ON MARKERESE

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1. *Introduction*.

Jerry Katz held that the sense properties of natural-language expressions – properties such as analyticity, redundancy, synonymy and antonymy – are grammatical properties of those expressions, on a par with their syntactic and phonological properties. As such, these properties constitute part of the domain of formal linguistics: for Katz, semantics is as much a branch of linguistic theory as syntax and phonology, and is subject to the same standards of explanatory adequacy.[1] A linguistic theory must account for the pretheoretic facts of natural-language expressions. It must make clear – if need be in terms of postulated underlying structures – *why* those expressions have the properties they do. Accordingly, the formalism of a linguistic theory must be adequate for the representation of the explanatory structures the theory postulates, and its formal representations must constitute a domain over which explanations can be formulated.

Katz's preferred formalism for the semantic component of a grammar is a system of "semantic markers" arranged in tree structures called "readings."[2] These readings are meant to represent the senses of expressions, and to provide the domain over which explanations of the sense properties and relations of expressions are formulated. Katz was always careful to

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[1] Linguistic theories of meaning are distinct from *philosophical* theories of meaning, which are concerned with such issues as the nature of meaning(s) and the form of a theory of meaning.

[2] A version of the tree notation was used in Katz's earliest publications (e.g., Katz 1963, Fodor and Katz 1963, Katz and Postal 1964). The version discussed here, which is different, is first used in Katz 1977. Katz 1972 employs a different but equivalent parenthetical notation.

distinguish sense and reference writings, and in his later writings dissociates them entirely. On his non-Fregean intensionalism (see, e.g., Katz 1988; In Press), sense does not determine the reference of expressions, but, rather, their pretheoretic sense properties and relations. The purpose of the notational system of semantic markers is the representation of sense, and sense only.[3]

In this paper I undertake review, critique, revision and application of Katz's formal semantics of sense. First, I present the basic principles and apparatus of Katz's formalism, making adjustments and additions along the way. Next, I present what I take to be some significant problems for the theory as presented by Katz, and suggest solutions. Finally, I show how the problem of complex indefinables (determinates under a determinable), including perceptual terms and natural kind terms, and the Leibniz-Aristotle disagreement over the nature of species definitions, have natural and effective solutions within Katz's formalism. I do not here defend Katz's thesis that the facts explained by formal semantic theories are, like syntactic and phonological facts, discovered through competent speakers' intuitions. Nor do I defend his platonistic view of natural languages or his non-Fregean intensionalism. These views are simply assumed here. My purpose is only to show that the formalism Katz introduced for the representation of sense is (with appropriate emendation and extension) a viable – indeed, quite useful – tool, which ought to be taken seriously by both linguists and philosophers of language.

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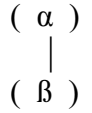
[3] The criticism – first made by Vermazen 1967 and reiterated from Lewis 1972 to Ludlow 1999 – that translation into Markerese is not interpretation because semantic markers have to be interpreted, is thus not to the point. Representation in Markerese is no more supposed to *be* interpretation than representation in first-order logic. Representations in any formal system require interpretation; the point of assigning them is to make the structure of what is represented (the interpretation) explicit. Moreover, given the autonomy of sense from reference, Lewis's (1972: 190) complaint that "Semantics with no treatment of truth conditions is not semantics" is merely a statement of preference.

2. *Markerese*.

2.1. *Basic Structures*.

A *semantic marker* is a simple representation of a sense and is formed by placing in parentheses a natural-language term that expresses the sense (such terms are used for mnemonic convenience only; senses themselves are taken to be the mind- and language-independent abstract objects expressed by them). Markers are used to represent both simple and complex senses. A marker representing a simple sense is *primitive*, and a marker representing a complex sense is *defined*.[4]

A *reading* is an arrangement of semantic markers involving two basic kinds of structural configuration. The configuration in (1)

(1)


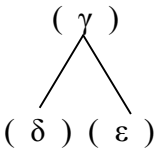
combines the markers '(α)' and '(ß)', by the operation Katz calls "appending" (Katz 1987: 216), and represents a complex sense containing the senses *α* and *ß*, with *α dominating ß*. The domination relation (indicated by placing '(α)' over '(β)' and joining them with a vertical line) represents the sense *α* as qualified by sense *ß* (what Katz calls the application of a "predicate function," in which a sense is converted into a more specified one (Katz 1977: 64). Thus, (1) represents the sense *α that is ß* (or, *βα*) (for example, taking *α* to be 'parent' and *ß* to be 'female', (1) represents the sense *female parent*).

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[4] The distinction is purely practical. It makes clear and manageable the illustration of the constructive and combinatorial principles of Markerese and the formal explication of pretheoretic semantic properties and relations. For Katz, a *complete* theory of sense will identify a finite stock of simple (unstructured) senses and a finite number of operations for the construction and combination of complex senses, and provide a representational scheme in terms of which sense properties and relations of expressions of natural language may be explained. In a complete semantic representation, all markers are primitive (stand for simple senses).

The configuration in (2),

(2)



formed by appending the markers '(δ)' and '(ε)' to the marker '(γ)', represents a complex sense containing the senses *γ*, *δ* and *ε*, with *δ* and *ε* both dominated by *γ*, but coordinate with each other. (There is, theoretically, no limit to the number of senses that may be coordinate with each other under a sense.) The coordination relation represents the senses *δ* and *ε* as qualifying the sense *γ* but not each other. Thus, (2) represents the sense *γ that is δ and ε* (or, *δ[and]εγ*) (for example, taking *γ*, *δ* and *ε* to be, respectively, 'woman', 'withered' and 'old', (2) represents the sense *withered old woman*).

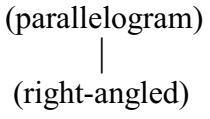
2.2. *Superordination*.

The hierarchical structure of these semantic representations enables the theory to capture different ways in which one sense may be contained in another.[5] The sense of 'parallelogram', for example, is contained in the sense of 'rectangle' in a different way than the sense of 'four-sided'. Intuitively, a rectangle is a *kind of* parallelogram (viz., one all of whose angles measure 90°), so a figure cannot be a rectangle without being a parallelogram, though the converse is not the case: a figure may be a parallelogram without being a rectangle. The theory captures this intuitive *superordination* relation in the following way. The sense of 'rectangle' is represented

[5] A sense σ_1 is *contained in* a sense σ_2 iff σ_1 is a *part of* σ_2. For example, the sense of 'female' is contained in the sense of 'female parent', and (in the same way) the sense of 'parent' is contained in the sense of 'mother'. The sense σ_1 is represented as contained in σ_2 iff the reading for σ_2 is a proper part of the reading for σ_1 (with qualifications I won't go into here).

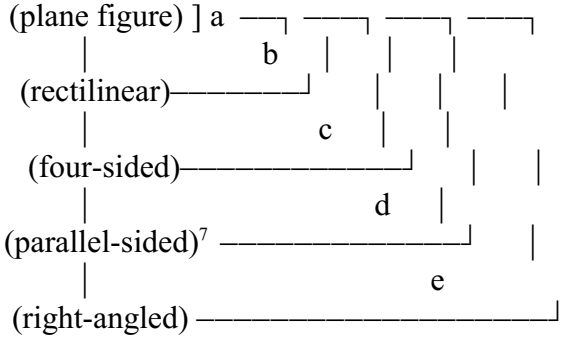
by the defined reading[6] (3):

(3)



where the marker '(parallelogram)' is the highest "node." Generally, a sense σ_1 is represented (by a reading) as superordinate to a sense σ_2 iff the representation of σ_1 is a "same-rooted subtree" (Katz 1988: 82) of the representation of σ_2: a reading R_1 is a same-rooted subtree of a reading R_2 iff R_1 is identical to a proper part of R_2 and the highest node of R_1 is identical to the highest node of R_2. The (defined) reading '(parallelogram)' is a same-rooted subtree of (3). Further decomposition of *parallelogram* reveals more superordinate structure:

(4)



(4) represents the senses *plane figure* (a), *polygon* (b), *quadrilateral* (c), and *parallelogram* (d) as superordinates of the sense *rectangle* (e). Each of a-d is a same-rooted subtree of the reading of 'rectangle'. Moreover, all of the superordinate relations among the senses "intermediate" between the senses of 'rectangle' and 'plane figure' are captured as well (e.g., *polygon* is a superordinate of *quadrilateral*, *quadrilateral* is a superordinate of *parallelogram*, etc.): a polygon is a kind of plane figure (a rectilinear one); a quadrilateral is a kind of polygon (one with

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[6] Extending Katz's primitive/defined distinction for markers, I will sometimes refer to a *reading* as defined, if it contains defined markers.

[7] I am using '(parallel-sided)' as an abbreviated representation of the complex sense *having opposite sides parallel*.

four sides); and a parallelogram is a kind of quadrilateral (one whose opposite sides are parallel).

Note that the sense *four-sided* is contained in the sense of 'rectangle', not as a superordinate, but as a qualifier with certain domination relations to other qualifiers. Though a rectangle is a kind of four-sided *figure*, and hence *four-sided figure* (the sense of 'quadrilateral') is a superordinate of *rectangle*, *four-sided* itself is not a superordinate of *rectangle*. The domination of '(parallel-sided)' and '(right-angled)' by '(four-sided)' should not be confused with superordination: domination in general is distinct from superordination. In (3), for example, '(parallelogram)' dominates '(right-angled)', but *parallelogram* is not thereby represented as superordinate to *right-angled*. Rather, *parallelogram* is thereby represented as superordinate to *rectangle*, a sense formed through a particular qualification of it. Generally, superordination relations hold within grammatical categories; that is, a sense that is superordinate to the sense of a noun must itself be the sense of a noun, a sense that is superordinate to the sense of an adjective must be the sense of an adjective, etc.[8] Domination relations, in contrast, hold between individual markers, which may represent senses of expressions of distinct grammatical categories. Thus, in (4) '(four-sided)' dominates '(opposite sides parallel)', but *four-sided* is not a superordinate of *rectangle* (though *quadrilateral* is). Thus, though the senses *parallelogram* and *four-sided* are both contained in the sense of 'rectangle', they are contained in different ways. A formalism that employed only logical notation could not make this distinction.[9]

Another example of these distinct kinds of containment will bring out other important

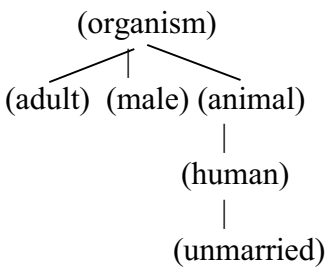
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[8] See below, section 5.4.2**, for further discussion.

[9] A predicate calculus representation of the sense of 'rectangle', for example, would (on the present analysis) be 'plane figure (x) & rectilinear (x) & four-sided (x) & parallel-sided (x) & right angled (x)'. This representation obliterates the distinction between superordination and other kinds of containment.

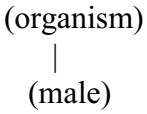
features of the representation of sense structure in Katz's theory. Consider the following as a reading of 'bachelor':

(5)



This reading represents the senses of both the adjective and the noun 'male'. The former is represented by the marker '(male)', which is dominated by the marker '(organism)'. The latter is represented by the reading

(6)



Thus, the adjectival sense *male* is represented as contained, not as a superordinate, but as a co-qualifier (or coordinate); it is not a same-rooted subtree of (6) but a coordinate of '(adult)', '(male)' and '(animal)' under the marker '(organism)'. The nominal sense *male*, on the other hand, is represented as a superordinate: the reading (6) is a same-rooted subtree of (5). Thus, bachelors are represented by (6) as kinds (though certainly not *natural* kinds) of males.

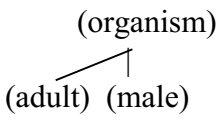
It is important to bear the distinction between adjectival and nominal senses, and their representation, in mind, since the use of defined markers and readings can easily lead to confusion as to exactly which senses are and are not contained in which. The marker '(male)', for example, may be a representation either of nominal or adjectival 'male'[10], so that the mere presence of it in a *defined* reading does not indicate which sense is represented as contained in the sense the reading represents.

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[10] Recall that, as noted above, this sort of ambiguity does not accrue to *primitive* markers.

(5) also represents the (nominal) senses *adult*, *animal* and *human* as superordinates of *bachelor*. These co-superordinates are, furthermore, represented as contained in a way distinct from that in which *plane figure*, *polygon*, *quadrilateral*, etc. are contained in *rectangle*. The superordinates of *rectangle* are 'nested' – there is a superordination hierarchy among them. This is also true of the senses *organism*, *animal* and *human* in *bachelor* (*organism* is a superordinate of *animal*, which is a superordinate of *human*), but not of the contained (nominal) senses *male* and *adult*. Thus, a sense may have more than one superordinate, and those superordinates themselves may be related either as superordinates or as coordinates.

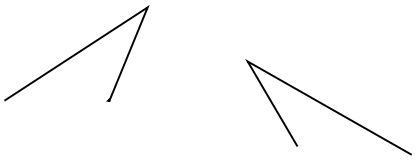
Next, consider the following part of (5):

(5') 

(5') represents of the sense of the synonymous expressions 'adult male' and 'male adult', where in the former 'adult' is an adjective and 'male' is a noun, and in the latter 'male' is an adjective and 'adult' is a noun. Adjectival *male* and *adult* are represented by the markers '(male)' and '(adult)', and nominal *male* and *adult* are represented (respectively) by those markers *dominated by '(organism)'*. Hence, the senses *adult male* and *male adult* are represented as *co-superordinates* of the nominal sense represented by (5'). If we coin a (species-netural) term to express this sense ('mon', for example), we can define it either as 'adult male' or 'male adult'. In contrast, the nouns 'adult' and 'male' are *not* indifferently definable as (respectively, in English) 'adult organism' or 'organism adult' and 'male organism' or 'organism male', since the latter definitions imply that *organism* is a sense qualifying *adult* and *male*. Since, however, the senses *adult* and *male* have *organism* as a selection restriction (see the next two sections),

organism must be a superordinate of any sense qualified by either *adult* or *male*.[11]

Finally, approaching the semantics of 'adult male' and 'male adult' from a compositional point of view will illustrate the combinatorial process Katz calls "merging." The reading for (adjectival)



2.3. *Selection Restrictions*.

The reading for 'bachelor' proposed above differs significantly from that proposed by Smith and Katz (in preparation, ms., chapter 2, p. 18), viz., (7)

(7) (object)

|

(physical)

[11] Note also that 'organismic adult' and 'organismic male' are both redundant (since the senses of nominal 'male' and 'adult' are, respectively, *male organism* and *adult organism*), and, hence, cannot be synonymous with 'adult organism' and 'male organism'.

(human) (adult) (male) (unmarried)[12]

A consideration of the differences will serve to introduce another important feature of Katz's formalism. The justifications for the reading I suggest for 'bachelor' are as follows. Intuitively, adjectival 'adult', the sense of which is (something like) *having attained a state of developmental maturity*, is a predicate that is applicable only to organisms (living systems which undergo processes of growth: adults are *mature* organisms).[13] In Katz's formalism, such limitations, called "selection restrictions," are encoded in readings as markers enclosed in angle brackets. These sorts of secondary marker provide conditions on combination with other readings: a term cannot be combined with another to produce a meaningful compound unless the sense represented by the marker in its selection restriction is contained (in the appropriate way) in the sense of the expression it is to be combined with. The selection restriction determines how the readings may combine. Violation of selection restrictions results in semantic anomaly – i.e.,

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[12] This is actually a defined version of what Smith and Katz offer. They represent *unmarried* as

(i) ((matrimonial status)$^{(\text{not united})}$))

and *male* as

(ii) ((sexual organs)$^{(\text{begetting})}$)

in order to illustrate the (superscript) notation that captures antonymy relations (e.g., male/female, married/unmarried, animal/vegetable/mineral). (Note, however, that (ii) is not quite right as a representation of *male*, since the sense of the *possession* of such organs is not represented.)

[13] Thus we have the anomaly (senselessness) on this sense of 'adult' of 'adult dump truck' and 'adult electron'. In compounds such as 'adult bookstore' and 'adult problems', which are not anomalous, 'adult' means something like, respectively, *for adults* and *of adults*, not *having attained a state of developmental maturity*.

absence of a reading (absence of sense). In the case of the adjectives 'male' and 'adult', the selection restriction '<(organism)>' (cf. the anomaly of 'male planet') restricts the appending of '(male)' and '(adult)' to the marker '(organism)' (or, since I take it that *organism* is not primitive, a more complex representation of the sense). Since 'human' (in the sense relevant here) is only applicable to animals (cf. the anomaly (on a literal reading) of 'human toaster'), the selection restrictions in its reading necessitate its being appended to the marker '(animal)' in (7). Finally, since only humans can have marital status, '(unmarried)' must be appended to '(human)'. On Smith and Katz's reading, in contrast, *adult*, *unmarried*, *human* and *male* are all represented as qualifying *physical object* – which, if what I have just said is correct, runs afoul of the facts about selection restrictions.[14]

2.4. *Derived and underived readings*.

A Markerese reading may be a representation of the sense of a syntactically simple or syntactically complex expression. The principles for the construction of readings for syntactic simples with complex senses ("underived" readings) are the same as the principles for the construction of readings for syntactically complex expressions ("derived readings"). Thus, the markers in (5), which was constructed on the basis of intuitions having to do with the sense of 'bachelor', also figure in the derivation of the reading (identical to (5)) of the synonymous expression 'adult unmarried male human animal organism'.[15] In simple adjectival modification,

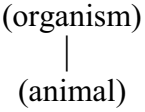
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[14] Though, of course, if *physical object* is a superordinate of *organism*, 'adult', 'unmarried', 'human' and 'male' will only be applicable to things that are physical objects. I would argue, however, that '(physical object)' is only a selection restriction on 'adult', etc. because '(human)' is.

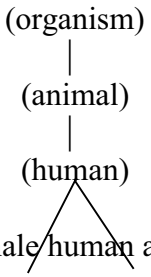
[15] English expressions corresponding to deep decompositions of complex senses usually have a fairly stilted ring – 'not maritally united developmentally mature rational animal organism with organs for begetting offspring' (a possible further decomposition of 'bachelor'), for example. Such analyses are sometimes held up in ridicule of decompositional semantics. But I

the reading for an adjective is appended to the marker (or reading) in the reading of the expression it modifies corresponding to its selection restriction; and that marker will represent a superordinate of the resultant sense.

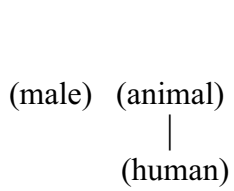
The reading for 'animal organism', for example, is constructed out of the markers '(animal)' and '(organism)', by appending the former to the latter, as in (8):

(8)


the reading for 'human animal organism' is constructed by appending the marker '(human)' to the marker '(animal)' in the reading of 'animal organism', as in (9):

(9)


and the reading for 'male human animal organism' is constructed by appending the marker '(male)' to the marker '(organism)' in the reading for 'human animal organism'

(10)


In each case the markers are appended in accordance with selection restrictions – '<(organism)>'

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take it that the awkwardness of (no doubt most) English expressions corresponding to the complete decompositions of complex senses does not count against them as analyses any more than would the (no doubt) near incomprehensibility of a set-theoretic analysis of, say, 'prime number' (cf. Quine 1966: 28-30). Their stiltedness is likely a pragmatic effect, due to the fact that English has available much shorter expressions that express the same sense.

for ‘(animal)’ and ‘(male)’ and ‘<(animal)>’ for ‘(human)’ – and the senses encoded in the selection restrictions are represented in the derived readings as superordinates of the resultant senses.

Note that the selection restrictions in these cases are nominal readings, so that the marker ‘(animal)’ in ‘<(animal)>’ must be taken to represent a distinct sense from that represented by ‘(animal)’ in (8) and (9), which I take to represent the sense of the *adjective* ‘animal’.[16] In (10) the nominal sense *animal* is represented by the part of the reading identical to (8) (which is, in addition to being a reading for the phrase ‘animal organism’, a reading for the noun ‘animal’, which means *animal organism*). In the construction of the reading for ‘human animal organism’ (in which ‘human’ and ‘animal’ are adjectival, and which is also a reading for ‘human animal’ and (nominal) ‘human’ as well), ‘(human)’ is appended to the lowest marker in a *complex* representation of the sense represented by a *single* marker in its selection restriction.[17] Nominal *animal* is represented as a superordinate of *human*, since the marker ‘(animal)’ (which would in any case disappear in a complete decomposition) is not a nominal reading and is not a same-rooted subtree of (10). In the cases of the terms ‘adult’, ‘male’, ‘animal’ and ‘human’, which have adjectival and nominal senses, the selection restriction in the reading for the adjective is a superordinate in the reading of the noun, and the sense of the noun is expressible as a compound

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[16] This marker ambiguity is due to the ambiguity of ‘animal’ in English and to the fact that defined markers are used here for convenience. Any ambiguities accruing to semantically simple English expressions would have to be handled through the introduction of some new notation – subscripts perhaps; markerese can contain no ambiguities if it is to represent distinct senses of lexical items as distinct.

[17] Likewise, ‘(unmarried)’ is appended to ‘(human)’, the lowest (adjectival) marker in a complex representation (cf. (11)) of the sense encoded in its selection restriction, viz., (nominal) *human*. It is convenient to represent selection restrictions by single markers, though there is no theoretical reason why they cannot be represented by complex readings (cf. Katz 1988: 87).

formed from the adjective and a term expressing the superordinate sense.

The readings for ‘adult male human animal organism’ and ‘unmarried adult male human animal organism’ are constructed in similar fashion.

2.5. *Argument Structure*.

Another basic component of Katz’s formalism is the representation of argument structure. The argument places of a predicate are represented by “categorized variables” (Katz 1972: 104). Categorized variables are the points at which the reading of a predicate is combined with the readings for its arguments, by the operation Katz calls “embedding.” In embedding, the categorized variable is replaced by the reading for the argument. The categorization of the variable determines syntactic conditions on the formation of a derived reading, and is represented by a symbol (square brackets containing one or more syntactic category symbols) for a grammatical function, corresponding to the relations between predicates and arguments – such notions as ‘subject of’, ‘direct object of’ and ‘indirect object of’.[18] The symbol ‘[NP, S]’, for example, when placed above a variable in the reading of a term indicates that the variable is to be replaced by readings for subjects of clauses. Thus, intransitive verbs generally will be represented as ‘sleep’ is in (11) (where ‘(sleep)’ is, of course, a defined marker):

(11) $\overset{[NP,S]}{((\text{sleep})\ X\ )}$[19]

In constructing a reading for the sentence

(12) The dog slept on the cat

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[18] Following Chomsky 1965. In more recent syntax, these grammatical functions have been subsumed by theta-roles, thematic roles, or the like. Whatever the nomenclature, the point is that variables are categorized according to the syntactic role played by the words whose readings may replace them.

[19] Note that Katz adopts a predicate-calculus style of predicate-argument notation.

the categorization of the argument place of ‘sleep’ prevents the reading for ‘the cat’ from replacing it, and, hence, prevents (12) from meaning *the cat slept on the dog*.

Selection restrictions associated with a predicate are also attached to the argument place. The categorized variable thus determines both syntactic and semantic conditions on the formation of derived readings. Assuming that the selection restriction on ‘sleep’ is ‘<(sentient)>’,[20] the reading for ‘sleep’ is

(13)
$$\begin{array}{c} \\ ((\text{sleep}) \quad X \quad) \\ \quad <(\text{sentient})> \end{array} \quad \begin{array}{c} [NP,S] \\ \\ \end{array}$$

(and (14) is predicted to be semantically anomalous:

(14) the mat slept on the cat.)

Predicates with more than one argument place are represented with the appropriate number of variables. The reading for a transitive verb such as ‘love’, for example, may be abbreviated as in (15)

(15)
$$\begin{array}{c} \\ ((\text{love}) \quad X \quad , \quad X \quad) \\ \quad <> \quad <> \end{array} \quad \begin{array}{c} [NP,S] \quad [NP,VP,S] \\ \\ \end{array}$$

though generally the categorized variables representing the argument places of polyadic predicates will be associated with different markers in a full decompositional representation.[22]

I have used the term ‘predicate’ to denote generally expressions taking arguments. Thus,

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[20] Only objects capable of being awake are capable of being asleep, and only sentient creatures are capable of being awake.

[21] Selection restrictions will be left unspecified when not at issue.

[22] In the case of verbs, the subject (or “external”) argument place will be associated with the marker representing what I call the “qualification base” (see section 5.4.2), while the object (or “internal”) argument places will be associated with distinct subordinate markers.

though throughout I have used verbs as examples, what I have said will apply to other expressions, such as prepositions, prepositional phrases and verb phrases. Adjectives are not represented as having argument places, since they do not take arguments directly. Predicate *phrases* constructed out of adjectives (e.g., 'is green'), on the other hand, do take arguments, and their readings will include categorized variables. Thus, adjectives themselves are not counted among the predicates (as is often done in standard first-order systems).

2.6. *Semantic Properties and Relations*.

Pretheoretic sense properties and relations may be given theoretic definitions in terms of this formalism. A few examples will serve to illustrate (see Katz 1972 and 1988 for full formal definitions). A modifier-head construction is *redundant* iff the reading of the modifier is identical to a part of the reading of the head.[23] Thus, on the basis of the analysis of 'bachelor' presented above, the expression 'human bachelor' is predicted to be redundant, since the reading assigned to 'bachelor' contains the (defined) reading of 'human'. An expression is *semantically anomalous* iff the formalism does not assign it a reading. Generally, this is a matter of violation of selection restrictions. If the reading of an expression α does not contain the marker contained in the selection restriction of an expression ß, in the proper structural position (i.e., such as to be accessible to one of the projection operations *appending*, *merging*[**say what merging is**] and *embedding*), then the readings of α and ß cannot combine, and the expression αß is assigned no reading. It is therefore semantically anomalous. A sentence is *analytic* iff its reading is contained in the reading of one of its terms. An expression α *analytically entails* an expression ß

[23] The readings representing the content of semantically complex expressions are constructed on the basis of speakers' intuitions about the pretheoretic semantic properties and relations of expressions. Thus, these definitions are formalizations of the very intuitions on the basis of which the readings over which they are defined are constructed.

only if the reading for ß is identical to a part of the reading for α.[24]

3. *Criticisms*.

3.1. *The Content of Sense*.

On Katz's theory, readings include syntactically categorized argument places. Senses are thus represented as intrinsically syntax-involving; but I think there is good reason to avoid this.

Senses and syntactic structures are independent existences, and (even if both are abstract objects) nothing intrinsic to a sense determines an association with one syntactic structure rather than another. There are infinitely many possible sense-syntax pairings, and none of them is objectively (i.e., from the point of view of no particular language) "correct." That senses are associated with the syntactic structures they are *in English* is a contingent fact – there are other possible languages in which they are associated with different syntactic structures, and some in which they are not associated with syntactic *structures* at all.[25] A system of sense-representations should not rule out this possibility. To represent a sense as intrinsically related to a particular syntactic configuration, or to any syntactic configuration at all, is to misrepresent it.[26]

Though I will not pursue this issue here, an obvious solution to this problem is to associate syntactic categorization of argument places with the *lexical items* senses are paired with, and leave the representation of the argument places themselves uncategorized. The

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[24] The converse does not in general hold. The reading of 'Giovanni was a baritone', for example, is identical to part of the reading of 'Claudio didn't think Giovanni was a baritone', though the latter does not analytically entail the former. The full formal definition of analyticity will thus be somewhat more complex.

[25] Consider, for example, a language in which the senses of English sentences are expressible only by syntactically *simple* expressions. (That such a language would be neither productive nor systematic is beside the point.)

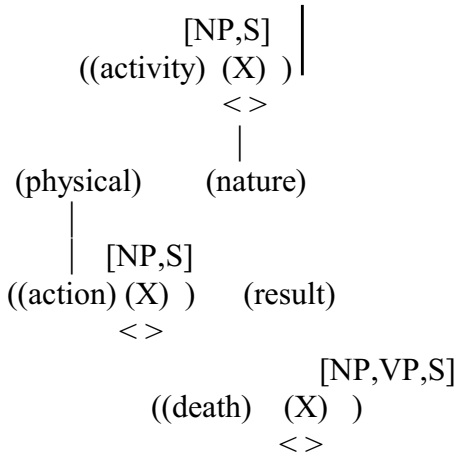
[26] A similar conflation of syntactic and semantic structure appears to beset semantic theories that appeal to "thematic roles."

association of argument places in a sense with argument places in a lexical item maybe achieved by an ordering convention (e.g., corresponding syntactic and logical categories have corresponding ordinal positions in their respective representations).

3.2. *Dimensions of qualification*.

Intuitively, a sense may be qualified in one or more *respects*. For example, the sense *activity* may be qualified with respect ontology (e.g., *physical* or *mental*), purpose (does it have one? – if so, what is it?), the result of engaging in it, etc. In several publications (1972; 1977; 1987) Katz has represented this aspect of sense structure by placing markers representing the dimension of qualification (e.g., '(nature)', '(purpose)', '(result)', etc.) between the markers representing the qualified and qualifying senses. For example, Katz's (1987) proposed reading for 'kill' is

(16)



The markers '(nature)' and '(result)' here are intended to represent the fact that killing is an activity of a particular nature (it is an action) with a particular result (viz., death).[27] The problem is that given the conventions for interpreting readings in markerese, this method of indicating dimensions of qualification will regularly generate incoherent readings. Recall that appending

[27] These aspects are part of what would distinguish killing from other activities that either are not actions (e.g., digestion) or are to no particular purpose (e.g., thumb-twiddling).

one marker to another expresses what Katz calls a *predicate function*, "that is, an operation of converting a less specified sense into a more specified one. ... The original semantic marker with the predicate function applied to it together represent a more highly specified sense than the one represented by the original marker alone." (Katz 1977: 64-65). According to this interpretive principle, then, the sense *kill* (as represented in (19)) contains the senses *action nature activity* and *death result nature activity*. But this is nonsense.

The revision I would propose involves separate treatment for these two markers. The sort of qualification Katz intends by '(nature)' is not, I would argue, *semantic* qualification. The fact that to qualify an activity as an action is to qualify it with respect to its nature (*as opposed to* its purpose or result) is not in fact part of any activity sense. 'Killing has a nature', for example, does not seem to be analytic. Such sentences seem rather to follow from a general *metaphysical* principle: something like, "any activity has a nature (is of a certain determinate kind)."

On the other hand, that killing is an activity that has a result does seem to be constitutive of the content of *kill*: 'killing has a result' and 'killing is an action' seem to be analytic). As such, the sense *result* should be represented in the reading of 'kill' – though not in the way that Katz proposes. Since it is, furthermore, a sense component on the basis of which certain systematic relations (akin to the sex-antonymy relations mentioned above) to other activity sense will hold – e.g., senses expressing other results or no results, it should not be represented as part of a single marker (e.g., '(resulting in death)' (to be appended to '(activity)')). As such, *result* would not be represented by a component of the reading, and could not serve as the basis for systematic generalizations.

What I propose is that *result* be represented by means of what I will call a "sense functor." A sense functor is an unsaturated element akin to a marker with a categorized variable

– though a sense functor does not accept readings of *syntactic* constituents. The argument of a sense functor is another component of the reading. Thus, instead of '(result)', dominating '(death)',[28] we would have

(17) (resulting in (death of X))[29]
< >

formed from the sense functor '(resulting in X)'. In general, those "dimensions of qualification" which are genuine constituents of a sense would be represented with sense functors.

3.2. *Adjectivals, nominals, verbals, etc*.

(16) illustrates another problem with the theory as developed by Katz. Note that the topmost marker in (16) is '(activity)', which I take to represent a *nominal* sense (i.e., the sense of a noun). Since this marker is a same-rooted subtree of the reading, 'kill' is represented as a kind of activity. But this is not right. Kill*ing* is a kind of activity (so '(activity)' would be appropriate as the root node in a reading for 'killing'); but the representation of the sense of the *verb* 'kill' must represent it as verbal. This will be true of verbs generally, as well as of items from the other syntactic categories that receive readings. I introduce the notion of a 'qualification base' to make this clear. Generally, the topmost node in a reading must have a marker representing a sense expressed by a lexical item of the same syntactic category as the item the reading is assigned to. Thus, if the reading is supposed to represent the sense of a noun, the topmost marker must be a

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[28] Note that '(death X)' in Katz's reading should actually be '(death *of* X)'.

[29] Or, perhaps:

(having as a result (death of X))
< >

nominal marker (i.e., a marker representing a sense expressed by a noun); if the reading is supposed to represent the sense of a verb, the topmost marker must be a *verbal* marker (i.e., a marker representing a sense expressed by a verb); etc. The topmost marker in each such case is the qualification base; it represents both the highest superordinate of the represented sense and the fundamental sense from which complex senses are formed by qualification.

On this proposal nouns, verbs, adjectives, prepositions, etc. may all have superordinate structure. For example, consider again the proposed reading (4) of 'rectangle'. With the exception of the marker '(plane figure)',[30] which represents the qualification base, all the markers in (4) markers are adjectival. Any subtree of this reading rooted in '(rectilinear)' will thus represent the sense of an adjective. For example, the subtree

(18)
(rectilinear)
|
(four-sided)

represents the sense of the adjective 'quadrilateral'; the subtree

(19)
(rectilinear)
|
(four-sided)
|
(parallel-sided)

represents the sense of the adjective 'parallelogramatic'; and the subtree

(20)
(rectilinear)
|
(four-sided)
|
(parallel-sided)

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[30] Which I am taking to be a defined marker, abbreviating the reading

(figure)
|
(planar)

|
(right-angled)

represents the sense of the adjective 'rectangular'.[31]

Thus, a semantic formalism of this type must represent as the ultimate semantic categories of language not only the *substantive* categories Katz explicitly recognizes, but also adjectival, verbal, prepositional, and perhaps other categories.[32]

4. *Applications*.

4.1. *Determinables and determinates*.

It has long been recognized that color terms are not definable. Though 'red is a color', for example, may appear to be analytic, it does not seem to be the case that those who have mastered 'red' can provide further necessary conditions on being red such that together with *being colored* they are sufficient for being red. Some philosophers, e.g., Fodor, et al. (1980), have taken this to be a counterexample to traditional decompositional approaches to lexical meaning: since color words cannot be defined, they do not have complex meanings. I have argued elsewhere (Pitt 1999) that this conclusion is a non-sequitur. Here I would like to examine the less pessimistic approaches to the semantics of color terms advocated by W.E. Johnson and John Searle, and

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[31] Quadrilaterals are quadrilateral plane figures, parallelograms are parallelogramatic plane figures, rectangles are rectangular plane figures. Though perhaps trivial sounding, these are surely all correct characterizations.

[32] Though Katz's (1972) formulation is general enough to allow for this:

> Those semantic markers appearing on the right-hand side of some semantic redundancy rules but not on the left-hand side of any such rules represent the most abstract senses, the semantic categories of the language. [p. 44]

(a redundancy rule serves to simplify dictionary entries by abbreviating frequently occurring senses (such as, for example, *manmade non-living physical object* – i.e., *artifact*)), it is not an aspect of the theory that Katz developed).

show how the difficulties of each can be overcome within Katz's formalism. I will also argue that this approach to color terms may be fruitfully extended to perceptual terms and natural kind terms, with important consequences for the sorts of cases Kripke and Putnam have urged as counterexamples to traditional decompositional semantics.

4.1.1. *Johnson*.

Johnson (1921) introduced the terms 'determinate' and 'determinable' to characterize the way in which color words are semantically related to 'color'. He distinguishes the relation between a determinate and its determinable from the relation between an individual and its class, to which it is superficially similar (cf.: 'Plato is a man', 'Red is a color').[33] Individuals belong to a class in virtue of possessing some property in common, and a class divides into subclasses on the basis of differences in the properties of those individuals.[34] But determinates "belong to" a particular determinable, Johnson argues, not in virtue of what they have in common, but in virtue of "the unique and peculiar kind of *difference* that subsists between the several determinates under the same determinable" (1921, Vol. I: 176; emphasis added). (Determinates under the same determinable are "comparable" while determinates under different determinates are "incomparable"). There is, Johnson says, no "(secondary) adjective which analysis would reveal as characterizing these different (primary) adjectives ['red', 'blue', 'green,']" (*ibid*.) – that is, nothing comparable to 'female' and 'male' with respect to 'brother' and 'sister'.

Johnson seems to be saying that *neither* color words *nor* the word 'color' itself are

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[33] By 'class' Johnson means (not *set*, but) something like *kind*.

[34] For example, individuals are members of the class of siblings in virtue of having parents who have at least one other child, and the class of siblings divides into the subclasses of brother and sister (and perhaps neuter-sibling and hermaphroditic-sibling) on the basis of the different sexes of its members. This is all reflected in the definitions of 'brother' and 'sister' as 'male sibling' and 'female sibling'.

definable: one can say neither what colors have in common that makes them all colors, nor what distinguishes them from one another. It is in virtue of unspecifiable differences, not commonalities, that co-determinates fall under their determinable.

However, Johnson does implicitly recognize the relation between the senses of specific color words and the sense of 'color' as *containment*, and inferences such as ' *x* is blue, therefore, *x* is colored' as *analytic*. Sentences such as 'blue is a color' and 'the author of the *Republic* is an individual' Johnson calls "structural propositions." In a structural proposition "the understanding of the subject-term ... demands a reference of it to the general category there predicated of it" (*op. cit*., Vol. II: 14). He explicitly identifies his structural propositions with Kant's *analytic* propositions, and says that "[a]ll structural statements contain as their predicate some wide logical category, and their fundamental characteristic is that it is impossible to realize the meaning of the subject term without implicitly conceiving it under that category" (*ibid*.: 15).

It is not clear, however, that Johnson has given us a satisfactory solution to the puzzle about the analyticity of 'red is a color'. For what are the "unique and peculiar kind of difference[s]" that distinguish determinates under the same determinable? The Kantian notion of analytic containment would seem to require that whatever it is that distinguishes the senses of color terms also be contained in their senses. But Johnson has said nothing about what this might be. (I argue in section 4.21 that Katz's formalism does provide a way of reconciling the claim of Kantian analytic containment with the insight that the way in which determinates under the same determinable are semantically distinguished from one another is distinctive.)

Further, Johnson distinguishes his structural propositions from Mill's *verbal* propositions, which he does not class as analytic. Such propositions, Johnson says, depend on an "arbitrary assignment of meaning to a word." The proposition 'the author of the Republic wrote

something', for example, is verbal, but not analytic, since it depends upon the (arbitrary) meaning of the word 'author'.

But it is hard to see why the sentence 'blue is a color' does not owe its semantic status to the assignment of meaning to 'blue' – especially given what Johnson says about the predicate of a structural proposition "realiz[ing] the meaning of the subject term." It seems more accurate, therefore, to class both structural and verbal propositions as analytic, in Kant's sense. Still, there does seem to be a difference in the predications of Johnson's structural and verbal propositions. The predications in structural propositions (at least in the examples Johnson offers) seem to be, intuitively, more "abstract" than those of verbal propositions.

We may accommodate this difference while recognizing that 'the author of the Republic wrote something', et al. are analytic in the same sense as 'blue is a color' by construing it as being between analytic sentences whose predicate term expresses a sense contained *as a superordinate* in the sense expressed by the subject term and analytic sentences whose predicate term expresses a sense contained, but not as a superordinate, in the sense expressed by the subject term. Thus, *color* is a superordinate of *red*, and *individual* is a superordinate of *author,* while *write* is contained in the sense of *author* in the way that, e.g., the senses *adult*, *male* and *human* are contained in the sense of *bachelor*.

4.1.2. *Searle*.

Searle (1959) develops an account of the logic of the determinate/determinable relation by comparing it to the relation between a *species* and its *genus*. Genera and determinates are what Searle calls "specifiers" of, respectively, species and determinables. A term *A* is a specifier of a term *B* iff *A* implies *B* but *B* does not imply *A* (e.g., 'rectangle' implies but is not implied by

'parallelogram'; 'red' implies but is not implied by 'color'). Species are distinguished from determinates by the existence of a second term, the *differentia*, which neither implies nor is implied by the genus, and which in conjunction with the genus implies the species. There is, Searle recognizes, no such term in the case of determinates. To give genus and differentia is to give necessary and sufficient conditions for membership in the species, i.e., a definition of the species term; determinate terms do not have definitions. It is thus necessary for a term *A* to be a determinate of a term *B* that *A* is a specifier of *B*, and there is no term *C* such that *A & C* implies *B*, but *C* by itself does not imply *B*.

Searle adds further conditions to rule out such pairs as 'red rose'/'color', 'red or yellow'/'color' and 'yellow'/'yengry' (a defined term meaning *yellow or angry*), which satisfy the above criteria but are not determinate/determinable pairs, and to include pairs like 'scarlet'/'red', which are determinate/determinable pairs but do not meet the above criteria.[35] To include "subdeterminates" such as 'scarlet' under their determinates, Searle introduces the further condition on the term *C* that its *negation* not imply the determinable. To exclude pairs like 'red rose'/'color', Searle introduces the condition that a determinate of a particular determinable not be a conjunction of terms one of which entails the determinable and the other of which does not. Finally, to rule out pairs like 'yellow'/'yengry', Searle introduces the condition that any two determinates under the same determinable be logically related (two terms are logically related if either entails the other or the negation of the other). 'Yellow' and 'angry' are both specifiers of 'yengry' that satisfy the conditions so far detailed (Searle calls such specifiers "non-conjunctive"), but they are not logically related to each other, so the term they are non-

[35] This is due to the fact that, given a finite number of non-scarlet shades of red, the denial of the disjunction of the terms for those shades in conjunction with 'red' entails 'scarlet' but does not itself entail 'red' (the negated disjunction is the term *C* in the schema in the text).

conjunctive specifiers of, ‘yengry’, is not a determinable.

These conditions taken together are, according to Searle, both necessary and sufficient for a term to be related to another as determinate to determinable, and characterize the relation between (among others) color words and ‘color’. The conditions also permit a characterization of the notion of determinates of different ‘levels’, such as ‘red’ and ‘scarlet’: two terms are same-level determinates of a third term iff they are both determinates of that term but neither is a specifier (implies but is not implied by) the other.

Searle has characterized the logical relations between determinables and determinates, and acknowledged the undefinability of determinates, but he has provided no *explanation* of these relations. *Why* is it that ‘red’ implies but is not implied by ‘color’? And what of the intuition that ‘red is a color’ is analytic? An adequate account of determinables and their determinates ought to explain these and other facts about them.

4.1.3. *Katz*.

Katz (1987) also recognizes the distinctive nature of the relation between color words and ‘color’ – though he does not use the terms ‘determinate’ and ‘determinable’ in characterizing it. Katz sees the relation in terms of a distinction between semantically *primitive* and semantically *simple* terms Terms that are not definable are primitive; a simple term is a term with no semantic structure. Katz argues that these notions are not equivalent: the analyticity of sentences such as ‘blue is a color’ together with the undefinability of ‘blue’ shows that color words are primitive, but not simple.

In responding to a criticism of Janet Fodor (1980: 150) that the undefinability of color words shows that semantic “decomposition stops short before all significant semantic relations have been captured,” Katz (1987: 228, fn. 16) suggests that the sense of ‘red’ be represented by

the reading

(21) (color)
|
(red)

construed as a primitive semantic marker. According to Katz, the components of (21) should not be taken to represent distinct senses in a qualification relation, but rather the internal articulation of a single marker. Thus, the sense of 'red' is represented as complex, but not as constructed out of independent component senses (it is primitive, but not simple). '(red)', cannot appear by itself as an undefined semantic marker, but must always be dominated by the marker '(color)'.[36] This fact formally distinguishes it from other semantic markers.

The containment of the marker '(color)' in (21) is the basis for the analyticity of 'red is a color', and the primitiveness of (21) reflects the undefinability of 'red'. Though Katz does not consider other complex primitives, it is obvious how his treatment of 'red' could be extended to account for any analytic inference involving terms related as determinate and determinable. To predicate a determinate of one of its determinables is to predicate a superordinate of a sense of that sense. Since superordinates are contained in the senses they are superordinates of, any such predication will be analytic.

This proposal marks a departure from Katz's earlier (1972) treatment of color terms, on which the differences among their senses was represented busing the apparatus of *distinguishers*. I think this earlier conception, which I will review below, is to be preferred to the more recent one, for the following reason. On the new account, the distinguishing feature of the sense *red* is represented using the notation (English parentheticals) introduced to represent *senses*. But what

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[36] Likewise, one supposes, the marker '(red)' would be dominated by but inseparable from the marker '(colored)' in the reading for *adjectival* 'red'.

sense is '(red)' in (21) supposed to represent? It cannot be the *nominal* sense *red*, since, for one thing, that is what (21) itself is supposed to represent, and, for another, '(red)' is itself a qualifier here, and hence must represent an *adjectival* sense.[37] That is, if '(red)' represents any sense at all in (21), it must be the sense *red in color* (or *colored red*). But red is not a color that is red in color (a red color). In fact, '(red)' *could not* represent *any* sense in (21), since this is just what the structure of determinates precludes: there is no sense *F* for any color term such that 'F color' is synonymous with it.

On the earlier proposal, in contrast, the distinguishing features of the senses of different color words are not represented as senses.[38] In Katz 1972, distinguishers do not have semantic content, though the presence of different distinguishers in otherwise identical readings makes those readings semantically distinct. They serve to mark purely perceptual distinctions among the referents of terms such as color words:

> Distinguishers can be regarded as providing a purely denotative distinction which plays the semantic role of separating lexical items that would otherwise be fully synonymous. Unlike semantic markers, which represent conceptual components of lexical items and expressions, distinguishers mark purely perceptual distinctions among the referents of

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[37] This will always be true in semantic representations on Katz's theory. The topmost marker in a reading represents a sense of a category corresponding to the grammatical category of the word whose sense the reading represents (i.e., nominal senses for nouns, adjectival senses for adjectives, etc.). Any markers appended to it will represent senses of categories appropriate to qualify it.

[38] Katz and Fodor 1963 use the terms 'marker' and 'distinguisher' to make another, unrelated distinction. They use markers to represent components in the sense of a term that determine systematic semantic relations with other terms in the language, and distinguishers to represent the components in the sense of a term that do not. For example, *male* and *female* are always represented by markers, because of the existence of sex-antonymous pairs such as 'sister'/'brother', 'aunt'/'uncle', 'cow'/'bull', 'doe'/'buck', etc. (pairs of terms whose meanings differ only in that one contains *male* where the other contains *female*), while *unmarried* (in, e.g., the sense of 'bachelor') is always represented by a distinguisher, because there is no analogous family of matrimonial-status-antonymous pairs in the language.

> conceptually identical senses[39] ... which the language records but for which it provides no conceptual interpretation. [84; 88]

To generalize, a distinguisher is appropriate where items are semantically distinct, but the *content* of the distinction – what it consists in – is not reflected in the senses of the terms.[40] I take it what Katz means by "denotational" is simply *extra-linguistic* – that is, whatever distinguishes the colors one from another, whether phenomenological properties or physical properties (they need not be, on my view, *perceptual*), is not encoded in the language.[41] That there are differences between red, blue, yellow, etc. is marked by language, but language does not provide information about the nature of those differences (as it does, for example, about the differences between brothers and sisters, or bachelors and spinsters). The natures of colors (apart from their being colors), their *real* "definitions," to borrow Locke's terminology, are left undetermined by the

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[39] What is meant here by 'conceptually identical' is, I take it, 'having all *markers* in common'. There is, however, another sense in which determinates are *not* conceptually identical: in virtue of containing different distinguishers in their readings determinates are represented as expressing non-identical concepts (senses).

[40] In Katz 1972, color terms are members of an "antonymous n-tuple" – a group of readings with a common superordinate marker and incompatible subordinate markers (or distinguishers). Such sets of markers are formally distinguished from readings with a common superordinate and different but *compatible* subordinates by listing them in the following form

$$(M\ ^{(\alpha 1)}),\ (M\ ^{(\alpha 2)}),\ ...,\ (M\ ^{(\alpha n)})$$

where '(M)' is the common superordinate marker, and '(α1), (α2), ..., (αn)' are the incompatible subordinate markers. On this earlier account, the distinctness and antonymy of color terms have the same source (the incompatible subordinates). Katz 1998 develops a more articulated account on which the distinctness and antonymy of color terms have different sources, the former determined by different subordinate markers (as in (21)), the latter by a further constituent common to all color terms. The more recent account provides for a decompositional explanation of both the analyticity of 'red is a color' and the contradictoriness of 'red is blue'.

[41] Though I would argue that it is incorrect to say that language *provides* such distinctions: it merely marks them, or provides *for* them (i.e., it allows that color terms literally refer to colors, *whatever* the nature of color turns out to be).

semantics of color terms – their nominal "definitions."

Following the notation of XX (19XX), I will use English words in brackets to represent distinguishers. The use of English expressions is merely a mnemonic convenience. Distinguishers do not represent senses; they serve only to mark one reading, and, hence, one sense, as distinct from another. Any set of distinguishable symbols would be sufficient for this purpose. The presence of a distinguisher in the reading for a color term indicates that the sense of that term is different from the senses of all other color terms, but that the difference is not itself a matter of sense. Though the symbols do not represent senses, their presence affects the interpretation of the terms whose readings they appear in. The *force* of a distinguisher can be captured in the phrase 'distinct from all others' (though *color distinct from all others* cannot be taken to be the sense of color terms, since they would thereby be represented as being synonymous).[42]

Distinguishers are appended to semantic markers in readings for determinables that represent the domain with respect to which the distinctions among the determinates are made. The common superordinate of a family of determinates determines a conceptual space which the distinguishers partition into distinct subdomains. Thus, for example, (22)-(24) represent the

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[42] There is some similarity between a distinguisher and a quoted term in a reading for a metalinguistic sense. For example, on Katz's view the sense of a name *N* is *the thing that is a bearer of 'N'*. The sense of a different name *M* is *the thing that is a bearer of 'M'*. Hence, the readings for those names will include names of those names ("'N'", "'M'", etc.) the senses themselves are represented as including. Names of names in readings do not represent senses, since names themselves are not senses. However, the presence of different names (of names) in otherwise identical readings for two names indicates the presence of different (named) names in the senses; and the presence of different names in otherwise identical senses distinguishes those senses.

Though to my knowledge Katz does not discuss the issue in print, I would assume that distinguishers in readings should be taken represent arbitrary formal objects (perhaps themselves) in senses.

senses of ‘red’, ‘blue’ and ‘green’, respectively

(22) (color)
|
[red]

(23) (color)
|
[blue]

(24) (color)
|
[green]

This notation is naturally extendable to determinates in general. For example, the following might be given as, respectively, representations of the senses of ‘sweet’, ‘sour’, ‘ache’ and ‘tickle’, all of which are, intuitively, undefinable though not unstructured (as evidenced by the analyticity of ‘sweet is a taste’, ‘sour is a taste’, ‘an ache is a feeling’ and ‘a tickle is a feeling’):

(25) (taste)
|
[sweet]

(26) (taste)
|
[sour]

(27) (feeling)
|
[ache]

(28) (feeling)
|
[tickle]

The contradictoriness of, e.g., ‘sweet is sour’ and ‘an ache is a tickle’ could be explained by expanding these readings along the lines suggested for color terms in Katz 1998.[43]

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[43] Philosophers from Leibniz and Hume to McGinn have supposed that perceptual concepts are not attainable in the absence of qualitative perceptual experience (Leibniz: “in order that a man may know what blue is it must be shown to him.” (1951: 356); Hume: “A blind man

4.1.4. *Putnam and Kripke on Natural Kinds*.

A further extension of the apparatus of distinguishers can provide for an accommodation of some of the intuitions urged by Putnam (1970; 1973; 1975a) and Kripke (1970) on the semantics of natural kind terms. Kripke and Putnam argued that the determination of an "essence" – the defining nature of a type of thing – is an *a posteriori* matter, depending upon and always revisable in light of empirical research, and not a matter of *a priori* linguistic or conceptual analysis. With the apparatus of distinguishers in place, we may agree that this is true of *some* terms (determinates) to *some* extent (the extent left open by their distinguishers), while denying the claims that meaning (*sense*) is determined externally, that semantics is empirical, and that there are no unrevisable truths of meaning. For example, we may accept that science could discover that redness is actually a matter of soundwave amplitude (and not wavelength of light), but *not* that science may discover that red is not a color, or that red is blue; and we may deny that

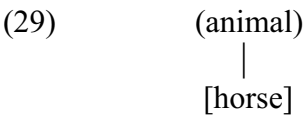
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can form no notion of colors; a deaf man of sounds." (1902: 20); McGinn: "You cannot acquire mental concepts for conscious states that you yourself do not enjoy." (1991: 71)). On the view of perceptual concepts I am urging here, however, one may perfectly well have the concept of, e.g., red without having the percept – i.e., without knowing what it is *like* to see red. One need not have visual experiences to understand that red is a color distinct from all other colors, that colors are aspects of visual experiences, that visual experiences are a kind of perceptual state distinct from all others, that perceptual states are a kind of mental state distinct from all others, etc. Indeed, we who can see have no greater *conceptual* understanding of what colors are than the blind – witness our inability to define color words. We may not know what it is *like* to be a bat, but it does not follow that we can have no *concept* of the bat's echolocatory experience, since such experience itself is not part of the concept of echolocation.

This approach to perceptual concepts is also relevant to the current debate over "phenomenal concepts" in the literature on consciousness and intentionality. Some philosophers, e.g., Chalmers (200X), Loar (200X) and Block (200X) have argued that representationalism (the view that the properties of conscious perceptual states are exhausted by their nonphenomenal representational properties) is incorrect, since some of our knowledge of our phenomenal states can only be explained in terms of concepts which *contain qualia*. It seems to me, however, that these arguments depend on the false assumption that possession of perceptual concepts requires experience of the qualities they denote. There are no such things as phenomenal *concepts*. (I hope to develop this point in future work.)

science could discover either that sisters are not female or that they are not siblings.[44]

If we treat natural kind terms as determinates, we can represent their senses using markers and distinguishers. For example, given that 'horses are animals' is analytic, though undefinable, we may represent its sense as in (29)

(29)


where '[horse]' marks the sense of 'horse' as distinct from the senses of other animal terms, but says nothing about the specific animal nature of horses.[45] If we accept this, we may view proposed definitions like 'equine animal' ('horse'), 'feline animal' ('cat'), 'porcine animal'('pig'), etc. as bogus in the same way that 'rubine color', 'verdine color', 'purpine color', etc. would be bogus as definitions of 'red', 'green', 'purple', etc. – either because 'equine',

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[44] We may also, of course, recognize the process whereby scientific definitions come to supplant phenomenological or otherwise pre-scientific ones in cases where empirical discoveries about the referents of terms do not contradict prescientific definitions (i.e., the discovery that water was H_2O, as opposed to the discovery that the all purring, meowing things in the world have always been robots), as well as the process whereby a real definition fills in the conceptual space left empty by a distinguisher and becomes part of a new sense for an old word.

[45] Thus, the distinction I am urging here is related to the distinction between natural and nominal kinds suggested by Schwartz 1977, though I would not, *a priori*, limit the non-nominal kinds to *natural* kinds (some philosophers (e.g., Johnson and Searle) have argued that shape terms, for example, are determinates), and I do not suppose that natural kind terms are purely referential.

Schwartz characterizes the distinction between nominal and natural kinds as follows:

> In using [nominal kind terms] we do not have some kind of thing in mind, name it, and then seek to discover what it is we have named as we do in the case of "gold" or "tiger." Rather we have a certain specification or description in mind and define anything that satisfies the description as having a right to the name. [Schwartz 1977: 38]

I would argue that the superordinates in the readings of natural kind terms represent the "*kind* of thing" we have in mind in using them.

'feline', 'porcine', etc. don't mean anything, or because they mean *horselike*, *catlike*, *piglike*, etc. ('cat', for example, does not mean *catlike animal*: 'cat*like*' does not entail 'cat').[46]

The *de re* nature of a particular species (its "real definition") is, as Putnam argues, not something that can be known *a priori* through semantic analysis; it is an empirical matter for scientific investigation. That two species are distinct, however, *is*, on this view, a matter of semantics. It could no more be discovered that dogs are cows than it could be discovered that breakfast is lunch. If it should turn out that the genetic codes (or whatever) of all the things we have ever referred to as 'dogs' and 'cows' are in fact the *same*, then we would have to say either that it had been discovered that there are no dogs, or that there are no cows, or both. (This situation is analogous to that argued for by Katz (1990; 1992) with respect to the analyticity of 'cats are animals': if it should turn out that the things we have been calling 'dogs' and the things that we have been calling 'cows' are not animals, then it would have been discovered that there are no dogs or cows.)[47]

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[46] Note that 'feline', at least, has a use on which it is synonymous with 'cat': we may refer to 'those felines', meaning those cats. Thus, 'feline' may function in the way color terms do, both to express a determinate concept (*cat*) and as a mnemonic in the distinguisher ('[feline]') – in which case, 'feline animal' would be bogus in the same way that 'red color' is.

[47] Katz (19XX) has accepted this proposal as one of three possible ways a decompositional theory can handle natural kind terms. (The other two involve treating natural kind terms under the same superordinate as differing *conceptually*, either in the way that, for example, the senses of 'doctor' (*medical professional*) and 'lawyer' (*legal professional*) do (i.e., as nonsynonymous and nonantonymous ('legal' and 'medical' are not antonyms)), or the way that the senses of bachelor (*unmarried man*) and husband (*married man*) do ('married' and 'unmarried' are antonyms).)

Katz develops an account of the reference of natural kind terms as "reference under an incomplete description," where an incomplete description is "a nominal definition of a term T which, considered as the criterion of application for T, underdetermines the extension of T as determined by its real definition" (Katz 19XX:). Those using the term "have to compensate with suitable conceptual content from extra-linguistic knowledge about the substance" (*ibid*.: 5) to get the extension right. This notion fits well with the present proposal to treat natural kind

4.2. *Species definitions*.

On the traditional (Aristotelian) view, a species (a kind) is definable in terms of its genus and differentia, where the differentia is a property that marks off the species from others within the same genus. The genus is thus supposed to have a kind of conceptual priority over the differentia (the differentia qualifies the genus, but not *vice versa*): the relation between the genus and differentia of a species is asymmetrical.

This view has been challenged by a number of philosophers, beginning with Leibniz.[48] Leibniz argued that the relationship between genus and differentia is in fact symmetrical, and, thus, that the intended distinction in conceptual priority is spurious. The distinction between genus and differentia is actually only the *syntactic* distinction between head (noun) and modifier (adjective). One may, for example, indifferently define 'square' as either 'equilateral rectangle' or 'rectangular equilateral' – i.e., either taking *rectangle* to be the genus and *equilateral* the differentia, or *vice versa* (with minor grammatical adjustment). Appearances to the contrary in cases such as the standard definition of 'human' – viz. 'rational animal' – are, Leibniz argues, due merely to the accidental absence from the language of a convenient substantive term cognate with the modifier: in fact, we may as well define 'human' as 'animal rational being' as 'rational animal' – or coin a new term, say, 'rationate', meaning *rational being*, and define 'human' as 'animal rationate'. The categories *rational* and *animal* are logically independent: there are animals that are not rational, and there (at least) may be rational beings that are not animals. Genus and differentia generally are logically independent; neither implies or is implied by the

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terms as determinates: a structure such as (29), above, is equivalent to a kind of incomplete description.

[48] See Prior 1949, part I, section (i) and references therein.

other.

I wish to argue that, though Leibniz is surely right about the cases he cites, we need not conclude that what is traditionally erroneously claimed for *all* species definitions is true of *none*. There are other examples of species definition that *do* exhibit the sort of conceptual structure supposed on the Aristotelian view.

Consider the definition of 'quadrilateral', viz. 'four-sided polygon'. This term is *not*, I maintain, also definable as 'polygonal four-sided thing': the terms 'four-sided' and 'polygon' are not logically independent. Intuitively, 'four-sided' presupposes 'polygon', but not *vice versa*; a quadrilateral is a polygon with four sides, not a thing with four sides that is a polygon.[49] Thus, *polygon* exhibits here just the kind of conceptual priority claimed for genera on the Aristotelian view, and 'four-sided' functions as differentia, marking the distinction of quadrilaterals from all other species (trilaterals, pentagrams, hexagrams, etc.[50]) within the same genus. Other examples of terms with Aristotelian definitions include 'quadruped' ('four-footed animal') and 'ungulate' ('hoofed animal') (note that 'four-footed' and 'hoofed' imply 'animal', but not *vice versa*).

The distinction between Aristotelian and Leibnizian definitions can be precisely characterized and represented within the formal semantic system presented in this paper. In an Aristotelian definition, the genus sense (expressed by the head noun) is encoded as a selection restriction in the reading of the differentia (the modifying adjective). Selection restrictions, recall, determine the marker the reading for a modifier is appended to in forming a derived

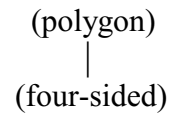
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[49] It is true that things like tables may be four-sided, but, I would argue, the sense of 'sided' here is not the same as the sense of 'sided' in the definitions of geometrical terms: table sides are spatio-temporal objects; geometrical sides are not. Furthermore, to say that a table has four sides is just to say that it approximates the shape of some quadrilateral.

[50] Triangles, pentagons, hexagons, etc. are defined as 3-, 5-, 6-, etc. *angled* polygons; trilaterals, pentagrams, hexagrams, etc. are defined as 3-, 5-, 6-, etc. *sided* polygons.

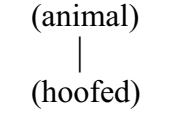
reading, which marker will be a superordinate of the derived concept. Thus, the (defined) reading of 'quadrilateral' will be

(30)



and the (defined) reading of 'ungulate' will be

(31)

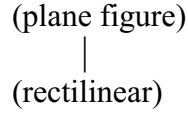


where the reading for the modifier is appended to the reading for the head. In the case of an Aristotelian definition, then, the sense encoded in the selection restriction for the modifier *is* the concept expressed by the head.

In the case of a Leibnizian definition, such as the definitions of 'square' and 'human' (as defined above[51]), in contrast, the sense encoded in the selection restriction for the modifier is expressed by a marker *contained in* the reading of the head. This creates a branching structure in the derived reading that allows for the sort of equivalence Leibniz observes.

For example, supposing *rectilinear* to be the selection restriction for (the adjective) 'equilateral' (only rectilinear plane figures can have equal *sides*), the marker '(equilateral)' will attach to the marker '(rectilinear)' in the reading of 'square', and not to the reading for 'rectangle' itself, thus:

(32)



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[51] As suggested above, I am inclined to think that 'human' is undefinable, being a determinate under the determinable 'animal'. But the proposed definition will serve for purposes of illustration.

(equilateral) (four-sided)
|
(parallel-sided)
|
(right-angled)[52]

Intuitively, since something may be a rectangle without being equilateral, or an equilateral without being rectangular, the senses *equilateral*$_n$ and *rectangle* – as well as *equilateral*$_a$[53] and *rectangular* – must be represented as logically independent of each other, which they are in (32). The left subtree of (32) represents the concept *equilateral*$_n$ and the right subtree represents the concept *rectangle*. Neither is a superordinate of the other. Taking 'rectangular' to mean *being right-angled parallel-sided and four-sided* (i.e., *having the form of a rectangle* – said of polygons), the right branch of (32) represents the sense *rectangular*, and the left branch represents the sense *equilateral*$_a$; neither is a qualifier of the other.

The modification of 'rectangle' by 'equilateral' splits the sense of 'rectangle' into a common superordinate, *polygon* (represented by the top two markers in (32)), and two qualifying senses, *equilateral*$_a$ and *rectangular*. Each of these qualifying senses together with the common superordinate forms a nominal sense – *equilateral*$_n$ or *rectangle*. (32) can be seen as the superimposition of the readings for two nouns ('rectangle' and 'equilateral'), the subtraction of either of which leaves the reading for an adjective ('equilateral' or 'rectangular'). Finally, (32)

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[52] Since

(plane figure)
|
(rectilinear)

is the reading for 'polygon' here, attaching '(equilateral)' to '(rectilinear)' in (32) is also attaching it to '(polygon)', construed as a defined reading.

[53] The 'n' and 'a' subscripts indicate, respectively, nominal and adjectival senses.

represents both of the senses *equilateral*$_{n}$ and *rectangle* as superordinates of *square*. Thus, 'square' is definable as either 'equilateral rectangle' or 'rectangular equilateral'.

Hence, Aristotle and Leibniz were both right, though they were talking about different sorts of structures that complex senses can have. It is a significant asset of Markerese that it can clearly and precisely represent such structures, and thereby provide a basis for the explanation of differing intuitions about the semantics of natural language-expressions.

NOTES