
Problems in the Representation of the Logical Form of Generics, Plurals, and Mass Nouns

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INTRODUCTION

We wish to discuss some problems involved in representing the 'logical form' of sentences whose subjects are generics, (bare) plurals and mass terms. We shall not here have much to say about the syntax of such sentences, except occasionally to refer to such (arguably) syntactic features as [\pm stative]. We shall also not get embroiled in such issues as exactly what information should be counted as part of the 'logical form' of a sentence in general. We will, for example, remain agnostic on the question of the proper place for (Montague-style) meaning postulates, the proper place for Quantifier Raising, and the proper place for the representation of certain ambiguities involving quantifiers and other logical operations. Instead, our concern is with the final representation of certain natural language sentences, a representation which is immediately correlated with the truth conditions of the original sentence. We take this to be more-or-less first-order quantification theory augmented with certain operators, but feel free to bring in Montagovian intensional logic, especially when discussing those

theorists who make it central in their account. To give a feel for what level our concerns lie at, consider

- (1) (a) Whales are mammals

Now, there are many 'levels of representation' that different theorists have proposed for such a sentence. Our concern is with such representations as¹

- (1) (b) $(\forall x: \text{whale}(x)) \text{mammal}(x)$
 (1) (c) **mammal'**('whale')

Or, if one prefers, rather than with these representations, we are concerned with the explicit truth conditions. We merely employ these symbolic forms as a convenient device to exhibit various properties such as scope and the interpretation of English quantifiers. Nothing we say is restricted to those interested in 'logic-like' logical form—the problems we shall discuss are applicable to any theory which claims that there is *some* semantic interpretation to be ascribed to the sorts of English sentences under consideration here.

As we indicated, our concern is with generics, bare plurals and mass terms. Yet, as we shall see, their interactions with quantifiers, time and frequency adverbials, and numerical modifiers are quite complex, interesting in their own right, and can contribute strong reasons for preferring some accounts of the logical form of generics, etc, over others. Our strategy here will be this. First we shall give a list of general problems with generic sentences, a series of problems about which we will have next to nothing to say. Then we will give the 'fundamental intuition' which motivates our thoughts on 'the problem of generics'. After this, we will present 'the simpleminded view'—a view many of us immediately jump to when challenged to account for the fundamental intuition. (No linguist we know of has ever propounded the simpleminded view, although it is unthinkingly expounded by authors of elementary logic textbooks, even sophisticated authors). The simpleminded view *is* simpleminded, and we present a series of (traditional and not-so-traditional) problems for it. We would wish next to move on to 'the sophisticated view', championed in the past 10 years or so by such writers as G. Carlson (1977, 1977a, 1979, 1982, 1985), Chierchia (1982a, 1982b), Farkas & Sugioka (1983), Enç (1981), Hinrichs (1985), and ter Meulen (1985). However, to explain this view adequately, we need first to give some background and so we provide a very general overview to Montague/Gazdar grammars and the associated intensional logic representation of the semantics of natural languages. This section can be skipped by anyone who has even a modicum of acquaintance with these theories. This sophisticated view, however, also suffers from lack of detail and also, importantly, seems unable to correctly capture the facts of cases

just slightly more complicated than those that gave us the fundamental intuition. Along the way we consider some more recalcitrant facts about the interaction of generics, plurals and mass terms with certain temporal and adverbial phrases. Finally we shall make a few proposals which appear to be useful in analyzing and giving appropriate logical forms to the type of constructions under consideration.

SOME GENERAL PROBLEMS WITH GENERICS

- (A) What *causes* a sentence to be generic?
- (1) Is genericity indicated by some element in surface structure?
 - (2) Is genericity carried by a feature on NPs? On VPs? On AUX? Is it some kind of agreement feature? Is it a matter for syntax to decide? Semantics? Pragmatics (whatever that is)?
- (B) What is the relation amongst sentences like
- (i) Snakes are reptiles
 - (ii) A snake is a reptile
 - (iii) The snake is a reptile
 - (iv) Any snake is a reptile
- (C) What is the relationship between generic sentences and 'habitual' sentences? Is
- (i) Sammy smokes cigars
a generic sentence?
- (D) Are mathematical (etc) truths generic sentences?
- (E) What is the interaction between generics and tenses?
- (i) Dogs bark (generic?)
 - (ii) Dogs barked (non-generic?)
- (F) If all babies ever born in Rainbow Lake, Alberta, happened to be right handed, would the generic sentence
- (i) Babies born in Rainbow Lake, Alberta, are right handed
be true?
- (G) Consider the generic sentences
- (i) Snakes are reptiles
 - (ii) Telephone books are thick books
 - (iii) Guppies give live birth
 - (iv) Italians' are good skiers
 - (v) Frenchmen eat horsemeat
 - (vi) Unicorns have one horn

Obviously, we understand the truth of (i)–(vi) as calling for different relative numbers of instances of the subject terms satisfying the predicate term. In (i) it is all; in (ii) most; in (iii) some subset of the females (=less than half); in (iv) some small percentage, but a greater percentage than other countries; in (v), quite possibly a very small percentage—somehow, from the vantage point of North America, the mere fact of its happening at all is striking; and in (vi) no unicorns have one horn.

(H) Is there a 'reading' of these sentences which is generic?

- (i) This car is guaranteed against rust for 5 years
- (ii) Every car in this lot is made in nine different countries

We do not have definitive answers to these questions. Indeed, we shall not discuss these matters directly at all, although partial answers to some of them will be implicit in our discussion of various proposals, including our own tentative proposals in the last section. (This is not to be taken as our thinking these to be unimportant matters. In fact we think them of the utmost importance in the topics, but our interests here are somewhat more specialized.) Our interests instead have to do with the logical form (of the sort described earlier) of certain kinds of sentences—or, more precisely, with the distinction in logical form between two types of sentences containing bare plural and bare mass nouns. It is 'the fundamental intuition' that some of these sentences are gnomic while others are not which motivates our discussion here. Thus, (1a), (Bi), (Ei), (Eii), (Fi), and all the (G) sentences are of direct concern to us; whereas (Bii)–(Biv), (Ci), (Hi), and (Hii) are not. Of course (Bii) and (Biii) *are* generic sentences, as (arguably) is one 'reading' of both (Hi) and (Hii), and many of our comments will bear on such sentences indirectly, providing that one has a way to tell when the subject noun phrases are being 'used generically'.

THE FUNDAMENTAL INTUITION

Intuitively, the subjects of the (a) sentences in (2)–(5) appear to generalize over 'kinds' ('species', 'generic entities', 'types'), while the subjects of the (b) sentences appear to refer to (some) particular 'instance(s)' ('realizations', 'manifestations', 'parts') of those kinds.

- (2) (a) Snakes are reptiles
- (b) Snakes are in my garden
- (3) (a) Snow is white
- (b) Snow is falling

- (4) (a) Dogs are loyal
 (b) Dogs are barking
 (5) (a) Children are persons
 (b) Children are present

The logico-linguistic problem is to (i) describe the difference and (ii) find a systematic method of generating the different logical forms (or of giving the different truth conditions).

THE SIMPLEMINDED SOLUTION

At first blush this difference might be supposed to be that the (a)-subjects involve implicit universal quantification while the (b)-subjects involve implicit existential quantification.

- (2') (a) $(\forall x: \text{snake}(x))\text{reptile}(x)$
 (b) $(\exists x: \text{snake}(x))\text{In}(\text{my garden},x)$
 (3') (a) $(\forall x: \text{snow}(x))\text{white}(x)$
 (b) $(\exists x: \text{snow}(x))\text{falling}(x)$
 (4') (a) $(\forall x: \text{dog}(x))\text{loyal}(x)$
 (b) $(\exists x: \text{dog}(x))\text{barking}(x)$
 (5') (a) $(\forall x: \text{child}(x))\text{person}(x)$
 (b) $(\exists x: \text{child}(x))\text{present}(x)$

There are a number of difficulties with the simpleminded view. Many of these difficulties have been pointed out by a number of authors, and so we shall only mention them briefly. (Cf, among others, Vendler, 1967; Jackendoff, 1972; Lawler, 1972; Nunberg & Pan, 1975; Dahl, 1975; Lyons, 1977; Carlson, 1977, 1982). For the most part we will concentrate on some issues not usually mentioned.

For one thing, while (3a) and (4a) are intuitively true even in the presence of some dirty snow and some disloyal dogs, (3'a) and (4'a) would be false. Furthermore, when the subject is a mass term, as in (3a), it is not even clear that the quantification makes sense—what *are* the values of *x* in *snow(x)*? Also, if one were to assume that the (a) sentences are universal and the (b) ones existential, what would we make of certain conjoined predicates, relative clauses, or anaphoric relations like

- (6) Snakes, which are reptiles, are in my garden
 (7) Snow is white and is falling throughout Alberta
 (8) Dogs are noisy animals and are barking outside right now
 (9) Although children are not interested in linguistics, *they* are often present at linguistics conferences

Moreover, neither a universal nor an existential 'reading' yields an acceptable interpretation in cases like

- (10) Water is scarce/abundant
- (11) Water is a scarce commodity/an abundant liquid
- (12) Dogs are man's best friend
- (13) Dinosaurs are extinct

If one were to stipulate a semantic interpretation radically distinct from the universal and existential we again are led to difficulties for sentences with compound predicates such as

- (14) Water is an abundant liquid and is transparent
- (15) Water is an abundant, transparent liquid
- (16) Dogs are loyal and are man's best friend
- (17) Dinosaurs are extinct but used to live in Alberta
- (18) Gold is scarce but can be found in my teeth

Furthermore, providing a consistent account of anaphoric relationships would be difficult. (This is not to say it cannot be done. Most theorists would say that terms somehow introduce some 'entities' into the 'model of the world' which has been built up from the preceding discourse; these entities, which can be referred to anaphorically, may be rather indirectly related to the denotations of the terms which introduced them. Nonetheless, the following sentences do pose a challenge for such theories if the theory incorporates the simpleminded view.)

- (19) Although snow is white, when *it* falls/is falling in the city *it* is dirty
- (20) Although water is scarce here, *it* is dripping from the faucet
- (21) Although Italians are good skiers, *they* are doing poorly in the downhill races I am watching on TV

Since the sentences (7)–(8) and (14)–(18) have just one subject, how can that one subject be assigned the distinct interpretations apparently required by the conjuncts comprising the predicate? In the sentences with relative clauses (6) and (8), and in the anaphoric pronoun cases (9) and (19)–(21), how can the anaphoric or relative pronouns be interpreted differently from their antecedents, as they apparently must be by the different predicates?

SOME METHODOLOGICAL REMARKS

It will be noted from the criticisms levelled against the simpleminded view that a certain 'semantic innocence' has been assumed. For instance in

sentences like our previous

- (6) Snakes, which are reptiles, are in my garden
- (7) Snow is white and is falling throughout Alberta

it was claimed that whatever semantic contribution *snakes* or *snow* makes, it makes that contribution once and for all in the sentence. For this reason the 'understanding' or 'reading' or denotation of these subjects could not be given twice for the one sentence, as would be intuitively required to account for the two different conjuncts in the predicate.²

Although we wish to keep our discussion of the difficulties involved with generic sentences at a very general level so as to show how they impact on any theory which assigns a logical form to such sentences, in order to discuss some recent writers we need to present a specific outlook on the semantics of natural languages. We do not aim here at any comprehensiveness nor at much detail; rather we outline in broad brush strokes the bare essentials needed to understand these recent theories.

The starting point for this conception of semantics is Richard Montague. (See Thomason (1974) for a collection of his papers, with a lengthy introduction. See also Dowty *et al* (1981) for a thorough introduction.) According to this viewpoint, the logical form of a natural language can be represented in a language called Intensional Logic. This language differs from first order logic in a variety of ways, but for our purposes the important differences are these.

(I) Intensional logic is *typed*. Each expression of the logic is assigned a type which determines (syntactically) the type of predicates which can be asserted of it and the type of arguments it can take. Furthermore this type is correlated with a semantic type which indicates the sort of entity it denotes. Basic terms, for example *a* and *b*, denote basic objects. Basic predicates, for example *F* and *G*, denote sets of the basic objects. Some predicates are not basic in this sense. They might denote sets of the basic predicates, for instance. One might claim that *is a colour* is such a predicate, and that *is white* is a basic predicate. Then a sentence like *white is a colour* might be represented as *colour'(white')*. (The primes indicate that we are talking about the logical translation of the word which is primed.) The syntactic type of *white'* would be written as $\langle e, t \rangle$, indicating that semantically, this predicate maps basic entities into truth values (i.e., its denotation belongs to the class of functions 2^D , where *D* is the set of basic entities and 2 is the set of truth values $\{0, 1\}$). The syntactic type of *colour'* would be written as $\langle \langle e, t \rangle, t \rangle$, indicating that semantically, this predicate maps predicates over basic entities into truth values (i.e., its denotation belongs to the class of functions $2^{(2^D)}$). More generally, syntactic types *A*, *B* may

be compounded freely to form a new type $\langle A, B \rangle$, and expressions of this type will denote functions from the type of objects A denotes to the type of objects B denotes.

(II) Intensional logic is *modalized*. Given an expression α of syntactic type A which denotes a certain type X of object, we can form the expression $\hat{\alpha}$ of syntactic type $\langle s, A \rangle$ which denotes that function from possible worlds to the X -type objects in that possible world. Similarly, if β is a function on possible worlds then $\hat{\beta}$ denotes the object which β picks out in the possible world under consideration. For example, $(is\ a\ person)'$ might denote a particular set of entities. $\hat{(is\ a\ person)'}$ then is said to denote the property of being a person—something which tells us, for each possible world, what entities in that world have *is a person* true of them. One of the most important reasons for introducing the operator $\hat{\ }$ is to permit a uniform approach to the semantics of intensional expressions such as *necessarily*, *believes*, *seeks*, and *fake*. The truth value of a sentence of the form *necessarily* Φ in a particular possible world in general depends not only on the truth value of Φ in that world but also on its truth value in other 'accessible' worlds (perhaps all possible worlds). This dependence can be allowed for by ensuring that *necessarily*' will be applied to the *intension* of the translation of the embedded sentence. Similarly the truth value of x *believes that* Φ depends in general on the intension (not just the extension) of Φ , the truth value of x *seeks* y depends on the intension of y , and the truth of x *is a fake* P depends on the intension of P . Since intensionality can occur at virtually all syntactic positions, Montague adopts a uniform policy of *always* intensionalizing an argument when applying a logical expression (which translates some English phrase) to it. Where appropriate, extensionality can be recovered, either by ensuring that the translation of the expression applied to the argument will contain an occurrence of the extension operator $\hat{\ }$ which 'cancels' the intension operator prefixed to the argument, or by reliance on *meaning postulates* (see below).

(III) If Φ is a formula then $(\lambda x)\Phi$ is a predicate of syntactic type $\langle A, t \rangle$, where A is the type of x . Intuitively, Φ should have a free occurrence of x , and this 'lambda abstraction' converts the open formula into a predicate; which predicate can then be applied to some term as usual. If Φ were $(Fx \ \& \ Gx)$ then we can form the predicate $(\lambda x)(Fx \ \& \ Gx)$ and apply it to some term of the same type as x , say a , to get $(\lambda x)(Fx \ \& \ Gx)(a)$ as a formula. A process of 'lambda conversion' alters this to $(Fa \ \& \ Ga)$. Since the language has expressions of all types, lambda abstraction (and conversion) can apply to all expressions. If H and J are predicates of the appropriate type, they can take other predicates as arguments. The formula $[H(P) \rightarrow J(P)]$ —where P is a free predicate variable—can be lambda abstracted to form $(\lambda P)[H(P) \rightarrow J(P)]$ and this might be predicated of the property F , which

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would yield $(\lambda P)[H(P) \rightarrow J(P)](F)$. And by lambda conversion this would become $[H(F) \rightarrow J(F)]$.

So far we have said little about the relationship between English and this representational language of intensional logic. For example we have not said whether English proper names should be translated as basic terms, or whether English predicates like *is a person* should be translated as basic predicates, etc. Montague in fact had a specific view on this matter, which view is rather complex. Most modern writers in the Montague tradition differ from him on many of these specific recommendations, and so we shall not say much about them. Instead we shall mention a few of the more general aspects of Montague's approach which are relevant to understanding the theories given in the next section, and apart from these, we will let those theories speak for themselves.

It is part of Montague's view that one can determine the semantic representation of any expression by examining the syntactic rule(s) that combine the parts to form that expression (plus the semantic representations of these parts). To determine the semantic representation of, for example, *barking dog*, it is sufficient to use the semantic representations of *barking* and *dog* and to know which syntactic rule allows these terms to be combined in that way. The idea is that every application of that syntactic rule yields the same result (modulo the representations of the parts). More exactly, one says that with each syntactic rule there is exactly one semantic function which takes as arguments the semantic values of the items used in the syntactic rule. According to this view of how one can determine the semantic representation of an expression, the standard method used in first-order logic to generate $(\forall x)(Wx \rightarrow Mx)$ as the representation of *all whales are mammals* is incorrect. This standard method somehow first generates $(Wx \rightarrow Mx)$ and then attaches $(\forall x)$ to it. But, the syntax of English makes *all whales* a unit and *are mammals* a unit. Thus the representation of the sentence must be some function of the representations of these units. One way to satisfy Montague's requirement, in this instance, would be to translate *all whales* as $(\lambda P)[(\forall x)(\text{whale}'(x) \rightarrow P(x))]$ and *are mammals* as *mammal'*, and to derive the translation of the sentence by applying the former to the latter. (Montague's translation, à la his (1973) would be quite similar to this, except that P would be prefixed by \sim , so that application of the translation of *all whales* to the intension of the translation of *are mammals* will give $(\forall x)(\text{whales}'(x) \rightarrow \sim \text{mammal}'(x))$, or $(\forall x)(\text{whale}'(x) \rightarrow \text{mammal}'(x))$ —see (II) above.) Of course, the translation of *all whales* must in turn be derived from the translation of *all* and the translation of *whales*. These can be taken to be $(\lambda Q)(\lambda P)[(\forall x)(Q(x) \rightarrow P(x))]$ and *whale'* respectively, so that application of the former to the latter yields the desired translation of *all whales*. (Again, Montague would

actually use $(\lambda Q)(\lambda P)[(\forall x)(\neg Q(x) \rightarrow \neg P(x))]$ and would apply this to the intensionalized argument 'whale'.)

Montague's translation of *all whales* as a property of properties, $(\lambda P)[(\forall x)(\text{whale}'(x) \rightarrow P(x))]$, may seem bizarre at first sight from the standpoint of classical philosophical logic. But in fact, the translation of all noun phrases as properties of properties allows a uniform and elegant treatment of the truth conditions for English, including intensional constructions, which is one of the strongest selling points of Montague Grammar. Note that the translation of *all whales* can be understood as describing the set of properties that all whales have (i.e., the intersection of the property sets of all individual whales). Similarly, the phrase *some whale* is translated as $(\lambda P)[(\exists x)(\text{whale}'(x) \ \& \ P(x))]$, i.e., the set of all properties possessed by at least one whale (or, the union of the property sets of individual whales); the phrase *no whale* is translated as $(\lambda P)[(\forall x)(\text{whale}'(x) \rightarrow \neg P(x))]$, i.e., as the complement of the set of properties possessed by whales; and a proper name like *Moby Dick* is translated as $(\lambda P)P(m)$, where m is an individual constant denoting the entity, Moby Dick, so that the name expresses the set of properties that Moby Dick has. Thus, since the subject of a sentence always expresses a property set, the condition necessary for the truth of a sentence is simply that the property expressed by the predicate be an element of the set of properties expressed by the subject. This, of course, is precisely how 'application' of the translation of the subject to the translation of the predicate is interpreted.³ (We have described the 'PTQ' version of predication (Montague, 1973). In his 'UG' version (Montague, 1970), predicates of English sentences are translated as predicates over property sets, allowing their application to the subject, instead of the other way around.)

Incidentally, we have argued (Schubert & Pelletier, 1982) that it is possible to gain Montague-like uniformity of translation without giving up the notion that proper names denote individuals (in favour of the notion that they denote property sets). We will avail ourselves of some of these devices developed in that paper, including a uniform approach to scope ambiguities (not available within Montague's original framework), in the concluding section.

The particular syntactic theory employed by Montague and by the writers to be discussed below is replaced here by the Generalized Phrase Structure Grammar (GPSG) of Gazdar (see Gazdar, 1982; Gazdar *et al*, 1985). In this theory the syntax is given by a set of context-free rules of the general form

$$A \rightarrow BCD \dots$$

Along with each rule stated the relevant semantic rule that combines the

representations of the right-hand side of the syntactic rule to form the representation of the left-hand side of that rule.⁴ In this theory a non-terminal symbol—e.g., the A of the rule stated above—is allowed to be ‘complex’ by containing ‘features’. E.g., the symbol ‘NP[+pl]’ is interpreted as a Noun Phrase with the feature ‘+plural’. It is the use of features, and certain principles governing their legitimate places of occurrence, that allows GPSG to capture such aspects of language as ‘agreement’ and other ‘unbounded dependencies’ (which aspects had led previous writers to assume that natural languages could not be described by any set of context-free rules). In what follows we will make only the most minimal use of features, but we do wish to emphasize that such use does not violate any of the essential properties of context-free grammars.

The final remark about these Montaguesque grammars has to do with *meaning postulates*. The point of a meaning postulate can best be explained by example. Suppose we are going to translate the two sentences *John is a bachelor* and *John is married*. From the ‘purely logical’ point of view, their translations into intensional logic could both be true—even if *John* is taken to denote the same entity. This is because there is a model wherein the denotation of *is a bachelor* partially overlaps the denotation of *is married*. But such a model is not relevant to describing English. All the models relevant to English have the two denotations completely disjoint. This fact is stated as a meaning postulate, such as

$$\Box(\forall x)(\text{bachelor}'(x) \rightarrow \neg \text{married}'(x))$$

which is taken to be a way of paring down all the possible models to ones which accurately describe English, at least with respect to the relationship between *bachelor* and *married*. Let us consider a somewhat more interesting case. Suppose we think that *blue* and *fake* belong to the same syntactic category, namely Adj, and that any Adj can syntactically be combined with a Noun. The relevant semantic rule corresponding to this syntactic combination cannot be one which says that the Adj is true of an object and also the Noun is true of it, for this would give the wrong result for such things as *fake diamond*, even though it would give the correct result for *blue diamond*. Instead we need to say that *fake* denotes some operation, which when applied to a Noun intension, yields some property that does not entail that the Noun is true of the object. But since *blue* and *fake* are in the same syntactic category, it follows that *blue* will have to denote this type of operation also. The relevant rule for these will be, then,

$$N \rightarrow \text{Adj } N, \text{Adj}'('N')$$

(where the part after the comma is the semantic rule corresponding to the syntactic rule before the comma). Here it is stated that an Adj can combine

syntactically with a N to form a (longer) N, and that the semantic representation of this larger N consists of the semantic representation of the Adj (indicated by Adj') applied to the semantic representation of the N (indicated by N'). This would assign *fake diamond* and *blue diamond* the representations, respectively

fake'('diamond')

blue'('diamond')

But we know that, in English, when *blue diamond* is true of some object, it is both blue and a diamond. But the last formula does not reveal that. Therefore we give a meaning postulate which guarantees this:

if $Q \in \{\mathbf{blue'}, \dots\}$ and $P \in \{\mathbf{diamond'}, \dots\}$ then

$$\Box(\forall x)[Q(\mathbf{P})(x) \rightarrow P(x) \& Q(x)]$$

We furthermore know that, in English, when *fake diamond* is true of some object, it is not a diamond; but again our formula does not reveal that, so we give a meaning postulate which guarantees it:

if $Q \in \{\mathbf{fake'}, \dots\}$ and $P \in \{\mathbf{diamond'}, \dots\}$ then

$$\Box(\forall x)[Q(\mathbf{P})(x) \rightarrow \neg P(x)]$$

With just this much of an introduction to intensional logic and Montague/Gazdar grammars, we are in a position to state and evaluate

THE SOPHISTICATED VIEW: THREE VERSIONS

General Remarks

Difficulties such as the ones mentioned above have led recent writers on the subject of mass terms and bare plurals to suggest that the (a)-sentences of (2)–(5) uniformly refer to 'kinds' ('substances', 'species', 'generic entities').⁵ To avoid making any assumptions about whether a 'kind' is to be identified with the intension of a predicate or with some other, 'more primitive' entity, we use the μ -operator to form a 'kind' (etc) from a predicate: $\mu(\text{snow})$ denotes the kind *snow*, $\mu(\text{dog})$ denotes the kind *dog*, etc.

In the sophisticated view, the semantic representations of (2a)–(5a) might be written schematically as

(2'') (a) reptile($\mu(\text{snake})$)

(3'') (a) white($\mu(\text{snow})$)

- (4'') (a) loyal($\mu(\text{dog})$)
 (5'') (a) person($\mu(\text{child})$)

where the predicates may either be simply the lexical translations **reptile'**, ... **person'** (Chierchia) or may be functional transforms of those translations (Carlson; Farkas & Sugioka).⁶ The quasi-universal import of the original sentences, that is, the fundamental intuition, would presumably derive from such meaning postulates as the following⁷

- (22) For $P \in \{\text{snake}', \text{snow}', \text{dog}', \text{child}', \text{idea}', \dots\}$ and $Q \in \{\text{reptile}', \text{white}', \text{loyal}', \text{person}', \text{expensive}', \dots\}$,

$$\Box[Q(\mu(P)) \rightarrow (Mx: P(x))Q(x)]$$

The fundamental intuition holds that there is a difference in logical form between the (a) and (b) sentences of (2)–(5). In what, then, does this difference consist? The consensus in the literature is that the (b) sentences should still involve the explicit existential quantification. But a point of contention is whether the existential quantifier is supplied by (the translation of) the subject NP itself or by the predicate. Consider for example

- (23) Dogs are barking
 (24) Snow is falling

Should the subject NPs *dogs* and *snow* be interpreted as equivalent to *some dogs* and *some snow* (thus supplying an existential quantifier directly)? Or should *dogs* here instead be interpreted as $\mu(\text{dog})$, and the existential quantifier brought in indirectly by interpreting *are barking* as equivalent to *has a realization/manifestation/instance which is barking*, i.e., $(\lambda y)(\exists x)[R(x,y) \ \& \ \text{barking}(x)]$? The latter approach can be seen to yield logical form expressions like⁸

- (23') $(\exists x)[R(x, \mu(\text{dog})) \ \& \ \text{barking}(x)]$
 (24') $(\exists x)[R(x, \mu(\text{snow})) \ \& \ \text{falling}(x)]$

where $R(x,y)$ means that x is an instance/realization/manifestation/etc of (the kind) y .

Krifka (1985), following Kratzer (1980), argues for the direct approach, citing cross-linguistic facts such as that many languages distinguish the (a) and (b) cases via case marking (Finnish), distinct articles (Bairisch), or partitives (French). However, it is difficult to see the relevance of these observations to the point at issue. There seems to be no reason to suppose that the semantic structure of

- (25) De l'eau coule du robinet

is phrase-by-phrase identical with that of

(26) Water is flowing from the faucet

or to that of

(27) Some water is flowing from the faucet

Nor, it should be added, is there any reason to suppose that the semantic structure of (26) is phrase-by-phrase identical to that of (27). Hence there is no reason to suppose it is the subject NP which supplies the existential quantifier in all three cases.⁹ And in any case such an approach seems in principle unable to give an account of conjoined predicates of the form we have considered earlier.

Our sophisticated theorists opt for the indirect approach. This has the advantage that it translates bare NPs (in subject position) uniformly in both the (a) and (b) cases as denoting kinds, rather than treating them as ambiguous: sometimes denoting kinds, and sometimes as-introducing an existential quantifier and treating the subject term as a predicate.

As suggested above, there are various flavours of the sophisticated view. In the sections which follow, we shall discuss three of them: G. Carlson's, Chierchia's, and Farkas & Sugioka's (see reference list). Other variants of it can be found in the literature, e.g., Enç (1981), ter Meulen (1985), and Hinrichs (1985), but we leave it as an exercise for the reader to apply the criticisms given here to these others.

Fundamental to all versions of the sophisticated view is that there are three (disjoint) types of entities in reality: *kinds*, *objects*, and *stages*. Objects are the familiar sort of thing . . . 'Jimmy Carter, the chair I now occupy, the world's fattest magician' (Carlson, 1979, p. 53) or 'the Empire State Building, my neighbor, . . . sincerity, the number 3' (Farkas & Sugioka, 1983, p. 226). A *kind* is also an entity (sometimes they are called *substances* or *species* or *generic entities*). They are such items as (the species) *dog* or (the element) *gold* or more complex generic entities like *students standing in line*. As before, we represent these by means of our μ -operator. A stage is a 'space-time slice of individuals'. Not only can objects have stages (such as the various space-time slices of my chair) but also kinds can have stages. (Exactly what is a stage of a kind is disputed by our various sophisticated theorists, and so we shall defer this description to the later sections.)

The sophisticated theory also takes the position that, semantically speaking, some predicates properly (or basically) apply only to kinds, some only to objects, and some only to stages. For example, the predicates *be extinct*, *be common*, *be widespread*, etc, properly apply only to kinds. The predicates *be loyal*, *be white*, *be a mammal*, etc, properly apply only to objects. And the properties *be barking*, *be falling*, *be dripping*, etc, properly

apply only to stages. This is claimed to be so in spite of the facts that *be loyal*, for example, syntactically can be correctly predicated of kinds (as in *dogs are loyal*) and that *be barking* can syntactically be correctly predicated of objects (as in *Fido is barking*).

The problem for the sophisticated theories therefore is to show how these syntactically legitimate predications give rise to the appropriate semantic representations, wherein the predicates are applied only to those types of entities of which they 'properly' hold. All of our sophisticated theorists are concerned to give an account which is *explicit*—one is not to 'intuit' the appropriate semantic (intensional logic) representation, but rather one is explicitly to give syntactic rules of formation and pair them with explicit translation rules (into the semantic representation language).

Before we move on to discuss the various individual sophisticated theorists, we might note two very general difficulties for any sophisticated approach.

First, the sophisticated approach posits a rather complex semantic structure for non-stative predicates like *falling* and *barking*, involving a 'realization relation' which has no counterpart in the syntax. This semantic structure is not shared by *falls* and *barks*: the sophisticated approach would treat

(28) Snow falls

(29) Dogs bark

as generics and translate them, accordingly, as

(28') falls(μ (snows))

(29') barks(μ (dog))

where 'falls' and 'barks' are functional transforms of *falls'* and *barks'* *not* involving realization relations. But as we have noted above, the sentences

(23) Dogs are barking

(24) Snow is falling

will be translated as

(23') $(\exists x)[R(x, \mu(\text{dog})) \ \& \ \text{barking}(x)]$

(24') $(\exists x)[R(x, \mu(\text{snow})) \ \& \ \text{falling}(x)]$

Secondly, in order to work properly for both cases like

(30) Snow is falling

(31) Snowflakes are falling

(32) Dogs are barking

and synonymous/equivalent cases like

- (33) Some snow is falling
- (34) Some snowflakes are falling
- (35) Some dogs are barking

either the (33)–(35) sentences must somehow suppress the quantification over realizations within the VP, or else the realization relation must be assumed to have a ‘bimodal semantics’. The suppression of quantification in the VP might be accomplished by having a syntactic agreement feature in the subject NP and VP which is sensitive to whether the NP is object-level or kind-level. When this feature is positive, the VP translation would lack the quantification over realizations. Alternatively, two rules of VP formation might be postulated, one of which introduces the quantification over realizations of the subject while the other does not. This would give rise to two syntactic analyses, and two different translations, of each sentence, one would be the correct translation if the subject happens to be kind-level, while the other would be the correct translation if the subject happens to be object-level. (This is Carlson’s approach.) The ‘bimodal semantics’ approach assumes that the VP-translation always introduces a quantifier over realizations, but defines the meaning of the realization in two parts, one appropriate to realizations of objects, the other appropriate to realizations of kinds. (This is Chierchia’s approach.) We are now in a position to examine the sophisticated theories in more detail.

Version 1: Carlson

Carlson’s Position

The founder of the sophisticated view is generally acknowledged to be G. Carlson (see especially his 1977 dissertation). Much of Carlson’s discussion is taken up with trying to justify the view that (sometimes, anyway) bare plurals and mass terms are ‘name like’ or ‘referential’ or ‘denoting’. We shall not consider all his reasons here, but will simply assume it true that there is such a class of sentences, including the sentences we have been calling generic. Briefly, his reasons include the following (besides the failure of quantificational approaches we have already discussed). In sentence pairs like

- (36) Dogs are mammals. They bark.

the pronoun can be replaced by the generic antecedent, without meaning change. This behaviour of generics resembles that of names:

- (37) John walked in. He smiled.

but not that of quantified phrases:

- (38) A man walked in. He smiled.

Also, Carlson (1982, p. 151) claimed that generic terms, like proper names, participate in *de dicto/de re* ambiguities and no others. (While this claim is faulty, the exceptions to it cause no problem for Carlson's theory, as we shall see.) Further, Carlson noted that generics, like proper names, participate in *so-called* constructions such as

- (39) Cardinals are so-called because of their colour

and they can be used to designate the values of a variable, as in

- (40) One of these kinds of mammals barks if and only if either dogs bark or cats bark

As mentioned above, Carlson has three ontologically distinct types of entities: kinds, objects, and stages. An object *realizes* or *manifests* a kind (of which it is an individual). This relation is represented as *R*. Objects have 'spatio-temporal segments', called stages. Such items are John-this-morning and the like. This relation is indicated by *R'*. Kinds also have stages, namely, the stages of the objects which realize that kind. (This is a point of difference with other sophisticated theories, so it is well to mark it.) In Carlson's terminology (although not in Chierchia's), objects and kinds are the two sorts of *individuals*, while stages are temporal manifestations of individuals.

Carlson assumes that certain English VP's, such as *runs into the room*, *found a match*, *ate a donut*, *is available*, *is present*, *is running around* (typically inducing an existential reading on a bare plural subject) apply 'basically' to stages/manifestations of individuals (=objects or kinds) only. However, such a stage-level predicate is translated either (on one syntactic analysis) so that it introduces an existentially quantified stage of the subject, or (on another syntactic analysis) so that it is transformed into a 'gnomic' (habitual or generic) predicate. In the former case, the translation is $(\lambda y^o)(\exists x^s)[R'(x^s, y^o) \& VP'(x^s)]$,¹⁰ while in the latter it is $Gn'('VP')$. Both of these translations are applicable directly to individuals, i.e., objects and kinds, but the former gives an episodic (transitory, time-dependent, non-dispositional) reading, while the latter gives a gnomic reading. This accounts for the differences in

- (41) (a) John ate a light breakfast back in those days.
 (b) $Gn'((\lambda x^s)A(x))(j)$ —where *A* translates *ate a light breakfast* (and the adverbial has been ignored)
- (42) (a) John ate a light breakfast this morning
 (b) $(\exists x^s)[R'(x, j) \& A(x)]$

or in

- (43) Athletes ate a light breakfast back in those days [involves Gn']
 (44) Athletes ate a light breakfast and then went to the game [involves R']

Additional examples of the habitual/episodic distinction are provided by habitual like

- (45) John smokes
 (46) John handles the mail arriving from Antarctica
 (47) John writes books

and episodic ones like

- (48) John is smoking a pipe in Edmonton
 (49) John is writing a book
 (50) John is sorting the mail from Antarctica

Carlson argues for his analysis of habitual sentences in terms of Gn' (as in (42)b), and against a quantificational analysis, on the grounds that no one quantifier serves in all cases, and allowing various quantifiers would predict ambiguities where there are none. Indeed, as Lawler (1972) and others had observed before, certain sentences attributing dispositional properties to the subject may be true even if there has *never* been an episode in which the disposition was actualized ((47) can serve as illustration). Carlson notes further that while episodic predications obey certain systematic constraints with respect to place and time of occurrence, habitual predications do not, e.g.,

- (51) John is smoking a pipe in Edmonton

precludes

- (52) John is smoking a cigar in Calgary

and entails

- (53) John is smoking a pipe in Alberta

but no such relations need to hold when *is smoking* is replaced by *smokes*.

This can be accounted for, he says, by assuming that habitual sentences attribute a property to an individual (whose temporal stages need not be spatially localized) while episodic sentences attribute properties to stages of individuals (which are typically quite localized in space and time).¹¹

Another group of English VP's, such as *knows how to dance*, *have ears*, *is a turtle*, *can read a newspaper* (typically inducing a quasi-universal reading on a bare plural subject) apply 'basically' to objects only. Such VP's

are also translated ambiguously, either without introducing realization or gnomic operators, or with a gnomic operator *Gn*. VP-translations of the former type combine meaningfully with object-level subjects, but not with kind-level subjects (even though such combinations are generated syntactically). Such translations are non-generic. VP-translations of the latter type, i.e., those of the form *Gn*('VP'), combine meaningfully with kind-level subjects, but not with object-level subjects (though again, such combinations are generated syntactically). Such translations are generic. This accounts for examples like¹²

- (54) (a) Fido is loyal
 (b) loyal'(f)
- (55) (a) Fido has a tail
 (b) $(\exists x^o)[\text{tail}'(x) \ \& \ \text{has}'(x)(f)]$

on the one hand, and

- (56) (a) Dogs are loyal
 (b) $\text{Gn}'(\lambda x^o)\text{loyal}'(x))(d)$
- (57) (a) Dogs have a tail
 (b) $\text{Gn}'(\lambda x^o)(\exists y^o)[\text{tail}'(y) \ \& \ \text{has}'(y)(x)])(d)$

on the other. In effect, *Gn* in the latter examples 'elevates' the object-level properties *is loyal* and *has a tail* to the kind level, producing the generic reading. Meaning postulates for *Gn'* and *Gn* take care of relating a predication of the form $\text{Gn}'(\text{P})(x)$ to stages of *x*, and a predication of the form $\text{Gn}(\text{P})(x)$ to objects realizing (the kind) *x*.

As in the case of (non-generic and generic) habitual sentences, Carlson argues against a quantificational analysis of generic sentences like (56)–(57) on the grounds that no one quantifier serves in all cases. Equally important, as already stated, is his observation that bare plurals pattern in many respects with names, rather than with quantified NP's.

Some VP's apply to kinds only, e.g., *are rare/common/widespread/extinct/in short supply/indigenous to, comes in many sizes*, etc. And finally, there are some VP's which apply to both objects and kinds (i.e., to individuals in general), e.g., *is popular, is interesting, is well-known*, etc. Unlike the previously mentioned stage-level and object-level VP's, they apply to objects and kinds 'directly', i.e., without modification by *Gn'* or *Gn*.

The logical form of 'atemporal *when* sentences', such as

- (58) Dogs are fat when they are intelligent

is taken as tantamount to

- (58) The kind of dog all of whose realizations are intelligent is (generically) fat

Or to be exact:

- (60) $\text{Gn}(\lambda x^o \text{Fat}'(x^o)) ((\iota y^k) \square (\forall z^o) [\text{R}(z^o, y^k) \leftrightarrow \text{R}(z^o, \mu(\text{dog}')) \& \text{Intelligent}'(z^o)])$

The first clause (the **Gn** clause) says 'is generically fat' while the second clause says 'the kind such that necessarily all of its realizations are dog-realizations and are intelligent'. The translation is obtained by regarding *are fat when they are intelligent* as a syntactic constituent (which combines with the subject *dogs*). This VP has the translation

- (60') $(\lambda x^k) [\text{Gn}(\lambda x^o \text{Fat}'(x^o)) (\iota y^k) \square (\forall z^o) [\text{R}(z^o, y^k) \leftrightarrow \text{R}(z^o, x^k) \& \text{Intelligent}'(z^o)]]$

which essentially combines the *fat*-predicate and the *intelligent*-predicate into the kind-level predicate (60'), which can now be applied to $\mu(\text{dog})$ to yield (60).

Carlson's analysis accounts for the synonymy of the above sentence with

- (61) Dogs *that are intelligent* are fat

It also accounts for the oddity of

- (62) John is fat when he is intelligent

(because there are no objects realizing John), and explains why

- (63) Dogs that are intelligent are widespread

is acceptable, while

- (64) Dogs are widespread when they are intelligent

is not (because we are applying **Gn** to a predicate which is already kind-level).

Carlson discusses the example

- (65) Someone is afraid of ghosts when they are evil

The apparent problem, in view of the preceding analysis, is that the generic to which the *when*-clause appears to apply is embedded in the object, rather than being in subject position. Thus it would seem that by the time we have combined *afraid of* with *ghosts*, we can no longer 'get at' the

generic and combine it with the when-clause. Carlson avails himself of Montague's trick of topicalizing an embedded NP, leaving a co-referential pronoun in the vacated position; i.e., the syntactic analysis uses the 'transformed' version of the sentence

- (66) Ghosts (are such that) someone is afraid of them when they are evil

(where the *them* and *they* are both translated as object-level variables and are co-referential with *ghosts*). Presumably this would also work for

- (67) Mothers of *premature babies* are fortunate when they are normal

(68) John likes to meet the parents of *girls he dates* when they are pretty and the like.

Carlson also has an account of 'adverbs of quantification'. For sentences like

- (69) Quadratic equations *usually* have two solutions

- (70) A cat *never* has six legs

- (71) Flags *sometimes* have stripes on them

- (72) Dogs are *always* fat when they are intelligent

he suggests that the adverb acts essentially as a quantifier over object-level realizations of the subject. Thus the above sentences are equivalent to

- (73) Most (realizations of) quadratic equations have two solutions

- (74) No (realizations of) cats have six legs

- (75) Some (realizations of) flags have stripes on them

- (76) All (realizations) of the kind of dogs all of whose realizations are intelligent are fat.

Note that he can, in principle, deal with cases like

- (77) John sometimes likes girls (he meets)

by again using Montague's trick of topicalizing the generic:

- (78) Girls (he meets) (are such that) John sometimes likes them

Technically, Carlson gets the effect of the above paraphrases by regarding the adverbs as VP-adverbs and not Sentence-adverbs. Thus, for example, *usually have two solutions* is rendered as *is a kind most of whose realizations have two solutions*, etc. When there is both a quantificational adverb and an atemporal *when*-clause, he modifies the earlier rule of translation so that instead of applying Gn to the main-clause predicate, it applies the adverb's translation. Thus such adverbs, just like Gn, are assumed to

'elevate' an object-level predicate to a kind-level predicate; specifically, this can be seen from the translation of

$$(79) \text{ always: } (\lambda P)(\lambda x^k)[(\forall y^o)[R(y^o, x^k) \rightarrow \neg P(y^o)]]$$

Carlson acknowledges that his analysis of atemporal *when*, atemporal *always*, etc, cannot be extended to the temporal uses of these words, so that a 'schizoid' analysis is required, treating such words as lexically ambiguous.

Finally, we should mention Carlson's tentative proposal with regard to indefinite generics (Carlson 1977). He suggested that a phrase like *a dog*, generically construed, be translated as $(\lambda P)[Gn(P)(d) \vee Gn'(P)(d)]$. When applied as subject to the intension of a predicate like *mammal'* or *bark'*, this yields

$$\begin{aligned} Gn('mammal')(d) \\ Gn'('bark')(d) \end{aligned}$$

respectively, after deletion of the meaningless disjunct in each case. These are, of course, exactly the desired generic translations of

(80) A dog is a mammal

(81) A dog barks

respectively. Notice that Carlson's translation of the indefinite generic in effect picks out the *object*-level and *stage*-level properties, which can be ascribed to a kind only after 'elevation' by *Gn* or *Gn'*. As a result, Carlson can explain why

(82) ?A dog is widespread

is odd: the translation treats *widespread* as object-level, attempting to elevate it to the kind level. Thus (contra Farkas & Sugioka, 1983) (82) is odd for the same reason that a sentence like

(83) ?Fido is widespread

is odd. Unfortunately, as we shall indicate, this treatment of indefinite generics is unsatisfactory in other respects.

Attractive Features of Carlson's Approach

Carlson's analysis of bare plurals as kind-denoting leads to a rather elegant, uniform account of a remarkably wide range of sentences with bare plural subjects, including both generic and episodic sentences, and sentences involving atemporal *when*. The theory's conformity with Montague grammar (compositionality, intensionality, pairing of syntactic with

semantic rules) would allow his analysis to be incorporated into a variety of other theories which require this, and ultimately into a larger grammar of English.

We mentioned above that Carlson believed that bare plurals participate in *de dicto/de re* ambiguities, but do not interact with quantifiers and logical connectives to produce scope ambiguities. However, there *is* such interaction, as illustrated by the following sentences:

- (84) Canadian academics are supported by a single granting agency
- (85) Storks have a favourite nesting area
- (86) Dogs have a tail
- (87) Sheep are black or white
- (88) Whales are mammals or fish

It is an important feature of Carlson's analysis (notwithstanding his inattention to such examples) that it can in principle account for these ambiguities. First, it should be noted that in the most natural syntactic analysis of sentence (84), the NP *a single granting agency* is embedded within the sentence predicate; its (intensionalized) translation will be similarly embedded within the translation of the sentence predicate, and the intension of that translation will in turn be operated upon by Gn (given that **supported-by'** is an object-level predicate and that **Canadian-academics'** is a generic subject). Clearly, this yields a narrow-scope reading of *a single granting agency*, wherein the granting agency in question may vary from academic to academic.

But, suppose that we introduce some mechanism such as an alternative syntactic analysis (*à la* Montague's topicalization), or a scoping mechanism (*à la* Cooper, 1983 or Schubert & Pelletier, 1982) to give the equivalent of

- (89) A single granting agency is such that Canadian academics are supported by it

as an analysis of (84), at least at the level of logical form. Then the alternative wide-scope reading becomes available as well.

Much the same can be said about (85) and (86).¹³ In (87) and (88) we can invoke conjunction reduction, either at the syntactic level or, more plausibly, at the level of logical form, to obtain the wide-scope *or* readings (again, see Schubert & Pelletier, 1982).

Along the same lines, it is worth noting (for later comparison with Chierchia) that Carlson's analysis yields satisfactory translations of sentences containing bound pronouns such as

- (90) Dogs like themselves
- (91) Dogs make their owners like them

The crucial point is that (just as in sentences (84)–(88)) the predicate is translated in the first place as an *object*-level predicate. In the case of (90), this predicate will say of an object to which it is applied that this object likes itself. Before application to the kind, dogs, this object-level predicate is elevated to a kind-level predicate by application of Gn to its intension. Via meaning postulates, this kind-level predicate will now say about certain *objects* realizing the kind—i.e., certain dogs—that they like themselves, and that is intuitively just what is required.¹⁴ The same point applies to (91), irrespective of what particular analysis is adopted for reflexives and other bound pronouns.

Version 2: Chierchia

Distinctive Features of Chierchia's Position

Chierchia (1982) proposes an intensional second-order logic called IL* as a logical form for a grammar of English. The distinctive feature of this logic (which is based on Cocchiarella's (1979) system HST* of 'homogeneously stratified types') is that it allows not only terms denoting individuals, but also arbitrary predicative expressions and intensionalized predicative expressions to occur freely as arguments of predicates. So, for example, if *Fido* and *Mary* are individual constants (and not, *à la* Montague, terms denoting individual concepts), *dog'* and *cat'* are monadic predicates, and *hate'* is a dyadic predicate, then not only formulas like

(92) *hate'*(*Mary*)(*Fido*)

are well-formed and interpretable, but also formulas like these are:

(93) *hate'*(*cat'*)(*Fido*)

(94) *hate'*(*cat'*)(*dog'*)

They are well-formed because predicates are typed only with respect to their adicity, not with respect to the types of their arguments, and accordingly may be applied to arguments of any type. Semantic evaluation relies on a function *f* which supplies an individual *concept correlate* for any individual or *n*-adic predicate extension or intension ($n = 0, 1, 2, \dots$) to which it is applied. (In the case of individuals, *f* acts as identity, i.e., individuals are their own concept correlates.) So, for example, given some interpretation, formula (94) will be true at a world-time index *i, j* just in case the pair of arguments consisting of $f[{}^{\wedge}\textit{cat}'(i, j)]$ (i.e., the concept correlate of the predicate intension which is the value of *cat'* at *i, j*) and *Fido* (if that is the individual denoted by *Fido* at *i, j*) renders the semantic function corresponding to *hate'* at *i, j* true.¹⁵ Thus concept correlates serve as 'surrogates' for more complex objects in the process of semantic evaluation.

In fact, (92)–(94) are precisely how sentences like

- (95) Fido hates Mary
- (96) Fido hates cats
- (97) Dogs hate cats

are translated by Chierchia. The permissive character of predication in IL* certainly leads to an attractively simple logical form for English. We should mention, however, that λ -abstracts in IL* behaves less permissibly than λ -free predicative expressions, in a certain sense. (As we will suggest later on, this point appears to be problematic for Chierchia's theory.) Specifically, according to the semantics of λ -abstraction in IL* (1982, pp. 325–326), in order for a λ -abstract such as $(\lambda x)Fx$ to be true of an argument c , it is insufficient that the concept correlate of the denotation of c make $F(x)$ true when used as the value of x ; the concept correlate must in addition be the concept correlate of some entity (individual, predicate, or predicate intension) *of the type determined by x* . For example, if x is an individual variable, then $((\lambda x)Fx)(c)$ can be true only if c denotes an individual; if P is a variable over monadic predicate intensions, then $((\lambda P)F(P))(c)$ can be true only if c denotes a monadic predicate intensions; and so on. In all other cases, the result of applying the λ -abstract is falsity.

Chierchia (1982a) extends his theory to deal with bare singulars, i.e., mass terms, treating these as kind-denoting just as in the case of bare plurals. In this combined theory of mass nouns and bare plurals, he modifies (and formalizes) Carlson's three-tiered ontology of stages, object, and kinds, but still relies crucially on having a logic like IL* for expressing the logical form, allowing free application of predicates to intensionalized predicates.

Chierchia endeavours to simplify the semantic apparatus of Carlson's theory, in particular by eliminating Carlson's gnomonic operator G_n for 'elevating' object-level predicates to kind-level predicates. (There is no need for such 'elevated' predicates because we have the 'concept correlates'.) Although he does not mention it, he would presumably retain some operator like Carlson's G_n' for 'elevating' stage-level predicates to object-level predicates, producing the 'habitual' reading of the predicate.

Seeking a further simplification of Carlson's theory, Chierchia collapses Carlson's realization relations R' and R (which respectively relate stages to individuals (in Carlson's sense of individual: a kind or an object) and objects to kinds) into a single, semantically 'bimodal' relation R_e . Again, this is made possible by the fact that wherever an object-denoting expression is permitted, a kind-denoting expression (i.e., a predicate intension) is permitted as well. Chierchia modifies Carlson's notion of a stage of a kind so that stages of any number of objects (but at least one) may be *part of*

it. This not only solves some of the difficulties we will mention below with respect to Carlson's account, but also aligns the account of mass terms with intuitions about the structure of 'quantities of matter'. Quantities of matter are the realizations of kinds such as wine, money, or furniture, and these can intuitively be fused to form larger quantities of the same kind, and can enter into 'part of' relationships.

Attractive Features of Chierchia's Approach

Chierchia's approach has the attractive features mentioned above for Carlson: it gives an elegant and uniform account of a wide range of data including generic and episodic sentences, and it is compositional in nature. In addition, the approach of using IL* appears to lead to a rather robust semantics for natural languages, in which there are no longer rigid type constraints on what may be predicated of what. Furthermore, given that first-order predicates are applicable to intensions of first-order predicates in his approach, he is able to identify kinds simply with predicate intensions. Thus *dogs* (as an NP) translates as $(\lambda P)P(\text{'dog'})$, *wine* (as an NP) translates as $(\lambda P)P(\text{'wine'})$, and so on.¹⁶ Another attractive feature of Chierchia's theory (in comparison with Carlson or Montague) is that he needs only one predicate to characterize the meaning of an extensional verb such as *love*, namely *love'*, dispensing with Montague's underlying extensional predicate *love*, (or Carlson's *love'*). (See Chierchia 1982, p. 337.)

Finally, Chierchia's notion of stages, unlike Carlson's, is fully formalized. In particular, Chierchia takes stages to be the (instantaneous) manifestations of objects at particular times, i.e., they are the values of objects at world-time indices. Stages that cut across several objects are obtained as mereological fusions of other stages. Fusion is taken as the join operator of a join semilattice with a partial ordering relation interpreted as 'part of'; this semilattice approach pretty well models the intuitions mentioned in the last subsection about Chierchia's handling of mass terms.

Version 3: Farkas & Sugioka

Distinctive Features of Farkas & Sugioka's Approach

The basic difference of Farkas & Sugioka's approach from that of Carlson's is that (generically construed) predicates applied to generic subjects are assumed to supply a G (for 'generally') *quantifier* (which can bind any number of free variables) rather than a *Gn* or a *Gn'* *predicate modifier*. This G is called an *unselective quantifier*, which combines with a proposition having at least one free variable. These quantifiers quantify over *cases* (the terminology is from Lewis, 1975) in which the open proposition is true. So a case is an admissible assignment of values for the variables of the open propositions, such that the assignment would make the open proposition

true. The quantifier binds *all* the free variables in the proposition. If the subject is a bare plural generic, the predicate also introduces a variable, again to be bound by **G**, over realizations (using the relation **R** which is a 'collapsing' of Carlson's **R** and **R'** into a single 'bimodal' relation)¹⁷ of a kind. In the translation of the predicate the kind itself is λ -abstracted upon, for binding to the subject. Thus a sentence like

(98) Dogs hate cats

would be translated as

$$(99) (\lambda u^k)(\lambda v^k)[\mathbf{G}(\text{hate}'(x^o, y^o))x^o : (\lambda z^o)\mathbf{R}(z^o, v^k), y^o : (\lambda z^o, u^k)] \\ (\mu(\text{dog}))(\mu(\text{cat}))$$

which, after two λ -conversions, becomes

$$(100) [\mathbf{G}(\text{hate}'(x^o, y^o))x^o : (\lambda z^o)\mathbf{R}(z^o, \mu(\text{dog})), y^o : (\lambda z^o)\mathbf{R}(z^o, \mu(\text{cat}))]$$

where, again, the superscripts ^o and ^k indicate variables of the object-level and kind-level respectively. The last two clauses of (100) tell us 'restrictions' on the type of assignments x^o and y^o can receive—namely that x^o must be a dog-object (a **R** of **dog'**) and y^o must be a cat-object (a **R** of **cat'**). The sentence (100), as a whole, says 'Generally, for x^o and y^o objects satisfying the appropriate semantic interpretation, x^o hates y^o .' Note that this process of 'restricting' the variables is metalinguistic, and that the 'object linguistic' formula is just the part $\mathbf{G}(\text{hate}'(x^o, y^o))$. The entire 'translation', viz, (99) or (100), is a mixture of object-language and metalanguage expressions. The quantifier **G** means 'generally' (or 'in a significant number of cases') and is said to be 'inherently vague'.

The main thrust of Farkas & Sugioka's work is to give an account of restrictive *if/when*-clauses. The analysis of a sentence like

(101) Bears are intelligent when they have blue eyes

amounts to saying that the 'object language part' is *generally, if x has blue eyes then x is intelligent*, the 'metalanguage restriction' is that x must be a realization of a kind, and this 'mixed language predicate' is applied to the kind, bears. Thus we get

$$(102) (\lambda y^k)[\mathbf{G}(\text{blue-eyed}'(x^o) \rightarrow \\ \text{intelligent}'(x^o))x^o : (\lambda z^o)\mathbf{R}^o(z^o, y^k)](\mu(\text{bear}))$$

which, after a λ -conversion, is

$$(103) \mathbf{G}(\text{blue-eyed}'(x^o) \rightarrow \text{intelligent}'x^o)x^o : (\lambda z^o)\mathbf{R}(z^o, \mu(\text{bear}))$$

Thus, unlike Carlson who analyzed the *when*-clause as a restriction upon bears (forming the kind, bears which have blue eyes, and applying the

predicate *are (generally) intelligent* to this kind), Farkas & Sugioka amalgamate the *when*-clause to the predicate (forming the predicate *if it is blue-eyed then it is intelligent*), and apply this to realizations of the kind, bears.

Farkas & Sugioka (1983, pp. 239ff) replace the material conditional '→' in sentences like (102) and (103) with a conditional (written 'c') whose truth conditions differ from those of '→' in that when the antecedent is false, (p c q) is 'not determined' or 'the possibility does not come into consideration'.¹⁸ The problem comes with 'monotone decreasing quantifiers' such as *never*, *seldom*, etc.

(104) Bears are never intelligent if they have blue eyes

(105) $\neg[(\text{blue-eyes}'(x^o) \rightarrow \text{intelligent}'(x^o))x^o : (\lambda y^o R(y^o, \text{bears}'))]$

But (105) is true if there is an object realizing *bears* that does not have blue eyes. Surely, though, that is not relevant to the truth or falsity of (105). Thus, say Farkas & Sugioka, the need for the conditional 'c'.

In their discussion of 'non-generic *when*-clauses' (1983, §.4.3), Farkas & Sugioka extend their analysis so that in addition to 'saying something about a kind by saying something which is generally true of objects realizing that kind' (as done with the 'generic *when*-clauses'), it is allowed to 'say something about an object by saying something that is generally true of its stages'. For example

(106) John is grouchy when he is hungry

'says something about John by saying something that is generally true of his hungry-stages.' In this discussion, Farkas & Sugioka introduce 'implicit time and place variables' (*t* and *p*) in order to generate the appropriate translation. Thus,

(107) Canaries are popular when they are rare

gives rise to

(108) $G[(\text{rare}'(c) \text{ at } t \text{ in } p) c (\text{popular}'(c) \text{ at } t \text{ in } p)]$

which intuitively says 'For times and places, generally speaking, if canaries are rare then and there, they are popular then and there'.

Farkas & Sugioka accommodate frequency adverbs within their framework by the analogue of Carlson's stratagem: when such an adverb is present, it is assumed to take the place of the 'default' quantifier G, i.e., such adverbs are treated as unselective quantifiers which bind all variables within their scope. Thus, for example, introduction of *always* into (98) would replace G by *always*' in (100), and similarly for (101)–(103) or (107)–(108).

Farkas & Sugioka also have an account of 'indefinite generics' such as

the generic reading of

(109) A dog is a mammal

As already noted, part of the problem with indefinite generics is that sentences like

(110) A dog is widespread

seem ill-formed. But if indefinites *can* receive generic interpretations, as in (109), and if generic subjects refer to kinds, why should (110) be bad? We saw that Carlson's solution is to say that when the subject is an indefinite, then the predicate must be a property of objects or stages. Farkas & Sugioka propose to translate (109) as

(111) $G[(\text{mammal}'(x^o))x^o : (\lambda z^o)R(z^o, d)],$

that is, roughly, as 'Generally, realizations of dogkind are mammals'—the same as the final translation (after λ -conversion) of *dogs are mammals*. Technically this is accomplished by translating *a dog* as a free variable, having a restriction to dogkind-realizations.

Attractive Features of Farkas & Sugioka's Approach

First and foremost should be mentioned the apparent breadth of coverage of a wide range of phenomena: bare plural generics, indefinite generics, 'habitual' sentences, and modification of each of these types by restrictive *if/when*-clauses and by temporal adverbs of quantification. Further, despite the wide range of phenomena apparently covered, the resulting translations are relatively simple and (quite often, anyway) seem to correctly show the relationships between distinct syntactic constructions.

Also, in comparison to Carlson, the ploy of regarding *when*-clauses as part of the sentence matrix (rather than as a restriction on the kind) correctly allows for *when*-clauses that do not have in them a pronoun co-referential with the subject, such as

(112) Bears have thick fur when the climate is cold

Such *when*-clauses do not seem amenable to Carlson's analysis (because *bears such that the climate is cold* does not seem to denote a kind), yet intuitively seem to manifest the same logical form as

(113) Bears have large foreheads when they are intelligent

The analysis of indefinite generics (as in Carlson's analysis) seems to yield the correct result that

(114) A dog is a mammal

and

(115) Dogs are mammals

will get the same logical representation, and that

(116) A dog is widespread

is bad for the same reason that

(117) Fido is widespread.

PROBLEMS WITH THE SOPHISTICATED APPROACH

We have seen how the various versions of the sophisticated theory differ from one another, but yet how they are fundamentally very similar to each other. In this section we will mention some difficulties with the sophisticated theory. Our method will be to first state criticisms which apply to one of the versions only and then go on to give criticisms that apply to any version of the sophisticated theory. It is with these criticisms in mind, especially the general criticisms, that we suggest some possibly fruitful lines of investigation in the section which follows.

Apparent Problems with Carlson's Approach

As we have seen, object-level predicates can be applied meaningfully to kinds only after they have been elevated to kind-level predicates by application of **Gn** to their intension. In a grammar conforming with the rule-to-rule hypothesis, this entails either that the VP-translation must be made *syntactically* sensitive to whether the subject NP denotes an object or a kind, or that a syntactic ambiguity must be artificially introduced, allowing a bifurcation of the VP-translation into object-level or kind-level predicates. (Carlson chooses the latter option.) Yet English does not make such a syntactic distinction (and we know of no language that does).¹⁹ As Enç (1981, p. 225) puts it, the operator **Gn** invoked by Carlson is a 'phantom' operator.

Furthermore, sentences like the following indicate that operators similar to **Gn** and **Gn'** are necessary to 'elevate' predicates with respect to argument positions other than the last (i.e., the subject).

(118) Dogs like people for what they are

(119) Paranoids never like people for more than a week

(120) Psychiatrists explain people to themselves

One reading of (118) is roughly equivalent to *Dogs like mankind for what it is*. This can be handled in Carlson's framework by assuming the object position of *like* to permit both sorts of individuals (i.e., objects and kinds). But then the second reading cannot be represented, according to which dogs like (most) individual people for what they are. Or rather, to represent the reading, an operator Gn_2 is needed which 'elevates' a two-place object-level predicate to a kind-level predicate with respect to its *first* (unsaturated) argument position. Similarly (119) shows an ambiguity with respect to the interpretation of the object position (i.e., whether the sentence is about liking people in general or about liking individual people) which again indicates the need for Gn_2 . And (120) shows an analogous need for Gn'_2 , so that the object-controlled reflexive reading can be obtained, without being rendered as *Psychiatrists explain people to people*. In general, it seems that *all* NP positions are potentially subject to this sort of 'elevation', so that the grammar will have to generate 2^n analyses (or employ *ad hoc* agreement features) for any sentence containing n NP's. (While *some* of these alternative analyses are needed to explain the ambiguity of sentences like (118)–(120), many or most will have meaningless logical translations if some of the NP's denote individual objects.)

Carlson thinks of stages of an object as being spatio-temporal segments of that object. Although he does not mention the possibility, it seems plausible to suppose that these segments can be extended in time. But also Carlson thinks of a stage of a kind as being a stage of some object instantiating that kind. Thus a stage of a kind is identical with a stage of some one object. This means that every sentence which uses an episodic kind-level predicate will be incorrectly interpreted. For example,

(121) Lemurs evolved from tree shrews

will be taken as referring to a (possibly temporally extended) stage of a particular lemur! Similar remarks hold for such sentences as

(122) Leaves cover the ground

and the like.

Even as just an analysis of progressive VPs, Carlson's theory falls short. For example

(123) Oil is becoming scarce

(124) Alligators are becoming extinct

express propositions about kinds, or perhaps about the totality of the current manifestations of those kinds (as allowed by Chierchia's theory), but certainly not about the current manifestations of particular individuals of those kinds.

The treatment of restrictive *when*-clauses, as well as that of frequency (quantificational) adverbs is non-uniform in Carlson. The treatment of 'atemporal *when*' in particular does not extend to cases in which the *when* clause lacks a pronoun coreferential with the subject NP, or to cases that 'shade off' into temporal readings. Similarly, his treatment of frequency adverbs is 'schizoid', depending on a distinction between an atemporal reading that implicitly quantifies over realizations of a generic subject, and a temporal reading which involves no such implicit quantification.

Carlson's proposal for handling indefinite singular generics, described earlier is ingenious but ultimately unworkable. Sentences like the following present apparently insuperable difficulties.

- (125) A bear sometimes has blue eyes
 (126) A house is sometimes built out of bamboo

The trouble with the translation $(\lambda P)[\text{Gn}(P)(b) \vee \text{Gn}'(P)(b)]$ for *a bear* is that it allows a 'generic bear' to have only properties that individual bears can have, and 'sometimes having blue eyes' is not such a property. **sometimes'** already elevates an object-level predicate to the kind level, and so

Gn('sometimes'('blue-eyed'))

is meaningless.

There appears to be a slight problem as well in the translation of plural generics as kinds whose realizations are *individual* objects of those kinds. Sentences like

- (127) Swarming killer bees are a serious menace
 (128) Convergent lines share a common point
 (129) Compatible employees make for a productive company
 (130) Opposing viewpoints can lead to a synthesis

suggest that the plural subject nouns *killer bees*, *lines*, *employees*, and *viewpoints* should be interpreted as applicable to *collections* of individuals, rather than single individuals, since a single bee cannot swarm, a single line cannot converge, and so on. Note that this problem is different from the problem in the conception of stages of kinds as stages of individual objects of those kinds. The problem here is not so much in the predicates themselves (which could be 'lowered' to apply to collections of individuals, via suitable meaning postulates); rather, the problem lies in Carlson's *definition* of kinds, e.g., the definition of swarming killer bees as the kind whose realizations are all *individually* swarming killer bees (in a given world). Predicates applicable to collections might be obtained from the singular by application of a 'plur' predicate-modifying operator (cf. the 'two-or-more'

operator in Schubert 1982). Thus plur(bee') holds of collections of one or more bees, plur(line') holds of collections one or more lines, and so on. Such an approach would also dovetail with a handling of numeral adjectives as operators which combine with plural noun denotations to form predicates applicable to collections of particular sizes. Note that such a collection appears to be referred to in

(131) Three men lifted the piano

Moreover, such collections allow the same sorts of generic readings as bare plurals:

(132) Three men can lift a piano

The subjects in these sentences could be translated as $\mu(\text{three}'(\text{plur}(\text{man}')))$, where **three'** transforms a predicate true of collections of arbitrary size to a predicate true of collections of size 3. This modification in the translation of plural generics would automatically solve the problem with stages of kinds as well: regarded as stages of *collections* of objects of those kinds, they would no longer be confined to single-object stages.

It might be thought that a distinction between singular and plural generics based on plur would resolve the difficulty with indefinite singular generics (114), (116), (125)–(126). However, since *definite* singular generics presumably do not involve a plur operator, yet allow attributions like

(133) The dog is widespread in urban areas.

the difficulty remains.

Apparent Problems with Chierchia's Approach

Most importantly, Chierchia's elimination of Gn also eliminates readings—often the preferred ones—of ambiguous sentences like the following (repeated from above)

(134) Canadian academics are supported by a single granting agency

(135) Storks have a favourite nesting area

(136) Dogs have a tail

(137) Sheep are black or white

(138) Whales are mammals or fish

and leads to faulty truth conditions for certain others involving pronouns bound to bare NPs, like the following (again repeated from above)

(139) Dogs like themselves

(140) Dogs make their owners like them.

For example, the translation of (136) is

$$(141) \text{ has}'(\lambda Q)(\exists x)[\text{tail}'(x) \ \& \ \text{'Q}(x)](\text{'dog'})$$

(where Q is a variable over predicate *intensions*); and by an extensionalizing postulate²⁰ this leads to

$$(142) (\exists x)[\text{tail}'(x) \ \& \ \text{has}'(x)(\text{'dog'})]$$

which is the non-preferred reading that there is a tail such that dogs have it. A similar difficulty would be encountered for sentences like (137), in which only a wide-scope reading of the disjunction would be obtained.

It may be possible to solve this particular problem by modifying the extensionalizing postulate to make it dependent upon whether the subject of the predicate is a kind or an object. However, no such escape seems available in the case of sentences (139) and (140), involving bound pronouns. The translation of (139) is

$$(143) (\lambda x)[(\lambda x_1)][\text{like}'(\lambda P)P(x_1)](x)(x)(\text{'dog'})$$

As noted earlier, the definition of λ -abstraction in IL^* ensures that this formula will be false, since x is an individual variable and the denotation of 'dog' , being a predicate intension, cannot be among the *individuals* in the extension of the λ -abstract. (As we pointed out, a sentence of this form will be false even if the assignment of the concept correlate of the argument as value of x in the embedded open sentence would have made it true.) While it would be possible to reformulate the rule of reflexive translation which gives the above result so that it abstracts a variable over predicate intensions rather than individuals, the resulting translation would, in effect, say that dogs like dogs, rather than themselves. Given the intensional translation of mass terms, the same difficulty is encountered for sentences like

$$(144) \text{ Damaged skin renews itself}$$

whose translation will be false or, with intensional reflexive variables, equivalent to *damaged skin renews damaged skin*.

Carlson (1982) has offered some objections to the view underlying Chierchia's treatment of generics and mass terms, that kinds are nominalized properties. He points to the contrast between such a and b pairs as

$$(145) \text{ (a) Redness is a property}$$

$$\text{ (b) Horses are a property}$$

$$(146) \text{ (a) The property of being a horse is a very abstract thing}$$

$$\text{ (b) Horses are a very abstract thing}$$

$$(147) \text{ (a) Being a horse is fun}$$

$$\text{ (b) Horses are fun}$$

One may question as well whether Chierchia's formalization of Carlson's stages as *instantaneous* manifestations of objects (or rather as the mereological fusion of instantaneous manifestations of objects) can properly serve the purposes for which Carlson seems to have enlisted this notion. Consider, for example, verbs like *displace*, *hollow out*, *envelop*, *build*, *fight a war*, and *throw a party*. All of these meet Carlson's main criteria for stage-level predicates: they induce existential readings on bare NP subjects, and they allow progressive forms. Yet it seems inappropriate to regard the following sentences as ascribing properties to instantaneous stages.

- (148) Mammals displaced the remaining dinosaurs
- (149) Water hollowed out the rock
- (150) Ivy gradually enveloped the building
- (151) New settlements were built on the West Bank
- (152) Wars have been fought over worthless land
- (153) Friends threw a party for him
- (154) Termites hollowed out the tree
- (155) Shah Jahan built the Taj Mahal

The following-out or envelopment cannot be ascribed to instantaneous manifestations, but only to (watery or leafy) individuals acting over some extended time period. It is hard to see how *building the Taj Mahal* could be true of anyone's instantaneous stage since the task took at least 14 years, or how *displacing the remaining dinosaurs* could be true of a species' instantaneous stage. These sentences show that the problem arises both for generics (bare plurals and for mass terms) and also for proper nouns. In all these cases, one can reasonably maintain that properties of *temporally extended* stages of kinds are being specified (though not if stages of kinds are stages of single objects of those kinds, as one of Carlson's meaning postulates requires). But treating stages as instantaneous makes this view much less plausible.

Apparent Shortcomings of Farkas & Sugioka's Approach

Surprisingly, Farkas & Sugioka do not attempt a treatment of 'existential readings' of bare NP's. In light of the fact that these were Carlson's motivation for introducing 'stages' in the first place, one wonders whether Farkas & Sugioka's relation *R* really bears any relation to Carlson's.

It should be noted that the approach has not been formalized, e.g., it is unclear when 'at time *t* and place *p*' are to be introduced and how they are to be formally interpreted. As remarked above, 'logical translations' for Farkas & Sugioka are a mix of object language and metalanguage formulas

(including metalanguage expressions embedded within object language sentences). Interpretation of such translations could turn out to be extremely difficult.

Farkas & Sugioka rely on a conditional which differs from the material conditional in that its value is undefined when the antecedent is false. But intuitively, a statement like

- (156) If a dog is always intelligent when it has purple eyes, and there is a dog with purple eyes on Mars, then there is an intelligent dog on Mars

is true—indeed, necessarily true—rather than meaningless, regardless of whether or not there are any purple-eyed dogs. But if they give up their non-standard conditional, there are serious technical problems for their translations of *when*-sentences.

According to Farkas & Sugioka, the sentence

- (157) Lizards are always pleased if the sun shines

means that all stages of the kind, lizards, are pleased if any stage of the sun shines. Now as this stands, it requires all stages of lizardkind, throughout all time, to be pleased, as long as some stage of the sun does in fact shine. Clearly, it remains to connect up the two parts of the conditional in time and space. As we have seen, a device that they use elsewhere is to append modifiers 'at t in p ' (i.e., 'at time t in place p ') to clauses in logical translations of generic sentences. With this device, the interpretation of the sentence could be refined to read, 'For all times t and places p , all stages of the kind, lizards, are pleased at t in p if any stage of the sun shines at t in p '. However, this translation *still* requires all stages of lizardkind, throughout all time, to be pleased, though now it requires them to be pleased at any time t and any place p featuring sunshine. But this is absurd, for a given stage of lizardkind is by definition the manifestation of that kind at a particular time, and such a manifestation cannot be pleased at some *other* time t . What seems to be required, to make the correct connection between stages and times, is a relation which expresses that a stage *occupies* a particular time. This would allow the meaning of the sentence to be expressed as 'For all times t and places p , and any stage of lizardkind occupying t , that stage is happy in p if a stage of the sun occupying t shines in p '.

It is not at all obvious, however, how to accommodate such an 'occupies' relation systematically in Farkas & Sugioka's translations. Also, were one to do so, it is not clear that stages would still serve any useful purpose as an ontological category. Why not render the meaning of the sentence simply as 'For all times t and places p , lizardkind (as an individual persisting in time) is happy at t in p , if the sun (as another individual persisting in time)

shines at t in p '? The fundamental problem, it seems to us, is that Farkas & Sugioka are trying to represent time relationships by quantifying explicitly over time variables, while adopting Carlson's 'stages' which are expressly designed to allow treatment of times as *indices*. These indices serve as arguments of semantic functions interpreting object language expressions, but cannot be referred to by object language variables. We shall come back to this observation later, when we discuss general shortcomings of the sophisticated approach.

Farkas & Sugioka translate generic sentences with the aid of an unselective quantifier G which, they say, is to be understood as 'in a significant number of cases', and which is 'inherently vague'. However, it is surely true that

(158) In a significant number of cases, leukemia patients are children yet it is surely false that

(159) Leukemia patients are children

Similar examples have already been noted by Carlson (1977, p. 40):

(160) Seeds do not germinate

(161) Books are paperbacks

(162) Prime numbers are odd

(163) Crocodiles die before they attain an age of two weeks

These false sentences become true when prefixed with *In a significant number of cases*. One basic difficulty in finding a workable quantifier lies in the neglect of a contextually determined 'ensemble of cases or situations', a topic to which we will return in our general critique of the sophisticated approach. Another serious obstacle to any quantificational approach is the inherently intensional character of certain habitual and generic statements, as pointed out by Dahl (1975) and Carlson (1982). For example,

(164) This machine crushes oranges

may be true even if the machine is fresh off the assembly line and is destined never to be used. Its truth comes from its *capability* for crushing oranges, an essentially modal notion. Similarly

(165) Members of this club help one another in emergencies

may be true, even though no emergencies have yet arisen to put this code of behaviour to the test. Much as in (164), its truth comes more from the *preparedness* of the agents to act in certain ways, than from their actually doing so.

Finally, the approach of Farkas & Sugioka is unable to handle relative-clause sentences like

(166) A man who owns a stubborn donkey usually beats it

because indefinite singular NPs are translated as free variables with metalinguistic auxiliary constraints restricting the free variable. Thus the relative clause *who owns a stubborn donkey* becomes part of a metalinguistic constraint on the variable translating the subject, so that *usually* fails to bind *a stubborn donkey*.

A General Critique of the Sophisticated Approach

In this subsection, we shall adduce some general doubts about the entire sophisticated approach. We intend these criticisms to apply to all the theorists we have considered above, and have in mind that appreciation of these points will lend credence to the proposals sketched in the next section.

In the first place there is the very general question of whether it is indeed appropriate to regard episodic predicates as applying to stages rather than to individuals. Various considerations appear to us to indicate that it is not. First, it seems a little puzzling why there are stage-level predicates at all, if they need to be converted to predicates over individuals (i.e., objects or kinds) in each case and every case in which they are actually applied. Second, the distinction between stage-level and object-level predicates leads to a formally very non-uniform treatment of semantically alike predicates such as those in the following (a) and (b) sentences:

- (167) (a) John is riding on the bus
- (b) John is a passenger on the bus
- (168) (a) John will speak at the conference
- (b) John will be a speaker at the conference
- (169) (a) John received a prize
- (b) John was the recipient of a prize
- (170) (a) John started the quarrel
- (b) John was the instigator of the quarrel
- (171) (a) John was subject to ridicule by Mary
- (b) John was subjected to ridicule by Mary
- (172) (a) Their eyes glowed
- (b) Their eyes were luminous

We do not deny that there are significant semantic differences between some of the (a) and (b) sentences, but we do feel that their truth conditions are equally dependent upon fleeting 'stages' of the subject. Conversely,

they can be viewed equally well as attributing properties to *objects* at particular times. Moreover, many predicates can induce quasi-universal readings (suggesting that they apply to objects, according to our sophisticated theorists) as easily as they can induce existential readings (suggesting that they apply to stages).

- (173) Poor people live in that part of town
- (174) Dollar bills are printed in that building
- (175) People devote years to the study of such problems
- (176) People are asleep/homeless/away from home/on the beach/on the brink of starvation
- (177) People with links to organized crime support his candidacy

(This point did not elude Carlson, who noted that many such examples involve locative adverbials.) Related observations can be made about progressive participles, which according to the sophisticated theory are paradigms of inducing the existential reading. There are a large number of such cases in which a *range* of interpretations seem possible, from the particular to the generic. For example,

- (178) Wildlife is being destroyed

might refer to a very limited number of individuals at a particular time (e.g., when the cause is a forest fire), or to a larger number of individuals over an extended period of time (e.g., when the cause is widespread and persistent hunting and poaching), or to wildlife *in general* (e.g., when the cause is man's encroachment on the natural habitats of all wildlife). In general, one can always get at least two 'interpretations' of such sentences as

- (179) Leaves are turning yellow
- (180) Ducks are flying south
- (181) Bats are hunting food
- (182) Wolves are howling
- (183) Dissidents are being thrown in jail

One reading derives from the 'on the scene reporter', who looks at his surroundings and 'states what he sees'. As the camera pans around him, our reporter says

Ladies and gentlemen, as you can see,
leaves are turning yellow and ducks are flying south

Later in the day, our reporter stumbles across a provincial capital, turns on his TV camera, and announces

Dissidents are being thrown in jail

And still later that night he again scans his surroundings with the camera and announces

You will note now that bats are hunting food and wolves are howling again reporting on what activities are before him. This 'on the scene' reporting is perhaps the sophisticated theory's 'realization reading'. But there is a second reading of these sentences provided by 'storytellers' remarking on the 'trends of the times'. Instead of reporting about the scene, our storyteller says:

It's that time of year, autumn.
Leaves are turning yellow and ducks are flying south

Our storyteller is not remarking about the current scenery, but rather about current trends pertaining to leaves and ducks *in general*—these are generic sentences. Let's listen to him again:

Ah, fall! It's election time in Central America: -
dissidents are being thrown in jail
It's midnight: it's that time when bats are hunting food
and wolves are howling

If these 'trends of the times' readings are possible for progressive cases—and they surely are—then it is incorrect to posit 'realization readings' as the logical form for *any* of the particular utterances of such sentences. Any 'realization reading' which can come out of them must then be accounted for by some other factor, such as the context of utterance. But then it would *not* be part of the meaning or logical form that they are about realizations rather than about the kinds.

Interpretation of episodic sentences in terms of stages runs into difficulty when the sentence predicates are intensional or involve reference to individuals displaced in time:

- (184) Houses are being designed
- (185) War heroes are being remembered
- (186) Nixon is fading from people's memories
- (187) Mozart is gaining new admirers

Clearly, (184) should not be interpreted as saying that a (present) stage of the kind, houses, is being designed, and (185) should not be interpreted as saying that a (present) stage of the kind, war heroes, is being remembered. The analysis of such sentences by Chierchia would have it that we are remembering a current, *instantaneous* stage of the kind, which is surely wrong. In Carlson, the stage might be temporally extended, but this is still

wrong, since (185) is not referring to any particular *stages* of war heroes, but rather is referring to *objects*—individual war heroes. Much the same can be said about (186) and (187).

As remarked in previous subsections, there is a more general point to be made about stages. They appear to be both intuitively and technically redundant in a theory that already posits time indices (for semantic evaluation). After all, talk of stages can be replaced by talk of individuals at particular times. Conversely, time is redundant (as a primitive notion) in a system with stages, since simultaneity can be expressed in terms of being part of a common stage, and time-ordering can be recast as stage-ordering.

An important shortcoming of all of the sophisticated accounts of generic sentences is their neglect of what strikes us as one of their most salient features: their explicit or implicit reference to an ensemble of situations or episodes with respect to which the main clause is to be evaluated. Consider, for example, the following sentences

- (188) (a) Robin Hood never misses
 (b) Robin hood shoots (an arrow) at a target
- (189) (a) A cat always lands on its feet
 (b) A cat drops to the ground
- (190) (a) A student (always) admires a fair professor
 (b) A student knows a fair professor (as a student in one of his classes)
- (191) (a) Men (usually) notice pretty women
 (b) Sm²¹ men are near *sm* pretty women (and not yet aware of them)
- (192) (a) Dogs give live birth
 (b) Sm dogs give birth

We shall return to these examples (and ones like them) and dwell on them at some length in the next section. For the present, we wish merely to draw attention to the implicit reference in the (a)-sentences to *underlying ensembles of situations or episodes* like those in the (b)-sentences. We will suggest that these situations or episodes are systematically related to the sentences to which they pertain, and that the frequency adverbs in the (a)-sentences are to be interpreted with reference to these underlying ensembles. Nowhere in the sophisticated theory is there to be found an explanation of how this can be. Notice that certain puzzles are immediately clarified by the assumption of such ensembles. For example, we can see why the truth of (189a) does not require cats to be landing all the time, or why it is irrelevant to the truth of (192a) what *fraction* of dogs give live birth.

SOME PROPOSED LINES OF INQUIRY

We have outlined some of the problems besetting any attempt to explicate formally the 'fundamental intuition' about sentences containing bare plurals, mass terms, and related constructions. The three 'sophisticated theories' we have discussed undoubtedly represent major steps forward in our understanding of such constructions. Yet, as we have tried to show, many facets of the problem remain obscure and puzzling.

In this concluding section we discuss two possible lines of further investigation, which seem to us to hold some promise. The first is a 'conservative' proposal: essentially, it attempts to find a middle ground between Carlson's and Chierchia's theories which would permit the simplicity of Chierchia's logical-form representations of generic (and related) sentences to be retained, while remedying the defects that seem to result from relinquishing Carlson's operator *Gn*.

The first proposal, however, seems fundamentally limited; the sort of approach indicated may be unable in principle to deal satisfactorily with indefinite singular generics, or with the problem of 'ensembles' underlying generic statements, or to avoid the 'schizoid' view of frequency adverbs as temporal/atemporal. The second, more radical line of inquiry is therefore one which proposes to take such ensembles seriously. In this sense it takes its cue from the Lewis/Farkas & Sugioka view of quantifying adverbs and restrictive clauses, although it seeks to ground 'cases' in something other than sets of free variables. However, here our discussion is even less concrete than in the case of the 'conservative' proposal.

Indirect Semantic Evaluation

The fundamental problem confronted by all theories of generics, as we have seen, is to explicate the truth conditions of sentences which, at least on the surface, appear to predicate the same property (such as the property of being intelligent) of both objects (such as Fido) and of kinds (such as dogs).

The simplest sort of account of this phenomenon would be one like Chierchia's, which takes the logical form of such sentences to be the same, regardless of whether the subject is an object or a kind. Indeed, Carlson's initial Montague-style fragment dealt with generic predications in this straightforward fashion. But, as Carlson noted, such an account misconstrues certain sentences involving bound pronouns, and we have given additional kinds of sentences, involving ambiguities, for which the straightforward account fails.

Is something like Carlson's **Gn**-operator (or Farkas & Sugioka's **G**-quantifier) essential at the level of logical form, then, if we are to make formal sense of generic predictions? We would hope not, since (as we showed) this would have undesirable effects on the formal syntax, introducing otherwise unmotivated syntactic ambiguities or features.

It seems to us that certain avenues remain open for retaining the simplicity of logical form sought by Chierchia, while avoiding the semantic problems such an approach can engender. We briefly sketch two closely-related possibilities. The idea in both is to shift some of the burden of providing correct truth conditions from the rules of translation to the rules of semantic evaluation; or, to put it a little differently, the idea is to 'liberalize' the logical syntax of predication slightly, at the expense of a slight complication in the rules of evaluation (no greater complication than in Chierchia's semantics, however).

In particular, we make the following observations. The standard way to evaluate a predication of the form $\Phi(t)$ is to say that this is true (i.e., $|\Phi(t)| = 1$ under a particular interpretation, for a particular variable assignment function, at a particular index) just in case $|t|$ is in the extension of $|\Phi|$ (under that interpretation, etc). Furthermore, to say $|t|$ is in the extension of $|\Phi|$ is standardly regarded as an alternative way of saying $|\Phi|(|t|) = 1$. There is, however, nothing sacred about either of these conventions. All we require, ultimately, is some formalized way of saying that for $\Phi(t)$ to be true in a state of affairs, whatever t denotes must have whatever property Φ denotes, in that state of affairs. (In fact, there are ways of proceeding, exemplified by the initial formulations of Situation Semantics, which take this statement essentially at face value.)

There is no reason in principle why we could not distinguish several ways of evaluating predications formally, depending on the types of the predicate and argument(s) involved, where these methods do not necessarily depend on checking whether the thing denoted by the argument is an object for which the semantic value of the predicate (when applied to the object) will yield 1.

To carry this proposal out, let us introduce our terminology. We use the term *extension* as the formal equivalent of 'the set of entities that have a particular property at a particular index'. Thus if *intelligent'* ($\mu(\text{dog}')$) is true, we want $\mu(\text{dog}')$ to be in the extension of *intelligent'*. In this we proceed as Chierchia (1982) and Cocchiarella (1979). Thus, to say $|\text{intelligent}'(\mu(\text{dog}'))| = 1$ is the same as saying $|\mu(\text{dog}')| \in \text{Ext}(\text{intelligent}')$. The concept of 'extension' is distinguished from the concept 'objects for which the semantic value of the predicate (at an index) yields 1'. We may, for example, wish to deny that $\mu(\text{dog}')$ is such an object when the predicate is *intelligent'*. This would mean that we do not equate extensions of

predicates with the subdomains on which semantic values of those predicates are 1, but rather, we just say that if t denotes a kind, and Φ is an object-level predicate, then the kind $|t|$ is in the extension of Φ (under an interpretation, for a given variable assignment function, at an index) iff $|\Phi|(t) = 1$ (under that interpretation, etc) for 'sufficiently many' realizations r of $|t|$ (under that interpretation, etc), i.e., if sufficiently many realizations of the kind are in the extension of Φ . This means that we do not identify $|\text{intelligent}'(\mu(\text{dog}'))| = 1$ with $|\text{intelligent}'|(|\mu(\text{dog}')|) = 1$. How many realizations are 'sufficiently many' can itself be made a matter of interpretation: we could specify, as part of an interpretation, which sets of realizations of any given kind will make any given (object-level) predicate true of that kind (at a given index). Technically, this requires that we associate with each object-level predicate a function which, given an index and a kind as argument, supplies a class of sets of realizations²² of that kind as value. The notion of 'sufficiently many' can be 'intensionalized' (by specifying, as part of an interpretation of an object-level predicate, which *mappings from indices* to classes of sets of realizations of a given kind will make the predicate true of the kind at a given index), and can be extended to n -adic predicates which are 'basically' object-level but allow kind-level arguments in any argument position. So we see that the above is a device for evaluating object-level predicates that have been applied to kinds. At the object level, we *do* assume that an object is in the extension of Φ iff $|\Phi|$ yields 1 for that object—this equivalence only breaks down for 'mixed' predications, *as it does in Chierchia's IL**.

The point is that there really *do* seem to be two distinct ways in which a predicate can truthfully be applied to a kind. This is what the problems with Carlson's initial fragment (without **Gn**) and the problems with Chierchia's theory indicate. For example, how is one to account for the ambiguity of

Storks have a favourite nesting area

and by contrast, the non-ambiguity of

Dinosaurs became extinct when a big meteor fell to Earth.

In Chierchia's theory there are no resources to distinguish these. Under the present theory, the former is true only 'indirectly', i.e., *has a favourite nesting area* is true of $\mu(\text{storks})$ only in virtue of being true of sufficiently many storks. The ambiguity formally corresponds to the logical forms (with $\text{HF}(x,y)$: x has a favourite nesting area y):

$$[(\lambda x)(\exists y)\text{HF}(x,y)](\mu(\text{storks})) \text{ vs } (\exists y)\{[(\lambda x)\text{HF}(x,y)](\mu(\text{storks}))\}$$

These do not collapse into the same reading precisely because of the 'indirect interpretation' semantics, for which λ -conversion does not apply

in general (for reasons we will discuss shortly) when the semantic types of the λ -variable and the argument do not agree. By contrast, the other sentence (using $BEM(x,y)$: x became extinct when meteor y fell to Earth) also will get these two types of logical forms, but after λ -conversion from *either* of them we will get

$$(\exists y)BEM(\mu(\text{dinosaur}),y)$$

because $|\mu(\text{dinosaurs})|$ has the property $(\lambda x)(\exists y)BEM(x,y)$ 'directly', that is, $|(\lambda x)(\exists y)BEM(x,y)|(|\mu(\text{dinosaur})|) = 1$ or alternatively put, the kind $|\mu(\text{dinosaur})|$ is in the domain of the function denoted by $(\lambda x)(\exists y)BEM(x,y)$. In the case of HF, $|\mu(\text{stork})|$ was *not* in the domain of the function denoted by $(\lambda x)(\exists y)HF(x,y)$. It is the ability to account for such examples, without invocation of **Gn** in the logical form translations, which is the proof of the 'indirect evaluation' pudding.

In the preceding account, a sentence like *Dogs are intelligent* would be translated as $\text{intelligent}'(\mu(\text{dog}'))$ and would be evaluated by applying a rule that would yield

$$|\text{intelligent}'(\mu(\text{dog}'))| = 1 \text{ [that is, } |\mu(\text{dog}')| \in \text{Ext}(\text{intelligent}') \text{] iff}$$

$$|\text{intelligent}'|(r) = 1 \text{ for 'sufficiently many' realizations } r \text{ of } |\mu(\text{dog}')|$$

The application of the evaluation rule makes it appear as though the syntax allows arbitrary predications without regard to the types of the predicate and its argument, and the semantic evaluation takes care of all such violations. Other sentences, however, explicitly introduce an 'adverb of quantification', as in *Dogs are generally intelligent*. Here the translation and evaluation would be (using **Gn** as the translation of the predicate operator *generally*):

$$|\text{Gn}(\text{intelligent}')(\mu(\text{dog}'))| = 1 \text{ iff } |\text{Gn}(\text{intelligent}')|(|\mu(\text{dog}')|) = 1$$

The explicit mention of *generally* explicitly 'elevates' the predicate *intelligent* so that it can be directly applied to $\mu(\text{dog}')$, and thus the evaluation is 'direct'. However, the understanding of these two sentences is the same; and so for the latter one, we will require some meaning postulate that will entail that 'sufficiently many' realizations of $\mu(\text{dog}')$ are intelligent.

The fact that our two sentences are understood the same way suggests that perhaps we should all along treat them the same. Rather than trying to 'inductively' evaluate them both (by considering only subformulas of the formula under consideration), perhaps we should use a 'non-inductive evaluation' on the former. This slightly tidier way of proceeding is very much in the spirit of Carlson's approach. We allow object-level predicates to be applied to kind-level arguments in the logical syntax, but rather than

regarding the resulting expressions as meaningless, we regard them as 'abbreviations', in which a Gn operator has been eluded. Or putting it in terms of truth conditions, we say that, where Φ is 'basically' object level and t is kind denoting, $|t|$ is in the extension of Φ (with respect to an interpretation, variable assignment, and index) iff $|Gn(\Phi)|(|t|) = 1$ (with $| \cdot |$ evaluated with respect to that interpretation, etc). This latter condition can be evaluated recursively in the usual manner, since $Gn(\Phi)$ is a kind-level predicate. In a similar way, Gn_2, Gn_3, \dots operators can be invoked in the evaluation of dyadic, triadic, etc, object-level predicates applied directly to a kind, where such application yields an object-level predicate of adicity reduced by 1.²³

This 'slightly tidier way of proceeding' is technically legitimate. It amounts to claiming that, when faced with the task of evaluating certain sentences, we should instead 'shift our attention' to the evaluation of a different sentence which is not a constituent of the sentence under consideration. To see the legitimacy of this, let us proceed by means of an analogy. Consider the case of a propositional logic in which there is a set of propositional variables $\{P_1, P_2, \dots\}$, parentheses as usual, and the connectives $\{\neg, \rightarrow, \&, \leftrightarrow\}$. (These connectives are to be considered as primitive and not introduced by means of definitions, although they are to receive their usual interpretation). I is an interpretation function that assigns to each P_n some truth value. Now, there are various ways to proceed in giving the recursive definition of truth of a formula (with respect to I). $|\Phi|$ indicates the function which, given I , maps arbitrary formulas Φ into the truth values $\{0, 1\}$. A standard way to define this function is

- (α) if Φ is a propositional variable, then $|\Phi| = I(\Phi)$
- (β) $|\neg\Phi| = 1$ iff $|\Phi| = 0$
- (γ) $|(\Phi \& \Psi)| = 1$ if $|\Phi| = 1$ and $|\Psi| = 1$
- (δ) $|(\Phi \rightarrow \Psi)| = 1$ iff either $|\Phi| = 0$ or $|\Psi| = 1$
- (ϵ) $|(\Phi \leftrightarrow \Psi)| = 1$ if $|\Phi| = |\Psi|$

This might be called 'the inductive interpretation' of the logic. The crucial feature of such an interpretation is that, for complex formulas Φ , one computes whether $|\Phi|=1$ by looking only to the values of the function of sub-formulas of Φ . But (α)–(ϵ) is not the only possible 'inductive interpretation' that will yield the same results. For example, (ϵ) could be replaced by

- (ϵ') $|(\Phi \leftrightarrow \Psi)| = 1$ iff both 1) if $|\Phi| = 1$ then $|\Psi| = 1$, and 2) if $|\Psi| = 1$ then $|\Phi| = 1$

More importantly for our purposes, 'inductive interpretations' are not the only viable methods of proceeding. A 'non-inductive interpretation' of

some formula Φ would provide a method of evaluating Φ which did not exclusively rely on the interpretations of subformulas of Φ . For example, (ε) might be replaced by

$$(\varepsilon'') \quad |(\Phi \leftrightarrow \Psi)| = 1 \text{ iff } |((\Phi \rightarrow \Psi) \ \& \ (\Psi \rightarrow \Phi))| = 1$$

It is easy to see that (α) – (δ) yields the same results whether joined to (ε) or to (ε'') . A ‘non-inductive evaluation’ (of \leftrightarrow formulas), one might say, is a recursive evaluation which is not an inductive evaluation. Such is our strategy for evaluating formulas like $\Phi(\alpha)$ when Φ is ‘basically’ an object-level predicate and α denotes a kind. We instead evaluate a different sentence which is not a subformula of the original, namely we evaluate $[\mathbf{Gn}(\Phi)](\alpha)$.

It is easy to see that the desirable properties of the sophisticated theory are retained on this modified account. The essential observation is that *lambda-conversion fails for object-level lambda expressions applied to kinds*. So for example, expressions like

- (193) (a) $(\lambda x^o)\text{like}'(x,x)$ —the property of an object liking itself
 (b) $(\lambda x^o)(\exists y^o)[\text{tail}'(y) \ \& \ \text{has}'(x,y)]$ —the property of an object having a tail

applied to a kind-level expression such as d (that is, $(\lambda x^k)[(\forall y^o)\Box[\mathbf{R}(x,y)\leftrightarrow\text{dog}'(y)]]$), *cannot* be converted to

- (194) (a) $\text{like}'(d,d)$
 (b) $(\exists y^o)[\text{tail}'(y) \ \& \ \text{has}'(d,y)]$

respectively, since the value of d is not in the domain of the functions denoted by those λ -expressions. Rather, the application of such object-level expressions to kind-denoting terms is interpreted using the ‘generic evaluation’ rule (which introduces \mathbf{Gn}) proposed earlier, instead of applying λ -conversion. Consequently, the truth conditions will not be those of (194), but rather, will require that particular dog-realizations like themselves (generally speaking), and have a tail (generally speaking).

We should mention that certain apparent λ -conversion identities, such as

$$(195) \quad [(\lambda x^o)\text{intelligent}'(x)](d) = \text{intelligent}'(d)$$

still hold (necessarily), but this is not so in virtue of λ -conversion, but in virtue of

$$(196) \quad \Box[(\lambda x^o)\text{intelligent}'(x) = \text{intelligent}']$$

A caveat about the above proposal is that the suggested generic rule of evaluation for object-level predicates applied to kind denoting terms must

be invoked only where the predicate is *exclusively* object level at the argument position in question. For, if the predicate allows both objects and kinds in its extension at some argument position (as many of Carlson's predicates do), sanctioning the generic rule of evaluation at that position would lead to ambiguity when the predicate is applied to a kind-denoting expression.

So, for example, if we want to hold (like Carlson) that *popular, well-known*, etc, apply directly to kinds (i.e., the kind is an object for which the semantic value of the predicate applied to it is 1), then a formula like

(197) $\text{popular}'(d)$

cannot be interpreted as a generalization about the popularity of individual dogs. But then how *do* we express generalizations about popularity (etc) of individuals, such as that *cheerleaders are popular (with the boys)*? The answer is that we need to posit a second translation, $\text{popular}'_2$, which is *strictly* object-level in its extension. Thus

(198) $\text{popular}'_2(c)$

will be the desired generalization about individual cheerleaders. So in general, if a predicate derived from English is thought informally to admit two sorts of interpretations with respect to a kind-denoting argument, one of which allows the property or relation in question to 'trickle down' to realizations while the other does not, then a lexical ambiguity must be stipulated for that predicate.

In summary, the idea in both proposals is to postpone the introduction of 'generalization' operators to the stage of semantic evaluation, rather than making the rules of translation responsible for their introduction. Logical translations which 'mix' object level predicates with kind level arguments are regarded as implicit generalizations. This strategy unburdens the syntax and rules of translation, obviating the need for artificial structural ambiguities, unmotivated syntactic features, and phantom operators in the rules of translation. As can be easily seen, this is quite close to Chierchia's proposal; it just replaces the notion of 'concept correlates', as a basis for evaluating generic predictions, with the notion of 'indirect evaluation', involving evaluation with respect to realizations, as we have outlined above.

Note that it would be wrong to regard this move as merely a notational trick. It does, after all, have the effect of assigning formal truth values to expressions such as $\text{intelligent}'(d)$, where d denotes dogkind, which were not assigned values on Carlson's account. In other words, a kind really *can* have an object-level property; it does so just in case its realizations 'generally' exhibit the property (at appropriate indices).

Let us preface our grammatical sketch with a word on our ontology. We

expressed certain doubts about the need for stages as an ontological category, particularly in a system in which time is already presupposed as a primitive. Hence we take a predication such as **happy'**(fido') to be about a particular individual at a particular time and not about a stage of an individual. The stative/nonstative distinction plays a significant role in the grammar (phrase structure rules and rules of translation) but not in the model theory.

We begin our grammatical sketch by presenting the translations of four of the sentences we used to illustrate 'the fundamental intuition' in the third section:

- (199) (a) Snow is white
 (b) white'(μ (snow'))
- (200) (a) Snow is falling
 (b) PROG(fall'(μ (snow')))
- (201) (a) Dogs are loyal
 (b) loyal'(μ (plur(dog')))
- (202) (a) Dogs are barking
 (b) PROG(bark'(μ (plur(dog'))))

The final step in the syntactic analysis of these sentences, and in the calculation of the translations, is determined by the rule pair

- (203) $S \rightarrow NP VP, VP'(NP')$

Here the phrase structure rule states that a sentence may be constituted of a noun phrase followed by a verb phrase. (Separate feature agreement and inheritance principles enforce constraints such as person and number concord and inheritance of certain features of the VP by the S.) The accompanying rule of translation states that the VP-translation is to be applied to the NP-translation to obtain the translation of the sentence.

Semantically, **snow'** is to be taken as 'basically' an object-level predicate true of 'snowy objects' (such as quantities of snow, snowflakes, and snowballs), and 'indirectly' (i.e., by the process of indirect evaluation we have sketched) a predicate over kinds, true of kinds of snow (such as powder snow, granular snow, or dirty snow). Similarly **dog'** is basically an object-level predicate, and indirectly, a predicate over kinds.²⁴ We remain non-committal about the exact interpretation of μ (snow'), μ (plur(dog')), etc except to say that $\mu(P)$ is some function $f(P)$ of the intension of P (possibly the identity, or possibly a function whose range consists of individuals sortally distinct from ordinary individuals). **white'**, **fall'**, **loyal'**, and **bark'** are similarly interpreted as basically object-level predicates. In all cases evaluation of predicates and formulas is indexed to worlds and times.

Since we do not evaluate objects at particular times, there is no difficulty

for sentences involving temporal displacement, such as

(204) Mozart is gaining new admirers

If we do not distinguish episodic from characterizing predicates in the model theory, how do we account for the fundamental intuition about the contrast between (199) and (200), or (201) and (202)? The answer is that we take the distinction to be a semantic (rather than model-theoretic) distinction, to be encoded in meaning postulates such as the following,

(205) For $P \in \{\text{white}', \text{loyal}', \text{soft}', \text{four-legged}', \dots\}$

$$(\forall x^k) \square [Gn(\neg P)(x^k) \leftrightarrow \square (My^o : R(y,x)) P(y)]$$

(206) For $P \in \{\text{fall}', \text{bark}', \dots\}$

$$(\forall x^k) \square [Gn(\neg P)(x^k) \leftrightarrow (M'y^o : R(y,x)) P(y)]$$

where M and M' encode slightly different notions of 'sufficiently many (much)', perhaps roughly verbalizable as 'most of the relevant' and 'significantly many (much)' respectively. The embedded necessity operator in (205) is intended to capture the gnomic, or lawlike, character of statements like (199a) or (201a).²⁵ That is, we are saying that if a substance is not white in most cases, it not only is not, but *cannot be*, snow; and if animals of a certain kind are not loyal in most cases, they not only are not, but *cannot be*, dogs. Admittedly (205) is a little too strong for *white'* and *loyal'*.²⁶ (Certainly we would not assert (205) for *all* stative predicates; for example, *is expensive*, *are cancer patients*, and *prefer vodka to beer* have a contingent character even when applied to kinds, and so fit better with (206)). Nevertheless, we regard the contrast between (205) and (206) as encapsulating, at least in an approximate way, and at least for many kinds of predicates, the 'fundamental intuition'.

Thus it is not an existential/universal distinction which underlies the fundamental intuition in examples of this type, but rather a contingent/necessary distinction. If snow is white (or solid, or crystalline, or frozen water) then it is necessarily so in the sense that most of its relevant realizations must be white, but if snow is falling (or on the ground, or causing me trouble), it need not be. The existential/universal distinction, on such an account, comes as a 'byproduct': necessary truths (other than logical ones) owe their status to *conventions* (linguistic, scientific, mathematical, or whatever) designed to match our vocabulary to the categorical, statistical and lawlike trends of the world. This makes it likely that they will have near-universal validity for the instances of the categories they talk about. On the other hand, contingent properties are acquired causally, and since causal effects are often localized, the number of objects of a particular

kind affected is often limited. This explains why, in some of our earlier examples, such as

- (207) Wildlife is being destroyed
 (208) Ducks are flying south

and so on, arbitrarily narrow or wide interpretations are possible, depending on how local or global the underlying causes are taken to be.

However, (205) will not serve in all cases of intuitively generic readings. For example,

- (209) Athletes ate a light breakfast in those days
 (210) People are poor in that part of the world
 (211) Canadian scientists are supported by a single granting agency
 (212) Frenchmen eat horsemeat

do not attribute essential properties to kinds, yet are generic in content. We will not attempt a detailed analysis, except to suggest that the relevant meaning postulate (except for sentence (212)) may be like (206), with M' replaced by M.

Our verbalizations 'most of the relevant' and 'significantly many (much)' for M and M' were deliberately chosen to allow for content-dependence. Again, we will not pursue this point further. However, we wish to comment that we chose 'most' rather than 'all' in the verbalization of M, because of examples like

- (213) Conservatives favour heavy investment in defense

(and many of the others we have considered). Note that there may be no factors dependent on content, or any general knowledge, allowing exclusion of exceptions to (213) as 'irrelevant'. This leaves the problem of explaining why some generic statements, such as

- (214) Dogs are mammals
 (215) Electrons are negatively charged.

appear to have genuinely universal import. The answer, it seems to us, lies in the availability of a meaning postulate stronger than (205) for predicates denoting natural kinds and certain scientifically formalized properties:

- (216) For $P \in \{\text{snow}', \text{dog}', \text{mammal}', \text{electron}', \text{negatively-charged}' \dots\}$

$$(\forall x^k) \square [Gn('P)(x^k) \leftrightarrow \square (\forall y^o : R(y,x)) P(y)]$$

Let us now return to grammar. The tense/aspect operators PAST, PRES, FUTR, PROG (signalled by *be V-ing*), and PERF (signalled by *have V-en*) are to be treated syntactically as VP-operators and semantically as

sentence operators, with the rule

$$(217) \quad VP \rightarrow F VP, (\lambda x)(F(VP'(x))), \text{ for } F \in \{\text{PRES}, \dots, \text{PERF}\}$$

where x is object-level or kind-level (or both) depending on the 'basic' type of VP' . PRES is taken as $(\lambda P)P$, and hence has been omitted in (199)–(201). We cannot here go into tense/aspect semantics, but should mention that we take the above operators as relating their operands not only to the time of speech, but also to a contextually determined reference time.

The translations of the noun phrases in (199)–(202) would come from

$$(218) \quad NP \rightarrow N, \mu(N')$$

which applies to both singular and plural phrases. (The translation of a plural N like *dogs* as $\text{plur}(\text{dog}')$ would derive from a morphological stage of analysis.)

Before proceeding to further rules, we should comment on the apparent lack of intensionality in the translations seen so far. As already stated, μ is in fact implicitly intensional. In addition, we intend functors we write in upper case (such as the tense/aspect operators) to be potentially intensional as well. Thus $\text{PAST}(\text{bark}'(\text{fido}'))$, for example, may actually stand for $\text{past}'(\text{bark}'(\text{fido}'))$ by setting $\text{PAST} = (\lambda P)\text{past}'(P)$; alternatively, we might not introduce the intension operator here at all, but rather arrange for the rules of evaluation to treat upper-case functions as intensional (in the traditional manner of modal logics). Of course, we might adopt Montague's strategy of uniformly intensionalizing operands, but this would somewhat obscure our exposition.

We now illustrate briefly the scoping mechanism from Schubert & Pelletier (1982). A quantified phrase such as *every woman* is analyzed and translated by the rule

$$(219) \quad NP \rightarrow \text{DET}[\text{QUANT}] N, \langle \text{DET}' N' \rangle$$

neglecting various fine points. The angle brackets indicate that the 'generalized quantifier' they enclose is ambiguously scoped. The translation of a sentence like (220a) is as in (220b).

$$(220) \quad \begin{aligned} & \text{(a) Some man loves every woman} \\ & \text{(b) love}'(\langle \text{every}' \text{ woman}' \rangle)(\langle \text{some}' \text{ man}' \rangle) \\ & \quad = \text{love}'(\langle \forall \text{ woman}' \rangle)(\langle \exists \text{ man}' \rangle) \end{aligned}$$

The two quantifiers can now be 'raised' to encompass any sentential formula that embeds them, at the same time introducing variables, with possible results

$$(221) \quad \begin{aligned} & \text{(a) } (\exists x: \text{man}(x))(\forall y: \text{woman}(y)) \text{ love}(y)(x) \\ & \text{(b) } (\forall y: \text{woman}(y))(\exists x: \text{man}(x)) \text{ love}(y)(x) \end{aligned}$$

It is this mechanism which allows us to retain the view that names denote individuals, and also to dispense with dual versions of predicates such as *love'* and *love** (or *love'*), which Montague introduced to distinguish the direct translations of English transitive verbs (whose objects are intentionalized property sets) from extensionalized versions (whose objects are individuals).

The same sort of scoping mechanism is used for coordination. Thus (222a) is translated as (222b):

- (222) (a) John will love Mary or hate Bill
 (b) FUTR[$\langle v \text{ love}'(\text{Mary}') \text{ hate}'(\text{Bill}') \rangle$](John')]

The ambiguously scoped conjunction allows the minimal scoping in (223a) or the wider scope in (223b), or the still wider scope in (223c) (with conversion from prefix to infix form):

- (223) (a) FUTR[$(\lambda x)[\text{love}'(\text{Mary}')(\mathbf{x}) \vee \text{hate}'(\text{Bill}')]$](John')]
 (b) FUTR[$\text{love}'(\text{Mary}')(\text{John}') \vee \text{hate}'(\text{Bill}')(\text{John}')]$]
 (c) FUTR($\text{love}'(\text{Mary}')(\text{John}') \vee \text{hate}'(\text{Bill}')(\text{John}')$)

As it turns out, all three 'readings' are equivalent. But if FUTR were *certainly'* (for example), (c) would be distinct from (a) and (b).

The same mechanism can now be deployed for frequency adverbs, regarded syntactically as VP operators and semantically as sentence operators:

- (224) VP[+STAT] \rightarrow ADV[FREQ] VP[-AUX, -STAT], $\langle \text{ADV}' \text{ VP}' \rangle$

Let us apply the rule to (226a), with result (226b):

- (225) (a) Dogs always bark
 (b) $\langle \text{ALWAYS}_1 \text{ bark}' \rangle (\mu(\text{plur}(\text{dog}')))$

The minimal-scope and wide-scope versions are then

- (226) (a) $(\lambda x)\text{ALWAYS}_2(\text{bark}'(\mathbf{x}))(\mu(\text{plur}(\text{dog}')))$
 (b) $\text{ALWAYS}_1(\text{bark}'(\mu(\text{plur}(\text{dog}'))))$

The first version *cannot* be λ -converted. Rather, by our rule of indirect evaluation, it is equivalent to

$$\text{Gn}(\sim(\lambda x)\text{ALWAYS}_1(\text{bark}'(\mathbf{x})))(\mu(\text{plur}(\text{dog}')))$$

and says that *dogs in general bark all the time*.

The alternative translation, (226b), is equivalent to

$$\text{ALWAYS}_1(\text{Gn}(\sim \text{bark}')(\mu(\text{plur}(\text{dog}'))))$$

and says in effect that *all the time, sm (significantly many) dogs bark*, via postulate (206).

Note that contexts are easily constructed in which these readings are salient; as far as we can tell, none of the theories we have considered can readily deliver both of them.

There is, however, a third reading not yet accounted for, namely one according to which *all dogs bark*. This corresponds to the 'atemporal' interpretation of *always*, and like Carlson, we find it necessary to treat *always* as ambiguous. Its second translation, ALWAYS₂, is regarded as an unambiguously scoped VP operator (both syntactically and semantically), accommodated by the rule

$$(227) \text{ VP}[+\text{STAT}] \rightarrow \text{ADV}[\text{FREQ}] \quad \text{VP}(-\text{AUX}, +\text{STAT}), \\ \text{ADV}'(\text{VP}')$$

Note that (in contrast with (224)) the VP daughter is here required to be stative. Thus ALWAYS₂ is not directly applicable to the nonstative predicate *bark'*. However, it becomes stative on a 'dispositional' interpretation via the rule

$$(228) \text{ VP}[+\text{STAT}] \rightarrow \text{VP}[-\text{STAT}], \text{ DISP}(\text{VP}')$$

where DISP is an intensional operator somewhat analogous to Carlson's Gn', though it operates on an object-level rather than stage-level predicate and its output is still object-level. (To the extent that Gn' is not a 'phantom' operator because it finds expression in the aspectual systems of various languages, neither is DISP.)²⁷

The new translation of (225)a obtained via (227) and (228) is

$$(229) \text{ ALWAYS}_2(\text{DISP}(\text{bark}'))(\mu(\text{plur}(\text{dog}')))$$

ALWAYS₂ (like Gn) is assumed to evaluate its operand to the kind level (i.e., making it applicable directly to kinds and inapplicable to objects). ALWAYS₂ might be taken as equivalent to $(\lambda P)(\lambda x^k)(\forall y^o : R(y, x))P(y)$.²⁸

Note that VP's admitted by rule (224) can feed into (227), as can VP's admitted by (227) itself. The latter are clearly ruled out by the semantics. The former may occasionally yield comprehensible results (cf Enç, 1981, p. 222).

Restrictive *if/when* clauses can be added to the grammar fragment along the lines suggested by Carlson, i.e., by arranging for the predicate expressed by the subordinate clause to combine with the subject, forming a more restricted kind. As far as the conversion of the (presumed) pronoun in the subordinate clause to a lambda variable is concerned, GPSG already has a suitable mechanism to accomplish this, designed to deal uniformly with reflexives and gaps (Pollard, 1983).

However, it is not clear that the exercise is worth the trouble, since the

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requisite syntactic and semantic manoeuvres are rather unnatural and intricate, and the results suffer from the same limitations as Carlson's: a 'schizoid' approach to adverbials, and severe difficulties in extending the treatment of atemporal restrictive clauses to temporal ones.

We are also unable at this time to deal with indefinite singular generics, and perhaps most importantly, the prospects for incorporating an intuitively satisfactory theory of 'cases' into the present framework do not seem very bright. That is why we now focus briefly on this topic.

Towards a Theory of Cases

We have already mentioned that we think one of the most salient features of habitual and generic statements to be their reliance on a reference to an 'ensemble of cases' for their semantic evaluation. For example, a habitual sentence with an explicit adverb of quantification like

(230) John usually beats Marvin at ping pong

does *not* say that most of the time John is beating Marvin at ping pong. Rather, the *usually* gathers a certain class of 'reference situations', namely situations in which John and Marvin play a game of ping pong, and the *usually* is evaluated with respect to this class of situations. Similarly, when the sentence is generic, such as

(231) Cats always land on their feet

it is *not* evaluated as if it said at all times cats are landing on their feet, but rather a certain class of 'cases' or 'situations' is set up—such as cases where cats drop to the ground—and the sentence is evaluated with respect to those cases.

Thus it is our view that semantic evaluation of habitual and generic statements depends on reference to these 'ensembles of cases', where the ensemble is determined in part or entirely by context, or in part or entirely by restrictive clauses and adverbials. There are two kinds of such reference ensembles, closely paralleling the two kinds of uses of adverbs of quantification: ensembles of (intuitively) *situations* (corresponding to 'temporal' uses of adverbs of quantification) and ensembles of *objects* (corresponding to 'atemporal' uses of adverbs of quantification).²⁹

Let us look first at examples involving reference ensembles of situations where these ensembles are determined by same-sentence context. Examples (232)–(247) are examples where the (a)-sentence is the gnomic sentence and the (b)-sentence gives the type of situation which is implicitly referenced by the (a)-sentence

- (232) (a) Robin Hood never misses
(b) Robin Hood shoots (an arrow) at a target

- (233) (a) John usually remembers people's names
 (b) John is called upon to remember the names of *sm* people whose names he has been told
- (234) (a) Canada Post sometimes loses letters
 (b) Canada Post has *sm* letters (for the purpose of conveying them from senders to addressees)
- (235) (a) John usually beats Marvin at ping pong
 (b) John and Marvin play a game of ping pong
- (236) (a) John is always teasing Mary
 (b) John is talking with Mary
- (237) (a) Tabby always lands on her feet
 (b) Tabby drops to the ground
- (238) (a) A cat always lands on its feet
 (b) A cat drops to the ground
- (239) (a) Cats usually land on their feet
 (b) *Sm* cats drop to the ground
- (240) (a) Nice guys finish last
 (b) *Sm* nice guys participate in a competitive event or process
- (241) (a) Lumberjacks drink their whiskey straight
 (b) *Sm* lumberjacks drink *sm* whiskey
- (242) (a) Bullfighters are often injured
 (b) *Sm* bullfighters participate in a bullfight
- (243) (a) Muggers often threaten their victims with a knife
 (b) *Sm* muggers mug *sm* people
- (244) (a) Hit-and-run drivers are almost always caught
 (b) *Sm* drivers have hit someone or something, have fled the scene, and are still at large
- (245) (a) A student (always) admires a fair professor
 (b) A student knows a fair professor (as a student in one of his classes)
- (246) (a) Men (usually) notice pretty women
 (b) *Sm* men are near *sm* pretty women (and not yet aware of them)
- (247) (a) Dogs give live birth
 (b) *Sm* dogs give birth

What is striking about those of the above examples which involve indefinite singulars and bare plurals (i.e., (238)–(247)) is that these singulars and bare plurals *appear to refer at one level to kinds, and on another level, to realizations of those kinds in particular situations*. In our (b)-sentences, the realizations at issue are signalled by the indefinite determiner *sm*. It is the reference to kinds which gives bare plurals and other generic terms their

name-like character (making them *rigid* designators), while it is their reference to realizations of those kinds in particular situations which gives them their indefinite character (or, we should say, their *non-rigid* referential character; this phrasing allows for definite and indefinite generic terms).

Moreover, this observation is closely related to the 'fundamental intuition' concerning 'quasi-universal' versus existential import of bare plurals and mass terms: in the (b)-sentences corresponding to the (a)-sentences under consideration, the occurrences of *sm* can be deleted, leaving bare plurals with existential import (under episodic readings of the sentences); the realizations these terms refer to are also what the generic terms in the (a)-sentences are 'non-rigidly' referring to (despite their 'quasi-universal' import).

It is this referential connection between generic sentences (at least those of the habitual or dispositional type illustrated above) and the presupposed underlying situations which is in need of formal explication. Of course, the approaches we have surveyed can be viewed as attempts to provide such an explication. In particular, the Lewis/Farkas & Sugioka approach tries to explicate a set of situations as a set of assignments to a tuple of variables, constrained to realizations of corresponding kinds, and the above referential connection is made by way of these variables. However, this view of situations discards much of their content. It says, for example, that (in (246)) a situation is which *sm* men are near *sm* pretty women is abstractly just a pair consisting of *sm* men and *sm* women. But that is no more accurate than saying that the content of the (*a*)-sentence (i.e., that men usually notice pretty women) just consists of such pairs. Besides, they do not have a mechanism for making an existentially quantified term in a restrictive clause (such as *sm cats* in (239b)) coreferential with a term in another clause (such as the subject in (239a) after pronominalization).

It therefore seems clear that an adequate theory of generic sentences (at least those of the above variety) must take situations seriously, incorporating them into the model-theoretic framework. That is to say, the generic terms in such sentences need to be treated as *indexical* (i.e., as having senses that are context-dependent). There needs to be a notion of 'an ensemble of situations (or a type of situation) referred to' as part of a context. (This point seems closely related to Enç's (1981) claim that nouns are indexical.)

After looking at some examples involving previous-sentence context, we shall attempt to formulate some principles concerning the way in which sentences like those above determine an ensemble of situations referred to. Then, following a brief statement of the relationship between sentences with an implicitly determined reference ensemble and sentences with a reference ensemble determined by an explicit *if/when* restrictive clause,

we shall offer some ideas on how the above 'referential connection' might be made.

Having seen examples where a sentence sets up its own reference ensemble of situations, let us turn to examples where the reference ensemble of situations is provided by a preceding sentence. In (248)–(251), the (a)-sentence is the context-setter while the (b)-sentence is the gnomic sentence.

- (248) (a) John is an excellent marksman
- (b) He rarely misses
- (249) (a) Canada is well-represented at world cup ski races
- (b) Canadians sometimes take the gold
- (250) (a) Most monkeys flee when leopards approach
- (b) Baboons form a protective circle with males on the outside
- (251) (a) Christmas has become a protracted event
- (b) Stores are decorated for at least six weeks

Note that it is often *presuppositions of the verb phrase*³⁰ which suggest the reference ensemble, especially in same-sentence-context examples. (See (232)–(235), (237)–(240), (244)–(247).) In addition, 'characterizing properties' of the subject can play a role, as in (232), (238)–(239), (242)–(245), and possibly (246). Presuppositions of the verb phrase may derive from an intrinsically presuppositional verb (as in (232)–(235), (237)–(240), (244)–(246)). Alternatively, presuppositions may derive from stress patterns, since stress of a phrase may be used to distinguish what is *not* presupposed in a sentence from what is presupposed. So, for example, when the phrase *in trees* is stressed in

- (252) (a) Leopards usually attack monkeys in trees³¹

there seems to be a presupposition that leopards do attack monkeys, while the information that such attacks usually occur in trees is the new, non-presupposed, information. So, because of the relation between presupposition and reference ensembles, the reference ensemble in (252a) consists of situations in which *sm* leopards attack *sm* monkeys.

Thus we have the following principle. For a sentence containing a quantificational adverbial (at the S or VP level), with a non-presuppositional verb, and with some phrase in the VP stressed,³² a sentence describing the presupposed type of situation (and hence the type of situation constituting the reference ensemble) can usually be derived by (i) dropping the adverbial, and (ii) 'generalizing' the stressed constituent. (For example, in (252a), *in trees* is generalized to *somewhere*.) So for (252a) we get

- (252) (b) (Situations in which) leopards attack monkeys (somewhere)

Similarly, other ways of assigning stress lead to other reference ensembles:

- (253) (a) Leopards usually attack monkeys in trees
 (b) (Situations in which) leopards attack monkeys near trees
- (254) (a) Leopards usually attack monkeys in trees
 (b) (Situations in which) leopards attack something in trees
- (255) (a) Leopards usually attack monkeys in trees
 (b) (Situations in which) leopards are near monkeys in trees

Note that in all cases, the 'generalization' is *entailed* by the ungeneralized version; e.g., attacking monkeys entails (has as prerequisite) being near them.

It is not clear how this sort of way of working out the reference ensemble interacts with presuppositions based on presuppositional verbs (as opposed to presuppositions based on stress patterns). Our impression is that verb presuppositions tend to 'win out' if there is a conflict. So when we say

- (256) Little John usually misses the target

this does not seem to say 'In most situations in which Little John misses something, he misses the target.' Rather, it is the presupposition of the verb, viz, *shooting*, which determines the reference ensemble; and the stress on *target* just gets interpreted as implicit denial of an alternative, i.e., he misses the target, but does not miss something else.

It is also not clear what the effect of stressing the subject NP is. We think that when *leopard* is stressed in the leopard sentence, we can get a reading in which *usually* quantifies over situations in which 'something attacks monkeys in trees' (i.e., it is usually leopards that are the culprits, when something attacks monkeys in trees). But in other sentences, this does not work at all:

- (257) Lumberjacks usually drink their whiskey straight

does not say that when people drink their whiskey straight, they are usually lumberjacks. Also

- (258) Bullfighters are often injured

does not say that when people are injured, they are often bullfighters, etc. Certainly there are many complications to what we have said about stress and VP presupposition as determiners of reference ensembles of situations. But we shall not here pursue this topic further.

We now turn our attention to sentences in which a reference ensemble of situations is determined by a restrictive clause or adverbial. We note that most of the sentences (232)–(248) can be turned into such examples via the pattern of combination:

When/if (b), (a)

or the pattern

(a), when/if (b)

except that generics and indefinites in (a) or (b) need to be replaced by pronouns. Thus we have, for example

When (sm) cats drop to the ground, they always land on their feet

Lizards are pleased when the sun shines

Small fish are widespread when big fish are rare

and so on.

Having seen various examples of reference ensembles of situations induced either by linguistic context or by explicit *if/when* clauses, we are ready for some brief speculation on the formal role of such ensembles. In essence, we would like to be able to 'quantify' over the situations in an ensemble, where (i) the quantification is potentially intensional as well as extensional (i.e., is evaluated with reference to situations in other possible worlds, as well as the current one), and (ii) a 'referential connection' can be made between entities in the situations quantified over and entities referred to in the matrix formula. For example, we would like to say something like the following for the representation of the *when* (b), (a) pattern for (240):

$$\text{USUALLY}(\text{WHEN}(\exists x : R(x, \mu(\text{cats})))\text{drop-to-the-ground}(x)) \\ (\text{land-on-feet}(x))$$

Note the 'dangling' variable in the matrix formula, which we would like to think of as bound implicitly in the 'quantifier' (viz, USUALLY in combination with its first operand); i.e., as we iterate through situations satisfying the WHEN-clause, we use choices of x which render the restriction true in order to evaluate the matrix formula. This distinction between the scope of a quantifier determining which occurrences of a variable are bound and the use of objects which satisfy one formula to be the objects that are used to give a value to a pronoun (free variable) in another formula, seems closely related to Evans's (1977) distinction between semantic binding (or semantic scope) and anaphoric binding.

Presumably, these are the sorts of intuitions which lay behind Farkas & Sugioka's approach. But notice that the above formula could be true even if *most cats* were too clumsy to land on their feet, as long as it was predominantly the agile ones that were involved in situations in which cats drop to the ground. However, we will not attempt to formalize these ideas. Perhaps a model theory could be provided for the above sort of extension to conventional logics; evidently the notion of what can serve as a 'situation' would need clarification. Perhaps some version of Situation Semantics

could serve our purposes. This would be very much in line with current trends in the theory of generics (ter Meulen, 1985; Carlson, 1985).

Besides *if/when* clauses, other sorts of restrictive clauses and adverbials include

- (259) *Around the New Year in Edmonton*, it usually snows
- (260) *In emergency situations*, flight attendants are (usually) effective
- (261) Cats *dropped to the ground* always land on their feet
- (262) Rats *crowded together in a small cage* are usually aggressive

Such examples could apparently be expressed formally in the same sort of way as those involving *if/when* clauses, though the details are far from clear.

As we noted above, we can also have reference ensembles of *objects* (as opposed to situations). This is the reason for using the more general term *cases*, subsuming both situations and objects. Here are some examples involving same-sentence context (plus presuppositions) only, in the determination of the reference ensembles:

- (263) (a) Dogs are usually intelligent
- (b) The dogs that have existed, currently exist (and will exist?) over some fairly extensive time span including the present
- (264) (a) Passengers on the No. 3 line often do not get seats
- (b) The passengers that have existed (*as* passengers, not as people) and currently exist over some fairly extensive time span including the present
- (265) (a) Dutchmen are good sailors
- (b) Dutchmen that have existed, currently (and will exist?) over some fairly extensive time span including the present, who are (or were) *good sailors as Dutchmen go*

(The (a)-sentence then claims these select Dutchmen (in (b)) are good sailors by *international* standards. We take this part of the interpretation as coming from context-dependent interpretation of *good*).³³

We now move to examples of explicit restrictive clauses and adverbials determining the objects comprising the reference ensemble:

- (266) Dogs with/that have blue eyes are (usually) intelligent
- (267) Dogs are (usually) intelligent *if/when* they have blue eyes
- (268) Dogs dislike cats when they (the cats) have blue eyes

We would want to represent all such examples in a manner similar to the 'situational' examples (again, in the spirit of Farkas & Sugioka's approach). For example, (268) might be

$$G(\text{WHEN}((\exists x : R(x, \mu(\text{dogs}))) (\exists y : R(y, \mu(\text{cats}))) \text{have-blue-eyes}(y))) \\ (\text{hate}(y)(x))$$

where variable bindings are again carried from the 'quantifier' into the matrix formula. The *G* here is a two-place operator (as opposed to the *Gn* predicate operator) which gathers together those cases described by its first argument for use in evaluating the sentence given as second argument—again, quite similar to Farkas & Sugioka's understanding, but without assuming that the cases are merely assignments of values to free variables.

To adequately convince the committed sophisticated theorist of the viability of our conception of semantics and the interpretation of generics and habituals (of the bare plural type, the bare singular type, the indefinite singular type, proper nouns, adverbs of quantification, restrictive *if/when* clauses, and the like) we ought to give an explicit grammar with explicit formal semantics that uses our reference ensembles. But this is not the place to attempt this; instead we hope that our critiques and suggestions for further work will provide an incentive for continued work in this intriguing and important area of linguistic semantics. A further development of our own account can be found in Schubert & Pelletier (1986).

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NOTES

¹ In (1b) we employ 'restricted quantification' in an obvious manner. The (1b) sentence is to be understood as a notational variant of the unrestricted $(\forall x)(\text{whale}(x) \rightarrow \text{mammal}(x))$; the restricted $(\exists x : \text{dog}(x)) \text{small}(x)$ as a variant of the unrestricted $(\exists x) (\text{dog}(x) \ \& \ \text{small}(x))$. Our use of the restricted notation is to capture the similarity between these quantifiers and the other ones (such as *most*) which do not have an unrestricted variant. *Most cats are small* would be $(Mx : \text{cat}(x))\text{small}(x)$. In general here we follow McCawley (1981). Our choice, in the Montaguesque (1c), of making the subject term denotation be the argument of the verb phrase denotation, or of using the intension operator $\hat{}$, should not be taken as indicating anything important. We are using these as examples only.

² The notion of 'semantic innocence' given here is really very weak and innocuous, saying only that the semantic value of one (lexically unambiguous) term is unique.

This conception is not to be confused with a somewhat stronger notion—which in fact we do not believe, but this does not form part of the present paper—to the effect that each (lexically unambiguous) term plays the same semantic role no matter where it occurs. We think, for example, that *wine* is to be interpreted (lexically) as a predicate, and that this is the role it plays in *the contents of this glass are (is) wine*. But in sentences like *wine is a liquid* it plays the role of denoting a kind. For further exposition on how this is possible, and what causes it, see Pelletier & Schubert (1985). Our thanks to Ernie LePore for pointing this out to us.

³ Formally, the *sets* we have talked about are determined by binary-valued functions, as should be clear from our earlier remarks on *typing*. So, for example, the value of *whale*' at a given index is a function in 2^D . As a function on I, *whale*' thus denotes a function in $(2^D)^I$. In general, Montague represents functions in the Schönfinkel–Church manner, i.e., a two-place function is represented as a one-place function whose values are one-place functions, a three-function is a function whose values are one-place functions whose values in turn are one-place functions, and so on.

⁴ In recent writings within GPSG, the two aspects of a phrase structure rule—what symbols are dominated by the left-hand side of the rule, and in what order these symbols occur—are separated. This is called 'the immediate dominance, linear precedence format' (ID/LP), and separate principles are employed in the two subparts of the theory. In the discussion which follows, we do not employ this format, instead retaining the original context-free rule statement which combines these two functions.

⁵ Both Carlson and Chierchia (personal communication, 1986) have expressed to us their dissatisfaction with the accounts they had given earlier. Carlson's new account will be given in a book he is currently preparing on the topic, and Chierchia would wish to avail himself of 'property theory' (see Chierchia & Turner, Ms.).

⁶ Various technical issues are raised here: not only is *Rover loyal* but so is $\mu(\text{dog})$. Is $\mu(\text{dog})$ a dog? Does this give rise to contradiction? Is $\mu(\text{dog})$ even of the right type for *loyal* to apply to it? These issues are dealt with quite differently in the different versions of the sophisticated approach, and so cannot be addressed at this point.

⁷ We have stated this meaning postulate with the quantifier 'Most'—so if *dogs are loyal* is true then *most dogs are loyal* is true. Recall, however, our earlier discussion of how there seems to be no good measure for the number of instances required to make the generic true. However, if the quantifier is interpreted *comparatively*, so that it merely requires most P's *belonging to a contextually determined reference ensemble* to be Q's, the meaning postulate becomes somewhat plausible. Meaning postulate (205) is a refinement of (22).

⁸ Ignoring, once again, the precise meaning of existentially quantifying over 'realizations of snow.' (That is, ignoring the problem of identifying what the values of x in (24') are.)

⁹ Besides, French *does* allow one to say

L'eau coule du robinet

¹⁰ The superscripts ^s, ^o and ^k indicate stage level variables, object level variables, and kind level variables respectively.

¹¹ This point—that episodic sentences seem to have these sorts of entailments while habitual ones do not—seems to us to be a matter of degree and not a matter calling for an ontological dichotomy. For example, a river could be simultaneously

flooding a city in Alberta and *flooding fields in Manitoba*; I could be *building a shopping mall in Edmonton* and *building a high-rise in Winnipeg*, etc. (Here we have cases of the episodic not precluding spatially different episodes). On the other hand it would be difficult to be *native to Edmonton* and also be *native to Calgary*, or not to be *native to Alberta*, even though predicates apply to objects and not their manifestations. (Of course Carlson probably does not consider the present 'entailment test' to be crucial to the episodic/habitual distinction. But these examples show that it seems to carry very little, if any, weight.)

¹² We follow Carlson (1982) in using simplified translations for purposes of exposition. For example, *has'* in (56b) cannot really be the lexical translation of *has* in a Montague (1973) style grammar, since the object of the lexical translation will be a property of properties, $(\lambda P)(\exists y^o)$ [*tail'*(*y*) & *P*(*y*)].

¹³ The reading of (86) according to which there is a tail such that dogs have it is eliminated on 'pragmatic' grounds.

¹⁴ The predicate in *Human beings are a hazard to themselves* might be taken to be ambiguous between an object-level predicate and a kind-level predicate. Thus one reading would be analogous to that of (90), while the other would be synonymous with *Mankind is a hazard to itself*.

¹⁵ More accurately, since semantic values of dyadic predicates are viewed as elements of $(2^D)^D$ (where *D* is the domain of individuals), the extension of *hate'* must map the first element of the pair into an element of 2^D which in turn maps the second element, *Fido*, into the truth value 1.

¹⁶ In a PTQ-style grammar (Montague, 1973), the translation of a sentence such as *dogs are mammals* would be obtained by applying the NP-translation, $(\lambda P P(\text{'dog'}))$, to the intensionalized VP-translation, 'mammal', yielding mammal' ('dog') after 'up-down cancellation'.

¹⁷ One might justifiably wonder what Farkas & Sugioka think a realization of a kind is: an object (as all their examples require) or a stage (as other examples discussed by Carlson and Chierchia would require). Farkas & Sugioka do not say, probably because they do not consider any of the examples that induce 'an existential reading' on the subject.

¹⁸ One must be careful when reading this section of Farkas & Sugioka: when they say 'ordinary *if* clauses', what they mean is 'counterfactual conditional'.

¹⁹ A better case seems to exist for identifying *Gn'* with absence of aspectual particles, or with certain inflections, in Turkish (see Dahl, 1975), Hopi, Chinese, and Slavic languages.

²⁰ Namely $\square[(R(x)(y) \ \& \ Qn(x)) \leftrightarrow \neg(\lambda z)[\neg Qn(z) \ \& \ R(z)(y)]\Delta x]$, where *Qn*(*x*) can be read as '*x* is a quantifier' (or '*x* is a property of properties') and $y\Delta x$ can be read as '*y* is in the extension of *x*'. See Chierchia (1982, pp. 337, 345).

²¹ *Sm* is the unstressed *some*.

²² Or an appropriate function from characteristic functions of sets of realizations to truth values.

²³ As a side benefit of doing this, we would be in a better position to characterize the role of *Gn* by means of axioms or meaning postulates uniformly, whereas in the former approach we have to separately state principles governing the two different cases.

²⁴ For some views on whether *dog'* can also apply to quantities of dog flesh and the like, see Pelletier & Schubert (1985).

²⁵ Cf Dahl (1975). We take the necessary operator as quantifying meta-linguistically over both worlds and times. Thus if snow is white, it always will be.

²⁶ We are inclined to replace the embedded necessity operator by a weaker one expressing 'in most of the relevant possible worlds'.

²⁷ It is worth remarking that DISP probably splits into a sense roughly equivalent to *is able (or prepared) to* and another roughly equivalent to *habitually*. Both interpretations are salient in *John speaks German, John rides a horse*, etc. (Cf Dahl, 1975.)

²⁸ But something would be lost in the translation, namely its gnomic character, and its residual temporal flavour, as evident in the absence of a reading like (i) or (ii) in sentence (iii)

- (i) All stars visible at this moment twinkle
- (ii) In all cases, stars visible at this moment twinkle
- (iii) Stars visible at this moment always twinkle.

²⁹ Some closely related views can be found in McCord (1981) and Aqvist *et al* (1980). In the former, reference situations or objects are encoded into restrictions on variables bound by unselective quantifiers, while in the latter, and explicitly statistical approach is proposed, though without grammatical underpinnings.

³⁰ Or perhaps it would be better to speak of sentence presupposition.

³¹ This example is from McCord (1981). McCord would say that *in-trees* is the 'focus' and that the sentence is to be understood as saying that the majority of leopard attacks on monkeys occur in trees. Our account is a little different in that it allows more ways of 'generalizing' to find the reference ensemble than merely the deletion of a conjunct (as McCord's theory has it).

³² Stress is ambiguous. It seems that if a word or phrase is stressed, then phrases terminating in that word or phrase can also be considered stressed.

³³ It is perhaps worth pointing out that Carlson's (1977, pp. 181-186) 'solution' to 'the Port-Royal Puzzle' does not work. The puzzle is that from *Dutchman are good sailors* we should not be able to derive *Dutchmen are sailors* even though all good sailors are sailors. Clearly *is a good sailor* is logically equivalent to *is a good sailor and is a sailor* (see Carlson's meaning postulate MP14, p. 264). But then by meaning postulate MP12 (p. 184) [Carlson erroneously uses Gn' here, but clearly intends Gn]:

$$(\forall P)(\forall Q)(\forall x^k)\Box[Gn('(\lambda y)P(y) \& 'Q(y))(x) \leftrightarrow Gn(P)(x) \& Gn(Q)(x)]$$

we obtain *Dutchmen are sailors* from *Dutchmen are good sailors*!

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