Lexical Semantics

Decompositional Composition and Bracketing Paradoxes

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In 1991, when the article on which this section predicated, the assumption that attribute phrases like *nuclear physicist* constitute a bracketing paradox had gone unchallenged for more than a decade. The assumption was that such paradoxes may be resolved by special rules such as head rules, rebracketing rules, and productive backformation rules. This section argues that such structural solutions do not work, since the same scope problems are reflected in phrases based on underived words with no morphological bracketing at all. In their place a solution based on FEATURAL or DECOMPOSITIONAL COMPOSITION is proposed, in which attributes compose semantically, not with the full set of features of their head, but rather with only one particular feature. This solution reduces the wide and narrow scope readings of attribute phrases to a question of which feature is selected, in effect making all attribute composition the same and obviating the distinction between wide and narrow scope readings of attribute phrases.

1. *Nuclear Physicist* and Related Constructions

So many different types of formal and semantic anomaly have been catalogued in the literature, that some linguists have abandoned hope of describing lexical processes in terms of regularity. This is unfortunate, since the preponderance of empirical and theoretical evidence still weighs in favor of a lexical component within the grammar, i.e. a strictly regular one. Although much has been written about 'lexical irregularity', there still has been no focused attempt to isolate and define the various types of lexical problems subsumed under this rubric. The purpose of this paper is to address this problem in hopes of increasing our perception of lexical regularity by decreasing the number of ostensible irregularities.

A range of scope ambiguities discussed originally in Bolinger (1967), Vendler (1968), D. Siegel (1974) and Allen (1978), and referred to in the literature as BRACKETING PARADOXES, has displayed uncommon resilience to general explanation (see Sproat (1984) and Spencer (1988) for reviews). It includes (i) problems of forms like *unhappier*, where the scope of the comparative category includes the prefix *un-*, but that of suffix, *-er*, does not; (ii) problems arising from stratal theories of morphology exemplified by ungrammaticality, where the Stratum I suffix *-ity* seems to attach after the Stratum II prefix *un-*, and (iii) Adj + N constructions of the *nuclear physicist* type, where both *nuclear* and *physics* fall within the scope of *-ist*, even though morphologically the suffix attaches to the latter stem alone.

This section focuses on the third type of construction, whose interest for linguistic theory was first discussed in Bolinger (1967). Consider the following examples, bracketed for the scopes of their potential readings:

(1) a. [nuclear] [physicist] 'a physicist who is nuclear (to some project)'
(1) b. [nuclear physic]ist 'someone who studies nuclear physics'

(2) a. [criminal] [lawyer] 'a lawyer who is criminal'
(2) b. [criminal law]yer 'someone who practices criminal law'

(3) a. [moral] [philosopher] 'a philosopher who is moral'
(3) b. [moral phrilosoph]er 'someone who studies moral philosophy'

(4) a. [Russian] [teacher] 'a teacher who is Russian'
(4) b. [Russian teach]er 'someone who teaches Russian'

(5) a. [first] [violinist] 'A violinist who is first (e.g. in a line of violinists)'
(5) b. [first violin]ist 'someone who plays first violin'

The problem is that these constructions seem to have, in addition to a wide scope reading $[[X_X][Y_Y]]$, exemplified by (a), which parallels syntactic structure, a narrow scope reading $[[X_X\ Y]_Y]$, exemplified in (b), which does not. Under the assumption of semantic-syntactic isomorphy, i.e. the assumption that semantic operations preserve syntactic structure, the narrow scope reading is not predicted.

The published accounts of the narrow scope reading have all assumed that constructions with this reading are superficially noncompositional, and thus advance elaborate syntactic and/or morphological machinery to render it compositional. This article, however, argues that the relevant constructions are in fact transparently compositional. This being the case, constructions of the *nuclear physicist* type do not bear on any issues in syntactic or morphological theory.

The section begins with a review of the data in the remainder of section 1, followed by comments on two types of solutions to the problem in section 2. Sections 3 and 4 then examine in some detail a semantic solution which applies to all attribute/head constructions and accounts for narrow and wide scope composition identically. Section 5 reviews some of the limitations on the solution proposed here and, finally, section 6 concludes with a brief discussion of the impact of this solution on grammatical theories which assume semantic-syntactic isomorphy.

1.1. Defining the Class of Data and its Range

Since the attribute scope problem of *criminal lawyer* is often catalogued with problems associated with the prefix *un-* and violations of morphological ordering principles such as are found in *ungrammaticality*, it makes sense to begin with an examination of the connection between these three types of cases. Pesetsky (1985), for example, has noted in this regard that the comparative suffix *-er* normally does not attach to trisyllabic stems, but only to monosyllabic stems and bisyllabic ones ending in /i/. It follows that *unhappier* can be structurally analyzed only as *un[happier]* so that *-er* is attached before *un-*. However, form-meaning isomorphy then forces the reading 'not happier', while the actual meaning is 'more not happy', i.e. [UNHAPPI]ER. A disparity thus arises between the morphological and semantic structures.

Ungrammaticality poses an ostensibly similar problem, at least within the framework of Stratal Morphology. Since '+' boundary affixes are attached at Stratum I and '#' boundary affixes at Stratum II, it follows that no '+' boundary affix may be inserted after any of the '#' type. This example then must be analyzed morphologically as *un[grammaticality]* given *un#* and *+ity*. As in the previous case, the semantic bracketing [UNGRAMMATICAL]ITY, is at odds with the morphological.

Classifying all these problems together, however, is a dubious maneuver. *Unhappier* differs significantly from (1-5). All the examples of (1-5) at least potentially have two readings; *unhappier* has but one, the narrow scope reading. Moreover, aside from this example, and, perhaps, unluckier, the semantically isomorphic analytic comparative, *more* + Adj, is consistently acceptable than the corresponding *un* + Adj construction:

(6) a. ?unwarier 'more unwary'
b. ?uncannier 'more uncanny'
c. ?unwieldier "more unwieldy"
d. ?unworldlier 'more unworldly'
e. ?unseemlier more unseemly

Spencer (1988, pp. 679-680), then, is probably right in claiming that this is a lexical problem, requiring *unhappier*, *unluckier*, and any other acceptable synthetic forms based on trisyllabic stems to be lexically listed. The problem with *ungrammaticality*, on the other hand, is internal to one theoretical framework. Given an alternative theory which fully specifies the exact range of stems and affixes with which a given affix may concatenate (Leitner, 1972; Fabb 1988) and the 'one structure' approach of Halle & Vergnaud (1987, pp. 81-83), these problems dissolve. To the extent that such problems persist in languages other than English, they seem to reduce to phonological issues unrelated to morphology (Sproat, 1985; Cohn, 1989).

Examples (1-5) raise issues quite distinct from those associated with *unhappier* and *ungrammaticality*. Unlike these two cases, (1-5) do not represent theoretical problems and they consistently have at least two readings associated with the single syntactic configuration. We must proceed, then, on the assumption that scope ambiguities in attribute phrases are not in a class with morphological bracketing paradoxes.

1.2. Testing for Narrow Scope Readings

Now that we have seen what (1-5) do not represent, we need a means of determining what they do represent. The literature on attributive phrases provides three tests for narrow scope readings; this section will outline the tests briefly. Section 1.3 will then illustrate how they may be applied to detect the various scope ambiguities of English Adj + N constructions.

The first test for a narrow scope reading is the 'as a' test (Bolinger, 1967), which probes whether the attribute + noun construction has a paraphrase with as a inserted between attribute and noun. *Good athlete* usually refers to someone who is good as an athlete, rather than 'an athlete who is good (as a person)'. The test also applies to derived attributive phrases: a free thinker in the narrow scope sense is free specifically as a thinker. However, the test is not completely reliable. For example, the common narrow scope reading of *nuclear physicist* is not someone who is nuclear as a physicist (though I will claim below that this is a potential reading of the phrase).

If the 'as a' test does not work, one of two other tests usually does. The first of these is the adverb-predication test (Marchand, 1966). If the noun is cast as a predicate, in the narrow scope reading the adjective may qualify that predicate as an adverbal modifier: a *free thinker* is one who thinks freely, a *fuzzy thinker*, one who thinks fuzzily.

The third test is the 'inherent feature' test (Bolinger, 1967). If the semantics of the noun is based on some salient inherent property or relation, in the narrow scope reading the adjective may be predicated of that feature. For example, *lawyer* presumably must be defined in terms of its relation to the semantics of *law*. The adjective in *criminal lawyer* modifies this central inherent feature rather than the head noun as a whole, so that the phrase refers to someone who practices criminal law. Likewise, an *old friend* is someone involved in an old friendship, where FRIENDSHIP must be a feature of *friend*.

1.3 The Range of Adjective Types Involved in Attribute Scope Ambiguities

The tests described in section 1.2 allow us to identify the narrow scope readings of all types of attributive adjectives. The adjectives usually associated with bracketing paradoxes of the criminal lawyer type are Relational Adjectives (RAdj), the "nonpredicating adjectives" of Levi (1978). The morphological and syntactic behavior of RAdjs sets them off sharply from Qualitative Adjectives (QAdj)[1]. QAdjs accept intensifiers, compare, undergo derivation freely, and occur predicatively, as illustrated in (7a-d):

(7) a. a very nice budget
b. a nicer budget than . . .
c. the niceness of the budget
d. the budget is nice

RAdjs are immune to these modifications, as (8) shows:

(8) a. *a very national budget
b. *a more national budget than . . .

c. *the nationality of the budget
d. *the budget is national

Some confusion is created by the fact that ambiguities arise in identical constructions with QAdj and RAdj readings. *Criminal lawyer* is a classic example of the ambiguity arising from the QAdj-RAdj distinction. In the QAdj reading, the lawyer is criminal; in the RAdj reading the lawyer merely practices criminal law. Note that, "Her approach is very scientific" is acceptable because of potential QAdj readings of *scientific*. However, "*This journal is very scientific" is impossible due to the fact that the sense of *scientific* required here is that of the RAdj. "This journal is a scientific one," is acceptable because the pronoun, *one*, functions as a head noun, making the RAdj appropriately attributive.

Marchand (1966) discovered the same narrow scope readings among pure QAdjs modifying deverbal agentive nominalizations as are found with RAdj attributes. The adjectives in these phrases seem to compose with the underlying base of the derived noun rather than with the derived nominal as a whole:

(9) a. [free think]er
b. [slow learn]er
c. [fast walk]er
d. [tight pack]er
e. [willing programm]er
f. [defiant protest]er
g. [lopsided fly]er

A heavy smoker usually is not a smoker who is heavy but someone who smokes heavily (the adverb predication test). We must conclude then that any general solution to the problem of attributive ambiguity must not restrict itself to RAdjs alone.

The nouns and adjectives exemplifying bracketing paradoxes are usually derived; however, the same narrow scope relations also occur in phrases with underived adjectives and nouns (Bolinger, 1967). As (10) demonstrates, the three narrow scope tests apply equally well to attribute phrases, neither member of which is derived:

(10) a. old friend
b. good athlete
c. genuine poet
d. probable hero
e. former diplomat
f. sure champion

An old friend is a member of an old friendship; a good athlete is someone who is good as an athlete and a probable hero is someone who is probably a hero. Neither the attribute nor the head noun in the phrases of (10) is derived, yet the same sort of testable narrow scope reading is available for each of them. The wide scope reading is possible in (l0a-c) but not in (l0d-f).

However, the adjectives in (l0d-f) are well-known exceptions to the QAdj distribution pattern by virtue of their narrowly restricted uses, i.e. their exclusion from predicate position and their inability to be intensified or nominalized.

To conclude, the disambiguating tests of section 1.2 apply equally well to constructions with derived and underived head nouns and to those with relational and qualitative attributes. Thus these distinctions are orthogonal to the matter of scope. All these types of heads and attributes must be examined if we are to arrive at a solution to the problems posed by narrow scope readings.

2. The Failure of Previous Solutions

Certain types of ambiguity are explicable under the assumption of syntax-semantic isomorphy without any suggestion of a bracketing paradox. Consider, for example, (11a-b) and (12a-b):

(11) a. the old man and woman
b. Flying airplanes can be dangerous.

(12) a. scientific research
b. I am looking for a dog.

Examples (11a-b) illustrate structural ambiguities which may be explained in terms of syntax-semantic isomorphism: different syntactic structures correlate with different semantic readings. These examples have two underlying syntactic structures each and two corresponding semantic interpretations. Examples (12a-b) reflect differences in lexical or semantic categorization. *Scientific research* can be either research in science (the RAdj reading) or research which is characterized by 'scientificness' (the QAdj reading).

The English indefinite article a can refer to a specific or nonspecific category, so that *a dog* may be a specific indefinite animal or a nonspecific one. Bracketing paradoxes differ from (11) in that all readings share an identical structure. They differ from (12) in that they occur among both major categories of adjectives, QAdjs and RAdjs. We cannot, therefore, reduce the problem of scope ambiguities to variant structural interpretations, and it is unlikely that they may be resolved by categorization (see Bolinger (1967), Vendler (1968) and M. Siegel (1976) for attempts at the latter). The next two sections comment on two more recent approaches: structural reanalysis and proportional analogy.

2.1 Structural Reanalysis (Restructuring)

Bracketing paradoxes differ from the structural ambiguities of (11) in that pairs manifesting them have identical structure. These ambiguities cannot be resolved by structural reanalysis at any level, since they occur among phrases like (10a-f) with underived heads (Fanselow (1988, pp. 114-115) makes the same point). Hence structural reanalysis at any level is an inadequate resolution of the problems of attribute scope ambiguity. Moreover, constructions like (10a-f) are in fact multiply ambiguous, so that a simple restructuring analysis will fail to predict the entire range of potential narrow scope readings in attribute phrases. Consider criminal lawyer , for example:

(13) a. [criminal lawyer] 'a lawyer who is criminal as a person'
b. [criminal law]yer 'a person who practices law criminally' (i.e. 'who is criminal as a lawyer')
c. [criminal law]yer 'a person who practices criminal law', where
(i) ?the law is criminal (QAdj reading) or
(ii) the law merely pertains to crime (RAdj reading)

The narrow scope tests of section 1.2 commonly uncover four potential interpretations in constructions like criminal lawyer; three of them are not transparently compositional. In the wide scope interpretation (13a), *criminal lawyer* refers to someone who is criminal and coincidentally practices law. One narrow scope reading, (13b), refers to someone who practices law criminally in the literal sense or metaphorically (very badly). The curious aspect of this second narrow interpretation is that it depends on the same paradoxical bracketing configuration as the RAdj interpretation (13cii), 'practitioner of criminal law', in which the law merely pertains to crime. The third possible QAdj reading (13ci), also of narrow scope, derives from the fact that criminal is both an RAdj and a QAdj: criminal law as law which is criminal, either literally or in the metaphorical sense of 'very bad'.

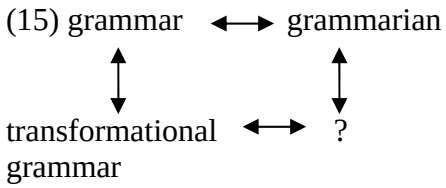
Thus structural reanalysis is inadequate to explain even those attribute phrases with derived constituents because the structure of derived attribute phrases can be reanalyzed only two ways while they regularly exhibit three-way ambiguity, aside from QAdj/RAdj polysemy. Example (13) demonstrates that attributive constructions containing an adjective with both QAdj and RAdj readings regularly have around four potential interpretations. While it is not easy to find individual adjectives which allow all four readings in sentences like (13), that all four are potential is demonstrated by the fact that attribute phrases with other adjectives, e.g. romantic novelist, have different gaps and may include the reading (c-i), questioned in (13):

(14) a. [romantic novelist] 'the novelist who is romantic as a person'
b. [romantic novel]ist 'a person who writes novels romantically' (i.e. 'who is romantic as a novelist')
c. [romantic novel]ist 'a person who writes romantic novels', where
(i) the novels are romantic$_{l,2}$ (contain romance$_{l,2}$) (QAdj
(ii) the novels' style or period is romantic

Example (14) further demonstrates that these four meanings are independent of any lexical polysemy, e.g. romance$_1$ 'adventure and intrigue' and romance$_2$ 'the tenderness of a love affair'.

2.2. Proportional Analogy

Spencer (1988) explores in detail a suggestion originating in Williams (1981) and Kiparsky (1983), that the analysis of bracketing paradoxes like (1)-(5) is a matter of proportional analogy, whereby *transformational grammarian*, for example, is licensed by the existence of *transformational grammar* and *grammarian*. Spencer proposes a "process of analogical backformation defined strictly over existing entries in the permanent lexicon, a novel type of productive word formation process" (Spencer 1988, 663). Narrow scope readings are licensed by a two-way lexical relation ship between idiomatic lexical listings such as that illustrated in (15):



Thus while Spencer's approach involves a rule operation, it rests on the assumption that only idiomatic, lexically listed attributive phrases are susceptible to attribute scope ambiguity.

Transformational grammarian may be idiomatic, as Spencer suggests, but the majority of attribute expressions with narrow scope readings are not. Examples (16) and (17) are open-ended lists of attribute phrases with multiple readings which may be extended by creatively substituting virtually any semantically suitable adjective:

(16) a. old friend
b. stalwart friend
c. weak friend
d. major friend

(17) a. electrical engineer
b. architectural engineer
c. fiber-optical engineer
d. ergonomic engineer

Since the same composition pattern is generally available to all Adj + N constructions, regardless of the subcategory of the adjective or its derivational status, no complete catalogue of expressions with narrow scope readings can be compiled. This is not to say that attribute phrases are immune to lexicalization; the output of every grammatical component is subject to idiomatization. Some Adj + N phrases have been lexicalized and are undoubtedly subject to special derivations like Spencer's. However, the entire issue of attribute scope ambiguity cannot be reduced to that of lexical storage. Although all idiomatic Adj + N phrases have narrow scope readings, it is not difficult to create contexts in which they may have productive narrow scope readings. For example, if some but not all grammars were capable of some transformation, say, a rapid historical change, transformational grammarian would be a transparent narrow scope appellation for a person who studies just those grammars which are transformational in this sense. Idiomaticity and narrow scope semantic interpretation therefore are dis crete phenomena, neither of which can be invoked to explain the other.

2.3. Conclusion

In conclusion, then, all structural approaches which reinterpret the relations of whole words or morphological parts of words fail to resolve the problems of attribute scope ambiguities for two reasons. First, attribute NPs containing an underived head offer no alternative structure. Second, even attribute NPs with derived constituents have more attribute scopes than potential

structures. Lexical approaches fail because narrow scope readings are productively available for all attribute phrases.

3. The Decompositional Composition Hypothesis

Uncovering the weaknesses of previous approaches in sections 1 and 2 has revealed a new aspect of the problem: attribute NPs have at least three potential narrow scope readings, apart from any differences attributable to lexical polysemy or RAdj-QAdj categorization. Comparing this insight with the three paraphrastic tests required to determine the range of narrow scope data suggests that the problem is a semantic, not a structural or lexical one. One test in particular, the inherent feature test, supports this interpretation, and further implies that the solution may involve sublexical semantic features.

This section will follow this lead and propose a semantic solution to the problem based on the semantic features of the constituents of attribute phrases. It begins by discussing three types of semantic fea tures required of lexical definitions in general and then demonstrates how scope within attribute NPs is determined by a single, consistent principle of semantic composition operating below word level.

3.1. The Lexical Semantic Framework

The semantic framework assumed here is roughly that of Jackendoff (1983; 1987), with irrelevant complexities omitted. Since this section deals exclusively with the semantic relationships of attribute composition, Jackendoff's superscript-subscript system for marking semantic relations has been replaced by a shorthand system in which features are marked for their argument positions by simple subscripts. Only when a feature has more than two arguments will the semantic relation of the argument be marked, again, in subscript. Thus [$ACTOR_X$ STUDY(XY) $PHYSICS_Y$] is the equivalent of [STUDY (ACTOR PHYSICS)].[2] But *flute* will have the features [$THING_Z$ $PLAY(XY_{INSTR}Z)$ $MUSIC_Y$], with the subscript INSTR(UMENT) indicating that its semantic relation (function) is that of an instrument for playing music. Much of the appeal of the semantic explanation offered by the hypothesis proposed in this article derives from the fact that it requires a simple theoretical apparatus with no special mechanisms at all, only a more refined notion of attribute composition.[3]

3.1.1. Three kinds of semantic features

Definitions of lexical entries will require category assignment, e.g. THING, ACTOR, EMOTION, ACTIVITY, a function indicator, e.g. CUT(XY), FRIENDSHIP(XY), STUDY(XY), and features representing properties which specify the category, e.g. LARGE(X), SHARP(X), RED(X), HUMAN(X), SUDDEN(X). (Notice that the terms 'property' and 'function' here refer only to natural, not logical, properties and functions.) While every lexical item may not contain all three types of features, these are the most salient types of definitional features that determine definitions as a class.

Assume further with Jackendoff that semantic categories are conceptual. Since lexical features represent conceptual categories, the fact that they are expressed syntactically by an English noun, verb or adjective is of no consequence. Functional concepts frequently cannot be divided neatly into predicates and terms, e.g. *love, fear, murder* are expressed as well by lexemes

of one category as the other. For this reason, and also to maintain strict autonomy of syntax and semantics, only nouns and verbs will be used to label semantic features in the remainder of this article and no significance is attached to the labels' belonging to one syntactic category or the other.

Thus the propositional relation [STUDY(ACTOR PHYSICS)], for example, will be the semantic representation of either 'someone (who) studies physics' or 'the study of physics by someone'. The intensions of reiational nouns like *friend* and *mother* will be considered function specifiers of the word at the conceptual level and treated propositionally like verbs, i.e. FRIENDSHIP(XY), MOTHERHOOD(XY), capable of functioning as terms or predicates. These concepts are comprehensible as 'X friendships Y' and 'X motherhoods Y', respectively, and are justified by various syntactic realizations, e.g. 'X (be)friends Y', 'X is friends with Y', 'X is friendly toward Y'.

One notational innovation will be introduced for the sake of consistency. Abstract properties (qualities) are usually symbolized as predicates, e.g. BLACK(X), while concrete properties, such as physical parts, are expressed as variables of some semantic operator like HAVE(X), WITH(X), or POSSESS(X), e.g. POSSESS(BLADE), a feature of *knife*. BLACK(X) is an inherent property of *crow* in the sense that *crow* cannot be fully defined without it. BLADE and *knife* enjoy this same conceptual relation. A blade is something which a knife must possess in order to be a knife; it is an inherent, definitional property of knives.

Because the properties of categories play such a crucial role in lexical definitions, it will be necessary in the following arguments to be able to refer to the 'property of ' relationship in a consistent, unitary fashion. Converting nouns like BLADE to adjectives, e.g. BLADED(X), would provide such consistency (cf. BLACK(X)). However, using the syntactic category 'adjective' to do the work of distinguishing properties from functions and categories is an artifice which misses a crucial semantic generalization: the relation of all properties to the categories which they specify is the same, whether they are concrete or abstract, expressed by adjectives or by nouns.

In keeping with the attempt to represent definitions as nonsyntactically as possible, and to represent all properties, concrete and abstract, identically, all category properties will be labeled by English nouns and their arguments will be marked by curly brackets, e.g. BLACKNESS{X}, SHARPNESS{X}, THINNESS{X} and BLADE{X}, HANDLE{X}, POINT{X} (see also Givón (1970, pp. 820-821)). From this point on, therefore, X(Y) will represent ordinary predicate/argument structure, used lexically to symbolize the functions of defined concepts, while X{Y} will exclusively symbolize the 'property of ' operator critical for specifying categories in lexical definitions.

3.1.2. Justifying the three feature classes

There is little question that the category of a lexical item must be specified in its definition. The category specifier in the following definitions will refer to what Jackendoff calls the 'primitive conceptual categories' of semantics, e.g. THING, ACTOR, and INSTRUMENT. They are further justified by their involvement in lexical derivation across languages, as in the agentive and instrumental nominalizations.

The idea of function specifiers in the definitions of verbs is not new; it remains to motivate their existence in the definitions of nouns. Kiparsky (1983, pp. 14-15) discusses some data relevant to this point. Kiparsky pointed out that when verbs are derived from nouns referring to

instruments, some inherit the full meaning of the underlying noun while others do not. *(To) pencil* is an example of the former; one can pencil something in only with a pencil. The verbs in (18) are examples of the latter in that they do not imply the use of the instrument referred to by the noun from which they were derived, as the instrumental PPs demonstrate:

(18) a. He brushed his coat with his hand.
(18) b. I paddled the canoe with a copy of the New York Times.
(18) c. He combed his hair with his fingers.

Kiparsky took this loss of specificity in the verbs in (18) to signify that they have become lexicalized and have to be listed in pairs with their corresponding noun, i.e. $brush_N$ and $brush_V$. A closer examination of Kiparsky's examples, however, reveals another possible analysis which is more in keeping with their high productivity. If instrumental nouns possess function specifiers such as DO(XY), it becomes easy to predict the sense of Kiparsky's verbs from their base. Begin with the natural assumption that the definition of the noun *hammer* is, roughly, [$INSTRUMENT_Z$ POUND($XY_{INSTR}Z$) HEAD{Z} HANDLE{Z}]. Assuming further that the derivation process in this instance is semantically vacuous, as the morphology indicates, the simplest explanation of Kiparsky's pairs is that the category and property specifiers are ignored when the noun is used in verbal contexts. If so, the predicted meaning of the verbal derivation can only be the function specifier of the noun. Thus, *(to) hammer* will mean 'pound', *(to) brush* will mean 'wipe (with the intent of removing)', and so on. If we assume further that the features other than the function specifier are not deleted during derivation, they automatically remain to define the default instrument, so that *he hammered in the nail* will mean, ceteris paribus, that he pounded it with a hammer.

The notation of the property specifier, Q{X}, represents a new symbolism for an old and widely accepted semantic relation, Inalienable Possession, motivated in Fillmore (1968, pp. 61-81) and Beard (1976). It is simply the relation between a property and any category which cannot be defined without it. Fillmore cited syntactic selection restrictions on nouns in a wide variety of syntactic structures in many languages which require the distinction between objects which are 'alienably' and 'inalienably' possessed. For example, in English one may say, 'I have a missing tooth', but not, '*I have a missing five-dollar bill', even though, 'I am missing a tooth/a five-dollar bill', are grammatical. One may say, 'The knife has a missing blade', but not, '*The knife has a missing holster', even though 'The knife is missing its blade/holster', are acceptable. The reason is that *have* can be used in the former constructions only if the possessed object is an inalienable possession, a definitional property of the possessor.

Qualitative genitive noun phrases of the form NP + of + NP represent another set of syntactic structures which manifest the relation of inalienable possession. Note that the second NP in (19a-c) must be an inalien able, definitional property of the head noun:

(19) a. a man of honor
(19) b. a woman of great intellect
(19) c. a person of questionable character

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Corresponding paraphrases like *a man who has honor, a woman who has a great intellect, a person who has a questionable character*, might seem to suggest that the relation is simply possession. However, it is not possible to express all forms of possession in this way:

(20) a. *a man of automobiles
(20) b. *a woman of great children
(20) c. *a person of questionable investments

In all these examples and many others cited by Fillmore and Beard, lexical selection is crucially determined by an inherent property of the possessor. It is this relation, that of an obligatory, definitional property, which the formalism Q{X} symbolizes.

3.2. The Principle of Decompositional Composition

Assuming the three kinds of features discussed in the previous section, we may now introduce a provisional definition of the Principle of Decompositional (Featural) Composition:
(21) The semantic features of an attribute subjoin with one and only one semantic feature of its head.

'Attribute' includes at least RAdj and QAdj quantifiers in H_{NP}Spec position and 'head' may be filled by any noun in an attribute NP phrase. 'Subjoin' means 'serve as a predicate or argument of '.

The point of (21) is that the semantic features of an attribute do not form a union with the features of the head, not even for the wide scope interpretation. Instead, within certain limitations, the features of the attribute serve either as a predicate (if it is a QAdj) or as an argument (if it is an RAdj) of the feature of the head which they select (section 4 provides details). Scheme (22), for example, represents the basic semantics of the phrase *old friend*. Since old is a QAdj, its meaning, OLDNESS{Z}, will compose with that of friend as a property, not of the entire semantic feature inventory of friend , but of just one of its features.[4] Assuming the definition of friend to be, roughly, [$ACTOR_X$ FRIENDSHIP(XY)], oldness may be predicated of either ACTOR or FRIENDSHIP:

(22) old friend

(23) a. [OLDNESS {$ACTOR_X$} FRIENDSHIP(XY)] 'an old actor in a friendship'
(23) b. [$ACTOR_X$ OLDNESS {FRIENDSHIP(XY)}] 'an actor in an old friendship'

When *old* is predicated of the category specifier, ACTOR, the resultant reading is 'an old actor in a friendship' (23a, antonym: *young friend*). If the meaning of old composes with FRIENDSHIP(XY), the result is 'an actor in an old friendship' (23b; antonym: *new friend*).

It is this latter composition with its noncategory-specifying semantic feature that lends the construction its narrow scope reading. The transparency of wide scope readings derives from the fact that the attribute specifies a feature which does not conflict with the category of the reference of the whole NP; it composes with the category feature of the head noun, ACTOR, and the NP as a whole refers to a category of ACTORs. The opacity of the narrow scope reading derives from a conflict between the reference of the feature with which the attribute composes and that of the NP as a whole. The narrow scope attribute composes with a covert, i.e. nonreferential feature, a feature whose reference is an abstract relation, while the NP as a whole refers to a category of concrete objects, ACTOR.

Evidence that the attribute in (22) does not form a union with the noun but subjoins with one feature of it in accordance with (21) is found in the fact that the wide scope interpretation contains no inference as to the longevity of the friendship, even though FRIENDSHIP must be part of the meaning of *friend* as a whole. *Old friend* (not *young*) does not imply that the friendship is old, only that the person is. Ten-year-old friends are not old people but two ten-year-olds could be old friends (not new) in the narrow scope reading if they have been friends most of their lives. However, it is impossible for old friend to refer simultaneously to an old person and an old friendship, which would result from the union of all the adjective and noun features.

Further evidence that attributes do not subjoin *in toto* with the features of their heads comes from the fact that the concatenation of identical attribute tokens does not result in semantic intensification as described in Beard (1976). The Principle of Semantic Intensification provides simply that the meanings of reiterated attributes accumulate with the effect of intensification; thus, a *red, red rose* means 'a very red rose', a *sad, sad, sad man* means 'a very, very sad man'. This feature accumulation is also a decompositional semantic process, for it operates equally well without the repetition of actual lexemes; only the repetition of a semantic feature is required.

If the semantics of an attribute is included in the meaning of the head, a single occurrence of that attribute results in semantic intensification. *Readable handwriting* means simply [CAN(READ(X HANDWRITING))], where *readable* adds [CAN(READ(XY))] to the composition. A *readable book*, however, is a 'very much able to be read book' and hence more readable than other (also presumably readable) books. This interpretation results from the adjective's repetition of the function specifier [READ(XY)] of the definition of book: [THING_{Y} READ(XY) ...]. The semantic result of composition here is [THINGy READ(XY) CAN (READ(XY)) ...], i.e. 'an object which is read which can be read'. The composition, by the Principle of Semantic Intensification, is interpreted as 'a very readable object', cf. also *playable piano* vs. *playable wash-board*, *drinkable wine* vs. *drinkable water*, *singable song* vs. *singable poem*). Thus two overtly or covertly represented semantic features are equivalent to one such feature intensified. An *old old friend* (as distinct from an *old, old friend*), however, has discrete readings for each instance of *old*. In the first instance it is the antonym of new and in the second, the antonym of *young*, cf. its antonym, a *young new friend*.

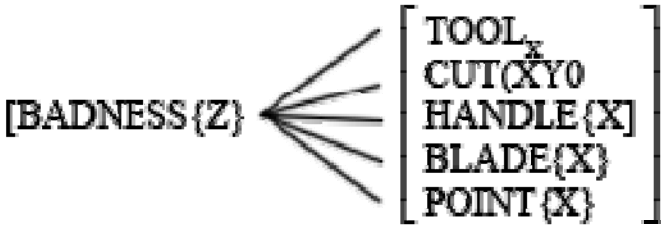
It is not possible to explain such different interpretations of *old* in terms of bracketing, i.e. [old [old friend]] vs. [old old [friend]], since the different meanings of *old* do not correlate with unique structures. Here the one attributive meaning [OLDNESS{X}], 'a chronologically extensive existence (relative to X)', combines twice with one noun meaning to create two discrete semantic structures. Nor do the two separate antonyms new and young signify that *old*

represents a pair of homophones, for the same observation applies to all repeated attributes: a *criminal criminal lawyer*, a *moral moral philosopher*, the *first first violinist*.

The problems discussed by Katz (1964) on the scope of evaluative qualifiers can also be explained by the Principle of Decompositional Composition in (21). To solve a wide range of problems in defining the word *good* which were raised originally by Ziff (1960), Katz claimed that nouns have an EVALUATION MARKER with which the semantic feature of evaluative adjectives, in his view simply '+ ' or '-', composes. The semantics of *good* does not compose with that of the head noun as a whole but only with its evaluation marker. On Katz's reading, *good knife* refers to a knife which specifically cuts well. This is because, for Katz, *knife* has a particular evaluation feature, [CUTS OBJECTS SOFTER THAN ITSELF], which may be positively or negatively specified by evaluative adjectives like *good* and *bad*. Evaluative adjectives hence are syncategorematic in that their meaning is relative to the evaluation marker of the noun with which they compose. Saying That a knife is good indicates '+[CUTS OBJECTS SOFTER THAN ITSELF)'; saying That a knife is bad specifies '-[CUTS OBJECTS SOFTER THAN ITSELF]'.

According to (21), however, evaluative adjectives predicate their properties of any single feature of the head noun. In the case of Katz's examples, *good knife* and *bad knife*, therefore, the positive and negative evaluation should be predicable of every inherent property of knives, not just their cutting efficiency. If Katz's example, *bad knife*, is semantically represented as in (24), then the negativity implied by *bad* should be predicated of each individual property category of knife and all of the inferences of (25a-e) should hold:

(24) bad knife



(25) a. This is a bad knife; you can't do anything with it: [BADNESS{TOOL}...]
b. This a bad knife; the handle is cracked: [BADNESS {HANDLE} ...]
c. This a bad knife; the blade is already rusting. [BADNESS {BLADE} ...]
d. This is a bad knife; the point is broken off. [BADNESS {POINT}...]
e. This is a knife; it wouldn't cut hot butter. [BADNESS {CUT(XY)} ...]

Examples (25a-e) demonstrate that in asserting a knife to be good or bad, a speaker may be claiming that any of its inherent properties is positive or negative in its nature or function.

A knife may be used for activities other than cutting, e.g. opening cans; however, *good knife* alone does not imply that a knife opens cans well. Rather, it implies positive values for all the properties listed in (24). In order to express evaluation of the head noun with respect to a noninherent property, that property must be overtly expressed in a second attribute, as in 'This is a good can-opening knife', or a *to/for* (purpose) complement: 'This knife is good for opening

cans.' Thus, the fact that other interpretations for *good/bad knife* are available with external complements does not imperil (21); indeed, these interpretations assist in verifying the number and nature of a word's semantic features.[5]

Decompositional attribute composition seems, in fact, to be available to all QAdj + N constructions with few exceptions. Consider, for example, the narrow scope reading of *free thinker*. In this phrase, the freedom of the thinker is predicated of the function specifier of thinker, which designates the activity of thinking, rather than of the category specifier, ACTOR. Hence the relation *free : thinker* is the same as that of *good : thinker* in the more common usages of these expressions. In both cases the narrow scope relation results from the kind of feature with which the qualifier composes, not from differences in structure, category, or lexical meaning, as (26) and (27) further illustrate:

(26) free thinker

$$\begin{bmatrix} \text{ACTOR}_X \\ \text{FREEDOM}\{Z\} \\ \text{THINK}(X) \end{bmatrix}$$

(27) a. [FREEDOM ACTOR_X} THINK(X)] 'a free person who thinks'
(27) b. [ACTOR_X FREEDOM {THINK(X)}] 'a person who thinks freely'

While a function specifier [THINK(X)] in deverbal nominalizations like *thinker* is overtly marked in the derivation and hence obvious, the evidence of function specifiers in denominal nominalizations like *lawyer*, *novelist*, *physicist* is just as robust. Without them, we would have no explanation of the interpretations of such derived phrases as *prolific novelist*, *reluctant novelist*, and *cautious novelist*, namely, 'a person who writes novels prolifically', '. . . reluctantly', '. . . cautiously'. The acceptability of these read ings and their productivity suggest that [WRITE(XY)] must be the function feature of novelist , so that we get a composition like (28):

(28) prolific novelist

$$[\text{PROLIFICITY}\{Z\}] \times \begin{bmatrix} \text{ACTOR}_X \\ \text{WRITE}(XY) \\ \text{NOVEL}_Y \end{bmatrix}$$

Within Spencer's framework, which relies on lexicalized underlying phrases to explain narrow scope readings, these expressions would be impossible given the absence of the underlying phrases **prolific novel*, **reluctant novel* and **cautious novel*. The lack of ambiguity in *prolific novelist* is irrelevant since similar NPs, e.g. *romantic novelist*, do manifest scope ambiguities, as (29-30) illustrate:

(29) romantic novelist

$$[\text{ROMANCE}_{1,2}\{Z\}] \times \begin{bmatrix} \text{ACTOR}_X \\ \text{WRITE}(XY) \\ \text{NOVEL}_Y \end{bmatrix}$$

(30) a. [$ROMANCE_{1,2}$ {$ACTOR_X$} WRITE(XY) $NOVEL_Y$] 'a romantic person who writes novels'
(30) b. ?[$ACTOR_X$ $ROMANCE_{1,2}$ {WRITE(XY)} $NOVEL_Y$] 'a person who writes novels romantically'
(30) c. [$ACTOR_X$ WRITE(XY) $ROMANCE_{1,2}$ {$NOVEL_Y$}] 'a person who writes romantic novels'

Assuming either meaning of romance, 'characterized by adventures' or 'characterized by the tenderness in love affairs', [ROMANCE{Z}] composes transparently with either [ACTOR] or [NOVEL]. Only the former sense of romance may subjoin with [WRITE(XY)] nonanomalously, i.e. 'to write adventurously'.

3.3. Proper Nouns and Ordinal Numbers

Since the Principle of Decompositional Composition sanctions the predication of an attribute to only one out of the total set of features of the head noun, a natural question is what happens if a member of an attribute phrase has a defective or otherwise unusual set features, as in the case of proper nouns and ordinal adjectives.

Composition with proper nouns, e.g. *Big John*, *Ivan the Terrible*, is unproblematic. Names of people presumably have no properties and only two relevant semantic constituents, [name of (X) $ACTOR_X$] , Here [name of (X)] represents a labeling device for proper terms, rather than a descriptive semantic feature, and hence cannot compose with semantic features. *Big*, *terrible*, etc., therefore, can only compose with ACTOR. West German, Communist Chinese, and the like present only slightly more complexity in that they are derivatives of proper geographical names, West Germany, Communist China, etc., differentiating a geographic part of Germany and a historical stage of China. Take Communist Chinese, for example. The orignative derivation adds, roughly, [$ACTOR_X$ FROM(XY)], to the proper name, [NAME-OF(Y) PLACE(Z)], to produce [$ACTOR_X$ FROM(XY) NAME-OF(Y) $PLACE_Y$(Z)], where Z represents the complex knowledge speakers have of China. Thus (21) predicts that Communist Chinese may refer to a communist person from China, a person from the communist place called 'China', or a person from the place called 'China' associated with communism in some other way. All these readings obtain.

Ordinal adjectives in English also combine with selected head noun features as predicates in accord with (21). The *first runner* might be the first person in a queue of runners or someone who runs first. The first author of a thriller is either the first in a succession of people, all of whom have written a thriller, the person who first wrote a thriller or the person who authored the first thriller. Even the difference between *the first house* and *her first house* is accounted for by (21), assuming that the definition of *house* is something like [$DOMICILE_Y$ LIVE IN(XY) $ACTOR_X$]. The first house on the street refers simply to the first domicile in a row while her first house refers to the house she first lived in. Moreover, assuming the idiomatic reading of *First Family*, the *First House* is a possible descriptive alternative for the *White House*, i.e. the domicile lived in by the 'First Actors'.

3.4. Conclusion

The evidence presented thus far suggests that both wide and narrow scope readings of attribute phrases like *nuclear physicist*, *free thinker*, and *old friend* result from attributes

subjoined to individual semantic features of the head noun, rather than from categorial differences or differences in mapping operations between syntactic and semantic structures. Wide scope readings are simply attributes which compose with the feature specifying the major category to which the referent belongs. Narrow scope readings result from attributes which compose with nonreferential features of the head noun. The semantic process involved in wide scope composition thus differs in no way from that which produces narrow scope interpretations. This approach accounts precisely for the range of interpretations which may be assigned to attribute phrases.

4. The Qualitative/Relational Adjective Distinction

Section 3 demonstrated the effectiveness of decompositional composition in explaining the scope ambiguities of QAdjs. In this section we will see how decompositional composition contributes to the solution of a classic problem of morphology: the constraints governing the distribution of QAdjs and RAdjs as described in section 1.3.

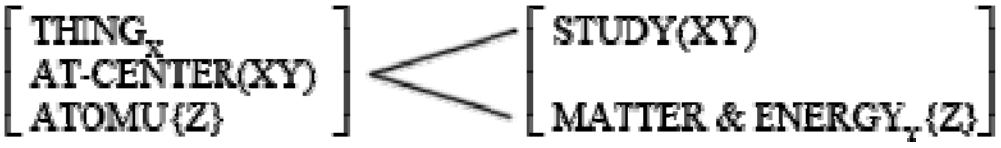
4.1. RAdjs and Inherent Functions

We have seen that the meaning of an adjective may compose with any logically compatible feature of its head noun, but little has been said about just how the distinction between QAdjs and RAdjs is determined. The definition of 'subjoin' in (21) was 'serve as either a predicate or argument of ' the selected feature. The referential capacities of the two basic types of adjectives, QAdjs and RAdjs, are controlled by the choice between subjoining as a predicate or as an argument: QAdjs subjoin as predicates, RAdjs as arguments. This may be stated as a revised definition of the Principle of Decompositional Composition (31):

(31) a. The semantic features, Q, of a QAdj in an attribute phrase, QAdj + N, serve as a predicate to one and only one semantic feature of its head.
(31) b. The semantic features, R, of an RAdj in an attribute phrase, RAdj + N, serve as an argument to one and only one semantic feature of its head.

Let us assume the classic definition of physics, the study of (the) matter and energy (of Z)', i.e. [STUDY(XY) MATTER & $ENERGY_Y${Z}]. Assume further that the definition of nucleus must refer to the central location of the nucleus in order to account for, e.g. a nucleus of researchers = the nuclear group of this project. Finally, let us assume that the RAdj *nuclear* is derived from *nucleus* via an adjectivization process which has no semantic effect on the base.[6] Complete definitions of nuclear physics and nuclear physicist[7]

(32) nuclear physics



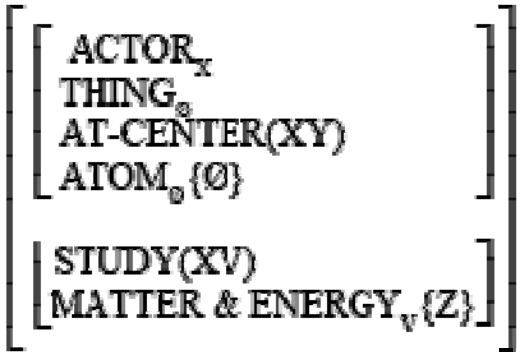
(33) nuclear physicist

Let us begin with the QAdj interpretation. Definition (32) predicts that *nuclear physics* will have at least two potential readings, namely, 'a nucleus study of matter and energy' and 'a study of nucleus matter and energy'. *Nuclear physicist* will have at least three QAdj meanings, two based on the meanings inherited from nuclear physics plus one based on the additional function added by the agentive nominalization which semantically designates an actor:

(34)
a. a nucleus (central) person studying matter and energy
b. a person of a nucleus (central) study of matter and energy
c. a person studying nucleus (central) matter and energy where the matter and energy is nuclear in the sense of 'central'

The QAdj senses (34a-c) are derived from subjoining one of the features of the QAdj, [AT-CENTER(XY)], i.e. 'central', to the selected head noun feature as a qualifying property of that feature.[8] In the case of the most obvious potential wide scope reading, 'a central actor in physics', the adjective feature subjoins the major categorial specifier, ACTOR. The composition of the semantics of nuclear with the feature ACTOR could be represented as in (35):

(35) nuclear physicist



The sense in which a physicist can be nuclear to the study of something involves subjunction with the feature [AT-CENTER(XY)]; that is, a nuclear person is someone who is central to, i.e. at the center of some undertaking.

Let us turn now to the RAdj reading of nuclear physicist: 'a person studying the matter and energy of the nucleus'. This reading may be rendered in features as [ACTORx STUDY(XY) MATTER & ENERGY{NUCLEUS{Z}}Y]. The crucial implication in this RAdj + N com position is that the matter and energy do not have any of the properties of a nucleus, but rather are properties of the nucleus themselves. QAdjs and RAdjs are, therefore, identical in their composition with one feature of their head. The semantic distinction between QAdj and RAdj attributes lies in the ability of RAdjs to find a function feature with an available argument, which it fills. QAdjs, on the other hand, serve as predicates to the feature which they select.

Other RAdj + N attribute phrases reflect the same relation as *nuclear physicist*. The national budget is the budget of the nation. Assuming that a budget is someone's plan of the economy of something, i.e. [PLAN(XY) ECONOMY y{Z}], the national budget is someone's plan of the economy of the nation, i.e. [PLAN(X ECONOMY{NATION})]. The remaining argument position (X) may be linked externally to other RAdjs like congressional, presidential, or possessive forms like *Obama's*. *National* cannot be predicated of *budget* because a nation cannot be a property—inherent or otherwise—of budget, thereby explaining the unacceptability of QAdj reading *the budget is national.

Electrical engineer is another ambiguous NP. Aside from the two metaphorical QAdj readings of 'an engineer who is electrical' as a person or as an engineer, there is an RAdj + N reading, 'one who engineers (plans) electricity': [ACTORx ENGINEER(XY) ELECTRICITY y]. The nominal concept ELECTRICITY underlying the RAdj electrical becomes an argument of some feature of the meaning of engineer; in this case it is the function specifier. Casting *electrical* as a predicate, ELECTRICITY{X}, of any of the possible semantic features of engineer results in (metaphorical) QAdj readings: 'a person with electricity (who is electrical) who engineers' or 'a person who engineers with electricity (electrifyingly)'. Whatever the features of the definitions of the head nouns in these constructions, the consistent distinction between QAdjs and RAdjs is that the former take some feature of their head noun as an argument while the latter serves as the argument from some feature in the semantic inventory of its head.

This account also explains many if not all of the distribution restrictions of RAdjs. An attribute which subjoins as a predicate should exhibit the grammatical properties of predicates; one which subjoins as an argument would be expected to have the properties of a term. If the base of RAdjs must be a term, it must be a nominal; thus, RAdjs should all be based on nouns, which is the case. RAdjs are also not comparable or intensifiable, since referential terms are not normally subject to these operations: **John likes (the) very much a girl*, **John likes (the) more girl than (a) woman*. Predicates as a class, on the other hand, do compare whenever referentially feasible: *John very much likes the girl, John likes the girl more than her sister*. It is quite natural, then, that the QAdjs are subject to all these operations: *John is very tall*, *John is taller than the girl*.

4.2. Deverbal Nominalizations

Deverbal nominalizations provide a good test of (31b), since the underlying verb in such nominalizations always has a propositional structure. The literature on nominalization makes it clear that RAdjs such as those in function as an argument, not property, of deverbal nominals:

(36) *regional support, departmental maintenance, managerial discovery, congressional investigation, institutional review, presidential oversight, American destruction, foreign investment*

The phrases in (36) exemplify nominals based on verbs with two-place predicates modified by attributive RAdjs whose underlying term may serve as either argument. Thus *regional support* can be support of some region, [SUPPORT (X REGION)], or support by a region, [SUPPORT (REGION Y)]. *Departmental maintenance* could refer to the maintenance of the department, [MAINTAIN(X, DEPARTMENT)], or the department's maintenance of some unspecified thing, [MAINTAIN(DEPARTMENT Y)].

With other nominalizations, RAdjs seem to be excluded from either the internal (37a) or the external argument position (37b):

(37) a. *presidential statement/directive, national expectations, mayo ral decision, managerial pronouncements, bureaucratic waste, Japanese investment, senatorial debate*

(37) b. *environmental protection, dental check(up), lexemic/lexical listing, urban renewal, organizational restructuring, budgetary calculation, mayoral election, industrial reorganization, capital investment*

In most cases the reason why the attribute meaning is prohibited from one argument position is obvious: the first argument requires animacy, while the second requires nonanimacy. A relatively small subset of RAdj + N constructions, for unclear reasons, exhibit unpredictable preferences for the first or second argument, e.g. *maternal love*, *managerial change*, *American defeat*. To pursue the issue would exceed the scope of this article, however, so this problem will be left for future research.

To conclude, then, RAdjs are distinguished consistently from QAdjs in two respects. First, QAdjs are restricted to the property/category relation, symbolized here by the notation, Q{X}, where Q is the property and X is the category that it inherently characterizes. This means that QAdjs in attribute position add their features as inherent properties to the features of their head noun. The function of *red* in *red car* is to reduce the referential scope of *car* to the subset of all red cars, where REDNESS{X} is the same type of inherent property as those internal to the definition of *car*, i.e. HOOD{X}, MOTOR {X}, FENDER{X}. RAdjs are underived referential terms marked vacuously by morphology. Also, RAdjs, after selecting the feature of the head noun they wish to compose with, serve as an argument, not predicate, of that feature. It follows that RAdjs must select features which are potential functions, not pure terms, and that the feature selected must have an argument position not filled within the semantic feature inventory nor linked elsewhere outside the inventory.

4.3. RAdjs and Virtual Functions

The hypothesis that RAdjs compose as arguments of inherent features of the head noun in attribute phrases is, unfortunately, inadequate to explain the full range of RAdj data. The array in (38) introduces examples of RAdj + N attribute phrases whose meanings cannot be explained in terms of the base noun underlying the RAdj serving as an argument of a function feature of the head. Each RAdj is listed with its gloss, showing that the interpretation is the function of an operator which is not an inherent feature of the head. The third column demonstrates that we are indeed dealing with RAdjs, and not QAdjs:

(38)	RAdj	Gloss of RAdj	QAdj Test
a.	musical clock	makes music	*the clock is musical
b.	electric clock	uses electricity	*the clock is electric
c.	theatrical dancer	dancer in the theater	*the dancer is theatrical
d.	presidential matter	matter for the president	*the matter is presidential
e.	Dalmatian wine	wine from Dalmatia	?the wine is Dalmatian

Marchand (1965) noticed that some RAdjs are distinguished from QAdjs by their lack of a VERB NEXUS, i.e. a semantic function which renders their relation to their head noun transparent. Clocks do not make music or anything else by their nature, i.e. by definition. The semantics of the noun clock is roughly, [MECHANISM$_X$ CALCULATE(XY) TIME$_Y$]. A musical clock therefore cannot be a clock which produces music inherently, so the QAdj reading is prohibited. This is demonstrated by the unacceptability of the adjective in predicate position: **The clock is musical*. *Musical clock* merely identifies a subset of clocks by some ancillary, not inherent, ability to make music.

The function features of the examples discussed in the previous section are inherent in the sense that no definition of the word in question is conceivable without reference to these features. It is impossible to define *physics*, for example, without referring to *matter* and *energy*. Inherent features consistently crop up in metaphorical usages, as in the meaning of *nuclear group*, a central subgroup. Virtual functions are distinguished from inherent functions in that they are not essential to the definition of the noun they belong to. The definition of a clock is not dependent upon references to .the production of music or consumption of electricity although these may be alienable properties of subsets of clocks. Hence [MAKE(XY)] and [USE(XY)], required by the definition of *musical clock* and *electric clock*, respectively, would be examples of virtual functions.

It is not clear that virtual functions can be defined. The problem is that the suffix *-al* does not consistently mean 'make' and nothing else in the expression accounts for the missing function. So how do we go about establishing that the functions for which *musical* and *electric* serve as arguments are, in fact, [MAKE(XY)] and [USE(XY)] rather than, say, [PRODUCE(XY)] and [OPERATE ON (XY)]?

Levi (1978) and Warren (1984) have argued convincingly that the RAdj functions may be reduced to a small number of high-level semantic categories, which Levi labels CAUSE, HAVE, MAKE, USE, BE, IN, FOR, FROM, ABOUT, and attributes of ACT, PRODUCT, AGENT and PATIENT NOMINALIZATIONS (Levi 1978, pp. 279-284)). If Levi's and Warren's positions hold, we could probably make the case that RAdjs with virtual functions behave essentially like those associated with inherent functions. Since all RAdjs under the hypothesis outlined here are by definition semantically empty variants of their underlying nominal bases, listeners must supply a function relating them to their heads. If an available argument position exists in the semantic feature inventory of the noun, the listener links the term underlying the RAdj to it by (31b), as in the semantic reading [MATTER & ENERGY{NUCLEUS}] of *nuclear physicist* above. If no such inherent function is available, the speaker assumes one of Levi's or Warren's high-level categories which fits the pragmatic situation.

Some rather weak evidence for this account is found in the paraphrases of the two types of RAdjs. Since they represent additional semantic prop erties beyond those found in the definition of the RAdj (or its head noun), virtual functions can only be paraphrased by supplementary lexical items (NEXI in Marchand's terminology), such as those emphasized in (39):

(39) a. electric clock clock using electricity
b. musical clock clock making music
c. theatrical dancer dancer in the theater
d. presidential matter matter for the president
e. Dalmatian wine wine from Dalmatia

RAdjs which serve as arguments of inherent features take their relation to the head noun from its semantic argument structure, so the relation of their base to the head noun may be marked by the empty case marker of in paraphrase:

(40) a. nuclear physics physics of the nucleus
b. national budget budget of the nation
c. electrical engineer engineer of electricity
d. presidential statement statement of the president
e. congressional investigation investigation of the congress

All the questions surrounding RAdjs cannot be fully resolved here. What is important is that an RAdj which does not serve as an argument of an inherent feature in the inventory of the head noun it modifies serves as an argument of some function selected from an outside source. Whatever the origin of these virtual functions, the RAdj is always one of its arguments. So long as the relation of virtual functions to RAdjs is consistent with that of inherent functions to RAdjs, (31b) need be only slightly extended to (3lb'):

(31) b'. The semantic features, R, of an RAdj in an attribute phrase, RAdj + N, serve as an argument to one and only one semantic feature, X, of its head, or of a virtual function, Y, supplied from a yet undetermined source.

RAdjs are a problem for any theory of attribute composition. The Principle of Decompositional Composition, however, places them in a new light, which should contribute to a final resolution of the questions surrounding them.

4.4. Conclusion

The traditional division of adjectives into qualitative and relational categories is motivated semantically as well as distributionally. However, this division is not based on intensional and extensional definitions, but rather on semantic structural relations. The readings of QAdjs and RAdjs hinge on predicate-argument relations which arise between the attributive adjective and semantic features of the head noun. Specifically, the relation of a QAdj to the features it selects in the head noun of attributive phrases is that of a predicate to its argument. The relation of an

RAdj to the head noun feature it selects is that of an argument to its predicate. Both types of composition result in narrow scope interpretations. This further confirms the earlier conclusion that scope ambiguities are not a function of attribute categorization.

5. Constraints on Compositional Composition

The application of the Principle of Decompositional Composition to attribute phrases is not without its limitations. This section is devoted to exploring these limitations. We will see that they are sufficiently circumscribed so as not to jeopardize the principle.

5.1. Semantic Anomaly

Some attributes do not compose with certain types of features because the result would be semantic anomaly. The QAdj *tall* in *tall friend* does not combine syncatgorematically with [FRIENDSHIP], as does *good* , *old* , and *close*, because the abstract concept, FRIENDSHIP, lacks the physical dimensions required of this QAdj's reference. Since agents do have physical dimensions, *tall* composes only with the categorial feature [ACTOR] in the definition of *friend*. To give another example, *red pencil* may refer to a thing which is red and writes or a thing of any color which writes red ('which pencils red'). Assuming that the semantic description of pencil is [$THING_Z$ LONGNESS{Z} THINNESS{Z} LEAD{Z} WRITE ($XY_{INSTR}Z$)], the semantic features of *red* may combine nonanomalously with the three nonqualifying features, THING, LEAD{Z}and WRITE($XY_{INSTR}Z$). Composition with [LONGNESS{Z}] and [THINNESS{Z}] is impossible due to the semantic anomalies it would create.

5.2. Preferential Feature Selection

Adjectives of measure and shape are subject to a restriction which might be called PREFERENTIAL FEATURE SELECTION. These adjectives subjoin preferably to some predominant property of their heads. *A big house*, for instance, is never a house simply with big windows or doors. *A tall tree may* be a tree with a tall trunk or crown, but not branches or leaves. *A round house* is not a house with round windows, although it might be one with only a round roof. *A long knife* more likely has a long blade than only a long handle although it is possible to refer to a knife with a long handle and a short blade as a 'long knife'.

Color terms behave similarly. For example, a house with red windows is not referred to as a *red house*, even though a red pencil is red by virtue of having either a red lead, sheath or by writing in red. Color terms are also subject to semantic resolution rules of some sort where multicoloring is involved, probably also based on preferential features. If the frame of a house is white and the roof is red, the house would probably be called a white one. Note, however, that the semantic interpretation of these attribute + noun phrases is not a union of all the features of the attribute and the noun; a house does not have to have red windows, doors and roof in order to be referred to as a red house. Rather than supporting the alternative, isomorphic composition, measure and color adjectives merely suggest that (31) will need to be modestly refined to account for preferential feature selection.

5.3. The Abstractness Criterion of the Inherent Feature Test

Spencer points out a problem among attribute phrases headed by agentive nouns derived from names of musical instruments like baroque flutist. He argues that bracketing paradoxes do not arise in similar productively generated NPs, e.g. *long flutist, because they are not among the set of lexicalized phrases to which narrow scope readings are restricted (see section 2.2). Spencer's 'lexicalization requirement', that if three of the four forms of a proportional analogy set be lexically listed, that predict the acceptability of *baroque flutist* and the unacceptability of **long flutist* from the assumption that baroque flute but not long flute must be lexically listed.

Even though many constructions, like those in (41), follow Spencer's prediction, many others, like those in (42), do not:

(41) a. *[silver flut]ist
b. *[scratched flut]ist
c. *[rented flut]ist
d. *[expensive flut]ist

(42) a. hot flutist
b. great flutist
c. jazz flutist
d. classical flutist

Since the phrases of both (41) and (42) are productively generated, the Lexicalization Requirement fails to explain the limitations on this class of attribute phrases in its entirety. However, while theories of semantic decomposition are superior to those which rely on lexical listing in predicting the narrow scope readings of attribute phrases like (42), decomposition theories must provide a means of prohibiting combinations like (41). The heads of the phrases of both (41) and (42) all have an underlying noun, *flute*, whose meaning, FLUTE, should serve as a salient inherent feature, as does NOVEL in *romantic novelist*. One would therefore expect the phrases to pass the inherent feature test of section 1.2, and hence be acceptable. However, the nonviability of (41) suggests that the inherent feature test fails to detect at least one class of unacceptable phrases and needs revising. Given the general dependability of this test elsewhere, why is it not possible to derive **silver*, **scratched*, **rented flutist* from the corresponding phrase with *flute*?

The inherent feature test detects acceptable narrow scope readings of agent nouns only if the inherent feature is abstract, The heads of *cellular biologist*, *nuclear physicist*, *structural linguist*, for instance, are all derived from the abstract nouns, *biology*, *physics*, *linguistics*, which become the salient inherent features of the derived agentives. Agentives derived from concrete nouns are not permitted, as can be seen by inverting these constructions: **biological cellist*, **physical nuclearist*, but *linguistic structuralist*. Attribute phrases based on nouns referring to vehicles of art, however, contain concrete nouns: novel, flute, violin. In fact, the abstractness criterion holds for these phrases, too. *Blue novelist* does not refer to someone who writes books with blue covers, but can refer only to someone who writes pornographic novels in the abstract, slang sense of blue novel. The same reasoning explains *heavy novelist*, which may refer only to someone who writes novels in the slang sense of heavy, 'serious novel'.

Returning now to the examples based on musical instruments, a first violinist is not 'someone who plays a first violin', i.e. a concrete object which is first among others in some physical measure; rather, it is simply someone who plays an abstract orchestral position designated as *first violin*. If this characterization reflects a greater generalization extending to (41) and (42), the normal paraphrase of *flutist* in those examples is not so much 'someone who plays a flute' as 'someone who plays flute music', where MUSIC is the abstract feature we need. This insight is captured by the natural assumption that the definition of flutist is [$ACTOR_X$ PLAY ($XY_{INSTR}Z$) $MUSIC_Y$ $FLUTE_Y$], rather than [$ACTOR_X$ PLAY(XY) $FLUTE_Y$].

This feature inventory allows the attribute to compose with the abstract feature, MUSIC, and be constrained from composing with the concrete one, FLUTE. We are left, however, with the curious ancillary condition that the constraint applies only if [ACTOR] is also present in the definition of the head noun; if the head noun is not agentive, this constraint does not apply: *good knife, greasy ax, broken bicycle*. Certainly, something more subtle than this explanation is afoot here, something which invites further investigation. Here, however, we need only see that the exceptions it causes are systematic and thus do not jeopardize (31).

5.4. Conclusions

No doubt attribute composition is further constrained. For example, it seems that while only one negative property generally categorizes an object negatively, positive judgments often require attachment of positive features to several properties of an object. If the blade or handle is dirty, we have a *dirty knife*, but most, perhaps all, parts of a knife must be clean to justify the description *clean knife*. In the overwhelming majority of cases, however, (31) works without further limitations: *hot knife*, *cold knife, greasy knife*, *sharp knife*, *useful knife*, *expensive knife*, *old knife*, and *good knife* are all interpreted as predicted. In short, despite several constraints on the application of (31), the evidence for decompositional composition is very strong.

Summary and General Conclusions

The initial motivation for this article was to demonstrate that Adj + N constructions of the type *nuclear physicist* do not represent bracketing phenomena at all, let alone paradoxical ones. The scope ambiguities of such phrases are apparently a general property of attribute/head composition ranging over all such constructions. Because the operations here are best explained in terms of the composition of features with features rather than of whole words with words, any solution involving syntactic or morphological bracketing will be underspecified. The semantic solution offered by decompositional composition removes the problems of attribute scope from the realm of grammar altogether.

A consequence of this solution is that bracketing paradoxes of the nuclear physicist type cannot be used to test or compare the adequacy of competing syntactic or morphological theories. Nevertheless, the principles of attribute composition of (31) do have morphological consequences: they bring us by a significant step closer to resolving the longstanding questions surrounding the relation of RAdjs and QAdjs.

The decompositional approach outlined in this article also provides a means of identifying some types of semantic features. Evaluation adjectives in phrases like *good knife* seem to single out inherent features of the nouns they modify when they are not accompanied by a restrictive clause like *for X*. The adverb predication test discovers covert function features in the head nouns of such phrases as *slow novelist* and *prolific novelist*. Future research will no doubt lead to

further refinement of principle (31) and to a more effective means of pinpointing the features which constitute definitions.

A final implication of decompositional composition is that semantic compositionality cannot be defined as a mapping preserving syntactic operations in semantics (Hoeksema 1985, p. 56), a point vividly demonstrated in Napoli (1989). Jackendoff (1987, p. 374) is correct in saying that such an idea is a remnant of the Katz-Postal Hypothesis, which invested only syntax with creativity while positing phonology and semantics as purely interpretive components. Although structural solutions may save this perception from the ambiguities of quantification and negation, they cannot work for attribute semantics. The semantic operations examined here are not only different from syntactic ones, but the semantic primitives on which they operate are not represented in syntax in any way. Crucially, no parallel exists between the attribute/noun configuration in the syntax and the semantic predicate/argument structure: attributive QAdjs function as predicates, attributive RAdjs function as arguments. The evidence examined here, therefore, supports the conclusion that the algebra of attribute phrase semantics is nonconfigurational and independent of syntax.

NOTES

[1]The terms are taken from the traditional Russian phrases otnositel'noe 'relative, relational' and kacestvennoe prilagatel'noe 'qualitative adjective'. The distinction is long established in the European schools of language study.

[2]The terms 'ACTOR' will be used throughout this article to refer to a semantic category very similar to, if not identical with, the common case function or theta role, 'Agent'. 'ACTOR' is used here to avoid confusion with what might be a grammatical, not semantic, funcof the category.

[3]This simplification of the semantic framework is not intended to imply that lexical semantics can be reduced to first-order logic. The semantic relation of all arguments will have to be specified in the larger theory along lines similar to those laid out by Jackendoff (1987). The semantic framework has been stripped down here only to expedite comprehension.

[4]Givón (1970) provides further justification for the semantic interpretation of adjectives like old as nominals of quality, i.e. [OLDNESS{X}].

[5]A question which haunts decompositional semantics is how semantic features are determined. The obvious answer is that the properties of the reference of the term or predicate determine both the nature and number of the features of the lexical item. As we have seen, evaluative adjectives provide a test for the inherent features of nouns. It should be the case that if a *good X* can refer to an X with a good Y, where Y is some category, property or function of X, and can so refer without the addition of a complement like *for Z*, then Y should be an inherent, definitional property of X. For example, if a good knife may refer to a knife which is good for cutting, but not for opening cans, we may safely assume that [CUT(XY)] is an inherent feature of knife. If, on the other hand, we must add an overt qualifier, say, for opening cans, and this leads to no redundancy or semantic intensification, we may conclude that [OPEN(XY) CAN_Y] is not an inherent feature of knife. Morgan (1970) advances a similar suggestion with respect to Adv + V attribute VPs.

[6]This means that *nucleus physics* should be just as meaningful as the RAdj reading of *nuclear physics*, though it is unfamiliar due to an accidental pattern of usage (cf. *particle physics*). The implication here, which will be left for future research, is that N + N attribute phrases should conform to the Decompositional Composition Principle in all essential aspects according to the RAdj patterns. Levi (1978, p. 38) makes this point, combining both under the rubric of complex nominals and citing such synonymous pairs as *atom* : *atomic bomb*, *mother* : *maternal role*, *industry* : *industrial output*, *ocean* : *marine life*, *language* : *linguistic skills*, *city* : *urban parks* as evidence.

[7]I assume from the fact that by the classic definition, physics is necessarily the study of both matter and energy. that [MATTER & ENERGY{X}] is one complex feature and hence determines only one reading of *nuclear physics*.

[8]The question of how metaphorical usage interacts with the Principle of Decompositional Composition represents a major topic in itself, too complex to treat fairly here. I have provided elsewhere a theory of metaphor is possible where I explain when only one feature of an attribute composes with the feature of its head noun selected by the attribute.

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