction is also absent from modern linguistic theory, which treats a passive construction as the product of a transformation from an active construction, so that the two constructions are supposed to be mere notational variants of a sentence that undergoes no change in meaning when the syntactic transformation is effected; see section 3.2.3.1.) All relational predicates can be viewed in this way. "New York City is bigger than Seattle" predicates of New York City that it is *bigger* than a certain other city. "Seattle is smaller than New York City" predicates of Seattle that it is *smaller* than a certain other city. Each sentence entails the other, but each predicate signifies a different type of being (*bigger than* in the first case, and *smaller than* in the second), and each proposition attributes that being to a different subject. "Socrates is in the cave" attributes being in the cave to Socrates, so that being in the cave is an aspect of Socrates's being; "The cave contains Socrates" attributes containing Socrates to the cave, so that containing Socrates is an aspect of the cave's being. The subject of predication is always the domain of being, with the predicate revealing some aspect of that subject's being. Noun phrases within nominal predicates do not signify the domain of being under consideration; in fact such noun phrases are not even referring expressions. In the proposition "Socrates is a man," the noun phrase "a man" is not interpreted into a certain man, with whom identity is predicated of

Socrates. Geach (1962) provides a test of whether a noun phrase headed by a common noun is a referring expression: Does it make sense to ask which individual of the named kind we are referring to? For the sentence "Socrates is a man," it makes no sense to ask, "Which man?" (The test gives the clearest results for denials; for the sentence, "Fluffy is not a dog," it clearly makes no sense to ask, "Which dog?"). The proposition "Socrates is a man" reveals that Socrates has the *intension* of the kind MAN; he has the *form* of a man. (In the case of a basic-level kind or species, or what the Greeks called an *eidos*, 'that which is seen,' namely the kind revealed by the shape or appearance of a thing, the *form* includes the shape and general appearance, such that "Socrates is a man" attributes, among other things, the shape and appearance of a man to Socrates. An instance of the shape and appearance of a man came to be when Socrates came to be, and it is by virtue of his being.) The subject noun phrase is interpreted into the only particular, and the only extended being, about which something is revealed in a proposition. (Using Geach's test, we can demonstrate that subject noun phrases do, in fact, refer to particulars; for instance, given the sentence "A ball rolled down the hill," it makes sense to ask, "Which ball?") Whatever the predicate signifies is some intension of the subject, in the sense that it is some aspect of the being of that particular, and it is not an aspect of the being of any other particular or set of particulars that might be named in the utterance. This is true even though a noun phrase that is part of the predicate may be a referring expression, as in the case of a noun phrase interpreted into the object of a relation; we can extend Geach's test to object noun phrases to show that, at least for definite noun phrases and indefinite ones in affirmations, the noun phrase refers: For the sentences "Marcus hit the ball," "Marcus did not hit the ball," and "Marcus hit a ball," it makes sense to ask, "Which ball?" (For a denial containing an indefinite object noun phrase, such as "Marcus did not hit a ball," the test shows that the object noun phrase does not refer in this case; it makes no sense to ask, "Which ball?") But even when an object noun phrase is a referring expression, the individual signified serves only to help define the nature of the relation that is

predicated of the subject, and that is an aspect of the subject's being. In "Marcus hit the ball," for example, the object noun phrase "the ball" helps define what sort of thing is being predicated of Marcus (i.e., not just hitting, but the hitting of a particular ball); in "John is taller than Joyce," the object noun phrase "Joyce" signifies the individual to which John is referred so that being taller than that individual can be understood as an aspect of his being. The predicate is of such a nature that it cannot be an aspect of the object's being. In "Marcus hit the ball," hitting the ball is not said to have been an aspect of the being of the ball, nor could it have been. Any theory of predication, whether in linguistics or in mathematical logic, must reflect the fact that the signification of the predicate is an aspect of the subject's being alone. The current ones do not. To rectify this situation, we would need to revive the distinction between an argument and a subject of predication, and to cease using the noun "predicate" when we mean 'predicator' and speaking of "two-place predicates" and "three-place predicates."

The linguist's notion of a thematic role or thematic relation may be seen as a failed attempt to capture the intuitions associated with the different ways in which a subject can be held responsible for a predicate. The failure can be attributed partly to a failure to distinguish a predicator and a predicate, such that many-place predicates are imagined to exist (whereas, in truth, only *predicators*, i.e., lexical items, can be said to take multiple arguments; a predicate does not have arguments, but rather a subject), leading to the erroneous conclusion that the nature of a predicate is constant regardless of which argument is the subject of predication. The different senses of responsibility are partially captured in the linguist's attributions of thematic roles, such as *agent*, *actor*, and *patient* or *theme*, to noun-phrase arguments; but these attributions are misleading or redundant or both. When acting is predicated of a subject, the subject must be responsible for the predicate by virtue of acting upon an intention, that is, the subject must be an agent or actor; the nature of the predicate demands it, because responsibility for acting can be attributed to a subject only if the subject willed to act and acted upon that intention, thus bringing to pass the action (for that is the way in which

actions come to pass). When the undergoing of action is predicated of a subject, the subject must be responsible for the predicate by virtue of having undergone the action, that is, the subject must be a patient, one who is responsible for the undergoing of action by virtue of its nature as a physical object. But because linguists fail to realise that predicates but not predicators signify extramental being, and that what is predicated of a subject is determined by the predicate, not by the predicator that heads the predicate, they take any proposition containing an action verb to be a sentence about acting, and fail to see that the object of an action is the true subject of the predicate in a passive sentence. For this reason, they feel a need to distinguish the "grammatical subject" from the "logical subject," who is the agent of the action, according to them. Likewise, they feel a need to assign to noun phrases "thematic roles" such as *agent* and *patient* to show that "the ball" plays the same role in "Marcus hit the ball" as in "The ball was hit by Marcus." But in fact, the ball can be interpreted as a patient only when the predicate one has in mind is the undergoing of action. The relation that a predicate headed by "hit" signifies is an aspect of the subject's being, and differs in nature depending on the subject: In the case of Marcus, the relation is one of hitting; in the case of the ball, the relation is one of undergoing hitting. When the ball is named as the subject in a proposition, no hitting is under discussion, and so no agency is imputed to anyone. When Marcus is named as the subject, no undergoing of hitting is under discussion, and so being a patient is not imputed to anything. Linguists may have the impression that both being an agent and being a patient are attributed, to different arguments, in a single utterance because of the facility with which we can shift between the two possible conceptualisations of an actional event, one of acting and one of undergoing action; but the two relations are nonetheless distinct, and a single predicate signifies just one of them. J. Macnamara (personal communication, e.g., April 28, 1989) has argued that thematic roles make no sense because one is supposed to call William an "agent" in the sentence, "William did not hit Thomas"; but how could William be an agent of an action that did not occur? The Aristotelian view may make sense of such

sentences. According to that view, the sentence asserts that William cannot be held responsible for hitting Thomas (either because somebody else hit Thomas, or because nobody did). Since "William" is the subject noun phrase, it is the potential subject of the predicate "hit Thomas," a predicate for which a subject can be held responsible only if the subject intended to act (i.e., to hit) and acted upon the intention (i.e., if it was an agent), but the predicate is negated by "did not." (I have adopted Aristotle's resolution of a proposition into "the predicate and that of which it is predicated, 'is' or 'is not' being added"; *Prior Analytics*, A.1, 24^b16-18.) The sentence tells us whether we can accuse William of the action of hitting Thomas (i.e., whether we can hold him responsible for such an action). Since the sentence declares that the predicate is false of William, we are, in effect, saying that William is not responsible for a certain action. The linguist's claim that in a proposition, such as this one, containing an actional predicate, the subject plays the role of *agent* implies that something was done, which leads to a contradiction; the sentence declares that the predicate is false of William, so nothing was done by William. The Aristotelian notion of predication does not lead to any contradiction: If a predicate is denied, then the predicate is not truly predicated of the subject, and so responsibility for the action is not ascribed. By treating predication as an attribution of responsibility, as opposed to tagging arguments with thematic roles, the responsibility for an action (or agency) is only attributed to a subject when an active actional predicate is affirmed; likewise, the responsibility (by virtue of one's nature as a physical object) for an undergoing of action (i.e., for being a patient) is only attributed to a subject when a passive actional predicate is affirmed. If linguists were to return to the classical grammatical distinction between a subject and a predicate, and interpret predication as an attribution of responsibility, they would realise that a verb's arguments are not all on a par semantically unless they slap thematic roles on them. (The subject noun phrase is distinguished syntactically from other noun-phrase arguments in the modern theory of syntax by its being a sister to the inflexional component of the auxiliary and its being the only argument of a verb

that is external to the verb phrase; but this position in the syntactic tree is not given any semantic characterisation.) If linguists recognised that predication itself gives one argument a special role, the role of subject (i.e., the one subject to charges of responsibility), and that a predicate, by its nature, determines both that for which the subject is held responsible (e.g., the undergoing of an action, i.e., being a patient of an action) and the way in which a subject can be held responsible for it (e.g., predication of an undergoing of action implies a nature that can give rise to the predicate, but not agency in the intentional sense), they would see that no need exists for thematic roles; a verb's arguments are distinguished semantically whenever the verb is embedded in a predicate in an affirmative proposition, with the subject being attributed with being an agent or a patient in keeping with the nature of the predicate, and with no such attribution occurring for the individual named as object within the predicate. Or at least in the case of two-place predicators, all a predicator's arguments are distinguished semantically in propositions. For a three-place predicator, such as "give," the language might require a preposition or postposition (e.g., "to" as in "Peter gave the book to Leila") or some other contrivance (such as case marking) to distinguish the third argument from the second and signal the way in which the action depended upon the referent of the additional argument (e.g., to indicate that Leila was that toward which Peter's giving tended).

Many of the oddities in modern syntactic theory can be attributed to a failure to consider seriously and carefully the meanings of utterances, and the semantics of predication and propositions in particular. The concentration on syntax in linguistics (a concentration advocated by Chomsky, among others; e.g., Chomsky, 1957) hides the fact that a sentence has a structure that is not independent of semantics. A sentence is not just an arrangement of phrases, ordered and organised according to syntactic rules. A statement has a semantic function, and its structure cannot be understood in purely syntactic terms – as a syntactic structure, *per se*; that is, attempts to understand its structure at a purely syntactic level lead to the sort of problems for which thematic roles were

suggested as a solution – a very messy solution⁴⁸ (e.g., the supposed "problem"

⁴⁸The hypothesis of thematic roles was not designed to capture the notion of responsibility for a predicate or any other notion that has been attached to predication; thematic roles were originally invented in order to capture the notions of motion and location – certain physical and observable phenomena. The inventor of thematic roles, Jeffrey Gruber (1976), argued that one noun phrase in any sentence has the role of *theme*, by which he meant that its referent is either (1) undergoing the motion that the verb signifies, or (2) in the location that some part of the proposition (e.g., a locative prepositional phrase) signifies; these two roles are supposed to apply both concretely, say with verbs of physical motion and phrases giving the physical locations of physical objects, and abstractly, say with verbs for transfers of goods (e.g., "inherit," "buy") and with the "locations" of abstract entities such as pieces of knowledge (which reside in persons). Gruber also invented other thematic relations, including *location*, *source*, and *goal*. The theme of motion and position is clear. Thematic relations were designed to capture the intuition that "the ball" plays the same role in the following two sentences in that it undergoes motion in both cases: "The ball rolled to the bottom of the hill"; "John rolled the ball to the bottom of the hill" (see Radford, 1981, p. 140). From the point of view of predication, though, the ball is the subject in the first case (i.e., the ball is held responsible for its rolling by virtue of it being in the nature of a ball to be able to roll down a hill), but not a subject in the second case (i.e., the rolling is attributed to John by virtue of his intentional action). Ray Jackendoff was sufficiently impressed with Gruber's invention to incorporate a revised version of Gruber's theory into the theory of generative grammar. He describes the motivation for introducing thematic roles into the theory as follows:

Much of the justification of transformations involves arguments about understood grammatical relations and their representations in deep structure [e.g., the supposed deep-structure "object" status of the grammatical subject in passive propositions]. Yet the "natural" grammatical relations such as subject and object do not correspond in any simple fashion to the understood semantic relations. Consider these well-known examples: . . . The door opened. . . . Charlie opened the door. . . . In the traditional sense of grammatical relations, . . . [the example sentences] have their underlying grammatical relations expressed in the surface as well; the sentences have undergone no movement transformations that would alter the underlying positions. But the grammatical relations do not express certain obvious semantic facts. *The door* has the same semantic function in . . . [the two sentences], although it is the subject in one and the object in the other. (Jackendoff, 1972, p. 25)

So thematic roles were introduced in order to capture the "obvious semantic fact" that the "semantic function" of "the door" is to signify that which is undergoing motion (i.e., the noun phrase is a "theme") both in "The door opened" and "Charlie opened the door." Likewise, the hypothesis of thematic roles is supposed to capture the "fact" that in the sentences "The circle contains the dot" and "The dot is contained in the circle," the "semantic function" of "the dot" is to signify that which is in the location signified by "the circle." Notice that the notions of "undergoing motion" and "in the signified location" are not reflected in the basic structure of a sentence (as, for instance, the semantics of predication is reflected in the subject-copula-predicate structure of a proposition), and so one wonders why any linguists would feel a need to make provision for them, first and foremost, in their theories. There seems to be a tendency among some linguists (e.g., Jackendoff) to hope for a semantics of the "all in one's head" variety that is tied closely to perception and motor behaviour – a hope guided, perhaps, by reductionist dreams. Such a semantics would clearly have to rely on notions such as motion and position, versus irreducible intentional notions such as reference, or metaphysical (continued...)

that propositions cannot undergo the "passive transformation" when the predicate is headed by certain verbs, such as "cost" and "touch" in its nonintentional sense, i.e., when the typing of "touch" is such that its first argument signifies a member of the kind PHYSICAL OBJECT rather than ANIMAL; see Jackendoff, 1972). The subject of a sentence is not just a noun phrase that occurs in a particular location in the sentence; its referent is a subject in the Aristotelian, or semantic, sense. The

⁴⁸(...continued)

notions such as the nature or kind of a thing. Jackendoff describes the motivation for an approach grounded in spatial concepts as follows:

... In exploring the organization of concepts that, unlike those of #physical space#, lack perceptual counterparts, we do not have to start *de novo*. Rather, we can constrain the possible hypotheses about such concepts by adapting, insofar as possible, the independently motivated algebra of spatial concepts to our new purposes. The psychological claim behind this methodology is that the mind does not manufacture abstract concepts out of thin air, either. It adapts machinery that is already available, both in the development of the individual organism and in the evolutionary development of the species. (Jackendoff, 1983, pp. 188-189)

One is reminded of Piaget's biologically-based theory of development, in which a mind is supposedly constructed upon a foundation of sensations and motor reflexes; Macnamara (1976, 1978) shows this theory to be incoherent. But such ideas easily take root in fields where the *Zeitgeist* is predominantly physicalist and reductivist (see Doan, 1981). The most popular semantic approaches are those that deny our direct experience of making intentional contact with extramental being through symbols, claiming instead that we only ever talk about our own mental representations, and that semantics is really a kind of "syntax of mental representations" (Chomsky, 1986, p. 363, p. 364). The ill-foundedness of such approaches is revealed in a quotation from Macnamara:

Jackendoff denies that . . . [natural-language expressions] put us in contact with extramental reality One might ask: Does the expression 'extramental reality' put us in contact with something outside the mental models? If it does, why do other words not? If not, what might the expression mean? And how could any of us conceive the existence of an extramental reality, let alone wallow in its exuberant presence. (Macnamara, 1989, p. 352)

Enough said.

It is of interest that in spite of their apparently physicalistic motivations, Gruber and Jackendoff saw a need to include among thematic roles the role of *agent* (to which Jackendoff, 1972, appeals in his efforts to explain the permissibility of imperatives, passives, and reflexive pronouns, and the distributions of certain adverbials such as *intentionally* and *accidentally*, among other phenomena). Jackendoff defines the agent role as that which "attributes to the NP will or volition toward the action expressed by the sentence" (p. 32). Nothing in the perception of physical things is a source of knowledge about human intentions. The intentional sense of responsibility for a predicate seems to have worked its way into these theories, as an "agent" role assigned to noun phrases, by virtue of its psychological and linguistic salience (i.e., by virtue of its pervasive effects on the way we construct sentences). But its introduction into linguistic theory as a thematic role is, I argue, inadequate.

structure of propositions is not equivalent to syntax; it cannot be understood without considering semantics, and predication in particular. So much for Chomsky's (1957) thesis that syntax is autonomous, that is, independent of semantics.

If the syntactic structure of propositions reflects the semantics of predication, a possibility remains nonetheless that propositional syntax could come to be independent of semantics to some degree. Once a formalism is created, it can be adapted to other uses, with the symbols taking on different interpretations. This happened, for instance, with the formalism associated with algebra. The formal language was created by François Viète (1540-1603) for one purpose, but was later adapted (unwittingly) by other mathematicians for a distinct purpose. In particular, the letters that Viète used in his formalism came to be reinterpreted. Viète introduced letters as signs for his "species," which were particular collections of particular geometrical objects, such as lines and figures, that served as counterparts or representations for magnitudes bearing the same relations to one another as the magnitudes of the entities making up the species; in Viète's genus of plane figures, for instance, one species is the rectangle, that is, a plane figure formed by combining lines that represent (as counterparts) a greater magnitude (or a "length") and a lesser magnitude (or a "breadth"), the multiplication of which produces a rectangular area. In the genus of solids, one species is the cube, the product of combining, by multiplication, a square plane figure and a side (i.e., a line understood to be part of a figure with equal sides, so that the line does not represent an instance of the greater or the lesser; see Viète's *Introduction to the Analytical Art* in the appendix of J. Klein, 1934-1936/1968; see also Schmidt, 1986).⁴⁹ Later mathematicians reinterpreted the letters, either as general numbers (i.e., as the general character of being a number; R. Schmidt, personal communication, January 24, 1995), or as numerical variables or indeterminate

⁴⁹The language may have been designed primarily to provide a means of stating and proving theorems about such species (R. Schmidt, personal communication, August 19, 1994).

numbers, and they used the formal language to carry out numerical calculations (Schmidt, 1986). John Wallis, for instance, concluded that "Viète . . . [made use of] the Letters A, B, C, etc., . . . to represent indefinitely any Number or Quantity, so circumstantiated as the occasion required" (Wallis, 1685, p. 66). And yet Viète explicitly denied that his logistic was a numerical logistic: ". . . The zetetic art does not employ its logic on numbers – which was the tediousness of the ancient analysts – but uses its logic through a logistic which in a new way has to do with species" (J. Klein, 1934-1936/1968, p. 321); "The numeral reckoning (*logistique numerosa*) operates with numbers; the reckoning by species (*logistique speciosa*) operates with species or forms of things . . ." (J. Klein, 1934-1936/1968, p. 328). The units of which numbers were understood to be multitudes (prior to Stevin) are distinct from the entities that make up Viète's species. Further, the results of an operation such as subtraction, which yields, in a numerical algebra, a collection of identical units (e.g., 3 units, which is the number 3), does not necessarily yield, in Viète's *logistique speciosa*, a collection of entities any of which is of the same species as any of those upon which the operation is performed; if, for instance, a lesser magnitude (represented by the letter *A*) is subtracted from a greater magnitude (represented by the letter *B*), the resulting entity, represented by $B - A$, need be neither *A* nor *B*; similarly, multiplication, which yields, in a numerical calculation, a collection of units of the same kind as those that are multiplied, yields, in Viète's algebra, a magnitude of a different genus than the magnitudes combined by multiplication; multiplying a lesser magnitude by a greater magnitude, for instance, yields a rectangular area – a plane magnitude. By contrast, subtracting the number I from the number IIII yields the number III, itself a collection of the entities represented by I and of the same kind as the entities that make up the collections represented by I and IIII (i.e., the units of counting or unit measures of magnitudes); likewise, multiplying II by III yields IIIII (abbreviated as VI), which is a collection of units of the same kind as those making up the collections II and III (see Schmidt, 1986). And yet Viète's formalism works well when applied to operations upon numbers, that is, when the

letters are given a completely different interpretation, so that the semantics of the language changes. Given the possibility of adapting a formalism to other purposes, the question arises whether the syntactic structure that permits predication – the structure of propositions, understood in purely syntactic terms – has been adapted to other purposes by speakers.

It might appear, at first glance, that passive sentences exemplify such an adaptation, but I will argue that they do not. As noted in my discussion of relations (see section 3.2.3.1), linguists distinguish a "grammatical subject" and a "logical subject" or deep-structure subject. According to modern linguists, the true, or "logical," subject does not appear in the position of the "grammatical" subject (i.e., the noun phrase external to the verb phrase) in a passive proposition. They equate the agent of an action with the "logical subject" and assert that a passive sentence is a syntactic variant of an active sentence that exists in "deep structure," that is, at a level where meaning is attached to the sentence. In doing so, they deny the possibility of attributing to a subject the undergoing of an action. (The word "passive" actually implies an undergoing of action. It is derived from the Latin noun *passivus*, which comes from the verb, *patior*, meaning 'be subjected to, experience, undergo, suffer.')

The problem stems from linking the semantics of predication to individual predicators, rather than to predicates, as is proper (i.e., it stems from the "compositional" view of sentence meanings, wherein the meaning of a sentence is thought to be determined by the meanings of the words within it). In the linguist's way of thinking, an action verb signals that acting is being predicated of a subject, who is necessarily its agent. But the presence of an action verb in a predicate does not guarantee that the proposition is telling us about an action. In a passive sentence, the predicate signifies the undergoing or suffering of an action, which is attributed to the object of the action. (As noted in section 3.2.3.2, Aristotle treated acting and undergoing action as distinct categories – distinct types of predicates. In English, the distinction between acting and undergoing action has sometimes led to the adoption of separate lexical items that can be used in signifying the two relations associated with a single event, as in the

case of "give" and "receive," and "ride" and "carry.") In the proposition "The ball was hit by Marcus," no claim is made that the ball, by virtue of being named in subject position, is accused of hitting; the predicate "hit by Marcus" signifies an *undergoing* or *suffering* of hitting (at the hand – or rather the bat – of Marcus). *That* predicate can surely be attributed to a ball. And so a ball can surely be the subject of which that predicate is predicated. If one distinguishes clearly predicates from predicators, and if one realises that predicates in propositions signify being that is attributed to a subject, but that predicators by themselves signify nothing and nothing is attributed to anything by virtue of them alone (unless they coincide with predicates that are predicated of subjects), then one will not be tempted to call "Marcus" the "logical subject" in the proposition "The ball was hit by Marcus." Nor will one conclude that a passive sentence is formed from an active sentence in a hypothetical "deep structure" through a syntactic transformation. And so one will not see any evidence in passive sentences for a divergence of the syntax of propositions from the semantics of predication.

The confusion about passives probably has its source in the fact that passives do not reflect the psychologically privileged way of understanding actional events, that is, as events of acting, and thus as aspects of the being of the agents of the actions. In passive sentences, the subject noun phrase does not signify an individual that can be held responsible for the predicate in the strongest sense of responsibility (i.e., the intentional sense) – but the individual is responsible for the predicate in a weaker sense; the undergoing of an action that is predicated of the subject, which is the object of the action, is attributable to that individual by virtue of its nature as a physical object; if a ball is hit, then the undergoing of hitting is an aspect of the ball's being that was able to come to be because it is in the nature of balls that they can be hit. But of course balls do not get themselves hit by virtue of their intentions (as far as we know). Our psychological bias toward intentional acting versus the passive undergoing of actions may explain the fact that most linguists see an active proposition hidden in every passive proposition; it may also help explain the fact that passives are exceedingly difficult for children to

learn, and are mastered very late in acquisition (e.g., Baldie, 1976; Bever, 1970; Brown, 1973; de Villiers & de Villiers, 1973b; Harwood, 1959; Horgan, 1978; Maratsos, 1974; Strohner & Nelson, 1974; Sudhalter & Braine, 1985; Turner & Rommetveit, 1967). (Other factors may contribute to the lateness of a mastery of passive constructions. Parents rarely use passives when speaking to young children, perhaps as a reflection of their own psychological bias, or perhaps because of their expectations of such a bias in their children; Rondal & Cession, 1990, found that among 18 mothers of children aged 1;8 to 2;8, none ever used a passive proposition in speaking to their children over the period of observation. Moreover, young children who have not yet learned the significance of word order, and who are as yet unable to process or interpret unstressed elements of the speech stream, will not be in a position to distinguish active from passive propositions, and a psychological bias toward interpretations of actional events as instances of acting versus the undergoing of action may lead to an interpretation of any proposition containing an actional verb as an active proposition; in effect, then, young children may not have propositions interpreted as passives as part of the input.) But despite the reality of a psychological bias that favours active propositions, the basic meaning of the subject-predicate distinction is not violated in passive constructions, contrary to modern linguistic thought. The syntax of "passive" propositions does not violate the semantics of subjects and predicates; such propositions merely go against our natural biases in interpreting events, for we normally think of an actional event as an event of acting, and thus as an aspect of the agent's being. But we can set aside our bias, and attend to that aspect of an actional event that is a suffering of action, and thus an aspect of the object's being.

There may be one phenomenon in which the syntax of propositions truly takes on a life of its own so that the syntax fails to reflect the semantics of predication, having been adapted to other purposes. For predicators formed from certain nouns, such as the verb "rain," the apparent absence of any argument, and the apparent absence of any subject, does not change the syntax of propositions in

which such verbs appear; the subject noun slot is filled with a pleonastic term (e.g., "It is raining"). This apparently syntactically motivated slot filling occurs for certain passives as well. M. C. Baker (1988) gives the following example: "It is (generally) believed that justice will prevail." He comments that,

VP . . . is always a predicate. . . . The thematic subject present in an active clause . . . is systematically absent in a passive. Nevertheless, the VP must be predicated of something given the Predication Condition [i.e., the principle that predicates must be associated with a maximal projection, namely the subject noun phrase, such that the predicate and the subject "constituent command" or "c-command" each other, i.e., they meet the conditions that the first branching node that dominates each one also dominates the other, but neither one dominates the other in the syntactic tree] The requirement of a subject can be met either by moving an NP into the needed position . . . or by inserting a 'dummy,' pleonastic NP This last example shows that the predication condition is not purely semantic, but rather a grammaticalization of an intuitive semantic relationship. (pp. 38-39).

It is possible, though, that the usual linguistic analysis of certain subject nouns as pleonastics (i.e., nonreferring terms) is mistaken, and that such nouns are actually subjects, in the Aristotelian sense. The verb "rain" might be best conceptualised as a one-place predicator, where its argument is a member of the kind RAIN or WATER, such that "It is raining" means 'Rain is raining down' or 'Water is raining down.' Under this conceptualisation, "it" is a pronoun that signifies the rain or water that is falling from the sky, and it is not pleonastic after all, despite linguistic claims to the contrary. But our use of expressions such as "It is raining cats and dogs" (versus "Cats and dogs are raining [down]") and "It's raining men" (versus "Men are raining [down]") suggests that "it" is, in fact, pleonastic when it appears in subject position with a predicate headed by the verb "rain." An evaluation of the possible pronominal role of supposedly pleonastic terms would require a linguistic analysis beyond the scope of this dissertation.

Aristotle gave several examples of propositions that he did not regard as examples of true predication because the predicate cannot be attributed to the individual named as the apparent (or syntactic) subject. He argued that

predication does not occur when the grammatical predicate is headed by a proper name and the external noun phrase signifies a concomitant thing rather than a basic-level individual, as in the sentence, "He who approaches is Socrates." The form of Socrates cannot be attributed to an approaching thing – although it can be attributed to that which underlies the approaching thing, namely Socrates (for an individual can be held responsible for the being of its own form; see *Metaphysics* Δ.18; for this reason, a proposition used in introducing someone, such as "This is John," is a valid instance of predication – although it might be better understood as being short for "This person is called John," i.e., as a proposition comparable to the French, "Il s'appelle Jean"). As another sort of instance of improper predication, Aristotle asked us to consider utterances: such as "The teacher built the house," where building a house cannot be attributed to a teacher qua teacher, for nothing in the nature of a teacher gives rise to housebuilding (although the person underlying the teacher can be held responsible for building the house). Aristotle described another circumstance in which no real predication occurs, according to him: when the syntactic predicate is headed by a noun for a kind subsumed by the kind named in the external noun phrase, as in "This animal is a tiger." A tiger can be held responsible for the coming to be and the being of the form of an animal, for the form of an animal comes to be whenever a tiger comes to be; but an animal cannot be held responsible for the coming to be or the being of the form of a tiger, for it is not the case that whenever an animal comes to be, the form of a tiger comes to be. Aristotle says,

. . . As the primary substances stand to the other things, so the species stands to the genus: the species is a subject for the genus (for the genera are predicated of the species but the species are not predicated reciprocally of the genera). (*Categories* 5, 2^b17-21)

One cannot hold a genus responsible for the being of a species or of its form; responsibility must be attributed in the other direction. The genus has being because the species making up the genus have being, and the genus has no form

except the form of some species.⁵⁰ But all of these apparent violations of the semantics of predication may, in fact, be valid instances of predication. As I argued earlier, genuine predication (i.e., an attribution of responsibility) can occur if we map from the individual named in surface structure to a basic-level individual underlying that individual, and then attribute the predicate to that underlying individual rather than the named individual. Evidence from typed predicators, such as the evidence from intuition implying that upon hearing "That dancer is beautiful" we map from the dancer signified into a member of the kind WOMAN before attributing the predicate "beautiful," suggests that such mappings into underlying individuals prior to applying predicates occur routinely.

Predication and Predicators

On a final linguistic note, the Aristotelian account of predication reveals some reasons for the privileged status of predicators in the predicate of a proposition. For a predicate headed by a predicator, the subject of predication is an argument of the predicator. Recall that predicators take arguments because of the nonseparability or dependence of that which the phrases they head signify; for true, affirmative, active propositions, an argument in subject position has as a nonseparable aspect of its being that which is signified by the predicate headed by the predicator of which it is an argument. Recall also that nonseparability implies responsibility for being (in the weakest sense of responsibility). It follows that whenever the subject of predication in an affirmative proposition is an argument

⁵⁰Aristotle says, ". . . The genus absolutely does not exist apart from the species which it as genus includes . . ." (*Metaphysics* Z.12, 1038^a5-6). He also says,

. . . It follows, if man and such things are substances, that none of the elements in their formulae [e.g., the genus] is the substance of anything, nor does it exist apart from the species or in anything else; I mean, for instance, that no animal exists apart from the particular animals, nor does any other of the elements present in formulae exist apart.

If, then, we view the matter from these standpoints, it is plain that no universal attribute is a substance, and this is plain from the fact that no common predicate indicates a 'this', but rather a 'such.' (*Metaphysics* Z.13, 1038^b30-1039^a2)

of a predicator that is the head of the predicate, and signifies an individual or set of individuals from which or from whom that which the predicate signifies is nonseparable, the subject is necessarily responsible for the being that the predicate signifies in at least one sense. Moreover, that which the predicate signifies, namely some property or relation, is not the sort of thing that can be held responsible for that which the subject noun phrase signifies, say a primary substance. One cannot hold an instance of greenness responsible for the being of a frog, for instance. For this reason, predicators typically head predicates rather than subject noun phrases. (Predicators can only head subject noun phrases if they have been nominalised – whether or not the nominalisation is marked – so that they name instances of properties or relations of which other properties or relations are predicated, e.g., "Her dancing is beautiful," or so that their referents are individuals in genera of properties or relations, as White in the genus COLOUR, e.g., "White is a boring colour.") Further, in consequence of the fact that the subject noun phrase is an argument of a predicator when it heads the predicate, that which gives rise to the need for a predicator to take an argument and that which permits a predicate headed by a predicator to be attributed to a subject are sometimes the same thing, namely nonseparability (although a subject may also be responsible for that which the predicate signifies in some sense stronger than nonseparability, e.g., by virtue of acting upon an intention). So predicators and predicates are conceptually related.

A Partial History of Predication

How did we get from the Aristotelian idea of predication to the modern ideas about predication, ones so incoherent that many come to reject the idea of predication altogether?

I will not attempt to trace the entire history of the concept. I will, instead, give the views of some influential thinkers of the past several centuries, beginning with some nominalists, to give a feel for the way in which views on predication have shifted with the prevailing *Zeitgeist*. It will become apparent that the

connexion of predication with being, as an attribution of responsibility for being, came to be more and more incompatible with prevailing views, as language came to be viewed less and less as an instrument for revealing being and more and more as just sets of strings of marks signifying mental representations. The divorce of propositions from extramental being rendered the notion of predication meaningless, paving the way for its demise.

I begin with William of Ockham (1285-1349). In his view, the subject and the predicate are merely names for the same object. In the passage reproduced below, ideas about predication that prevailed during his time are contrasted with his nominalist view:

For the truth of . . . a singular proposition, . . . it is not required that the subject and the predicate be really the same, nor that the predicate be really in the subject, or really inhere in the subject, nor that it be really united with the subject outside the mind. For instance, for the truth of the proposition 'This is an angel' it is not required that this common term 'angel' be really the same with that which has the position of subject in this proposition, or that it be really in it, or anything of the sort; but it is sufficient and necessary that subject and predicate should stand for the same thing. If, therefore, in the proposition 'This is an angel' subject and predicate stand for the same thing, the proposition is true. Hence it is not denoted, by this proposition, that this [individual] has 'angelity,' or that 'angelity' is in him, or something of that kind, but it is denoted that this [individual] is truly an angel. Not indeed that he is this predicate ['angel'], but that he is that for which the predicate stands. In like manner also the propositions 'Socrates is a man,' 'Socrates is an animal,' do not denote that Socrates has humanity or animality, nor that humanity or animality is in Socrates, nor that man or animal is in Socrates, nor that man or animal belongs to the essence or quiddity of Socrates or to the quidditative concept of Socrates. They rather denote that Socrates is truly a man and that he is truly an animal; not that Socrates is the predicate 'man' or the predicate 'animal,' but that he is something that the predicate 'man' and the predicate 'animal' stand for or represent; for each of these predicates stands for Socrates. (*Summa totius logicae* 2, c. 2; see Ockham, 1324/1957, pp. 76-77)

The idea that the subject and the predicate name the same thing does not hold up under analysis. Geach describes the problem this way:

On the face of it, if I use the term "man" in the context ". . . is a man" or ". . . isn't a man", it is mere nonsense to ask which man or men would be referred to, or whether every man or just some man would be meant. If I said "Tibbles isn't a dog" and some nonphilosopher asked me with apparent seriousness "Which dog?", I should be quite bewildered – I might conjecture that he was a foreigner who took "isn't" to be the past tense of a transitive verb. (Geach, 1962, p. 13)

. . . Consider propositions like "Socrates became a philosopher."
 . . . If Socrates did become a philosopher, he certainly did not become Socrates, nor did he become any other philosopher, say Plato; so "philosopher" does not stand for a philosopher – it does not serve to name a philosopher. (Geach, 1962, p. 35)

Materialism, which precludes intentional states having objects outside the mind (or what the scholastics called "first intentions"), and thus any contact of utterances with extramental being, forced a change in views on predication, placing it in the realm of the mental. This shift into the mental realm had become apparent when Thomas Hobbes (1588-1679) expressed his views on speech and propositions:

. . . Words so and so connected, signify the cogitations and motions of our mind.

. . . Words so connected as that they become signs of our thoughts, are called SPEECH, of which every part is a *name*.

. . . Names, though standing singly by themselves, are marks, because they serve to recall our own thoughts to mind So that the nature of a name consists principally in this, that it is a mark taken for memory's sake; but it serves also by accident to signify and make known to others what we remember ourselves, and therefore, I will define it thus:

. . . *A NAME is a word taken at pleasure to serve for a mark, which may raise in our mind a thought like to some thought we had before, and which being pronounced to others, may be to them a sign of what thought the speaker had, or had not before in his mind.* And it is for brevity's sake that I suppose the original of names to be arbitrary, judging it a thing that may be assumed as unquestionable. For considering that new names are daily made, and old ones laid aside; that diverse nations use different names, and how impossible it is either to observe similitude, or make any comparison betwixt a name and a thing, how can any man imagine that the names of things were imposed from their natures?

. . . But seeing names ordered in speech (as is defined) are signs of our conceptions, it is manifest they are not signs of the things themselves; for that the sound of this word *stone* should be the sign of a stone, cannot be understood in any sense but this, that he that hears it collects that he that pronounces it thinks of a stone. (Hobbes, 1655/1839, pp. 15-17)

A PROPOSITION is a speech consisting of two names copulated, by which he that speaketh signifies he conceives the latter name to be the name of the same thing whereof the former is the name; or (which is all one) that the former name is comprehended by the latter. For example, this speech, man is a living creature, in which two names are copulated by the verb is, is a proposition, for this reason, that he that speaks it conceives both living creature and man to be names of the same thing, or that the former name, man, is comprehended by the latter name, living creature.

. . . Wherefore, in every proposition three things are to be considered, viz. the two names, which are the *subject*, and the *predicate*, and their *copulation*; both which names raise in our mind the thought of one and the same thing . . . (Hobbes, pp. 30-31)

Now these words *true*, *truth*, and *true proposition*, are equivalent to one another; for truth consists in speech, and not in the things spoken of . . . Truth or verity is not any affection of the thing, but of the proposition concerning it.

. . . The first truths were arbitrarily made by those that first of all imposed names upon things, or received them from the imposition of others. For it is true (for example) that *man is a living creature*, but it is for this reason, that it pleased men to impose both those names on the same thing. (Hobbes, pp. 35-36)

. . . Names have their constitution, not from the species of things, but from the will and consent of men. And hence it comes to pass, that men pronounce *falsely*, by their own negligence, in departing from such appellations of things as are agreed upon, and are not deceived neither by the things, nor by the sense; for they do not perceive that the thing they see is called sun, but they give it that name from their own will and agreement. (Hobbes, p. 56)

. . . Every proposition, universally true, is either a definition, or part of a definition, or the evidence of it depends upon definitions. (Hobbes, p. 62)

For Ockham, the subject and the predicate stood for (or signified) the same object in extramental being. For Hobbes, a proposition signified that the speaker *conceived* the two expressions to be names of the same thing as a consequence of

the fact that the expressions *brought to mind* a *thought* of the same thing. Hobbes did not assert that the subject and the predicate actually signify the same extramental individual. Hobbes could not accept the idea that words are signs for extramental things because of their arbitrariness; he seemed to think that something could be a sign of something only if it *resembled* it in some way, thereby confusing signs or symbols with representations (as do many modern scholars, e.g., Jackendoff, 1991). And yet he allowed words to be signs of *thoughts*, even though they do not resemble the thoughts either. For Hobbes, a *sign* was not that which signifies something in the sense of directing the mind toward it (i.e., in the intentional sense); he conceived signs to be "the antecedents of their consequents, and the consequents of their antecedents, as often as we observe them to go before or follow after in the same manner" as, for instance, "a thick cloud is a sign of rain to follow" (Hobbes, p. 14). So a word was a sign in the sense that it allowed the listener to divine what thought was in the mind of the speaker. The truth of a proposition lay not in its unconcealment of extramental being, but in the way men had defined words, so that if the two expressions that were the subject and the predicate of a proposition were so defined that they could be taken to be names for the same thing (because both raised in the mind a thought of the same thing), the proposition would be "true"; but, in Hobbes's view, this truth depended on the arbitrary conventions of naming that are specific to a language.

Gottfried Wilhelm Leibniz (1646-1716) was critical of Hobbes's view of predication because it rendered arbitrary truth and falsity, which became dependent upon human conventions of naming:

. . . Hobbes saw that all truths can be demonstrated from definitions but held that all definitions are arbitrary and nominal, since we impose arbitrary names upon things. He therefore concluded that truths also consist merely in names and are arbitrary. (Leibniz, 1679/1989c, p. 231)

Hobbes seems to me to be a super-nominalist. For not content like the nominalists, to reduce universals to names, he says that the truth of things itself consists in names and what is more, that it depends on the human will, because truth allegedly depends on the

definitions of terms, and definitions depend on the human will.
 . . . Yet it cannot stand. In arithmetic, and in other disciplines as well, truths remain the same even if notations are changed, and it does not matter whether a decimal or a duodecimal number system is used. (Leibniz, 1670/1989d, p. 128)

. . . Can anyone depart so far from a sound mind as to persuade himself that truth is arbitrary and depends on names, though he knows that the geometry of the Greeks, Latins, and Germans is the same?

. . . For although characters are arbitrary, their use and connection have something which is not arbitrary, namely a definite analogy between characters and things, and the relations which different characters expressing the same thing have to each other. This analogy or relation is the basis of truth. For the result is that whether we apply one set of characters or another, the products will be the same or equivalent or correspond analogously. But perhaps certain characters are always necessary for thinking.

. . . And the analytic or arithmetical calculus confirms this view. For in numbers the problem always works out in the same way whether you use the decimal system or as some mathematician did, the duodecimal. Afterward, if you apply the solution you have reached by calculation in several different ways, by arranging kernels or some other countable objects, the answer always comes out the same. (Leibniz, 1677/1989a, pp. 183-184)

Leibniz's own view of predication, which he took as the received view coming out of Scholastic logic, made truth dependent upon concepts:

A proposition is composed of subject and predicate

Thomas Hobbes, everywhere a profound examiner of principles, rightly stated that everything done by our mind is a *computation*, by which is to be understood either the addition of a sum or the subtraction of a difference So just as there are two primary signs of algebra and analytics, + and -, in the same way there are as it were two copulas, 'is' and 'is not'; in the former case the mind compounds, in the latter it divides.

. . . Let any given term be analysed into formal parts, i.e. let its definition be given, and let these parts again be analysed into parts, i.e. let there be a definition of the terms of the definition, down to simple parts, i.e. indefinable terms.

. . . these primitive terms being called "first terms."

. . . The predicates of a given subject are all its first terms; so are all derived terms nearer to the first terms, of which all the first terms

are in the given subject. If, therefore, a given term which is to be a subject is written in its first terms, it is easy to find those first terms which are predicated of it; it will also be possible to find the derived terms, if the complexions are arranged systematically. But if the given term is written in derived terms, or partly in derived and partly in simple terms, whatever is predicated of the derived term will be predicated of the given term. All these are cases of something wider being predicated of something narrower; but there is also predication of one equal of another, when a definition is predicated of a term. This is when either all its first terms together, or the derived terms (or the derived and simple terms) in which all the first terms are contained, are predicated of the given term. These are as many as the ways in which, as we have just said, the one term can be written (Leibniz, 1666/1966, pp. 3-5)

With predication defined in this way, the predications "Man is rational" and "Man is an animal" are grounded by the fact that the formula or definition of man is "the rational animal." By basing predication upon formulae (even though ultimately upon terms that cannot be defined), Leibniz puts predication in the realm of the conceptual.

Leibniz's idea of predication was expressed elsewhere as the predicate being *in* the subject, by which he meant that the concept of the predicate was part of the concept of the subject:

Every true categorical proposition, affirmative and universal, signifies nothing but a certain connection between the predicate and the subject This connection is such that the predicate is said to be in the subject, or to be contained in it, and this either absolutely and viewed in itself, or in some particular case. Or in the same way, the subject is said to contain the predicate; that is, the concept of the subject, either in itself or with some addition, involves the concept of the predicate. And therefore the subject and predicate are mutually related to each other either as whole and part, or as whole and coinciding whole, or as part to whole. In the first two cases the proposition is universal affirmative. So when I say, 'All gold is a metal,' I mean by this only that the notion of metal is contained in the notion of gold in a direct sense, for gold is the heaviest metal. And when I say, 'All pious people are happy,' I mean only that the connection between piety and happiness is such that whoever understands the nature of piety perfectly will see that the nature of happiness is involved in it in the direct sense

But in the *particular affirmative proposition* it is not necessary for the predicate to be contained in the subject per se and viewed absolutely, or for the concept of the subject per se to contain the concept of the predicate. It suffices that the predicate be contained in some species of the subject or that the concept of some instance or species of the subject contain the concept of the predicate; of what kind the species must be, the proposition need not express. Hence, if you say, 'Some expert is prudent,' this does not assert that the concept of prudence is contained in the concept of expert viewed in itself, though this is not denied, either. It suffices for your purpose that some species of expert has a concept which contains the notion of prudence, even though it is not made explicit what sort of species this may be, for instance, even if the proposition does not express that the expert who also possesses natural judgment is prudent. It is enough to understand that some species of expert involves prudence. (Leibniz, 1679/1989e, pp. 236-237)

The predicate or consequent therefore always inheres in the subject or antecedent. And as Aristotle, too, observed, the nature of truth in general or the connection between the terms of a proposition consists in this fact. In identities this connection and the inclusion of the predicate in the subject are explicit; in all other propositions they are implied and must be revealed through the analysis of the concepts, which constitutes a demonstration a priori. (Leibniz, 1682/1989b, pp. 267-268)

By making the predicate part of the concept of the subject, Leibniz was forced to make everything that could ever be predicated of a subject part of its concept. This implied that everything that ever was or will be true of a subject is part of its concept, and so a part of the subject itself, always.

The complete or perfect concept of an individual substance involves all its predicates, past, present, and future. For certainly it is already true now that a future predicate will be a predicate in the future, and so it is contained in the concept of the thing. (Leibniz, 1682/1989b, p. 268)

Moreover, because an infinity of things hold true of a subject (e.g., "Jack is 3000 miles from the Eiffel Tower"; "Betty was born 300 years after Leibniz"), the whole universe is somehow represented in the concept of a single substance:

Every individual substance involves the whole universe in its perfect concept, and all that exists in the universe has existed or will exist.

For there is no thing upon which some true denomination, at least of comparison or relation, cannot be imposed from another thing.

. . . *All individual created substances, indeed, are different expressions of the same universe* and of the same universal cause, God. But these expressions vary in perfection as do different representations or perspectives of the same city seen from different points. (Leibniz, 1682/1989b, p. 269)

Leibniz would have done well to respect Aristotle's distinctions among being predicated of a subject, being in a subject, and being in the what of a subject (i.e., being part of its essence as a member of a basic-level kind). Aristotle was clear in stating that some things can be in a subject, as whiteness is in a body or a piece of grammatical knowledge is in a person's mind (and notice that being in something does not mean that the concept is in the concept of something, but that the thing itself is in some other extramental thing), without being predicable of the subject (for whiteness is predicable of a subject, as when we say "The rabbit is white," but the colour white itself is not predicable of a subject, and a piece of grammatical knowledge is not predicable of a subject). Further, some things are predicable of a subject, but not in any subject (as "man" is predicable of Socrates, but the kind MAN is not in Socrates; see *Categories* 2, 1st20-1st9).

Immanuel Kant (1724-1804) was interested in propositions as judgements, as were many who followed him. The act of judging whether a proposition is true or false succeeds the act of predicating, in which something is accused of a subject – just as in a legal trial, in which judgement is the final event. But Kant's view of predication is implicit in his writings on judgement, as in the following passages:

In all judgments in which the relation of a subject to the predicate is thought . . . this relation is possible in two different ways. Either the predicate B belongs to the subject A, as something which is (covertly) contained in this concept A; or B lies outside the concept A, although it does indeed stand in connection with it. In the one case I entitle the judgment analytic, in the other synthetic. Analytic judgments (affirmative) are therefore those in which the connection of the predicate with the subject is thought through identity; those in which this connection is thought without identity should be entitled synthetic. The former, as adding nothing through the predicate to the concept of the subject, but merely breaking it up into those

constituent concepts that have all along been thought in it, although confusedly, can also be entitled explicative. The latter, on the other hand, add to the concept of the subject a predicate which has not been in any wise thought in it, and which no analysis could possibly extract from it; and they may therefore be entitled ampliative. (Kant, 1787/1965, p. 48)

The knowledge yielded by understanding, or at least by the human understanding, must therefore be by means of concepts, and so is not intuitive, but discursive. Whereas all intuitions, as sensible, rest on affections, concepts rest on functions. By 'function' I mean the unity of the act of bringing various representations under one common representation. Concepts are based on the spontaneity of thought, sensible intuitions on the receptivity of impressions. Now the only use which the understanding can make of these concepts is to judge by means of them. Since no representation, save when it is an intuition, is in immediate relation to an object, no concept is ever related to an object immediately, but to some other representation of it, be that other representation an intuition, or itself a concept. Judgment is therefore the mediate knowledge of an object, that is, the representation of a representation of it. In every judgment there is a concept which holds of many representations, and among them of a given representation that is immediately related to an object. Thus in the judgment, 'all bodies are divisible,' the concept of the divisible applies to various other concepts, but is here applied in particular to the concept of body, and this concept again to certain appearances that present themselves to us. These objects, therefore, are mediately represented through the concept of divisibility. Accordingly, all judgments are functions of unity among our representations; instead of an immediate representation, a *higher* representation, which comprises the immediate representation and various others, is used in knowing the object, and thereby much possible knowledge is collected into one. Now we can reduce all acts of the understanding to judgments, and the *understanding* may therefore be represented as a *faculty of judgment*. For, as stated above, the understanding is a faculty of thought. Thought is knowledge by means of concepts. But concepts, as predicates of possible judgments, relate to some representation of a not *yet* determined object. Thus the concept of body means something, for instance, metal, which can be known by means of that concept. It is therefore a concept solely in virtue of its comprehending other representations, by means of which it can relate to objects. It is therefore the predicate of a possible judgment, for instance, 'every metal is a body.'

... Logicians are justified in saying that, in the employment of judgments in syllogisms, singular judgments can be treated like those that are universal. For, since they have no extension at all, the predicate cannot relate to part only of that which is contained in the concept of the subject, and be excluded from the rest. The predicate is valid of that concept, without any such exception, just as if it were a general concept and had an extension to the whole of which the predicate applied. (pp. 105-107)

Like Leibniz, Kant is concerned with the relations of mental entities to one another, with the predicate sometimes being a concept that is part of the concept of the subject, and sometimes being a concept connected with the concept of the subject in some other way. The contact of a proposition (or "judgement") with extramental being is indirect because concepts do not give us any immediate contact with extramental being, but only with mental representations of it.

Predication as a phenomenon of mind alone became more firmly established after the rise of empiricism, a movement rooted in skepticism about our capacity to make mental contact with the things outside our minds in any way that reveals their true nature.⁵¹ For the empiricists, a noun did not signify a kind, but an idea (which was itself the result of a sensation). A transitive verb did not signify a relation of one individual to another, but an idea (J. Mill, 1869) or a connexion between ideas such that one introduces the other (Hume, 1740/1978). An adjective did not signify a property, but an idea. A sentence was conceptualised as a string of marks for ideas. James Mill (1773-1836) described predication as "a contrivance for marking the order of ideas" (J. Mill, p. 187):

The joining of two names by [the] peculiar mark ["is"], is the act which has been denominated, PREDICATION; and it is the grand contrivance by which the marks of sensations and ideas are so

⁵¹This skepticism stands in sharp contrast to the Greek faith in our ability to arrive at an understanding of the true nature of being, including invisible essences and ideals, through the use of the intellect in *logos* (from the verb *legō*), where the latter, whether in the form of a true affirmation or *kataphasis* (i.e., *logos apophantikos*), demonstration or a syllogism (related to *sullegō*), or dialectic (from *dialogō*), has the power to unconceal being to the mind's eye, according to Plato (e.g., *Sophist*, 262c; *Republic* 6, 510-511, and 7, 533-534) and Aristotle (e.g., *On Interpretation* 4, 16^b28 - 5, 17^a12; *Prior Analytics* A.1, 24^b18-20; *Topics* A.1, 100^a25-30; see also Heidegger, 1975/1988, pp. 215-216).

ordered in discourse, as to mark the order of the trains, which it is our purpose to communicate, or to record. (J. Mill, p. 161)

As an example, he describes the sequence of sensations that lead to the predication, "The sun rises": "First sensation, 'sight of the sun'; second sensation, 'rising of the sun'; these two denoted shortly and in their order by the Predication, 'the sun rises'" (J. Mill, p. 185).

J. Mill (1869) argued that all predication is of the species or genus or a subclass of one of these (often with their names left out; e.g., "Man is rational" *really* means 'Man is a rational animal': ". . . When it is said that man is rational, the term rational is evidently elliptical, and the word animal is understood"; p. 169); but he had in mind, not classes of individuals (as in the modern class-inclusion view of predication; see below) or classes of attributes of individuals (see below regarding the views of J. S. Mill), but classes of *ideas*. He wrote of "arranging ideas in classes" and of "breaking them down into smaller parcels, or sub-classes" (J. Mill, p. 144) by conjoining them with other ideas (or applying the names for other ideas "as marks upon the mark of the great class"; p. 145), and especially by conjoining the ideas signified by nouns with the ideas signified by adjectives and verbs. The following passages show that his view of predication is an empiricist version of nominalism, with the subject and predicate naming the same idea(s):

. . . All Predication, is Predication of Genus or Species, since the Attributives classed under the titles of *Differentia*, *Proprium*, *Accidens*, cannot be used but as part of the name of a Species [i.e., a subspecies]. But we have seen . . . that Predication by Genus and Species is merely the substitution of one name for another, the more general for the less general; the fact of the substitution being marked by the *Copula*. It follows, if all Predication is by Genus and Species, that all Predication is the substitution of one name for another, the more for the less general. (J. Mill, p. 169)

The Predication consists, essentially, of two marks, whereof the first is called the Subject, the latter the Predicate; the Predicate being set down as a name to be used for every thing of which the Subject is a name; and the *Copula* is merely a mark necessary to shew that the

Predicate is to be taken and used as a substitute for the Subject. (J. Mill, p. 171)

. . . There is perpetual need of the substitution of one name for another. When I have used the names, James and John, Thomas and William, and many more, having to speak of such peculiarities of each, as distinguish him from every other, I may proceed to speak of them in general, as included in a class. When this happens, I have occasion for the name of the class, and to substitute the name of the class, for the names of the individuals. By what contrivance is this performed? I have the name of the individual, *John*; and the name of the class *man*; and I can set down my two names; *John, man*, in juxta-position. But this is not sufficient to effect the communication I desire; namely that the word man is a mark of the same idea of which John is a mark, and a mark of other ideas along with it, those, to wit, of which James, Thomas, &c. are marks. To complete my contrivance, I invent a mark, which, placed between my marks, *John* and *man*, fixes the idea I mean to convey, that *man*, is another mark to that idea of which *John* is a mark, while it is a mark of the other ideas, of which *James, Thomas, &c.*, are marks. For this purpose, we use in English, the mark "is." (J. Mill, pp. 160-161)

From an empiricist standpoint, the copula cannot signal that a statement is about extramental being, since a statement is simply a sequence of marks that signify ideas. For Mill, extramental being was that from which we may have sensations (p. 157), for all knowledge comes through the senses (which is the very opposite of the Platonic view, in which knowledge comes through the intellect, with the senses deceiving us about the nature of being). More importantly, the view that predication is about ideas, and not ever about extramental being, precludes the acceptance of the Aristotelian idea of predication as an attribution of responsibility for something's being. Even an attribution of responsibility to one idea for the being of another idea is ruled out; as George Berkeley pointed out, ideas (of the empiricist variety) are not responsible for the existence of other ideas:

All our ideas, sensations, or the things which we perceive . . . are visibly inactive, there is nothing of power or agency included in them. So that one idea or object of thought cannot produce, or make any alteration in another. . . . It is impossible for an idea to do

anything, or . . . to be the cause of anything. (Berkeley, 1710/1982, p. 33)

Mill's view of predication did not become the established one, but it shares points of contact with a view that did become popular. The view that came to predominate was one in which predication signals class inclusion, that is, the inclusion of the subject in a class of individuals of which the predicate is true. Mill's son John Stuart Mill (1806-1873) described this view:

Although Hobbes's theory of Predication has not, in the terms in which he stated it, met with a very favourable reception from subsequent thinkers; a theory virtually identical with it, and not by any means so perspicaciously expressed, may almost be said to have taken the rank of an established opinion. The most generally received notion of Predication decidedly is that it consists in referring something to a class; i.e., either placing an individual under a class, or placing one class under another class. Thus, the proposition *Man is mortal*, asserts, according to this view of it, that the class *man* is included in the class *mortal*. "*Plato was a philosopher*," asserts that the individual *Plato* is one of those who compose the class *philosopher*. If the proposition is negative, then, instead of placing something in a class, it is said to exclude something from a class. Thus, if the following be the proposition, *The elephant is not carnivorous*; what is asserted (according to this theory) is, that the elephant is excluded from the class *carnivorous*, or is not numbered among the things comprising that class. There is no real difference, except in language, between this theory of Predication and the theory of Hobbes. For a class *is* absolutely nothing but an indefinite number of individuals denoted by a general name. The name given to them in common, is what makes them a class. To refer anything to a class, therefore, is to look upon it as one of the things which are to be called by that common name. To exclude it from a class, is to say that the common name is not applicable to it. (J. S. Mill, 1851, pp. 103-104)

J. S. Mill (1851) described this theory as "a signal example of a logical error very often committed in logic, that of . . . explaining a thing by something which presupposes it" (p. 104), that is, explaining, say, assent to the proposition "*snow is white*" in terms of the class of white things, when the classification required to determine the class presupposes judgements about the whiteness of things. He presented his own view:

Every proposition consists of three parts: the Subject, the Predicate, and the Copula. The predicate is the name denoting that which is affirmed or denied. The subject is the name denoting the person or thing which something is affirmed or denied of. The copula is the sign denoting that there is an affirmation or denial; and thereby enabling the hearer or reader to distinguish a proposition from any other kind of discourse. . . . The word *is* . . . serves as the connecting mark between the subject and predicate, to show that one of them is affirmed of the other

Dismissing, for the present, the copula, . . . every proposition, then, consists of at least two names; brings together two names, in a particular manner. . . . It appears from this, that for an act of belief, *one* object is not sufficient; the simplest act of belief supposes, and has something to do with, *two* objects: two names, to say the least; and (since the names must be names of something) two *nameable things*.

. . . Let me say, "the sun exists." Here, at once, is something which a person can say he believes. But here, instead of only one, we find two distinct objects of conception: the sun is one object; existence is another. (J. S. Mill, pp. 19-20)

Let the predicate be, as we have said, a connotative term; and to take the simplest case first, let the subject be a proper name: "The summit of Chimborazo is white." The word white connotes an attribute which is possessed by the individual object designated by the words, "summit of Chimborazo," which attribute consists in the physical fact, of its exciting in human beings the sensation which we call a sensation of white. It will be admitted that, by asserting the proposition, we wish to communicate information of that physical fact, and are not thinking of the names, except as the necessary means of making that communication. The meaning of the proposition, therefore, is, that the individual thing denoted by the subject, has the attributes connoted by the predicate.

If we now suppose the subject also to be a connotative name, the meaning expressed by the proposition has advanced a step farther in complication. Let us first suppose the proposition to be universal, as well as affirmative: "All men are mortal." In this case, as in the last, what the proposition asserts, (or expresses a belief of,) is, of course, that the objects denoted by the subject (man) possess the attributes connoted by the predicate (mortal). But the characteristic of this case is, that the objects are no longer *individually* designated. They are pointed out only by some of their attributes: they are the objects called men, that is, possessing the attributes connoted by the name man; and the only thing known of them may be those attributes: indeed, as the proposition is general,

and the objects denoted by the subject are therefore indefinite in number, most of them are not known individually at all. The assertion, therefore, is not, as before, that the attributes which the predicate connotes are possessed by any given individual, or by any number of individuals previously known as John, Thomas, &c., but that those attributes are possessed by each and every individual possessing certain other attributes; that whatever has the attributes connoted by the subject, has also those connoted by the predicate; that the latter set of attributes *constantly accompany* the former set. Whatever has the attributes of man has the attribute of mortality; mortality constantly accompanies the attributes of man.

If it be remembered that every attribute is *grounded* on some fact or phenomenon, either of outward sense or of inward consciousness, and that to *possess* an attribute is another phrase for being the cause of, or forming part of, the fact or phenomenon upon which the attribute is grounded; we may add one more step to complete the analysis. The proposition which asserts that one attribute always accompanies another attribute, really asserts thereby no other thing than this, that one phenomenon always accompanies another phenomenon; insomuch that where we find the one, we have assurance of the existence of the other.

. . . The object of belief in a proposition . . . is generally . . . either the coexistence or the sequence of two phenomena. At the very commencement of our inquiry, we found that every act of belief implied two Things; we have now ascertained what, in the most frequent case, these two things are, namely two Phenomena, in other words, two states of consciousness; and what it is which the proposition affirms (or denies) to subsist between them, namely either succession, or coexistence.

. . . Besides the propositions which assert Sequence or Coexistence, there are some which assert simple Existence; and others assert Causation

To these four kinds of matter-of-fact or assertion, must be added a fifth, Resemblance. . . . As, This colour is like that colour (J. S. Mill, pp. 108-112)

J. S. Mill rejected the idea that predication shows the individual(s) named as subject to be included in the class of individuals named in the predicate, but replaced that view with one in which the attribute named in the predicate is included in the class of attributes connoted by the subject's name. The attributes are experienced as, and are the causes of, sensations or states of consciousness, and belief in (but not necessarily the truth of) a proposition rests on one's

experience of co-occurrences or successions of attributes. If we experience dogs and animals as having some set of attributes in common, such that every attribute connoted by "animal" is also connoted by "dog," then we can state as if true that "Dogs are animals." The problems raised by this account are too numerous to discuss. Let us just say that it is very far from the Aristotelian view, in which this instance of predication reveals that the form of an animal has (actual) being only by virtue of the being of dogs, among other animals (i.e., cats, squirrels, etc.).

Edmund Husserl (1859-1938) devoted an entire study to judgement, attempting to clarify "the essence of the predicative judgment by means of an exploration of its origin" (Husserl, 1948/1973, p. 11). The term "judgement" itself emphasises a mental act, and such was Husserl's concern; in particular, he concerned himself with the mental acts, primarily predicative acts, that lead to knowledge. He contrasted the accretion of knowledge possible through predicative acts with the sameness of the knowledge of a substance that comes initially through intuitions associated with perceptual acts:

Every act of predicative judgment is a step in which a permanent store of knowledge is produced. (Husserl, p. 62)

This achievement of knowledge is an activity *attached* to pregiven objects, but attached in a completely different way than the merely receptive activity of apprehension, explication, and relational contemplation. Its outcome is the possession of knowledge. In the pregnant concept of an object as the object of knowledge it is implied that the object is identical and identifiable beyond the time of its intuitive givenness, that what is once given in intuition must still be capable of being kept as an enduring possession even if the intuition is over, and, what is more, in structures which, through indications at first empty, can again lead to envisionment of the identical – to an envisionment whether by presentification or by renewed self-giving. Thus it is a matter here of objectifying achievements of a new kind, not merely of an activity *attached* to the pregiven and receptively apprehended objectivities; rather, in predicative knowledge and its deposit in the predicative judgment new kinds of objectivities are constituted, which can then themselves be apprehended again and be made thematic as logical structures, i.e., as what we call *categorical objectivities*, since they arise from the *katēgorein*, the act of declarative judgment, or also (since judgment is

certainly an activity of the understanding) *objectivities of the understanding*. (Husserl, pp. 198-199)

We will . . . take our point of departure from the simple perception and explication of an as yet undetermined substrate *S* and . . . will limit ourselves at first to its explication according to a dependent internal determination [i.e., some aspect of its being that is in it and dependent upon it for its being], a moment which we will designate as *p*. . . . What is the new achievement which occurs when, on the basis of explication, we come to the predicative determination "*S* is *p*"?

We have seen that, in the explication of a substrate *S*, a coincidence takes place between *S* and its determining moment *p*. As a substrate still remaining in grasp, the substrate has obtained in this synthesis of transition from *S* to *p* an accretion of sense. But when, retaining *S* in grasp, we pass to its moment *p*, therefore when we witness this coincidence, this "contraction" of *S* in *p*, we have not yet, for all that, posited *S* as subject in a predicative judgment, and we have not yet determined it as having the moment *p* in the manner "*S* is *p*." This, rather, is the *achievement of a new kind of activity*. Already in the act of apprehension and receptive explication there were active steps: in an active turning-toward, the substrate *S* was first apprehended in its undifferentiated unity, made a theme, and then its determination *p* was actively apprehended in the explicative synthesis. The work of the activity of the ego went thus far. Beyond this, the explicative coincidence arose *passively* between the substrate *S*, still retained in grasp, and its determination *p*, and the thematic object-substrate found its enrichment of sense in this passive modification.

When the transition from *S* to *p* has taken place in this way, there then develops on the basis of active contemplation an *interest of higher level* in the object-substrate, an interest, proceeding from this contemplation, *in retaining* the accretion of sense arising from it, the *S* in its enrichment of sense. . . . The interest now betakes itself in the direction of *S* in its enrichment of sense, which supposes that we *again* pass to *p*. For originally, *p* emerges as the enrichment of sense [of *S*] only in the synthetic transition [from *S* to *p*] in the explicative coincidence. But the transition is now guided by the cognitive will to retain *S* in its determination. An *active* intention aims at apprehending what previously was a merely *passive* coincidence, therefore, in the active transition to *p*, at producing in an original activity what accrues to *S*. As an active ego, directed toward *S* in its accretion of sense, and in my interest focused on this accretion itself, I bring about the transition and the partial coincidence as free activity and thus bring about the fulfillment of

the determining intention, the intention toward *S* in the sense accruing from the transition and coincidence. I have *S* as the substrate of a determination and actively determine it. The object-substrate takes the form of the predicative subject; it is the subject-theme as *terminus a quo*, and the activity goes over to the predicate as the opposed *terminus ad quem*. It is only then that there is realized in a productive activity – which is not only a synthetic activity in general but, at the same time, the *activity of synthesis itself* – the consciousness that *S* receives a determination by *p* in the mode "*S* is *p*."

. . . [*S*] is posited in the form of subject, and *p* expresses the determination. In the "is," the form of the synthesis between explicand and explicate is expressed in its active accomplishment, i.e., as the apprehension of being-determined-as, and in the predication this form is a component of the total "state of affairs" which attains expression.

. . . The ego in its interest turns back to *S* and, for example, first taking *p* particularly in grasp again and directing a new ray of attention toward it, becomes aware of the enrichment of sense and is saturated with it, while it again reproduces it by an original activity in a new passage to *p*; and thus for each of the determinations.

. . . Thus is described the process of predication which tradition always already had in view under the terms "synthesis" and "diaeresis" without actually being able to come to grips with it. (Husserl, pp. 205-209)

The members of a judicative proposition [such as "*S* is *p*"] not only have a *syntactical formation* as subject, predicate, etc., as *functional forms* which belong to these propositions as elements of the proposition, but, underlying these, they have still another kind of formation, the *core-forms*: the subject has the core-form of substantivity; in the predicate, the determination *p* is in the core-form of adjectivity. The form of substantivity, therefore, should not be confused with the subject-form. It designates "being-for-itself," the independence of an object . . . , as contrasted to adjectivity, which is the form of "in something," of the dependence of the object-determination. (Husserl, p. 210)

When the predicate signifies a relation of the subject to some other substantive object, "adjectivity" is not something that is *in* the subject; Husserl describes it this way:

Adjectivity constituted on the basis of external contemplation in the act of relative determination, or, as we can also say, in relational judgment, is thus distinguished from adjectivity constituted in simple

determinative thought (erected on internal explication) in that, apart from the substrate, a substantive functioning as a subject, it requires a counterpart, so to speak, an additional substantive, namely, the relative object, with which it is united relative to consciousness.
Every determination of a subject which is relative determines it on the basis of a synthesis of transition to a second substantive object.
 (Husserl, p. 224)

Husserl distinguishes absolute adjectivity, which he describes as "a dependent moment of the substrate of determination, arising in internal explication and determination," and relative adjectivity, which arises "on the basis of external contemplation and the positing of relational unity, as well as the act of relational judgment erected on it" (pp. 224-225). For nonrelational predicates, the being-in-a-substrate to which Husserl points in characterising the predicate is only one of the relationships of a predicate to a subject that Aristotle considered, and he was explicit in distinguishing being predicable of a subject from being in a subject (which is characteristic of the being signified by predicates only when they are headed by predicators; see *Categories* 2, 1^a20-1^b9, 5, 2^a11-14, 3^a7-28). Husserl describes the predicate as a determination of the subject. He seems to mean by this that the predicate brings to mind one aspect of the subject's being so that the mind turns toward something determinate and knowledge about the subject is acquired. In this and other ways, Husserl's account of predication moves close to Aristotle's. But his views had just as little an effect on the prevailing views.

In this century and the last one, a movement outside of philosophy had an effect on our views about predication. The formalisation of natural-language propositions with symbolic mathematical logic seems to have contributed to the demise of the subject and the predicate as traditionally understood. Symbolic logic was first developed in the last century and came to be extended beyond number science through the introduction of variables that could take values other than numeric ones, including the things signified by phrases in propositions (e.g., Whitehead & Russell, 1910).

Among the first to describe a symbolic logic that could be applied to natural-language sentences was George Boole (1815-1864). He attempted to apply

the language of algebra to natural language. His account of predication rested on the idea of class inclusion, and is an example of the view that J. S. Mill described as an established opinion:

That which renders Logic possible, is the existence in our minds of general notions, – our ability to conceive of a class, and to designate its individual members by a common name. The theory of Logic is thus intimately connected with that of Language. A successful attempt to express logical propositions by symbols, the laws of whose combinations should be founded upon the laws of the mental processes which they represent, would, so far, be a step toward a philosophical language. . . . Assuming the notion of a class, we are able, from any conceivable collection of objects, to separate by a mental act, those which belong to the given class, and to contemplate them apart from the rest. Such, or a similar act of election, we may conceive to be repeated. The group of individuals left under consideration may be still further limited, by mentally selecting those among them which belong to some other recognised class, as well as to the one before contemplated. And this process may be repeated with other elements of distinction, until we arrive at an individual possessing all the distinctive characters which we have taken into account, and a member, at the same time, of every class which we have enumerated. It is in fact a method similar to this which we employ whenever, in common language, we accumulate descriptive epithets for the sake of more precise definition. (Boole, 1847, pp. 4-5)

How was Boole able to substitute classes for predicates? He did so by treating predicates (or predicators; he did not distinguish the two clearly) as attributes of bare particulars:

. . . If an adjective, as "good," is employed as a term of description, let us represent by a letter, as *y*, all things to which the description "good" is applicable, i.e. "all good things," or the class of "good things." (Boole, 1854, p. 28)

Boole resolved a verb into the copula conjoined with an expression signifying one or more individuals – members of some class. Thus, "Caesar conquered the Gauls" is restated as "Caesar is he who conquered the Gauls" (Boole, 1854, p. 35). For Boole, a proposition such as "The sun shines" was equivalent to "The sun is a shining thing," and the copula "is" expressed an identity between the sun and a member of the class "things which shine." (See Boole, 1854, p. 53.) As J. S. Mill

pointed out, nothing is explained by saying that something is white by virtue of its inclusion in the class of white things, since membership of a thing in the class of white things presupposes the judgement that the thing is white. Predication as class inclusion creates other problems. Whenever the predicate is headed by a verb or adjective, the necessary formation of a class presupposes bare particulars that can be classified on the basis of the attribute signified by the predicate. But predicators are typed by kinds, and the connotations and intensions of the predicates they head differ depending on which kinds type them. Would we want to include in the class of "running things" mammals, rivers, sap, and politicians, and then say that Colin is included among the members of this class because he is running? Could this in any way illuminate what it means for Colin to be running, when the sap coming out of a particular tree is also included among the running things? Suppose, instead, that we restricted membership in the class to individuals of a kind to which the subject of predication belongs, since the subject noun phrase is one of the arguments of the predicator, and the subject's kind is among those kinds that type one of the predicator's arguments; as long as the predicator's meaning did not depend also on the kinds to which additional arguments belonged (as it typically does with many-place predicators), this would limit members of the class to ones possessing a typed attribute, namely the attribute signified by a predicate headed by the predicator when it is typed (at least partially) by the kind to which the subject belongs, or by some more inclusive kind. But this would amount to treating "The politicians are running" as "The politicians are running politicians." And yet the class or subkind of running politicians is determined by which politicians are running. Nothing is gained by constructing a class or subkind of individuals of which the predicate is true. More importantly, the being of running is not equivalent to the being of running things, or of running sap, or of running mammals – that is, to the being of primary substances in a subkind. There is more to a running mammal than its running; running can only ever be one aspect of its substrate's being; the being of running cannot be equivalent to the being of the substance that is its substrate (i.e., its *hupokeimenon*), not even just

while the substance is running. So predicating of a subject, say a man, that he is running cannot be equivalent to predicating of him that he is a running mammal (for instance).

As the symbol for the copula "is," Boole chose '='; this decision suggests an interpretation of the copula as a sign of identity, in all cases. In algebra, identity (under the kind NUMBER) is the only relation that might be signified by virtue of "is" (e.g., "three plus two is five"). Clearly this will not do for natural language, though. Recall Aristotle's claim that being and "is" have a different meaning for each of the categories, such that predication of a kind, as in "Charlotte is a person," is associated with an "is" that reveals the being of a form attributed to a substance, whereas predication of a quality, as in "Snow is white," is associated with an "is" that reveals the being of whiteness as something that comes to be within and is present in one or more primary substances, in this case portions of snow – and so on for the remaining categories. "Is" means something different again when the subject of predication is a concomitant thing; in "The approaching one is a singer," "is" reveals the being of a form attributed to the substance that underlies the named subject; and for instances of proper predication where the subject is not a substance, "is" reveals being that comes to be in dependency upon an individual that is not a substance, as in the proposition, "The carpenter is building a house." Such subtleties were apparently lost on Boole as he attempted to cram propositions into the mould of the language of algebra.

Giuseppe Peano (1858-1932) saw an equivalence between the calculus of sets and the calculus of propositions, which is not far from Boole's position. For instance, he saw the mathematical expression of the truth that the subset of A in the complement of B is the empty set as "substantially equivalent to the universal affirmative proposition 'every A is a B '" (Peano, 1888/1973, p. 77). This set-theoretic approach is virtually identical to the class-inclusion approach.

One of the early developers of symbolic logic was Gottlob Frege (1848-1925), whose interest was in providing "a formalized language of pure thought modelled upon the language of arithmetic" (see Frege, 1879/1952a, p. 1). Frege

felt that the ideas of a subject and a predicate needed to be excised if mental judgements were to be understood:

A distinction of *subject* and *predicate* finds *no place* in my way of representing a judgment. . . . [Take] the two propositions 'the Greeks defeated the Persians at Plataea' and 'the Persians were defeated by the Greeks at Plataea' Now I call the part of the content that is the same in both the *conceptual content*. *Only this* has significance for our symbolic language; we need therefore make no distinction between propositions that have the same conceptual content. (Frege, 1879/1952a, pp. 2-3)

Frege was able to reject the ideas of a subject and a predicate, which were so central to Aristotle's logical demonstrations, because of his view of the nature of the distinction between them, which is revealed in the following passage:

When people say 'the subject is the concept with which the judgment is concerned,' this applies equally well to the object. Thus all that can be said is: 'the subject is the concept with which the judgment is chiefly concerned.' In language the place occupied by the subject in the word-order has the significance of a *specially important* place; it is where we put what we want the hearer to attend to specially. This may, e.g., have the purpose of indicating a relation between this judgment and others, and thus making it easier for the hearer to grasp the whole sequence of thought. All such aspects of language are merely results of the reciprocal action of speaker and hearer; e.g., the speaker takes account of what the hearer expects, and tries to set him upon the right track before actually uttering the judgment. In my formalized language there is nothing that corresponds; only that part of judgments which affects the *possible inferences* is taken into consideration. Whatever is needed for a valid inference is fully expressed; what is not needed is for the most part not indicated either; *no scope is left for conjecture*. In this I follow absolutely the example of the formalized language of mathematics; here too, subject and predicate can be distinguished only by doing violence to the thought. (Frege, 1879/1952a, p. 3)

In his formalisation, Frege *did* break up a statement at the boundary of the subject and the predicate, but he conceived of the predicate as a *function*, and the subject as a *variable* which is the argument of the function, such that "Caesar conquered Gaul" can be represented as the function *Conquered-Gaul(a)* with the variable *a* replaced by the constant value *Caesar* (see Frege, 1891/1952b). In keeping with

the traditional resolution of a proposition into a subject and a predicate (and sometimes a copula as well) and the subject-dependence of a relation's nature (see section 3.2.3.1), he allowed the nature of the function to vary across arguments as subjects:

[Consider] the proposition 'Cato killed Cato' If we imagine 'Cato' as replaceable at its first occurrence, then 'killing Cato' is the function; if we imagine 'Cato' as replaceable at its second occurrence, then 'being killed by Cato' is the function; finally, if we imagine 'Cato' as replaceable at both occurrences, then 'killing oneself' is the function. (Frege, 1879/1952a, p. 13)

While this conceptualisation takes us far from any traditional view of predication, it at least makes the nature of the predicate function subject-dependent and keeps all parts of the predicate together (except when both arguments are imagined to be replaceable); Frege's introduction of many-place functions, and their widespread adoption in later symbolic logic, led to the dismantling of the predicate as a syntactic unit. Frege introduced many-place functions as follows:

Suppose that a symbol occurring in a function has so far been imagined as not replaceable; if we now imagine it as replaceable at some or all of the positions where it occurs, this way of looking at it gives us a function with a further argument besides the previous one. In this way we get functions of two or more arguments. E.g. 'the circumstance of hydrogen's being lighter than carbon dioxide' may be regarded as a function of the arguments 'hydrogen' and 'carbon dioxide.' (Frege, 1879/1952a, p. 14)

It is significant that Frege does not, in this case, describe the nature of the function; to do so, he would have to decide between 'being lighter than' and 'being heavier than,' the first being the relation of hydrogen to carbon dioxide, and the second being the relation of carbon dioxide to hydrogen. When neither argument is specified to be the subject (i.e., when both arguments are regarded in the same way, with neither being part of a predicate), the nature of the relation (or "function") is indeterminate. Frege recognised that something was lost in failing to distinguish the subject from the other argument, but he misidentified that which was lost so that he regarded the distinction as arbitrary:

The speaker usually intends the subject to be taken as the principal argument; the next in importance often appears as the object. Language has the liberty of arbitrarily presenting one or another part of the proposition as the principal argument by a choice between inflexions and words, e.g., between active and passive, 'heavier' and 'lighter,' [or] 'give' and 'receive'; but this liberty is restricted by lack of words (Frege, 1879/1952a, pp. 14-15)

As symbolic logic evolved, logicians came to talk, not just of many-place functions, but also of many-place *predicates*. A supposed example of a three-place predicate is "give," which has three argument places for a giver, a gift, and a recipient; this "predicate" can be symbolised as follows: *Give(a, b, c)*. It appears that David Hilbert (1862-1943) and his coauthors were among the first mathematicians to use the term predicate (*Prädikat*) for Fregean "functions" such as this one (see, for e.g., Hilbert & Bernays, 1934). Hilbert and Ackermann (1938/1950) explain the motivation for many-place "predicates"; having introduced a sentential calculus, and then a predicate calculus for one-place predicates, they introduce and attempt to justify a calculus with many-place predicates:

... The Aristotelian formalism [based on propositions, i.e., predicates combined with single subjects] turns out to be inadequate even in quite simple logical situations. It is basically insufficient for dealing with the logical foundations of mathematics. It fails, specifically, whenever a *relation among several objects* is to be represented symbolically.

This may be clarified by a simple example. Consider the statement: "If *B* lies between *A* and *C*, then *B* also lies between *C* and *A*." ... In the [one-place predicate calculus, the statement] may in fact be formulated thus: "If an ordered triple of points has the property that the second point lies between the first and third, then it also has the property that the second point lies between the third and first." This formulation, however, fails to express the logical essence of the statement, namely, the symmetry with respect to *A* and *C* of the relation "between." Therefore, it cannot be employed to derive the mathematical consequences of the statement under consideration.

... Since the foregoing calculus has turned out to be inadequate, we are forced to seek a new kind of logical symbolism. For this purpose we return to that point in our discussion at which we first went beyond the sentential calculus. The decisive step there was the division of sentences into subject and predicate. ... [We

now] separate in the rendering of a sentence the *objects* (*individuals*) from the *properties* (*predicates*) attributed to them and . . . symbolize both explicitly.

This is done by employing *functional symbols with argument places* (n -adic functional symbols where n is the number of argument places) for the symbolic rendering of predicates, in which symbols representing objects are to be substituted in the argument places. . . . If the relation of the smaller to the greater is expressed by the two-place functional symbol $<(,)$, then $<(2, 3)$ is the symbolic rendering of the sentence "2 is less than 3." Likewise, the sentence " B lies between A and C " may be rendered by $Z(A, B, C)$.

All mathematical formulas represent such relations among two or more quantities. For example, to the formula $x + y = z$ there corresponds a triadic predicate $S(x, y, z)$. The truth of $S(x, y, z)$ means that x, y , and z are connected by the relation $x + y = z$. (pp. 55-57)

In this formulation, a relation, and thus a relational predicate, is reconceptualised as a formula, or something akin to a formula, or something inclusive of formulae. Hilbert and Ackermann describe such "relations" as "predicates having several subjects" (p. 45), revealing their failure to recognise that the predicate will change with the subject (see section 3.2.3.1), and obliterating any distinction between a subject and an argument. In the quotation below, they reveal that functions in general are to be included in their new formulation of a "predicate":

Hitherto it has been customary in logic to call only functions with one argument place predicates, while functions with more than one place were called relations. Here we use the word "predicate" in a quite general sense. (Hilbert & Ackermann, p. 57, fn 1)

Clearly a function or a formula is distinct from a relation or a predicate. In a function or formula, which is just as often a tool for calculation that represents mathematical operations as it is a means of signifying being, no individual plays the role of subject. A many-place function or a formula may *entail* relations of pairs of individual numbers or sets to one another (with each such relation a potential predicate), but none of those relations is explicitly signified by the string of symbols giving the function or formula (i.e., the string is not a predicate in the traditional sense, one signifying a relation). In formalising logic, mathematicians such as Hilbert have tended to shift the goal of logic away from the acquisition of

knowledge about being and toward the provision of a means of determining and proving mathematical consequences. The modern formal "logics" (which are not based upon *logos* as a proposition) are therefore not useful in attempts to understand natural-language propositions or predication.

This modern logical notion of a predicate, which treats relational (e.g., actional) "predicates" as formulae involving multiple individuals, might be better applied in the domain of the lexicon than in the domain of propositions. The now-standard logical notion of a "predicate" obscures the distinction between a predicator, which has an argument structure, and a predicate, which is predicated of a subject; a predicate is reduced to a predicator. (Linguists now use the term "predicate" for a predicator as well; see, for e.g., van Riemsdijk & Williams, 1986.) In logical notation, we find one-, two-, or three-place "predicates," where all of the arguments of the predicate are on a par; from a semantic point of view, they all have the same status; all that distinguishes them is their place in an order, as in an example from Carnap (1954/1958), in which the sentence "*a* is jealous of *b* with respect to *c*" is translated into logical notation as follows: *Jealous(a, b, c)* (p. 5). To permit any sort of mapping from syntactic structure to semantic structure, the notation would need to be more along these lines: *Jealous-of-b-with-respect-to-c(a)*.

The fallout of the development of symbolic logic can be seen in Carnap's student Quine's writings on language:

Thus we may best picture predication in the neutral logical schematism '*Fa*', understood as representing not only '*a* is an *F*' (where '*F*' represents a substantive) but also '*a* is *F*' (where '*F*' represents an adjective) and '*a* *Fs*' (where '*F*' represents an intransitive verb). (Quine, 1960, p. 96)

Note that the copula or auxiliary verb "be" is absent from the logical notation, and so the statement is no longer explicitly about being; moreover, we are left with no means of revealing tense, aspect, or mood. Quine dispensed with the "is" of a statement as follows:

The copula 'is' or 'is an' can accordingly be explained simply as a prefix serving to convert a general term from adjectival or substantival form to verbal form for predicative position. 'Sings', 'is

singing', and 'is a singer' thus all emerge as verbs, and interchangeable ones apart from some subtleties of English idiom. (Quine, 1960, p. 97)

. . . subtleties of idiom that have the inexplicable power to keep separate the three parts of speech. Quine appears to have been influenced by Peano in his strange views on the copula (see Peano, 1930/1958a, 1912/1958b).

In mathematical logic, the class inclusion (or set inclusion) approach to predication continues to dominate, and the failure to distinguish grammatical predicates from predicators continues; also, the copula remains absent.

Some logicians understand the distinction between a subject and a predicate as the distinction between a particular term and a universal or general term, an idea that partially reflects the Aristotelian view of predication. Lyons (1968) describes this view:

. . . We must return to the Aristotelian doctrine of the 'categories' of predication It has been mentioned that the first category of *substance* was taken to be logically more fundamental than the remaining *accidental* properties: substances were persons or things of which the accidental properties (of quantity, quality, relation, action, place, state, etc.) could be predicated (or asserted) in logically well-formed propositions. According to this view, "John ran away," "He is in London," "My friend is tall," etc., are logically well-formed: "John," "he" and "my friend" denote substances (in these instances, persons); and "ran away," "is in London," and "is tall" make predications ('say something') about these substances — predications of action, place and quality, respectively.

Now, proper names, as well as pronouns and phrases which identify a definite person or thing (like "John," "he" and "my friend," in the examples [given above]) are to be regarded as the most 'substantial' — the most truly 'nominal' — of the expressions in a language (hence the traditional term 'substantive' for 'noun'). They are *particular* (or 'singular') terms, denoting some definite, *individual* substance. Other words and phrases, including indefinite 'common' nouns ("Man," "book," etc.) and 'abstract' nouns ("goodness," "beauty," etc.), as well as verbs, adjectives and adverbs, are *universal* (or 'general') terms: they do not of themselves denote individual substances (unless they are syntactically determined, in the descriptive specification of an individual, e.g., "the man over there"), but they denote either a class of individuals or qualities, states, actions, etc., which may be associated with individuals.

Some logicians distinguish two kinds of universal terms (and, for convenience of exposition, we will adopt this terminological distinction): (i) *sortal* universals, which serve to group individuals into classes (whether these classes are thought to be definable on the basis of some inherent properties of their members or not), and (ii) *characterizing* universals, which refer to qualities, states, actions, etc. Typical sortal universals are the 'common' nouns of traditional grammar; typical characterizing universals are 'abstract' nouns, verbs, adjectives and adverbs.

On the basis of these distinctions, we can formulate the following important principle of traditional logic: whereas universal terms are found in both subject and predicate position in well-formed propositions, particular terms are restricted to subject position. Stock examples of propositions constructed out of a particular and a universal term are "Socrates is a man" (sortal) and "Socrates is wise" (characterizing); and of a proposition composed of two universal terms, "Men are wise." (We will not go into the further traditional principle that, of two universal terms, it is the less specific term that is predicated of the more specific.) (pp. 337-338)

This position preserves some of the outcomes or consequences of Aristotle's view of predication, without explaining them. In prototypical instances of predication, why should the subject be a particular, and the predicate a characterising term? Because a particular permits the realisation of a property or relation, the sort of thing that phrases headed by characterising terms signify. Why cannot particular terms appear as predicates? Because a basic-level individual, or primary substance, has a form for which no other individual can be held responsible. Why should the less specific term be predicated of the more specific term, as in "Socrates is a man" (as opposed to "A man is Socrates") and "The cat is an animal" (as opposed to "The animal is a cat")? Because cats are responsible for the being of the form of an animal, for whenever a cat comes to be, so does the form of an animal, but animals in general cannot be held responsible for the being of the form of a cat, for it is not the case that whenever an animal comes to be, the form of a cat comes into being.

In modern linguistics, the standard view of predication is as follows: The subject is that which is talked about and the predicate is that which is said about it. Hockett describes the standard view in this way:

The most general characterization of predicative constructions is suggested by the terms "topic" and "comment" . . . : The speaker announces a topic and then says something about it. (Hockett, 1958, p. 201)

Lyons (1968) describes this view as the "traditional" one "from the time of Plato onward."⁵² This characterisation of predication is so vague as to be uninterpretable. What does it mean to "say something" about something? Does it only imply that words come out of one's mouth? And what does it mean for something said to be "about" that which is the topic of the utterance? Further, the distinction between a topic and a comment does not seem to apply to all propositions. As I pointed out in section 4.1, the subject noun phrase in the proposition "That idiot wrecked my car" seems to comment upon the character of the subject; the subject noun phrase does not serve merely to identify an individual about whom something is to be said.

An alternative view that is prevalent among linguists and psycholinguists is that the subject specifies given or old information, and the predicate specifies new information:

The topic-comment distinction is frequently glossed . . . in terms of contextual dispensability or predictability: the topic, or 'subject of discourse,' is described as that element which is *given* in the general situation or in some explicit question to which the speaker is replying; and the comment as that part of the utterance which adds something *new* (and thus communicates information to the hearer). (Lyons, 1968, p. 335)

This idea bears a vague resemblance to the belief held by Plato and Aristotle that a noun (*onoma*) by itself reveals nothing in extramental being to the mind; it just brings to mind (or unconceals) the thought (*to noein*) of something with which we

⁵²This view may indeed be similar to Plato's. Plato describes a proposition as the utterance of *ta onta*, 'existent things' or 'beings,' *peri*, 'about,' *tinou*, 'something,' by which he means the subject (*Sophist* 262c-263d). But he also makes clear that a proposition, as *logos*, unconceals being; for instance, in a discussion of a combination of a noun and a predicator as the prototype of a proposition, he says (at 262a), ". . . Epi tais praxessin on dêlōma rhēma pou legomen," or '. . . We might define a predicator (read predicate) as a means of revealing being with respect to the actions' (the translation is mine); he also says (at 262d), that a noun combined with a predicator in a proposition *dêloi*, 'reveals,' something about being.

are familiar (e.g., a kind; see Aristotle, *On Interpretation* 1, 16^a9-18, 3, 16^b19-22; *Metaphysics* Θ.10, 1051^b18-1052^a4); but the combination of a noun (read noun phrase) and a predicator (read predicate) in a true affirmative proposition reveals something new in the sense that it brings to mind some aspect of the subject's being, bringing something that *is* (or was, or is becoming, or will be) into the light (see Aristotle, *On Interpretation* 1, 16^a9-18, 4, 16^b28 - 5, 17^a12, and Plato, *Sophist* 262d). The predicate (headed by or equivalent to the predicator) signifies some property or relation that comes into being by virtue of the subject, coming to be, in dependency upon this particular, out of nonbeing, and out of the limitless, into being, and into the limited, that is, into the particular that is its substrate. The limitation or determination of a predicate by a noun phrase in a true affirmative proposition, which Plato and Aristotle called *logos* (from the verb *legō*, 'determine' or 'bring to a limit,' as well as 'utter [one or more propositions]') or, sometimes, *logos apophantikos*, 'a revelatory, or appearance-permitting, utterance (or determination),' unconceals being and adds to the listener's knowledge – or to the knowledge of both the speaker and the listener when *logos* takes the form of dialectic (from *dialegō* or *dialegomai*, 'speak [or determine] through [to the end],' or 'speak [or determine] apart, or by a split' because the dialectic, when in the form of a questioning, asks for a choice between two contradictory propositions; Aristotle, *Prior Analytics* A.1, 24^a24-25, 24^b10-11; see Plato, *Republic* 6, 510-511, 7, 532-533; see also Aristotle's *Topics*) or demonstration (*apodeixis*; see Aristotle's *Posterior Analytics*), including a syllogism (see Aristotle's *Prior Analytics*), both of which are properly forms of *sylogismos* (e.g., *Topics* A.1, 100^a25-30), or 'syllogism,' related to *sullegō* (but derived directly from *sylogizomai*), 'speak (or determine) together' or 'gather together,' because both dialectic and demonstration determine so as to reveal being through the use of conjoined propositions.

APPENDIX C

Detecting Word Boundaries

This appendix contains a review of the literature relevant to determining whether young children and others just learning a language can locate the boundaries of words so that they can extract from the speech stream those units for which they must make part-of-speech decisions.

Gleitman and Wanner (1982; see also Gleitman, Gleitman, Landau and Wanner, 1988) argue that children initially equate words with stressed syllables, that is, syllables characterised by greater duration and intensity, shifts in fundamental frequency, and clear vowel quality (e.g., Bolinger, 1958; Fry, 1955, 1958; Klatt, 1976; Morton & Jassem, 1965; Parmenter & Treveno, 1936; Rigault, 1964; Vanderslice & Ladefoged, 1972; Westin, Buddenhagen, & Obrecht, 1966). This strategy would allow children to identify all monosyllabic members of open classes. Where the root morpheme of a multisyllabic word is stressed, children could extract the root from a word string, if not the whole word. Identifying stressed syllables as words would work quite well, then, for languages such as English that place stress on the root of an open-class word in most instances. (Cutler & Carter, 1987, found that 90 percent of the open-class English words in a 190,000-word sample of natural speech had stress on the first syllable; this syllable corresponds to the root or part of the root.)

There is considerable evidence for the use of a stress-based strategy in demarcating word boundaries. Children initially isolate in the speech stream just those words, or parts of words, that receive stress (e.g., Wijnen, Krikhaar, & den Os, 1994). When imitating speech, they produce strongly stressed syllables more frequently than those that are weakly stressed (Blasdel & Jensen, 1970; Risley & Reynolds, 1970). The first words isolated and analysed are members of open classes, and these are the words that receive stress; unstressed words, such as conjunctions and determiners, are not isolated in children's early analyses of sentences (Brown, 1973; Holden & MacGinitie, 1972; Waterson, 1971). Evidence

from several languages indicates that any word-initial unstressed syllables are often dropped in children's imitations of adult utterances and in their spontaneous speech (for evidence from English, see Aitchison & Chiat, 1981; Allen & Hawkins, 1977, as cited in Hochberg, 1988; W. Miller & Ervin, 1964; Moskowitz, 1970; N. V. Smith, 1973; and Waterson, 1971; for Finnish, see Bowerman, 1973; for French, see Ingram, 1974; for Hebrew, see Berman, 1981, 1985; for Hungarian, see MacWhinney, 1985; for Mohawk, see Feurer, 1980; for Quiché, see Pye, 1983; for Romanian, see Vogel, 1975). Even in Quiché (a Mayan language), where morphemes do not always coincide with syllables in verbs, Pye found that children would adopt, as a word, just the stressed syllable in a verb (e.g., a final syllable consisting of the final consonant of the root morpheme and a vowel-consonant combination that terminates the word).

The importance of stress is underlined by the fact that words often lose, over the course of the history of a language, unstressed syllables or segments of unstressed syllables (Hochberg, 1988). In addition, evidence shows that adults stress syllables when speaking to children that they do not stress when speaking to adults, so that a short sentence may contain two instances of primary stress on a syllable; they also lengthen syllables in verbs and adjectives when speaking to children (Garnica, 1977), making them more salient. Experimental evidence shows that stress provides clues to word boundaries for adult listeners (Nakatani & Schaffer, 1978).

In a language like Spanish, where stress can fall on a syllable of an inflected form that is not part of the root, children might have more trouble identifying the root morpheme; they might have to rely on the distributions of word-final syllables (for instance) such as *-a*, *-o*, and *-e* to discover roots (i.e., familiarity with members of the small closed class of such syllables might cause a shift in their attention to the elements that vary more across utterances: the roots of words). But the most frequent words in Spanish, and those that dominate children's early vocabularies, are monosyllabic or else disyllabic with stress on the penultimate syllable, so that stress falls on the root of the word (Hochberg, 1988).

Where stress does not fall on the root, other factors may conspire in allowing the child to isolate a part of the word that contains the root. Syllables that are not separated by pauses may hang together perceptually and be retained (MacWhinney, 1985). Speakers attempting to speak clearly are careful to place pauses before words, especially if a word begins with an unstressed syllable; they also lengthen the syllable that comes before a word, especially if the word's first syllable is unstressed (Cutler & Butterfield, 1990); adults may do the same when speaking to children. Children tend to place a word boundary before a consonant, so that even an unstressed initial syllable may be included in the word if it begins with a consonant (at least in Mohawk; see Feurer, 1980). The last syllable of a word is often included with the stressed syllable (Viktor, 1917, as cited in MacWhinney), especially if the word is utterance-final (see Clancy, 1985, for evidence showing that utterance-final portions of inflected forms and particles in Japanese are included with words at an especially early age); some researchers attribute this phenomenon to an effect of recency, but it may be due to vowel lengthening of final syllables, which has been found in Swedish (Lindblom & Rapp, 1973, as cited in Klatt, 1975, 1976) and English (Barnwell, 1971, as cited in Klatt, 1975, 1976; Lehiste, 1972; Oller, 1973). Lengthening is one component of stress (see M. R. Smith, Cutler, Butterfield, & Nimmo-Smith, 1989, for evidence suggesting that relative duration can signal word boundaries). Finally, caretakers may facilitate children's identification of word boundaries by virtue of the way they speak to children. Parents speaking to their young children tend to place critical words at the beginning or end of an utterance; they sometimes do so even if the result is ungrammatical (Aslin, 1993). If a word is placed at the end of a sentence, its final syllable will be lengthened, and that syllable will be more likely to be recognised as part of the word. The parental tendency to place key words at the beginning or end of an utterance facilitates children's identification of word boundaries in and of itself; the pause between sentences (which may be very long) signals one boundary of a sentence-initial or sentence-final word.

Children may also be capable of using the phonotactic features of word boundaries in their native language to locate word boundaries, that is, the orderings of phonetic elements that can occur at the beginning or end of a word. Friederici and Wessels (1993) have shown that infants (aged 0;9) can distinguish orderings of consonant sounds at the boundaries of isolated words that are legal in their native language from those that are illegal (e.g., in English, *str-* is legal at the beginning of a word, as in "street," but illegal at the end of a word; infants aged 0;9 oriented longer to a speaker that played nonwords containing legal, versus illegal, orderings of consonant sounds at the word boundaries; this difference was not found among infants aged 0;6). At age 0;9, infants show a preference also for monosyllabic nonwords with legal (versus illegal) orderings at their boundaries when the nonwords are part of a string of nonwords – but only if they are bracketed on either side by identical nonwords (as in "mig bref mig") and spoken in motherese. Around the age of 0;11, infants may have the general ability to detect word boundaries in strings (Kemler Nelson, 1989, as cited in Friederici & Wessels; Werker & Pegg, 1992), and, according to Friederici and Wessels, such detection may be facilitated by knowledge of legal orderings of phonetic elements at word boundaries.

Phonetic clues to word boundaries are available, and a possibility exists that children can use these clues in extracting words from the speech stream. Among the allophones of a single phoneme, those that are word-initial can differ from those in other positions within a word in features such as duration, aspiration, and voicing (Lehiste, 1960), so that allophones might serve as word-boundary clues. Nakatani and Dukes (1977) found that high-school students made use of the following clues to word boundaries, most of which are present at the beginning of a word: bursts, aspiration, glottal stops, laryngealisation, and distinct allophones of /l/ and /r/ in syllable-initial and syllable-final position. It remains to be seen if such clues are specific to English, and if young children are able to use them in detecting word boundaries.

In addition to these factors, children may use the rhythm of a language to locate word boundaries. The basis of rhythm is language specific: In English, rhythm is based on stress; in French, it is based on the syllable; in Japanese, rhythm is based on a unit known as a *mora* (which is defined, according to Mann, 1986, as "an isolated vowel, a vowel preceded by a consonant, an isolated /n/, or the first consonant in a geminate cluster"; p. 71). (Bolinger, 1978, argues that English contains no "stress rhythm"; he asks us to consider the string [where stress is marked with acute accents], "the quíte unnécessary incomprehensibility of his wórds." The sentences children hear, though – that is, short sentences consisting mainly of monosyllabic words – probably have more rhythm.) Whatever the basis of rhythm in a language, native speakers of a language appear able to use rhythm to segment a speech stream into units (words, syllables, or morae), or at least the units they are able to extract from the speech stream are those upon which the rhythm of their language is based (e.g., for evidence for English, see Cutler & Butterfield; Cutler & Norris, 1988; Nakatani & Schaffer, 1978; for French, see Mehler, Dommergues, Frauenfelder, & Segui, 1981; Segui, Frauenfelder, & Mehler, 1981; for Japanese, see Otake, Hatano, Cutler, & Mehler, 1993); moreover, they are unable to segment a speech stream into units upon which the rhythm of their language is not based (e.g., English speakers cannot perform well on tasks requiring syllabic segmentation of English or French, and English and French speakers cannot segment Japanese into morae; Cutler, Mehler, Norris, & Segui, 1986; Otake et al.). Infants appear able to learn the rhythm of their caretakers' language in their prelinguistic phase of life (Cutler & Butterfield, 1992). (Cutler, 1994, compares this learning of rhythm to parameter setting because bilingual adults can use language-specific rhythm to segment speech only for their most dominant language, even when they are fluently bilingual.) While little direct evidence exists for young children's ability to segment speech on the basis of rhythm, considerable evidence exists for children's responsiveness to rhythm. Condon and Sander (1974) found that newborn infants move in synchrony with the rhythm of speech, regardless of the language (but not with the rhythm of

other kinds of sound). Very young infants can distinguish stress contrasts, which are important to the rhythm of languages like English that have stress-based rhythms (Jusczyk & Thompson, 1978; Karzon, 1985; Spring & Dale, 1977), and newborns can distinguish groups of syllables that differ in the number of syllables (Bijeljac-Babic, Bertoncini, & Mehler, 1993), suggesting that they could learn a syllable-based rhythm. The babbling of infants gradually shifts in the direction of their caretakers' language in terms of its prosodic structure (Whalen, Levitt, & Wang, 1991) and its rhythmic structure (Levitt & Utman, 1992; Levitt & Wang, 1991). Jusczyk, Cutler, and Redanz (1993) found that by age 0;9, infants showed a preference for listening to speech that instantiated the rhythmic structure of their caretakers' language; the preference remained when the speech was low-pass filtered, removing segmental information but leaving its prosodic and rhythmic structure intact. Indirect evidence for the use of rhythmic structure in segmenting speech is available for young children (aged 2;0 to 7;0). Wijnen et al. (1994) found that two children learning Dutch tended to retain the parts of words that followed a rhythmic pattern of strong-weak stress, a pattern fairly characteristic of Dutch words. Likewise, English-speaking children may make use of stress rhythm to segment speech, for they extract and imitate portions of speech that together follow a stress pattern of alternating strongly and weakly stressed syllables, in keeping with the rhythmic structure of the language (Gerken, 1991; Gerken et al., 1990); they do so even if it means producing indistinct versions of unstressed syllables that the children have not fully analysed (Peters, 1985). Children learning languages with syllabic rhythm segment utterances into syllables (i.e., they have difficulty breaking a syllable down into phones or phonemes; Alegria, Pignot, & Morais, 1982; Content, Kolinsky, Morais, & Bertelson, 1986). Japanese children segment utterances into morae (such that they have difficulty breaking a mora into phonemes; Mann, 1986). Cutler argues that the earliest segmentation of speech into words draws upon knowledge of rhythmic structure learned in the prelinguistic stage of life. Wherever that structure is stress-based, segmentation will typically yield words (at least in English, where about three quarters of the

tokens of strongly stressed syllables are the initial syllable or only syllable of an open-class word, and about two thirds of the tokens of weakly stressed syllables are the initial or only syllable of a closed-class word; see Cutler & Carter, 1987). For languages with other types of rhythm, children may initially divide the speech stream into units smaller than words (e.g., syllables or morae).

If children, in given instances, fail to correctly identify the boundaries of a word, they are nonetheless able to extract some part of the word, use that as a word, and attribute to it a meaning (e.g., one boy learning Mohawk used a suffix as a predicator meaning 'see'; see Feurer, 1980). If their caretakers can guess their intended meaning when the children use the word, they will probably correct the children, and eventually the children will replace one lexical entry with another (the correct one); presumably, at that point, the part-of-speech membership of the anomalous word will be inherited by the conventional word. It is also possible that children's productions of parts of words do not reflect the lexical items they have stored: children may store a word in its entirety, but produce just one syllable of it due to production constraints. Pye (1983) found that children learning Quiché Mayan sometimes produced one syllable of a verb in some utterances, and a different syllable of the same verb in other utterances. The choice of the verb syllable appeared to depend on the position of the "word" in a sentence. In clause-final position, the termination of a verb is stressed, and children using a verb in that position tended to produce just the final syllable of the verb (i.e., the final consonant of the root morpheme plus a vowel-consonant ending). A verb appearing in clause-medial position receives stress on the root morpheme, and children using a verb in that position tended to produce a part of the word that included the root morpheme. So the children appeared to have adopted the strategy of producing the part of the word that would be stressed in an adult production, where the stressed part was determined by the position of the word in the utterance. This pattern of production implies that the whole word was stored, but that only pieces of it were uttered. Other researchers have found that parts (e.g., consonants) of unstressed syllables are often added to or substituted for

segments of the syllable that is uttered (which corresponds to the stressed syllable in adult production; Allen & Hawkins, 1980; Fikkert, 1991, as cited in Wijnen et al., 1994); this observation suggests that unstressed portions of a word that are not uttered, in their entirety, as part of a word are nonetheless stored as part of the word's mental representation. So children may succeed in correctly identifying the boundaries of a word and storing the complete word, but are only able to produce one syllable at a time. In general, they appear to do very well in extracting words from the speech stream.

APPENDIX D

Instructions Used in Experiment 3

In this experiment, you will be taught some words. It will be your task to guess the meaning of each word, and to guess its grammatical category. By grammatical category, I mean a category such as "noun" that allows you to construct grammatically correct sentences because the rules of grammar are formulated in terms of these categories of words.

My real interest is in how very young children (about two years of age) learn words. Unfortunately, the tasks involved in this experiment are far too complex for a young child. So I am running the experiment with adults, but the learning situation is set up to mimic the situation in which a young child learns.

The experiment mimics the child's situation in a number of ways.

Young children do not know the meaning of every word they hear, but they often know the meaning of a few words in a sentence. To mimic this situation, you will be presented with strings of words that sometimes contain English words you know; but they will always contain one word that is unfamiliar (and in fact I made it up, but pretend that it is real!). Just as the young child must guess the meaning of a new word, you will have to guess the meaning of the unfamiliar word. (The unfamiliar word may or may not correspond in meaning to a real English word.)

Young children also have a very limited knowledge of the grammatical rules of the language that they are learning. Because of this, they cannot always use information about the structure of an utterance (e.g., the order of the words, endings added to words, etc.) to determine the grammatical category of a word. An adult knows that in the utterance "HIS GORP" the word "gorp" must be a noun, but a young child might not yet know that the word "his" appears only before nouns, so its presence might not help him or her. To mimic this situation, the string of words in which an unfamiliar word appears may or may not be a grammatical English utterance. So sometimes grammatical clues to the category of a word are present, and sometimes they are not.

Children have less exposure to the world than adults, and they often encounter a situation in which they don't know a word to describe some aspect of the situation. To mimic this limited knowledge of the world, you will sometimes be shown videos that involve the unfamiliar. You may or may not know a word for what you see.

Children learn language by listening to people talk about whatever is going on around them. They are never taught the grammar of a language explicitly, but they pick it up easily. Nor are they taught the meanings of words. They just somehow guess their meanings correctly. You will be asked to do the same, and, like the young child, you will learn words just by relating word strings to situations in the world (which will be shown on video). The intuitions that guide children in language learning are available to adults too, although we rarely need to draw upon them. I ask you to tap into these intuitions, and trust them completely. You do not need to know any grammar as it is taught at school to perform the tasks, and in fact any attempt to use what you have been taught in school will interfere with your performance. Just listen to those intuitions. Follow your instincts, your "gut" feelings. Don't try to be clever, or try to outguess the experimenter! Your intuitions and instincts are your best guide to successful performance.

On each experimental trial, you will be asked to read an unfamiliar word in the context of a word string, which appears on a piece of paper. You will then watch a brief video. The word string is supposed to be a comment on what is in the video (in our imaginary experimental world). From reading the word string and watching the video, you should be able to guess the meaning of the unfamiliar word, and you should have some idea of its grammatical category.

To indicate what you think the word means, you will be asked to choose among the following options:

- 1) a specific individual (as a name)?
- 2) a type of animate bounded object?
- 3) a type of inanimate bounded object?
- 4) a type of stuff or substance?

5) a type of activity, action, process, or change of state?

6) a type of property, quality, attribute, or state?

7) other (please specify) _____

In numbers (2) and (3) "animate" means living and "inanimate" means not living; the words "bounded object" refer to any physical object that has fixed boundaries, such as a cup. If a cup is broken into pieces or cut in two, the pieces cannot be called cups, and the collection of pieces is no longer a cup; only the combination of all the pieces, fitted together appropriately, constitute a cup. Also, if two cups are glued together (say bottom to bottom), the result is not a cup. Two small cups together do not form one larger cup. This shows that cups have boundaries that cannot be arbitrarily changed without the objects ceasing to be cups. Contrast cups with clay. A lump of clay can be divided into any number of lumps, and each lump is equally a lump of clay. And two lumps of clay can be put together to form one larger lump of clay. So a lump of clay is not a "bounded object," but a cup is a bounded object. A puddle is not a bounded object because its boundaries can change as rain increases its size or the water in it evaporates, and yet it still remains a puddle. Examples of bounded objects are chairs, people, apples, televisions, and books. If the idea of a bounded object is not clear, please ask the experimenter about it.

Next, you will be asked to guess the grammatical category of the word. To do so, you do not need to know the names of grammatical categories, or remember anything you learned in school. In fact I would rather that you **forget** everything you were taught in school! You just need to follow your intuitions as you perform two tasks. In the first task, you will be asked to match the word to one of two lists, basing your decision on your intuitions about the word's grammatical category. If one list contains any number of words that seem to belong to the same category as the new word, then match the word to that list. When you have made one choice, you will be asked to choose among two more

lists, and so on. After you make a choice, you should indicate how confident you feel about your decision by checking one of five boxes, where the box on the far left means that you are just guessing at random, and the box on the far right means that you are sure that you have matched the word to the correct list. The other boxes are reserved for intermediate levels of confidence about your choice.

The final task involves making judgments about various contexts for the word. You will be presented with the following word contexts:

I am thinking of another _____.

There is too much _____.

Ask _____ to do it.

She/it was _____-ing it/her.

He/it was _____-ing.

He/it remains _____.

He/it is really _____.

Let's talk about the _____ one.

Your task is to mentally fill in the blank with the word you have just learned, which appears at the top of the page, and decide if the word sounds okay in that context. The meaning is not the critical thing. You are to concentrate on whether the sentence sounds grammatically correct. For example, in the sentence, "Colourless green ideas sleep furiously," the words in combination don't mean anything (except perhaps on a poetic level), but you probably have an intuition that the grammatical structure of the sentence is okay. In contrast, the sentence "Run a dog black the to store" may evoke a vision of a black dog running to the store (i.e., you may be able to assign a meaning to it), but the sentence clearly does not follow the rules of grammar. You do not need to know the rules of grammar explicitly and consciously to make this judgment. Your intuitions tell you clearly whether a sentence is grammatical. So trust those intuitions. When you decide if a word sounds okay or not in a particular context, you will be asked to check one of five boxes, where the box on the left indicates that the context is clearly not appropriate for the word (because the sentence does not seem

grammatical at all), the box on the right indicates that the context is clearly appropriate (because the sentence seems perfectly okay), and the other three boxes are reserved for intermediate levels of appropriateness (e.g., fairly inappropriate but not completely, neutral, and fairly appropriate but not completely).

To begin, you will be presented with eight common English words, and you can practice the tasks on these words. Turn to the next page to begin these practice trials. Feel free to refer back to these instructions during the practice trials or to ask questions of the experimenter, but please try to restrict your questions during the actual experiment later on.

APPENDIX E

Word Lists Used for the List-Matching Task in Experiment 3

(The part-of-speech labels were not present in the versions of the lists that were given to subjects. Lists that are side by side were used for one matching decision.)

Nouns	Predicators
table	hit
sand	think
Mary	main
idea	afraid
justice	happy
Peter	consider
vehicle	dance
jewellery	rightful
Proper Nouns	Common Nouns
Kathy	somersault
John	macrame
Peter	box
Mary	water
Rhonda	ball
Edward	sand
Fido	backbend
Mickey	tennis
Count Nouns	Mass Nouns
somersault	macrame
table	carpeting
animal	furniture
ball	sand
backbend	tennis
box	water
idea	justice
vehicle	jewellery

Verbs

run
clean
breathe
destroy
cry
hold
wait
consider

Adjectives

fuzzy
former
asleep
cool
sole
ashamed
difficult
main

Intransitive Verbs

run
dance
breathe
think
sit
sleep
cry
wait

Transitive Verbs

clean
hit
destroy
like
feel
hold
rub
consider

Adjectives

fuzzy
purple
smooth
cool
gentle
thoughtful
happy
difficult

Attributive Adjectives

former
main
total
sole
prime
rightful
avid
outright

Predicative Adjectives

ready
asleep
afraid
aglow
copacetic
akin
alive
ashamed

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STATEMENT REGARDING ORIGINALITY

All elements of this dissertation are original, namely the critical review of theories of part-of-speech identification, the new theory presented, the literature reviews regarding assumptions and proposals of the theory, and the three experiments reported. The analysis of historical change in the concept of a relation that appears in Appendix A and the analysis of Aristotle's theory of predication and the history of predication that appear in Appendix B are also original.