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GENERICS AND ATEMPORAL *WHEN*

ABSTRACT. Beginning with analyses of English generic sentences and English plural indefinite noun phrases (e.g. *dogs*), we proceed to apply mechanisms there motivated to a characterization of atemporal *when*, a sense of *when* which does not appear to involve time. Dealt with are such examples as "Dogs are intelligent when they have blue eyes", and their relationships to examples like "Dogs that have blue eyes are intelligent". The proposed treatment of atemporal *when* helps motivate the existence of a generic verb phrase operator in English, as well as the treatment of indefinite plural noun phrases as disguised definite descriptions.

INTRODUCTION[1]

This study has two general aims. The first is to propose an analysis of a body of data which involves one aspect of the semantics of the word *when*. The second aim is to introduce the reader to a theory of generics as developed in Carlson (1977), (1978), and to demonstrate how the notions there developed are crucial for the analysis of *when* to be proposed. Presupposed is familiarity with transformational syntax and what has come to be known as Montague grammar.

1. ATEMPORAL *WHEN*

In isolating the data we will be concerned with, we must distinguish what we will henceforth assume to be two different instances of the English word *when*. The distinction will be noted in purely informal terms for the moment, with the purpose in mind of simply marking off the territory for analysis.

Any adequate analysis of *when* would appear to involve crucially the notion of time, an assumption that will go unchallanged here (but see Bach (1977) for an alternative point of view). In a sentence such as (1) below, *when* has the function of relating the clauses it connects on a temporal dimension. The relation would be roughly that of simultaneity, though this notion of course requires a good deal of refinement.

(1) Phil rose when the king entered the room.

In (1) it is asserted that an event of Phil rising was (roughly) simultaneous with an event of the king entering the room. In this regard, *when* functions very much like *while*, *after*, *as*, *before*, and other temporal

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adverbials. The examples of (2) would appear to have kindred analyses.

(2) Phil rose { while / as / before / after } the king entered the room.

These temporal adverbials may also appear felicitously in generic, or habitual sentences as well, as illustrated in (3).

(3a) Phil rises when the king enters.
(3b) Max cleans house while Mary cooks.
(3c) Air rises after it has been heated.

However, in many examples of generic sentences containing *when* or other temporal adverbials, the nature of the subordinate clause gives rise to a strange interpretation. Impressionistically speaking, this arises when the subordinate clause would not be thought of as denoting an event. There is something strange about the examples of (4).

(4a) Max can read newspapers when he is intelligent.
(4b) Fred eats rice when my cat Sven is of a rare breed.
(4c) Sally bakes cookies when her parents are alive.
(4d) That woman is a great poet when she has blue eyes.

While it is doubtless possible to imagine some reading for these, we all recognize that there is something unusual about (4) as compared to the examples of (3). Exactly what is wrong with (4) is not an issue we will concern ourselves with here; it is sufficient for now to simply note our intuitions concerning (4). I am not suggesting that these examples be in any way marked as semantically ill-formed. Perhaps perfectly reasonable pragmatic accounts could be offered.

Whatever the source of our intuitions concerning the nature of the sentences of (4), the mere fact that certain predicates appear in the subordinate clause does not in all cases give rise to an unusual interpretation. The examples of (5) have perfectly reasonable interpretations in spite of their similarity to the examples in (4).

(5a) Wolves can read newspapers when they are intelligent.
(5b) Dogs are expensive when they are of a rare breed.
(5c) People are not orphans when their parents are alive.
(5d) Women are great poets when they have blue eyes.

Note by way of contrast that substitution of other temporal adverbials

(especially *while*) in the examples of (5) still does not allow for natural interpretations.

(6) Wolves can read newspapers { while / as / before / after } they are intelligent.

We will henceforth refer to the sensible readings of (5) as containing instances of *atemporal when*. This terminology is introduced because the interpretation of *when* in these cases does not crucially involve the notion of time. Rather, the *when* clause has the function of telling us *which* wolves read newspapers, *which* dogs are expensive, and so forth, and not at which *times* wolves read newspapers, etc. (In all cases temporal readings are possible, though, giving rise to interpretations that are strange in the same way as (4).) It will henceforth be assumed that there are at least two distinct instances of *when* in English, one temporal in nature and the other atemporal.[2]

Not every instance of *when* is ambiguous between a temporal and an atemporal sense, for certain conditions must be fulfilled before an atemporal interpretation of *when* is possible. The differences we find between the examples of (4), which have no atemporal readings, and the sentences of (5), which have atemporal readings, lead us to the primary observations.

First, there must be an NP in the main clause that is of "the right sort". Not just any NP qualifies. The (a) examples below do not have the appropriate type of NP and likewise have no atemporal reading; in (b) an appropriate NP appears and so does an atemporal reading.

(7a) ?*John* is intelligent when he is tall.
(7b) *Giraffes* are intelligent when they are tall.
(8a) ?Bob hates *this dog* when it has three legs.[3]
(8b) Bob hates *this type of dog* when it has three legs.
(9a) ?*Some man* is most handsome when he has blue eyes.
(9b) *Some kind of mammal* is most handsome when it has blue eyes.

Bare plural NP's (as in (7b)) and NP's that refer to kinds or types of things constitute the class of NP's that are of the "right sort". NP's which denote (property sets of) individuals (as in (7a)) do not allow for atemporal readings. It is important to note that I am claiming that it is the interpretation of the crucial NP, and not its morphological form, which determines the possibility of an atemporal reading.

A second restriction on atemporal *when* is that there must be a pronoun in the *when* clause that is anaphorically related to an appropriate NP in the main clause. In the absence of such a pronoun, only a temporal interpretation is possible. The (a) examples below have only temporal interpretations.

(10a) ?Cats are intelligent when dogs have blue eyes.
(10b) Cats are intelligent when *they* have blue eyes.
(11a) ?Bob likes dogs when he is intelligent.
(11b) Bob likes dogs when *they* are intelligent.
(12a) ?Some people$_i$ worship chipmunks when they$_i$ have red hair.
(12b) Some people worship chipmunks$_i$ when *they*$_i$ have red hair.

A third restriction on atemporal *when* is that the main clause (or, more accurately, the predicate of the main clause) must be interpreted generically, and not as an "event". To illustrate, note that the following examples do not have generic interpretations readily associated with them.[4]

(13a) Sailors were in the next room.
(13b) Beavers build a dam. (Cf: Beavers build dams.)
(13c) Dogs were barking at the mailman.

As usual, instances of temporal *when* may be associated with (13).

(14a) Sailors were in the next room when the crime occurred.
(14b) Beavers build a dam when they have nothing else to do.
(14c) Dogs were barking at the mailman when I arrived.

However, no reading for atemporal *when* appears if associated with the examples of (13). This is because the presence of atemporal *when* requires a generic interpretation of the main clause, which conflicts with the inability of (13) to exhibit generic readings. The examples of (15) have only (strange) temporal interpretations in spite of the presence of an appropriate NP in the main clause and an anaphorically related pronoun in the subordinate.

(15a) Sailors were in the next room when they had blue eyes.
(15b) Beavers build a dam when they have 4 legs and buck teeth. (Cf: Beavers build dams when they have 4 legs and buck teeth.)
(15c) Dogs were barking at the mailman when they were of a rare breed.

Atemporal *when* thus requires a generic interpretation of the main clause, though not necessarily of the subordinate clause.

With this set of data in mind, we devote the remainder of this paper to a presentation of an analysis of these characteristics of atemporal *when*, as well as other characteristics to be noted as we proceed. The treatment of *when* to be proposed involves notions from the theory of generics as developed in Carlson (1977), (1978). In the following section, this theory will be briefly outlined. Highlighted will be points of the theory that are directly relevant to the treatment of atemporal *when*.

2. GENERICS

In this section will be presented the basics of an approach for semantically representing generic sentences of English. The arguments that support this approach, as well as arguments that are directed against proposed alternatives, will not be recapitulated, as they may be found elsewhere (Carlson (1977), 1978)). Here we will only be summarizing conclusions. The semantic interpretation is carried out within the framework of a modified Montague grammar, the chief modifications being the admission of transformational rules into the syntax, and a reorganization of the domain of entities.

The discussion that follows proceeds in three sections. In Section 2.1, will be presented the reorganization of the domain of entities, and how this reorganization bears intuitively on the representation of generic sentences. Section 2.2 introduces the English generic operators and points out some of their salient properties. Section 2.3 is devoted to a discussion of the semantics of the English "bare plural" construction. These notions will then be used to account for the properties of atemporal *when*.

2.1. *Entities*

In analyses such as those of Montague (1974) and Bennett (1974), the domain of entities is taken to be homogeneous in makeup. However, we will here regard the set of entities as consisting of at least three disjoint subdomains, or subtypes. These subdomains are labeled *stages*, *objects*, and *kinds*. These subtypes are related to each other in very specific ways by relations to be introduced shortly. Of these subtypes, *objects* are the most familiar, for these are what are most readily thought of as constituting entities, or as corresponding to the set of (possible) individuals. Objects, then, are things like Jimmy Carter, the chair I now occupy, or the world's fattest magician. The domain of *kinds* is likewise regarded as constituted of individuals, these individuals being (possible) kinds of

things. Here, kinds of things are looked upon not as being sets of objects, as is commonly supposed, but rather as being individuals themselves. More will be said about them below. Stages, the last subtype of entities, are essentially time-space slices of individuals. Though they are here regarded as entities, they are not individuals.

The intuitive significance of this arrangement is that individuals are entities that serve to "tie together" a series of stages to make them stages of the same individual. Thus, a series of stages may be organized into an individual, and the fact that they are stages *of* that individual makes them stages of the same thing. So, for instance, two distinct time–space slices of Jimmy Carter, though quite dissimilar in appearance, are thought of as being the same thing in that they are stages of the same individual. A similar line of thought holds for kinds of things, where two distinct stages are nonetheless recognized as being stages of the same thing, and hence in some way the same.

Just as there are proper names for objects, such as "John" or "Fido", there are constructions in English which serve as proper names for kinds. This is the function of the English "bare plural" construction (see Chomsky, 1975). Just as "John" names an individual, "cats" names an individual as well.[5] And just as an NP such as "that man" refers to some contextually-defined individual, and NP such as "that kind of animal" refers to a contextually-defined individual as well (e.g. dogs). Stages, unlike kinds and objects, are never named. Only individuals may bear names.

In the semantics, we represent the notion that a stage is a stage *of* some individual by a relation R' (for "realizes"), which is a function from ordered pairs of stages and individuals to truth-values. For instance, the set of John's stages, relative to given points of reference, is represented by the following formula.

$$\lambda x^s[R'(x^s, j)]$$

Here, x^s is a variable that takes only stages as its values, and J denotes the object John. In similar manner, we represent the set of stages of the kind cats (denoted by c), an individual like John in many respects, by the same sort of formula.

$$\lambda x^s[R'(x^s, c)]$$

The relation of realization (or, to use another term, manifestation) extends to the relationship that holds between objects and kinds as well. If a given object is an object of a certain kind, that object is said to realize that kind (this, however, is not to suggest that objects are

sometimes classified as stages, for they are not). Thus, the set of objects that are of the kind cats is given us by the following formula.

$$\lambda x^0[R(x^0, c)]$$

Here, x^0 is a sorted variable taking as values entities from the domain of objects, and R is a relation intuitively much like R' except that R is a function from ordered pairs of objects and kinds to truth-values. Given this specification of R, objects have no realizations that are themselves objects. Objects may have only stages as realizations (entities related by R'). Kinds, on the other hand, have realizations on two levels, objects and stages (these stages also being the stages of the realizing objects).

An intuitively correct property of kinds we wish to capture in our semantics is that, for instance, something realizes (by R) the kind cats iff it is in the set of cats. The following two formulae are logically equivalent.

$$\hat{}\textit{cat}'(=)\hat{x}^0[R(x^0, c)]$$

Here, ***cat'*** is the translation of the basic CN *cat*, and this is regarded as a function from objects to truth-values.[6] In this way, by use of R, we can state the close relation that holds between the intension of a CN and a given kind.

Given this organization among the entities and the relations that hold among them, we may now begin to sort the predicates themselves into groups that apply to stages, to objects, to kinds, or to combinations of these. Perhaps the most notorious group of English predicates that fits into this organization would be the group that is here represented as applying meaningfully just to the domain of kinds. These are such words as *rare, common, widespread, extinct,* and such phrases as *indigenous to, in short supply, comes in* (many sizes), and the like. These all appear felicitous with bare plural subjects and subject NP's that refer to kinds (or types) of things, but are anomalous with subject NP's that would be here represented as denoting (the property set of) objects, such as "several cats".

(16a) ?Several cats are common/extinct/widespread/in short supply.

(16b) Cats are common/extinct/widespread/in short supply.[7]

(16c) This kind of animal is common/extinct/widespread/in short supply.

As *cats* and *this kind of animal* refer to entities from the domain of kinds, and as the predicates listed apply only to kinds, (16b) and (16c)

are acceptable. However, as *several cats* (on its most salient reading) refers to objects, and not kinds, the predicates listed will not felicitously apply (i.e. will be treated as undefined in the sorted logic).

The vast majority of predicates, however, apply to stages or objects and not just to kinds. The predicates that apply to stages superficially appear to take subjects that are either on the kind-level or on the object-level, but in fact apply to stages of the subject NP. If a bare plural NP is the subject, the predicate selects the "existential" reading of the NP, and not the "universal" reading. Intuitively, stage-level predicates speak of events and occurrences that have a distinct temporal tenor. The majority of English verbs apply to stages. These, for the most part, are those verbs that allow a progressive form. Consider the examples of (17).

(17a) John ran into the house.
(17b) Dogs ran into the house.

We analyze (17a) as meaning that there was a stage of John that was in the set of stages denoted by the predicate *ran into the house.* Similarly, (17b) is to be analyzed as asserting that there was a stage of the kind dogs in the set of stages denoted by the predicate. Note in (17b) that the existential reading of the bare plural NP is selected. This is the result of applying a predicate which makes a claim about stages to the bare plural, which in (17b) is still functioning as the name of a kind of thing.

By way of contrast, consider a verb like *know*, which allows no progressive form.

(18) *John is knowing how to ride a bicycle.

This verb also selects the "universal" reading of the bare plural.

(19) Dogs know how to ride a bicycle.

We consider *know* to be a verb which applies to *objects*, and not to stages (we will discuss shortly why it can apparently also apply to kinds, as in (19)). In (20), we take the predicate *know how to ride a bicycle* as denoting a set of objects, and not stages, and the claim is that the individual John (and not one of his stages) is in the set denoted.

(20) John knows how to ride a bicycle.

The distinction we feel to exist between the examples of (21) serves to illustrate the difference between predicates that apply to stages (21a) and those that apply to individuals (21b), a distinction we are attempting to represent here by subtyping the predicates.

(21a) John ran into the house.
(21b) John knows how to ride a bicycle.

(21b), and not (21a), seems to say something about a general characteristic of John, and involves some notion of permanance, or at least generality through time. The former, (21a), speaks of something more fleeting and temporary, and seems to be a much less general statement about John's makeup. We represent these intuitions as being correlated with the sort of entity the predicate meaningfully applies to. If the predicate speaks of general characteristics, or dispositions, we represent it as applying to a set of objects. If something more fleeting is intended, somehow more temporary, and in some sense less intrinsic to the nature of a given individual, the predicate is represented as denoting a set of stages. This distinction is intended to correspond to the basically atemporal nature of individuals as opposed to their time-bound stages.

Time and space do not permit a full exposition of a set of criteria that may be employed in distinguishing among these types of predicates, and to be sure the criteria do not always give clear results. Selection of the existential reading of a bare plural NP is one test that has been alluded to above as a means of locating predicates that apply to stages. Below I give a listing of examples of some predicates that apply to stages and some that apply to objects in the hope that this may serve to clarify somewhat the concepts involved. In general, verbs that take a progressive form apply to stages, and the remainder (generally) apply to objects. All predicate nominals apply to objects,[8] while the majority of prepositional phrases in predicate position apply to stages (especially the locatives). Adjectives appear to be a mixed group, with perhaps the majority applying meaningfully to objects.

Stages	*Objects*
ran into the room	know how to dance
found a match	have ears
ate a donut	(be) a turtle
(be) sick (physically)	(be) an orphan
(be) in the next room	(be) intelligent
(be) available	(be) sick (mentally)
(be) present	(be) fat
(be) drunk	weigh 250 kilograms
(be) running around	can read a newspaper
(be) on top of the house	(be) able to leap tall buildings

2.2. *The Generic Operators*

In light of these remarks we choose to analyze a sentence such as (22) as having the predicate *eat a light breakfast* denote a set of stages. The sentence then makes the claim that there was a stage of John that is in that set of stages.

(22) John ate a light breakfast (e.g. yesterday morning).

However, this predicate can also be taken as applying not to a set of stages, but to objects as well, where a more general property is being ascribed to John, which has a much less fleeting nature. This is the generic or habitual reading of (22).

(23) John ate a light breakfast (before he became a health nut).

In the simple present tense, this is the most natural reading for this particular predicate.

(24) John eats a light breakfast.

(Of course, under certain circumstances (24) may be interpreted as applying to stages as well, as in a play instruction.)

A similar sort of ambiguity may be found with a kind-level subject as well, as with a bare plural NP.

(25a) Athletes ate a light breakfast (then went to the game).
(25b) Athletes ate a light breakfast (back in those days).

The overriding generalization appears to be that for any verbal predicate (one containing a verb other than *be*) which applies to stages, there is a corresponding predicate of the same form which also applies to objects. That is, in general there is a generic reading for any verbal predicate that also speaks of an event. The generic reading will also always apply to kinds as well as objects. In order to capture this generalization, we posit a (morphologically unrealized) VP operator, here represented as ***Gn'*** (for "gnomic"), which has the effect of taking any verbal predicate that denotes a set of stages and mapping it into a predicate which applies to individuals (that is, the union of the sets of objects and kinds). It is of sorted type $\langle\langle s, \langle e^s, t\rangle\rangle, \langle e^i, t\rangle\rangle$ (where e^s is the subtype of stages and e^i is the subtype of individuals). This operator has the formal effect of "elevating" a predicate in the semantics to a new level. Intuitively, it represents generic attribution. Syntactically, ***Gn'*** will combine with any verbal VP (but not with VP's like (be) *drunk* or (be) *in the necessary place*, thus no generic readings for these). Recall that applying a predicate to an individual, rather than to a

stage of an individual, is intended to represent something general or dispositional about that individual. This is precisely the flavor that generic sentences possess. Note also that applying a generic predicate to a kind results in a "universal" reading, as in (25b).

The notion that ***Gn'*** represents a mapping from sets of stages to sets of individuals is also intended to account for our intuition that a generic statement such as 'John eats with a knife" in some sense has something crucial to do with the non-generic reading of "John eats with a knife". The fact that the object John is in the set of things that (generically) eat with a knife in some way involves some of John's stages being in the set of things that (non-generically) eat with a knife, and not some of John's stages being in the set of things that shovel the driveway in the winter.

We oppose this intuition of a generic having something crucial to do with syntactically related statements about stages to other sentences containing predicates which apply directly to individuals themselves (not via ***Gn'***), for which there are no morphologically identical (or similar) statements about stages that the generalization is relevant to. Such is the case with the examples of (26), which contain predicates applying directly to objects and which do not contain instances of ***Gn'*** to "elevate" the predicate to the object-level

(26a) John is a Dodger fan.
(26b) John knows that the world is round.
(26c) John resembles Boris Karloff.

In these cases, there are no corresponding event-type statements related to (26) in the same way (22) is here claimed to be related to (23).

The terminology concerning the relationship that holds between generic statements and corresponding event-type statements is intentionally quite vague. At first sight, the relation represented here by ***Gn'*** may appear to be (simply) a matter of induction. If John eats with a knife "enough" times (i.e. has *x* number of stages in the set of stages denoted by the predicate ***eat with a knife***), then he generically eats with a knife. In stating generally what "enough" is (which amounts to treating generic attribution as quantification over events), one soon finds no simple solution to be available. Statements of frequency or of absolute number of occurrences cannot be stated generally for all generic sentences. Consider how many times corresponding stage-level statements must hold in order for the following to be true.

(27a) John eats at his mother's house.
(27b) John executes criminals for California.

(27c) John writes novels.
(27d) John beats his wife.
(27e) John runs to work.
(27f) John runs the mile in 4:15.6.
(27g) John smokes.

Even brief reflection yields a haphazard array of criteria when these matters are couched in quantificational terms.

Further, the ***Gn'*** operator is also to account for law-like and prescriptive statements, which may not be based on any inductive evidence at all. The sentences of (28) could hold even if the corresponding events were never observed.

(28a) Hot air rises.
(28b) In chess, bishops move diagonally.
(28c) This machine generates any given finite-state language.

(Note that still in the examples of (28) the generic statements have something crucial to do with the corresponding stage-level statements – i.e. of hot air actually rising, of bishops actually moving diagonally rather than on the columns, or of the machine in fact generating any given language. However, the relation would seem at first sight to differ from the relationship found in an example like (27).)

Explicating further what relationship ***Gn'*** is to represent would take us too far afield, and in any case there is little hope of resolving the matter here. So matters are left quite open at this time. We will here simply specify what *sort* of function ***Gn'*** is to be without attempting to explain precisely *which* function it is to be. This is very much in accord with the general approach taken in this framework for most lexical items. It is specified that, for instance, the word *cat* translates as a constant of type $\langle e, t \rangle$, but there is no attempt to specify exactly which constant this is. We take a similar approach for ***Gn'***.

Just as there is a relation (***Gn'***) which maps stage-level predicates into individual-level ones, there is a similar sort of relation which maps predicates that basically apply to objects into predicates that apply to kinds. There is no predicate of English I am aware of which felicitously applies to an NP such as "Fido" that does not also apply to an NP such as "this kind of animal" (assuming Fido to be an animal).[9] As noted above, there are predicates such as *widespread* which apply to kinds to the exclusion of objects, but the reverse case never appears. To account for these facts, we posit the existence of another generic operator that is intuitively like ***Gn'***. We call the new one ***Gn***, which is a mapping from

predicates that apply basically to objects (such as predicate nominals) to predicates that apply to kinds. In the syntax, ***Gn*** combines with any VP. Again, we find that the presence of the operator can account for the intuition that generic generalization attributed to a kind in some obscure way has something to do with statements about objects of that kind. To illustrate, consider these examples.

(29a) Dogs are intelligent.
(29b) Dogs are widespread.

We assume *intelligent* to be a predicate that basically applies to objects, and in (29a) it has been "elevated" to a predicate that applies to kinds by the presence of ***Gn***. *Widespread*, as noted earlier, applies basically to kinds. So (29a), but not (29b), contains an instance of ***Gn***. In (29a) we have the intuition that the truth or falsity of the statement somehow involves the predication of intelligence to individual, particular dogs. Contrast this to (29b), where its truth or falsity has nothing whatsoever to do with predicating *widespread* of any individual dogs at all. In inductive terms, we might think "Fido is intelligent, Rover is intelligent, . . . therefore, dogs are intelligent'. But we certainly would not think "Rover is widespread, Fido is widespread, . . . therefore, dogs are widespread."[10] The interpretations given (29) would be schematically represented as follows.

(29'a) $Gn(\hat{}\textit{Intelligent}')\ (d)$.
(29'b) $W(d)$ (W = the translation of *widespread*)[11]

Predicating intelligence of dogs involves generic attribution by use of ***Gn***; predicating widespreadness does not.

In order to explicate this notion a little bit further, though falling short in terms of formal rigor, I offer the following quasi-meaning postulates. They are intended simply as an informal aid to the reader, and have no formal status.

Q-MP1 If the translation of a sentence is of the form $Gn'\ (P)\ (x)$, the truth or falsity of that sentence has something directly to do with statements of the form $\exists x^s[R'(x^s, x)\ \&\ {}^{\vee}P(x^s)]$.

Q-MP2 If the translation of a given sentence is of the form $Gn(P)\ (x)$, the truth or falsity of that sentence has something directly to do with statements of the form $\exists x^0[R(x^0, x)\ \&\ {}^{\vee}P(x^0)]$.

Thus (by QMP2) the translation of "dogs are intelligent", of the form $Gn(\hat{}\textit{Intelligent}')\ (d)$, has something directly to do with statements of the form $\exists x^0[R(x^0, d)\ \&\ \textit{Intelligent}'\ (x^0)]$.

The positing of these generic operators has a number of consequences for the semantics, two of which are of relevance here. The first is that they serve to create an intensional context in the VP, a more or less automatic consequence in the Montague framework presupposed here.[12] As all rules of functional application operate on the intensions of the argument, if nothing more is said, an intensional context is created in the argument. Extensionality requires a special statement, generally in the form of a meaning postulate. As a concrete example, we consider the predicate *have a head* to be one that basically applies to objects. If this predicate is applied directly to an object-level NP, no intensional context is created.

(30) This man has a head.

From (30), we can conclude that there is some head that this man has, as we see from its "translation" (30').

(30') $\exists x[\textit{head}'(x) \,\&\, \textit{have}'(x)(\textit{this man})]$

However, in (31) the predicate is applied to a kind-level NP via ***Gn***, and we find no similar conclusion can be drawn, as we see from examination of its "translation" 31'.

(31) This kind of animal has a head (and four legs).

(31') $Gn(\hat{y}^0\exists x[\textit{head}'(x^0) \,\&\, \textit{have}'(x)(y^0)])$ (this kind of animal)

We are not licensed to conclude that there is a head that this kind of animal has.

If there is attribution of stage-level predicates to individuals by use of ***Gn'***, an intensional context is created for both kind-level and object-level subjects. The examples of (32) do not differ in the same way as (30) and (31) with regard to opacity of the VP.

(32a) John eats with a knife.

(32b) Athletes eat with a knife.

In (32) we are licensed to conclude neither that there is some knife that John eats with, nor that there is some knife that athletes eat with. This is due to the presence of ***Gn'*** in (32).[13]

The other consequence of interest involves coreference. Consider a sentence of the following sort.

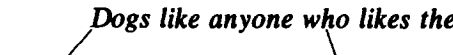
(33) Dogs like anyone who likes them.

We consider the verb *like* to create in concert with its complement a predicate that basically applies to objects. Example (33) is at least two ways

ambiguous with respect to the reference of the pronoun *them*. The first reading has the pronoun coreferential with the kind dogs, and is then equivalent to (34).

(34) Dogs like anyone who likes dogs.

We obtain this reading in a straightforward way. We quantify in the NP *dogs*, thereby binding the variable in the translation of *them*, which must be able to take as values kinds. Ignoring all but relevant material, we can schematize the syntax and semantics of this reading of (33) as follows.



$\lambda x_0^k[\boldsymbol{Gn}(\hat{}\textit{like anyone who likes } x_o^k)\ (x_0^k)]\ (d)$.

This formula is equivalent to:

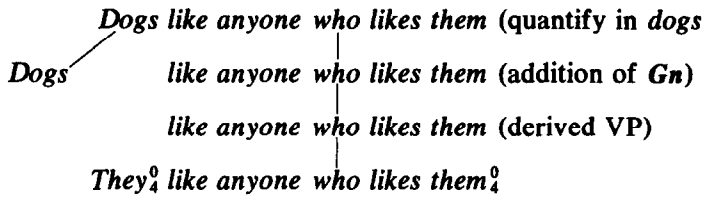
$\boldsymbol{Gn}(\hat{}\textit{like anyone who likes } d)\ (d)$.

Here, d is the individual dogs, and this formula represents the reading of (33) under discussion.

There is, however, another reading of (33) which is roughly equivalent to (35).

(35) Any dog likes anyone who likes it (i.e. that dog).

The pronoun *them* in (33) under this reading is not coreferential with the kind dogs, but is in some way coreferential with particular individual dogs. The sort of coreference exhibited in this interpretation of (33) will be referred to as coreference on an object-by-object basis. In order to represent this reading in the current framework, we must assume the existence of a derived VP rule in the grammar (introduced in Partee (1976); see also Williams (1977) for use of this rule in a different framework). The derived VP rule takes a sentence which has a free variable pronoun as its subject and syntactically deletes that subject, giving rise to a VP derived from a sentence. In the semantics, a predicate is formed by lambda-abstraction on the free variable in the interpretation of the subject. The newly-formed predicate may then be combined with anything a normal VP could combine with. As ***Gn*** may operate on a VP, it can also operate on a derived VP. With this rule in mind, we are now in a position to represent this second reading of (33). Again ignoring all but relevant portions of the derivation, (33) could be derived thus:



The resulting interpretation would be essentially as follows.

$$Gn(\hat{x}_4^0[x_4^0 \text{ like anyone who likes } x_4^0])\ (d)$$

The generic generalization here has something to do with a function applying to objects, where those objects are in the set of objects that like anyone who like it. When compared to the first reading of (33), paraphrased as (34), we see that in the former case the generic generalization is based on a function applying to objects which specifies a set of objects that like anyone who likes *dogs*. So the ***Gn*** operator in conjunction with the derived VP rule can account for object-by-object coreference possibilities for kind-level NP's.

It should be noted that in the absence of ***Gn***, object-by-object coreference does not appear. Contrast (36a) and (36b).

(36a) Dogs are more intelligent than people who own them.
(36b) Dogs are more widespread than people who own them.

(36a) is ambiguous in exactly the same way as (33) is. On one reading it asserts that dogs are (generally) more intelligent than people who own dogs. On the other reading, where the pronoun is coreferential on an object-by-object basis, it says that (roughly) any dog is smarter than its owners. These readings correspond to the following representations.

$$Gn(\hat{}\textit{be more intelligent than people who own } d)\ (d).$$
$$Gn(\hat{x}^0[x^0 \textit{ be more intelligent than people who own } x^0])\ (d).$$

In (36b), where the kind-level predicate *widespread* appears in place of the object-level predicate *intelligent*, we find there to be but one reading for the pronoun, and not two. Lacking is the reading which requires coreference on an object-by-object basis. (36b) can only mean that dogs are more widespread than people who own dogs, and it cannot mean that dogs are more widespread than the owners of that dog are. This failure to obtain object-by-object coreference can be attributed to the absence of ***Gn*** in (36b), as opposed to its presence in (36a). As *widespread* does not apply to objects, there can be no meaningful formula of the following form corresponding to the second reading illustrated for (36a) above.

$$^{*}Gn(\hat{x}^{0}[x^{0} \textit{ be more widespread than people who own } x^{0}])\ (d).$$

(36b) could only be represented as follows.

$$\lambda x^{k}[x^{k} \textit{ be more widespread than people who own } x^{k}]\ (d).$$

This is equivalent to:

d be more widespread than people who own d

It is the presence of *Gn* that can give rise to object-by-object coreference with kind-level NP's in subject position.

In summary, the presence of the generic operators has the effect of "elevating" the level of the application of a predicate from the level of stages to that of individuals, or from the the level of objects to that of kinds. These operators also have the effect of creating an opaque context and of making object-by-object coreference possible for kind-level NP's. Generic attribution is considered to be nothing more than attribution of a predicate to an individual, rather than to a stage of that individual.

2.3. *Translation of the Bare Plural*

To this point, bare plural NP's, such as *dogs*, have been treated as the names of kinds of things, and the informal notation has been used where *d* is the individual dogs, *c* is cats, and so on. However, bare plural NP's may be of considerable complexity as there may be any number of associated modifiers. To ignore this obvious internal structure and to treat all bare plural NP's as semantically unanalyzed wholes would certainly be mistaken.

In the semantics, we wish for there to be a kind (i.e. some entity) which corresponds uniquely to the intension of every CN in the language.[14] As English CN's of any length can be constructed, each with a different sense, it follows that the domain of kinds is infinite. This may not be so unpalatable as it may first appear, as the domain of (possible) individuals on the object level must likewise be infinite, as pointed out in Partee (1977). The infinitude of kinds is hence not a difficulty particular to this analysis should one object to the infinitude of the domain of entities.

Bare plural *NP*'s will be treated as definite descriptions of a very special sort. They will pick out that unique entity that "corresponds" to the intension of the *CN* being operated on. Below is illustrated the derivation of the NP *dogs* from the *CN dog*. Following Bennett (1974), the addition of plurality is assumed to have no correlated semantic effect.

dogs NP (= *T*)
|
dogs CN
|
dog CN.

In the transition from CN to NP in the derivation above, the following semantic rule applies.

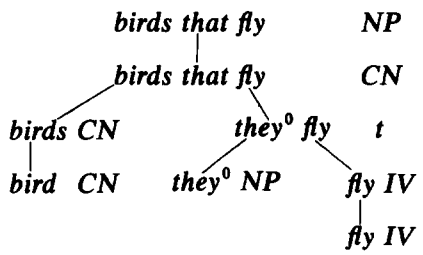
> If α is a plural *CN* and α translates as α', then $F_m(\alpha)$ (where F_m is the syntactic function which takes plural *CN* to *NP*) translates as: $\lambda P^{\vee}P(\imath x^k \Box \forall y^0[R(y^0, x^k) \leftrightarrow \alpha'(y^0)])$

$\imath$ is the definite descriptor, x^k is a variable ranging over kinds, and y^0 is a variable ranging over objects. *R* is the realization relation introduced earlier. As a concrete example, the translation of the *NP dogs* is as illustrated.

$$\lambda P^{\vee}P(\imath x^k \Box \forall y^0[R(y^0, x^k) \leftrightarrow \boldsymbol{dog}'(y^0)]).$$

This is the set of properties associated with that unique entity such that necessarily whatever realizes that kind is a dog, and whatever is a dog realizes that kind. The kind dogs thus corresponds to the intension of the set of dogs. A meaning postulate ensures that any two kinds that have all the same realizations are in fact the same kind (e.g. woodchucks and groundhogs), so uniqueness is guaranteed.[15]

The presence of modifiers in the *CN* does not alter the basic form of the translation, though it does increase complexity. Below is shown the translation of the *NP birds that* (generically) *fly*.



Translation: $\lambda P^{\vee} P(\imath x^k \Box \forall y^0[R(y, x) \leftrightarrow \boldsymbol{bird}'(y) \,\&\, \boldsymbol{Gn}'(\hat{}\boldsymbol{fly}')(y)]).$

We will in similar fashion be able to build up translations for any bare plural NP regardless of what modification occurs in the *NP*.

We are here in no way making a distinction between what may be termed "natural kinds", and the remainder (?unnatural kinds), regardless of what interpretation is placed on the term "natural kinds". In our

semantics, expressions such as *wolves* and *rusty or unoiled Victorian bicycles* are treated on a par. Both denote (property sets of) entities within the domain of kinds. The reason for this collapsing of what appear to be philosophically distinct types of things is that the semantics of the language does not appear to dictate such a distinction. Hence no distinction is made.

With these concepts in mind, we will now return to an explication of the properties of atemporal *when*, showing how the concepts outlined above play a crucial role in an account of atemporal *when*.

3. ANALYSIS OF *WHEN*

3.1. *A Conditional Analysis*

Let us now return to the data presented at the outset and examine it in light of the previous section.

Let us begin by reconsidering the semantics of an example such as (37).

(37) Wolves are intelligent when they have blue eyes.

We here observe that *when* in this case does not operate on the meanings of the clauses it connects. That is, the meanings of the clauses in isolation, as in (38), do not appear to be constituents of the meaning of (37).

(38a) Wolves are intelligent.
(38b) They (wolves) have blue eyes.

In analyzing conjunctions like *although*, *because*, or (causal) *since*, we note that such meanings do appear to be present.

(39) Wolves are intelligent $\left\{\begin{array}{c}\text{because}\\ \text{since}\\ \text{although}\end{array}\right\}$ they have blue eyes.

This indicates that the parts of the meaning of (37) are not simply two sentences joined by *when*, but rather the parts are arranged in a somewhat less straightforward manner.

As a first approximation of the semantics of *when*, we might take a lead from the similarity it bears to a conditional. It is at first sight plausible to think of (37) as paraphrased by (40).

(40) For any wolf, if it has blue eyes, then it is intelligent.[16]

However, I do not find (40) in fact an accurate paraphrase of (37), as (40) is much too strong. My intuition is that (37) allows for there to be some blue-eyed wolves that are nonetheless quite stupid. Claiming that (40) paraphrases (37) is the same as claiming that (41a) exactly paraphrases (41b).

(41a) Any wolf is dangerous.
(41b) Wolves are dangerous.

While a single docile wolf falsifies (41a), it does not falsify (41b). Similarly, a single stupid blue-eyed wolf would falsify (40), but not (37).

It might instead be claimed that the appropriate quantifier is not a universal like *any*, but is much more like *most*. (40) then becomes (42), intended as a paraphrase of (37).

(42) For most wolves, if they have blue eyes, then they are intelligent.

Unfortunately, the change from a universal quantifier to something weaker has the following undesirable result. So long as the property attributed in the *when* clause (i.e. the antecedent) is false of the vast majority of the individuals quantified over, the sentence will turn out true regardless of the content of the main clause. For instance, very few cows are purple; so the antecedent clause of the proposed analysis of (43) – example (44) – will be false for most cows, and thus the conditional will be true. Our claim would then be that (43) is in fact true under this analysis.

(43) Cows are not purple when they are purple.
(44) For most cows x(x is purple $\rightarrow$ x is not purple)[17]

This result is clearly not desirable, and it will follow from use of anything weaker than a universal quantifier.

There is another reason for rejecting this general type of approach. Consider (45).

(45) People are always intelligent when they are scholars.

This sentence contains an instance of what Lewis (1975) calls an adverb of quantification, *always*.[18] Though (45) has a reasonable interpretation (which is atemporal in nature), note that (46) is strange.

(46a) ?Each man is always intelligent.
(46b) ?John is always intelligent.

In attempting to represent (45) in terms of some quantifier plus a

conditional, one is at an intuitive loss as to how the adverb of quantification fits into the interpretation. There is something incorrect about the following paraphrase of (45).

(47) For all/most people, if they are scholars, then they are always intelligent.

Whatever is wrong with (46) is also wrong with (47), yet example (45) has a natural reading associated with it.

Further, this type of analysis has little to say about why it is that the main clause must be interpreted generically, for the main clause of a conditional clearly need not be.

Though the possibility remains that there is some way of eventually getting around these problems while retaining this type of analysis, I believe there is a much more revealing analysis available which avoids the problems inherent in this general approach.

3.2. *A Relative Clause Analysis*

A somewhat more promising treatment rests on the observation that there is a very clear semantic relation between atemporal *when* clauses and relative clauses. The (a) and (b) examples below are paraphrases.

(48a) Wolves are intelligent when they have blue eyes.
(48b) Wolves that have blue eyes are intelligent.
(49a) People are orphans when their parents are not alive.
(49b) People whose parents are not alive are orphans.
(50a) Dogs are expensive when they are of a rare breed.
(50b) Dogs that are of a rare breed are expensive.

I detect no difference between these pairs. If I am blind to some nuance of meaning, the fact remains that these pairs are at the very least equivalent in truth-value under any circumstances.

Let us then consider momentarily the following line of analysis. We take all atemporal *when* clauses as being in "deep structure" relative clauses. Prior to the application of the syntactic rules associated with relative clauses, there is the option available of moving the clause to the end of the sentence transformationally and inserting *when* appropriately. Under this hypothesis, the (a) versions above are syntactically derived from the (b) versions. Deriving both from the same deep structures accounts for the relation of synonymy in these examples.

Though this suggestion may appear implausible at first sight, it does have a good deal to recommend it in terms of what it can account for

semantically. First of all, the adverbs of quantification become unproblematic. The fact that (51) is acceptable is because it essentially has (52) as its deep structure.

(51) People are always intelligent when they are scholars.
(52) People that are scholars are always intelligent.

Once we have an analysis of (52), to be presented below, we automatically have an analysis of (51).

Another semantic parallelism between *when* clauses and relative clauses arises if we note that relative clauses of (53) in conjunction with the heads they modify give strange results.

(53a) ?dogs that are collies.
(53b) ?mammals that are dogs.
(53c) ?cats that are cats that chase mice.

Whatever the exact source of the difficulty in (53), it extends to atemporal *when* clauses as well. The examples of (54) are unacceptable in the same way as (53).

(54a) ?Dogs bark loud when they are collies.
(54b) ?Mammals are intelligent when they are dogs.
(54c) ?Cats are quite peppy when they are cats that chase mice.

Likewise, we find there is also something strange about the examples in (55).

(55a) ?Dogs are collies.
(55b) ?Cats are cats that have four legs.[19]

With the addition of a relative clause to the subject NP, acceptability is increased.

(56a) Dogs that have long snouts and shaggy coats are collies.
(56b) Cats that can run full speed are cats that have four legs.

But the examples of (55) can be made much more acceptable with the addition of a *when* clause as well, illustrated in (57)

(57a) Dogs are collies when they have long snouts and shaggy coats.
(57b) Cats are cats that have four legs when they can run full speed.

Whatever the source of the unacceptability in (55), in treating *when* clauses as relative clauses we would automatically have an account of the acceptability of (57) once we have an account of (56).

When clauses also appear to function like relative clauses with regard to anaphora. For instance, relative clauses may be pronominalized by *such* (see Carlson (1978) for an analysis of *such*).

(58) Dogs that have three legs are illformed. Such dogs (= dogs that have three legs) should be protected from cats.

Likewise, it appears that *such* may refer back to a *when* clause in exactly the same way. In (59) we may obtain the same interpretation for *such* as we find in (58).

(59) Dogs are ill-formed when they have three legs. Such dogs should be protected from marauding cats. (i.e. dogs that have three legs should be protected)

We may also use a definite pronoun to refer back to a combination of the "head" *NP* and the *when* clause just as if they constituted a single constituent, as do a head and relative clause. The following example would sound strange if the antecedent of *they* were taken as the *NP dogs*, but (60) does have a natural reading.

(60) Dogs are expensive when they are of a rare breed. This is strange because they (= dogs that are of a rare breed) are usually worse pets than other dogs.

While the indications above would have to be substantiated by detailed analysis (see Cooper (1976) for an analysis of pronouns), it would appear on balance that treating *when* clauses as relative clauses would lead one to anticipate the observations noted, and as such this constitutes support for the relative clause analysis.

In spite of these points, there are a number of reasons for rejecting the analysis as it stands. First of all, and perhaps most important, there is no syntactic evidence I have found which indicates the *syntactic* desirability of a derivation of the type proposed. All motivation appears semantic (or even pragmatic) in nature. However, the analysis has a number of empirical shortcomings as well, for there are crucial ways in which *when* clauses and relative clauses differ both in terms of syntactic properties and in terms of semantic interpretation.

Treating *when* clauses as underlying relatives would not be capable of accounting for the difference between (61a) and (61b).

(61a) Dogs that have two heads are rare.
(61b) *Dogs are rare when they have two heads.

Recall that *rare* is a predicate which applies meaningfully only to kinds,

and not to objects and stages. None of the kind-level predicates, such as *widespread* and *extinct*, are acceptable if predicated of the "crucial" *NP* in the main clause (nor are they generally acceptable in the subordinate clause either).[20] The relative clause analysis makes no such prediction.

We also find that an ambiguity appears in the presence of the *when* clause which fails to appear in the presence of a relative clause. In (62) the scope of the *when* clause is ambiguous.

(62) Everyone believes dogs are intelligent when they have blue eyes.

Depending upon whether the *when* clause is a constituent of the matrix sentence or of the subordinate clause, (62) can be read in the ways illustrated by the rough paraphrases of (62').

(62'a) If a dog has blue eyes, then everyone believes it is intelligent.
(62b) Everyone believes that if a dog has blue eyes, then it is intelligent.

However, if a relative clause is present, no similar sort of ambiguity is to be found. As bare plural *NP*'s denote the same entity at all points of reference (an automatic consequence of the translation given them), scope of quantification of these *NP*'s makes no difference in interpretation. Clearly, example (63) is not ambiguous in the same way as (62).

(63) Everyone believes that dogs that have blue eyes are intelligent.

If the unambiguous (63) is to be the source for the ambiguous (62), it would be necessary to invoke a host of unwarranted mechanisms, in all likelihood, to account for the ambiguous (62).

A further indication that *when* clauses are not relative clauses comes from examination of *NP*'s that have words like *kind, type,* or *sort* in them. The definite article *the,* unlike other determiners, requires the presence of a relative clause or other restrictive modifier to avoid a judgment of ellipsis. While (64a) is well-formed, (64b) is not; addition of a relative clause, as in (64c), restores acceptability in the presence of *the.*

(64a) *That* kind of dog chases badgers.
(64b) ?*The* kind of dog chases badgers.[21]
(64c) *The* kind of dog *we were just discussing* chases badgers.

The addition of a *when* clause fails to have the salvaging effect of the relative clause in (64c). (65) is as bad as (64b).

(65) ?The kind of dog chases badgers when it has a long snout.

When clauses can, of course, be associated with the type of *NP* found in (64c).

(66) The kind of dog we were just discussing chases badgers when it has a long pointy snout.

Restrictive relatives such as those in (64c) may be optionally extraposed, so no general restriction may be invoked which prohibits separation of relative clause from head to avoid (65).

(67) The kind of dog was being discussed that chases badgers and has a long pointy snout.

Deriving *when* clauses from relative clauses will not account for this set of data, either.

Although bare plural NP's in conjunction with *when* clauses give rise to close paraphrases if a relative clause is substituted, other *NP*'s that refer to kinds of things, especially those with overt determiners and quantifiers, do not allow for convincing paraphrase. Consider the following pairs of examples.

(68a) One kind of dog is herbivorous when it has blue eyes.
(68b) One kind of dog that has blue eyes is herbivorous.
(69c) That type of creature is normal when it has three heads.
(69d) That type of creature that has three heads is normal.
(70a) Each kind of car is safe when it is made in Detroit.
(70b) Each kind of car that is made in Detroit is safe.

The examples above clearly differ in interpretation, and treating the *when* clause as an underlying relative would not be able to naturally account for these differences in interpretation.

The final difficulty with the relative clause analysis we will note involves examples such as (71), with the *when* clause in preposed position.

(71) When dogs have three heads, they are lousy show dogs.

The problem with (71) on the relative clause analysis is that the former "head" of the relative clause appears inside the putative relative clause itself. Provided (72) would essentially be the source for (71), it would require some type of syntactic rule (without independent motivation) to accomplish the desired result.

(72) Dogs that have three heads are lousy show dogs.

In particular, it is impossible to place the *NP dogs* in (71) appropriately by the usual rule of quantifying in.

While the relative clause analysis appears at first sight to have a good deal to recomended it, there are serious syntactic and semantic shortcomings which call for its rejection. We now turn to an analysis which retains the favorable points of the relative clause analysis, yet avoids the problems noted and gives an account of these problems in a fairly natural way.

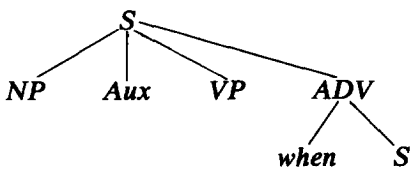
3.3. *A Revised Relative Clause Analysis*

Let us begin by summarizing the relevant characteristics of atemporal *when* which any adequate analysis must shed light on.

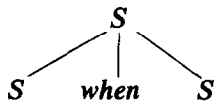
(a) The main clause must be interpreted generically.
(b) There must be an *NP* in the main clause of the appropriate sort – that is, an *NP* on the kind level.
(c) There must be a pronoun in the *when* clause anaphorically related to the appropriate *NP* in the main clause.
(d) The appropriate *NP* in the main clause must not have predicated of it a kind-level predicate (e.g. *widespread*).
(e) The *when* clause exhibits scope ambiguities.
(f) There is a strong paraphrase relation between the *when* clause and a relative clause if a bare plural *NP* is the appropriate *NP*, but not if that *NP* is quantified. Further, there is no syntactic evidence for the *when* clause being an underlying relative.
(g) The appropriate *NP* may appear in the *when* clause if it is proposed.

The revised analysis below will account for these characteristics, as well as others yet to be encountered.

Syntactically, *when* seems to form a constituent with the subordinate clause, and that constituent probably attaches to the main clause at the sentence level. This systactic configuration for atemporal *when* is illustrated below.



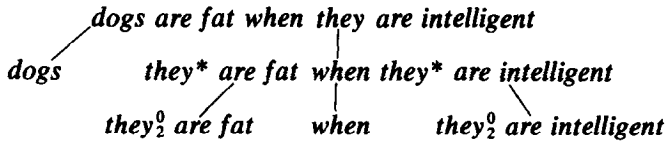
However, to simplify exposition of the semantics, we will treat *when* as if it syntactically conjoins two clauses, as illustrated.



Treating *when* in this manner will expedite presentation of its semantics without seriously affecting what a more "realistic" treatment would look like.

An informal description of the proposed analysis runs as follows. The *when* clause is to be treated semantically as a relative clause, though not derived from one in the syntax. It will be the relative clause of a new derived bare plural expression. The "head" of the relative clause will be the crucial kind-level *NP* in the main clause. The "head" and the "relative clause" will be combined by *when* to denote a new kind-level entity, much as the *CN bird* and the relative clause *they fly* combine as illustrated earlier to form an expression which denotes the (property set of the) kind *birds that fly*. The main clause contains the predicate which is attributed generically, via ***Gn***, to that new entity, ***Gn*** being introduced in effect as a part of the meaning of *when*. *When* finds an object-level free variable in the main clause and abstracts over it, making the main clause into a predicate which is generically attributed to the derived kind-level entity.

The actual workings of this analysis are illustrated by the following derivation of the sentence "dogs are fat when they are intelligent". A partial analysis tree indicates how the relevant portions of the sentence are combined.



The rule of syntax which combines the two clauses together with *when*, the first step illustrated above, is as follows.

S When: If ϕ, $\psi \in P_t$, then $F_{99,n}(\phi, \psi) \in P_{t/t/e}$ where $F_{99,n}(\phi, \psi) = \phi'$ *when* ψ', where ϕ' and ψ' are gotten from ϕ and ψ respectively by changing all occurrences of they$_n^0$ and them$_n^0$ to they* and them*, respectively.

We will discuss the relevance of the they* notation momentarily. The corresponding rule of translation (which will be loosely referred to as the translation of *when*) is as indicated.

T When: If ϕ translates as ϕ' and ψ translates as ψ', then $F_{99,n}(\phi, \psi)$

translates as:
$\lambda x^k \boldsymbol{Gn}(\hat{x}^0_n \phi')(\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow R(z^0, x^k)\ \&\ \lambda x^0_n \psi'(z^0)])$.

T When results in a predicate which denotes a set of kinds of things.[22] Applying this translation to the example above, prior to the addition of the *NP dogs*, the translation would be as follows:

$$\lambda x^k \boldsymbol{Gn}(\hat{x}^0_2\ \boldsymbol{Fat}'(x^0_2))(\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow R(z^0, x^k)\ \&\ \boldsymbol{Intell}'(z^0)]$$

(Here, as elsewhere, tense is ignored, transparent abbreviations are used, and much lambda-conversion has been carried out.) The *when* clause is now part of an expression denoting a kind-level entity (everything to the right of the definite descriptor), and the main clause has been formed into a predicate that is now generically attributed to that kind (the part to the left of ι). The whole expression is now a predicate that applies to kinds. Intuitively, it is a predicate that denotes the set of kinds of things which may serve as the head of the relative clause *that are intelligent* in the expression "____that are intelligent are fat".

We are now in a position to add the *NP dogs*. This is accomplished by the following rule.

SNP_W: If $\alpha \in P_{NP}$ and $\beta \in P_{t/IIe}$, then $F_{100}(\alpha, \beta) \in P_t$, where $F_{100}(\alpha, \beta) = \beta'$, where β' is gotten from β by replacing the first instance of they* or them* with α, and changing all subsequent occurrences of they* and them* to *they* and *them*, respectively.

The corresponding rule of translation is functional application.

TNP_W: If α translates as α', and β as β', then $F_{100}(\alpha, \beta)$ translates as $\alpha'(\hat{}\beta')$.

SNP_W will place the *NP dogs* in the analysis tree as indicated. The rule of translation will give us the following interpretation for the whole sentence (here, *d* abbreviates the full definite description which picks out the entity *dogs*).

$$\boldsymbol{Gn}(\hat{x}^0_2\ \boldsymbol{Fat}'(x^0_2))(\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow R(z^0, d)\ \&\ \boldsymbol{Intell}'(z^0)])$$

In this formula, the property of being generically fat is attributed to that kind of thing which has as all and only realizations on the object level that are dogs and are intelligent – dogs that are intelligent. This would appear to accurately reflect the semantics of the sentence we set out to analyze.

Before proceeding with further comments on the semantics, the

function of the * notation in the syntax requires explanation. The asterisk marks those pronouns, in an admittedly ad hoc manner, which correspond to those variables that are abstracted over in the semantics by application of T When. The kind-level *NP* is to eventually occupy the position of one of the pronouns that has been abstracted over, a position that could be anywhere in the sentence, and not just in subject position. The usual way of accomplishing this placement, by quantifying in, would give us incorrect semantic results. If we were to quantify in the *NP dogs*, we would have to semantically abstract over the free variable in the position quantified in to. However, in the translations given, the variable is no longer free at this juncture, but is bound by application of T When, and hence cannot be bound again. Even if we were to leave the variable free, the kind-level *NP* would then be replacing an object-level pronoun, and abstraction over the free variable would derive a predicate which would apply only to objects, and not to kinds. The result would be either falsehood in all cases, or else an undefined expression, depending on how one would choose to handle the matter. As we cannot achieve the correct results by quantifying in, we must resort to another syntactic device to place the appropriate *NP* correctly; thus the use of the asterisk. This allows replacement of an object-level pronoun with a kind-level *NP* without having to subsequently bind that pronoun in the semantics. I am currently not aware of any other places in the grammar a similar type of device is required, but even lacking this independent motivation, the sort of rule proposed appears quite essential in order to obtain the correct results in the semantics. On this basis it is presented as a genuinely new type of syntactic device required in the grammar.

Let us now examine this revised solution with some of the characteristics of atemporal *when* noted earlier in mind. If we were to present the translation of example (73) in detail, its final form would be as indicated below.

(73) Dogs that are intelligent are fat.
$\boldsymbol{Gn}(\hat{}\boldsymbol{Fat}')(\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow \boldsymbol{dog}'(z) \,\&\, \boldsymbol{Intell}'(z^0)]$.

Recalling there to be a logical equivalence between $\hat{}\boldsymbol{dog}'$ and $\hat{x}^0 R(x^0, d)$, and given the equivalence between $\hat{x}^0\ \boldsymbol{Fat}'(x^0)$ and $\hat{}\boldsymbol{Fat}'$, the translation of (73) is equivalent to the following.

$$\boldsymbol{Gn}(\hat{x}^0\ \boldsymbol{Fat}'(x^0))(\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow R(z^0, d) \,\&\, \boldsymbol{Intell}'(z^0)]).$$

But this is precisely the translation accorded example (74) as shown above.

(74) Dogs are fat when they are intelligent.

(73) and (74) under this analysis mean the same thing, as reflected in the translations accorded them. The *when* clause acts semantically like a relative clause, but it is not syntactically derived from one. This escapes the problems noted for the previous approach outlined in Section 3.2.

Given the rules outlined and assuming there to be a transformational rule of adverb preposing, we may easily show how the "head" of the "relative clause" may end up inside it. The *when* clause is moved to the front of the sentence prior to the placement of the appropriate *NP* (perhaps invoking a transformation here is not even necessary), making the leftmost occurrence of a pronoun marked with an asterisk a part of the subordinate clause. Rule SNP_W will then place the kind-level *NP* in the subordinate clause without special instruction. This results in a sentence such as (75).

(75) When dogs are intelligent, they are fat.

The stipulation that the predicate of the main clause be interpreted generically is provided for in this analysis as well, as generic attribution is here regarded (essentially) as being a part of the meaning of *when* itself (i.e. ***Gn***). If the main clause cannot, for whatever reason, have a generic reading associated with it, this will conflict with part of the meaning of atemporal *when*, and should not result in a possible atemporal reading. As observed earlier, this appears correct.

The requirement that there be an appropriate sort of *NP* in the main clause receives the following account. The crucial *NP* must be one that is capable of having object-level realizations. As object-level entities have only stages as realizations, and cannot have other objects as realizations, the translation of a sentence containing atemporal *when* would not be well-formed if an object-level *NP* were introduced by SNP_W. For instance, the translation that would have to be accorded (76) would have to be as indicated.

(76) John is fat when he is intelligent.
$\boldsymbol{Gn}(\hat{}\boldsymbol{Fat}')(\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow \textcircled{R(z^0, j)} \ \& \ \boldsymbol{Intell}'(z^0)])$

The portion circled is treated as undefined, as *j* denotes an object-level entity and thus cannot have other objects as its realizations. It is the wrong sort of thing. In this way, the translation of (76) indicates why it has no atemporal reading associated with it.

We can also provide something of an account as to why there must be a pronoun in the subordinate clause as well. If there were none, the

abstraction provided for in T When would be vacuous for the *when* clause, and we would arrive at a "relative clause" that has no relativized element (such as "the man that John saw Mary last week"). Whatever is wrong with relative clauses lacking a relativized element will also be what is wrong with an atemporal *when* clause that has no pronoun bound in the translation. Similarly, if the *when* clause is preposed, a pronoun must likewise appear in the matrix clause. (77) has only a temporal reading.

(77) When dogs are intelligent, John wears a beard.

If no pronoun is in the matrix clause to be bound by T When, no attribution at all is made to the derived kind-level *NP*, as the abstraction there, too, would then be vacuous.

Let us now turn to the question of why it is that (77a) is sensible, but (77b) is not.

(77a) Dogs that are intelligent are widespread.
(77b) Dogs are widespread when they are intelligent.

For brevity, let *id* stand for the kind of dogs that are intelligent (actually the definite description $\iota y^k \Box \forall z^0 [R(z^0, y^k) \leftrightarrow \textit{dog}'(z^0) \,\&\, \textit{Intelligent}'(z^0)]$, or any of its logical equivalents). As *widespread* is a predicate that applies just to kinds (that is, denotes a set of kinds at given points of reference), the translation of (77a) would be of the following form, by direct application of the subject-predicate rule.

(78) $\textit{Widespread}'(id)$

(77b), however, cannot be of this form in translation, as atemporal *when* is required to abstract over *object*-level variables in both the subordinate and matrix clauses. In (77b) the only possible position in the matrix clause for such a variable would be the subject of *widespread.* If (77b) were translated as specified in accordance with the rules outlined, (79) would be the outcome.

(79) $\textit{Gn}(\hat{x}^0[\textit{widespread}'(x^0)])(id)$

But *widespread* does not apply to objects, though here it must. The result is anomaly. We therefore have the same feeling about (77b) that we have about (80).

(80) Bob is widespread.

This seems correct. As a result, we cannot have any kind-level predi-

cates in the matrix clause attributed to the crucial *NP*. These predicates may not appear in the subordinate clause predicated of the required pronoun for the same reason.

So far, we have an account of all but two of the properties of atemporal *when* listed on page (37). One matter we have yet to examine is the ambiguity of (81a) vis-a-vis (81b).

(81a) Everyone believes that dogs are intelligent when they have blue eyes.

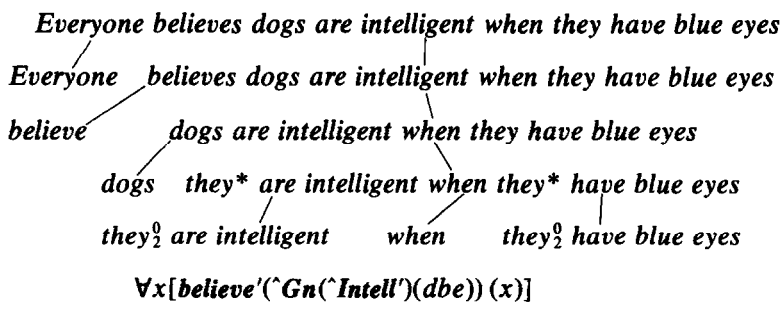
(81b) Everyone believes that dogs that have blue eyes are intelligent.

Bare plural *NP*'s are here treated as being proper names, in that they denote the same entity at all points of reference. Any potential ambiguity in (81b) would arise from quantifying in, but relative scope of quantification of proper names results in no corresponding difference in interpretation. Hence the lack of ambiguity in (81b). In rough form, (82a) and (82b) are equivalent in interpretation (here, *dbe* abbreviates the definite description of dogs that have blue eyes).

(82a) Everyone believes ($\hat{}$***Gn***($\hat{}$***intell'***)(*dbe*))

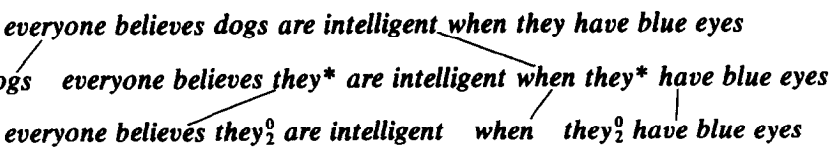
(82b) λx^k[everyone believes ($\hat{}$***Gn***($\hat{}$***intell'***)(x^k))](*dbe*)

(81a), on the other hand, exhibits a clear scope ambiguity. One reading, where the *when* clause is syntactically associated with the complement clause, is equivalent to the reading of (81b). The relevant parts of the syntax are illustrated, and an abbreviated form of the final translation appears below that.



This is the same interpretation rendered (81b).

But if the *when* clause is not introduced until the matrix sentence level in the syntax, the result is as follows.



The translation that results yield a predicate that is generically attributed to the kind *dbe*, as on the prior reading, but the predicate is different. Instead of ***Intell'*** being generically predicated of *dbe*, now it is the predicate $\lambda x^0 \forall y[\textit{believes}(\hat{}\textit{Intell}(x^0))(y)]$. Translation:

$$\textit{Gn}(\hat{x}^0 \forall y[\textit{bel}'(\hat{}\textit{Intell}'(x^0))])(\textit{dbe}).$$

It is the scope of the generic operator, and not the scope of the *NP* itself, which gives rise to the ambiguity of (81a). Depending upon whether the *when* clause is a constituent of the subordinate or the matrix clause, the scope of the generic operator in (81a) will either include the property of being intelligent, or else the property of being something that everyone believes is intelligent. These properties are quite distinct, and the two translations accorded the syntactically ambiguous (81a) have correspondingly different interpretations.

(81b) has no interpretation like the second one illustrated for (81a) as the ***Gn*** operator will combine syntactically only with verb phrases to form new verb phrases. The only *VP* that is attributed to dogs that have blue eyes in (81b) is the *VP (are) intelligent.* There is no *VP* of the form *believed by everyone to be intelligent.* However, if by application of the Passive transformation we do syntactically derive such a predicate, we can then (via the derived *VP rule*) generically attribute that to the kind *dbe.* Then, I believe, we *do* obtain a reading of (83) that is the same as the latter interpretation of (81a).

(83) Dogs that have blue eyes are believed by everyone to be intelligent.

In fact, (83) is ambiguous in the same way as (81a), though I am aware of a certain divergence of opinion on this matter.

As we see, then, the analysis proposed for atemporal *when* can quite naturally account for the ambiguity of (81a) as opposed to (81b). The scope of the introduction of *when* determines the scope of the generic operator.

It finally remains to be shown why there is a failure of a relative clause paraphrase if the crucial kind-denoting *NP* is a quantified *NP* and not a bare plural. The examples of (84) have synonymous readings, but the examples of (85) have none.

(84a) Dogs are expensive when they cannot bark (=)
(84b) Dogs that cannot bark are expensive.
(85a) One kind of dog is expensive when it cannot bark.
(85b) One kind of dog that cannot bark is expensive.[23]

It has been previously demonstrated that the translations of such examples as those in (84) will turn out equivalent. However, the translations of those in (85) will not. In the abstract, the reason for the relative clause paraphrase in the case of bare plurals is that atemporal *when* builds up an expression that is of exactly the same type as a bare plural expression. If the crucial *NP* is not semantically of the type of a bare plural, as is the case with any quantified *NP*, atemporal *when* will build up an expression of a type quite different from that quantified *NP*, and no paraphrase relation results. Let us look at an example to clarify these vague remarks. However, we must first present in brief the semantics of such an *NP* as "One kind of dog".

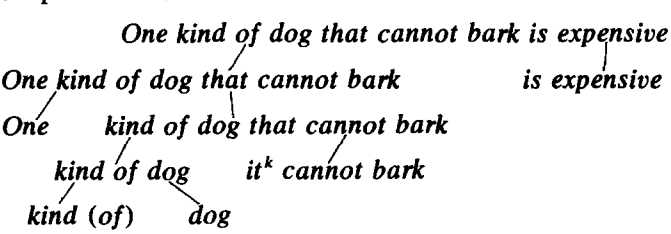
We take the word *kind* (like *type*, *sort*, and related words) to be a function that applies to intensions of *CN*'s to yield intensions of other *CN*'s. The *CN* serving as argument must denote a set of objects, but the resulting *CN* denotes a set of kinds. In this case, application of the word *kind* to the *CN dog* will yield the function which picks out the set of kinds of dogs.

In principle, the relative clause in the *CN kind of dog that cannot bark* may modify either the *CN dog*, or the *CN kind of dog*. If the modifier is an adjective, the position of the adjective resolves this ambiguity.

(86a) some *friendly* (kind of dog)
(86b) some kind of *friendly* (dog).

It seems that the most natural interpretation for the relative clause is the one where *kind of dog* is in its scope, which analysis we will adopt here. The "narrow-scope" reading will be ignored, as it will not affect our observations below; in any case the readings are, at most times, quite difficult to distinguish.

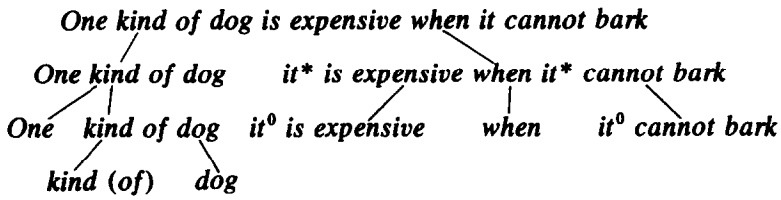
Let us first illustrate the translation that would be given (85b), where there is no instance of *when*. The quantifier *one* is here represented as a simple existential.



The translation would essentially boil down to three conjuncts.

$$\exists x^k[\textit{kind of dog}(x^k) \,\&\, \textit{Gn}(\hat{}\textit{cannot bark})\ (x^k) \,\&\, \textit{Gn}(\hat{}\textit{expensive})\ (x^k)].$$

Compare this result to the one obtained from the derivation for (85a), which exhibits atemporal *when*.



The translation is as follows:

$$\exists x^k[\textit{kind of dog}(x^k) \,\&\, \textit{Gn}(\hat{}\textit{expensive})\ (\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow R(z^0, x^k) \,\&\, \textit{cannot bark}\ (z^0)])$$

If we examine which entity great expense is attributed to in these examples we find there to be a great difference. This might be best illustrated by informally instantiating the existential quantifier in these translations. Let c be the kind collies; substituting c for x^k in these formulae, and removing the binding quantifier, we arrive at the following representations.

(a) $\textit{kind of dog}\ (c) \,\&\, \textit{Gn}(\hat{}\textit{cannot bark})\ (c) \,\&\, \textit{Gn}(\hat{}\textit{expensive})\ (c)$

(b) $\textit{kind of dog}\ (c) \,\&\, \textit{Gn}(\hat{}\textit{expensive})\ (\iota y^k \Box \forall z^0[R(z^0, y^k) \leftrightarrow R(z^0, c) \,\&\, \textit{cannot bark}\ (z^0)])$

In (a), it is asserted that collies cannot bark and that they are expensive. In (b), however, no such claims are made. Great expense in (b) is not attributed to collies, but to another entity, that entity being the kind all of whose realizations are collies and all of whose realizations cannot bark – collies that can't bark. It is quite clear that one could be true while the other false under the same set of circumstances, indicating these examples have quite different interpretations. The paraphrase relation that holds between relative clauses and *when* clauses is the result of treating bare plurals essentially as proper names, rather than as quantified *NP*'s which fail to give rise to such a paraphrase relation.

Before turning to the final problem at hand, that of adverbs of quantification, it is worthwhile pointing out some further consequences of the analysis which seem desirable. As we find in examining the translation associated with atemporal *when*, the operator *Gn* is added to a predicate that is formed by abstraction from a whole sentence. Unless

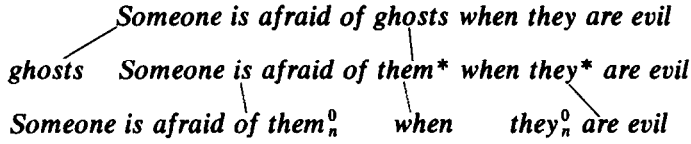
the variable abstracted over is in subject position, the intensional context created by ***Gn*** will include any *NP* that occupies the subject position. This makes the prediction that there should be a possible difference with respect to the examples of (87) concerning interaction of ***Gn*** and the quantifier in subject position.

(87a) Someone is afraid of ghosts that are evil.
(87b) Someone is afraid of ghosts when they are evil.

While (87b) has a reading in common with (87a), there is a reading for (87b) not present in (87a). This is the reading which asserts, roughly, that for most evil ghosts, there is someone or other who is afraid of that ghost. It need not be the same person fearing all the ghosts. I find this to be the most likely reading for (88).

(88) When ghosts are evil, someone hates them.

This reading would be obtained in the following manner. We here treat "be afraid of" as translating as a relation that holds between objects and individuals; *eg* abbreviates the definite description which picks out the kind *ghosts that are evil.*



Translation:

$$\textit{Gn}(\hat{x}\exists y^0[\textit{be-afraid-of}'\ (x)(y^0)])(eg)$$

The existential quantifier associated with the translation of *someone* appears here in the scope of ***Gn***. There is, of course, a reading represented by introduction of the existential outside the scope of ***Gn***, which would be the first reading mentioned.

For (87a), where there is no instance of atemporal *when*, there would be essentially one analysis tree, as the relative scope of quantification of the two *NP*'s makes no difference in interpretation; further, there is no need to introduce ***Gn*** into the translation given our suppositions about the type of relation *be afraid of* represents. Its translation would be as follows.

$$\exists x^0[\textit{be-afraid-of}'\ (eg)(x^0)].$$

There is here no possibility of the existential appearing in an intensional context, and there is no reading similar to the one illustrated above for (87b).

For those who feel that even the reading of (87b) represented by a wide-scope existential fails to perfectly paraphrase (87a), an examination of the analysis presented reveals a difference in interpretation is predicted. For my own part, it seems in (87b) that there is an acquaintance with particular ghosts imputed to the subject of the sentence in a way that is not implied in (87a). Let us choose another example that will illustrate this difference more clearly.

The predicate *(be) popular*, when predicated of a kind-level subject, appears at first to be a predicate that basically applies to kinds. Consider (89).

(89) Shirts that have brass buttons are popular (now in the midwest).

It does not appear that this implies that there must be any *particular* brass-buttoned shirts of which one could predicate popularity. Suppose we were to represent *popular* as being a predicate which, like *intelligent*, denoted a set of objects. (89) would then be represented roughly as follows:

$$\boldsymbol{Gn}(\hat{}\textit{popular})\ (\textit{shirts-with-brass-buttons})$$

This, then, by Q–MP2, should have something to do directly with a statement of the form:

$$\exists x^0[R(x^0,\ \textit{shirts-with-brass-buttons})\ \&\ \textit{popular}\ (x^0)]$$

However, as noted, the most natural reading of (89) seems to make no such claim. We would then best represent this as attributing popularity directly to the kind itself, without applying the generic operator:

$$\textit{popular}'\ (\textit{shirts-with-brass-buttons})$$

This treats *popular* as a predicate which, like *rare*, applies basically to kinds. However, in light of the well-formedness of examples such as (90), we must take *popular* as applying to objects as well.

(90) Senator Roberts is very popular.

There is no conflict here. We will simply represent *popular* as being an example of a predicate which applies to individuals, whether objects or kinds, but not to stages. (Other examples of predicates of this type include *interesting*, *famous*, *unknown*, and others of this sort.)

Let us examine the interpretation of (91).

(91) Shirts are popular (now in the midwest) when they have brass buttons.

Compare (91) and (89). (91) quite clearly leaves the impression that there must be some particular brass-buttoned shirts that are popular. As shirts are not the sort of things that one might normally ascribe popularity to on an individual basis, there is something seemingly strange about (91) which is not strange about (89). This is because the only interpretation (91) will receive would be the following.

$$Gn(\hat{x}^0[popular(x^0)])\ (shirts\text{-}with\text{-}brass\text{-}buttons)$$

Popularity here is ascribed to shirts via ***Gn***, which must be present in (91) as (91) contains atemporal *when*. We are not forced to use ***Gn*** in (89), as the predicate there could apply directly to the kind without use of ***Gn***.

This line of analysis is the one that would potentially account for differences that are also illustrated by the following pairs. While the exact analyses of (92)–(94) remain unclear to me, the examples point up the same type of difference as appears in (89) vs. (91).

(92a) Horses that pull carts were first tamed by the Assyrians.
(92b) Horses were first tamed by the Assyrians when they pull carts.
(93a) Birds that eat lions are unknown to me.
(93b) Birds are unknown to me when they eat lions.
(94a) I am sick of movies that depict overt acts of shoplifting.
(94b) I am sick of movies when they depict overt acts of shoplifting.

4. Adverbs of quantification

In Lewis (1975), a class of adverbs is discussed which, like *when*, exhibits both temporal and atemporal senses. Lewis argues quite convincingly that the italicized adverbs in the following types of sentences are to be analyzed in non-temporal terms.

(95a) Quadratic equations *usually* have two solutions.
(95b) A cat *never* has six legs.
(95c) Flags *sometimes* have stripes on them.
(95d) Even numbers *always* have an even square.

Lewis' conclusion is that the adverbs in (95)–on the most natural readings – are not quantifying over times, but rather over *cases*. Other adverbs that behave similarly are *frequently, often, mostly, once in a while, generally* and *normally* (the latter two seem to contain further material of a non-quantificational nature). The notion that the adverbs are quantifying

over cases arises from the intuition that in an example such as (95c), what is being asserted is that there are some cases of flags that bear stripes. Indeed, (95c) can be paraphrased by associating a quantifier with the subject *NP*.

(96) Some flags have stripes.

The remaining examples of (95) also appear amenable to such paraphrase.

(97a) Most quadratic equations have two solutions.
(97b) No cat has six legs.
(97c) All even numbers have even squares.

Lewis' analysis suggests that the adverbs of quantification simultaneously bind all free variables in a sentence they are operating on, the set of one or more free variables defining a set of cases, presumably the values that would satisfy the formula. He further suggests that an *if* clause, if present, can have the function of restricting the set of cases defined in the main clause. We will here present an analysis which differs from this in certain respects, but which is in basic agreement with Lewis' conclusions.

One of the striking parallelisms between the adverbs of quantification and atemporal *when* is that just those *NP*'s that allow an atemporal interpretation of *when* also give rise to atemporal interpretations of the adverbs of quantification. The examples of (98) have only temporal interpretations, while those of (99) can be interpretated atemporally.

(98a) John is always intelligent.
(98b) Some Irishman is sometimes tall.
(98c) All dogs never have seven eyes.
(99a) This type of person is always intelligent.
(99b) Irishmen are sometimes tall.
(99c) Dogs never have seven eyes.

In short, it appears that adverbs of quantification require kind-level *NP*'s as their subjects.

In addition, predicates that apply to kinds, such as *widespread*, do not allow quantificational readings for these adverbs, just as they disallow atemporal interpretations for *when*. (100) has only a temporal sense.

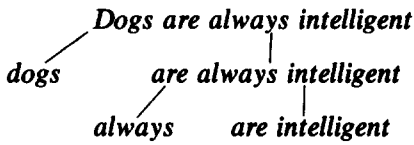
(100) Dogs are usually widespread.

Within the framework introduced here, we will represent the notion of a *case* as being an object-level realization of some kind. The adverb of quantification is then quantifying over these objects. Unlike Lewis'

account, we will here stipulate that there is only one *NP* "quantified over" per instance of an adverb of quantification, and that the *NP* may only be in subject position.[24] The adverbs of quantification are treated as verb phrase operators which create new verb phrases. Thus, the translation associated with atemporal *always* is as follows.

$$\lambda P \lambda x^k [\forall y^0 [R(y, x) \rightarrow {}^{\vee}P(y)]].$$

Though the syntactic rules necessary remain unstated, the derivation of an example sentence with atemporal *always* would proceed in the following manner.



Using *d* to abbreviate dogs, the resulting translation is:

$$\forall y^0 [R(y, d) \rightarrow \textit{Intelligent}'(y)]$$

Assuming we translate the *NP* "all dogs" as $\lambda P[\forall y^0 \textit{dog}'(y^0) \rightarrow {}^{\vee}P(y^0)]$, we can readily see that "dogs are always intelligent" and "all dogs are intelligent" are equivalent. The translation of "all dogs are intelligent" is as follows.

$$\forall y^0 [\textit{dog}'(y^0) \rightarrow \textit{Intelligent}'(y^0)]$$

As has already been established, this is equivalent to the immediately preceding formula.

It is assumed that there are parallel treatments available for the remaining adverbs of quantification, though it is not presently clear how to treat such expressions as *normally* and *generally*. In the main, however, we can effectively treat all these adverbs as predicate operators that map object-level predicates into kind-level predicates. This accounts for the nature of the subject *NP* required for atemporal interpretations, and for the impossibility of having kind-level predicates such as *widespread* co-occurring with an atemporal reading of an adverb.

The general treatment of the adverbs of quantification proposed here, as applying to object-level predicates to derive kind-level predicates, is precisely the same treatment accorded the generic operator ***Gn***. The adverbs of quantification, then, appear to function semantically and syntactically as if that class included the generic operator ***Gn***.

As both the adverbs of quantification and atemporal *when* create

kind-level predicates, one would expect that the adverbs of quantification and atemporal *when* would occur in mutually exclusive environments. However, this expectation is not borne out, as noted above in Section 3. All the examples below have simultaneous atemporal readings for both the adverbs and for *when*.

(101a) Dogs are always intelligent when they have blue eyes.
(101b) Numbers never have even squares when they are odd.
(101c) People are never orphans when their parents are alive.
(101d) One kind of animal is often tall when it has a diet consisting solely of dandelions.

It appears to me in these examples that the adverbs of quantification are quantifying over the object-level realizations of the kind derived by adding the *when* clause. Thus, a constituent of the meaning of (101a) is not something that has the interpretation of (102).

(102) Dogs are always intelligent.

The adverb is not quantifying over *dogs* alone. The semantics of (101a) appear much more like the semantics of (103).

(103) Dogs that have blue eyes are always intelligent.

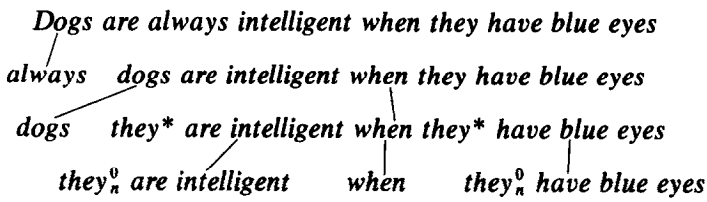
(104) also seems to paraphrase (101a).

(104) All dogs that have blue eyes are intelligent.

If we readjust the translation associated with atemporal *when* somewhat, we can account for the possibility of co-occurring adverbs of quantification. It was noted above that the adverbs of quantification under this treatment are of the same type as ***Gn***. In the previous section it was proposed that ***Gn*** is in effect a part of the meaning of atemporal *when*. This need not be so. By removing this element from the translation and leaving a "slot" for any adverb of this class to fill, we arrive at a translation for atemporal *when* that is a function from two propositions, a kind-level entity, *and* an adverb (to include ***Gn***) to truth values. Leaving a "slot" is accomplished by lambda abstraction over a free variable of the appropriate type occupying the position of ***Gn*** in the interpretation of *when*. Illustrated below is the resulting formula for what would be the translation of atemporal *when*. Adv_q is the semantic category of the adverbs of quantification and of ***Gn*** (i.e. $\langle\langle s\langle e^0, t\rangle\rangle, \langle e^k, t\rangle\rangle$).

$$\lambda p \lambda q \lambda x^k \lambda\, Adv_q[Adv_q(\hat{x}^0[\check{}q])(\iota y^k \Box \forall y^0[R(y^0, y^k) \leftrightarrow R(y^0, x^k)\ \&\ \lambda z^0[\check{}p](y^0)])]$$

Below is exhibited the semantics of the sentence "Dogs are always intelligent when they have blue eyes." Postponed briefly is mention of the syntactic rules involved.



Letting I be the translation of the object-level predicate *intelligent*, *HBE* stand for *have blue eyes*, and d be dogs, and making use of the interpretations accorded *when* and *always* above, we arrive at the following formula.

$$\forall z^0[R(z^0, \wedge x^k \Box \forall y^0[R(y^0, x^k) \leftrightarrow R(y^0, d) \,\&\, HBE\,(y^0)]) \rightarrow I(z^0)]$$

Roughly, this says that anything realizing the kind *dogs that have blue eyes* is intelligent. This would turn out equivalent to (103) and (104) were we to exhibit their interpretations.

Syntactically, this revised treatment requires that we adjust our categories in an appropriate fashion so the adverb of quantification is placed properly. Due to the ad hoc nature of such categories and rules (at least at the present), and given that the syntactic category is largely recoverable from the semantic type, we will present no new syntactic rules in this section. I do not disclaim responsibility for formulating these rules, however.

I wish to point out a couple of consequences of this amended treatment of *when*, and then we conclude with some general comments on the analysis presented.

Given this revised treatment of *when*, it follows that any adverb of quantification which appears in a sentence could not be added prior to the introduction of atemporal *when* if both operate on the same clause. This is because the *when* clause creates the kind quantified over by the adverb (the *when* clause restricts what is quantified over, just as Lewis observed concerning the function of *if* clauses). Prior to introducing *when*, an object-level variable was present where the kind-level *NP* appears, precluding adverbs of quantification. This consequence can be most clearly observed if we examine sentences of the sort discussed earlier, in which there is a scope ambiguity with respect to the *when* clause, as in (105).

(105) Everyone believes dogs are intelligent when they have blue eyes.

If our analysis is correct, we should not be able to interpret the *when* clause as being a constituent of the matrix sentence if we simultaneously have an adverb of quantification in the complement sentence. In (106) we see this expectation borne out; the only interpretation for *often* is temporal if *when* is interpreted atemporally.

(106) ?When dogs have blue eyes, everyone believes that they are often intelligent.

If the *when* clause is a constituent of the complement, an atemporal reading is possible for both *when* and *often* simultaneously.

(107) Everyone believes that, when dogs have blue eyes, they are often intelligent.

Since the adverb of quantification in the complement has to be added prior to the embedding of that complement under *believes*, it will have no kind-level *NP* operate on in (106) when it is added. In (107), however, it will.

In addition, the revised treatment of *when* affords us a means of accounting for the semantics of atemporal *whenever*, illustrated in (108).

(108a) Dogs are intelligent whenever they have blue eyes.
(108b) John hates cats whenever Mary likes them.

One of the characteristics of *whenever*, as opposed to simple *when*, is that it cannot co-occur with an adverb of quantification in the same clause. In the following examples, it is not possible to interpret both *whenever* and the adverb atemporally at the same time.

(109) Dogs are sometimes intelligent whenever they have blue eyes.
(109b) Numbers always have even squares whenever they are even.
(109c) Dogs are usually collies whenever they have long snouts and certain markings.

My intuition is that *-ever* behaves something like a universal quantifier. A sentence like (108a) seems to mean the same as an example like (110).

(110) All dogs that have blue eyes are intelligent.

We can quite naturally account for these facts by having built into the translation of *whenever* an adverb of quantification, "filling" the slot for an adverb left open in this revised treatment of *when*, which has the

properties of *always*. This makes it impossible to combine the expression with another adverb of quantification or *Gn*. The translation of *whenever* would be as follows: (t, u, v, w, x, y, z are type $\langle e \rangle$ variables)

$$\lambda p \lambda q \lambda x^k [\forall y^0 [R(y^0, \wr z^k \Box \forall w^0 [R(w^0, z^k) \leftrightarrow R(w^0, x^k) \\ \& \lambda u^0 [\check{p}](w^0))]] \rightarrow \lambda t^0 [\check{q}](y^0)].$$

Though the appropriate syntactic rules again are not explicitly presented, the ultimate translation of (108a) would be the following. Obvious abbreviations are used.

$$\forall y^0 [R(y^0, \wr z^k \Box \forall w^0 [R(w^0, z^k) \leftrightarrow R(w^0, d) \ \& \ HBE(w^0)]) \\ \rightarrow I(y^0)].$$

This says that anything that is a blue-eyed dog is intelligent. This analysis captures the semantics of (108a) and shows its relationship to (110) in a fairly straightforward manner.

5. Conclusion

The analysis of atemporal *when* presented here has offered an account of all relevant characteristics noted.[25] It has been shown how several notions derived from a study of generics and bare plurals are crucial to the analysis of *when* – the particular treatment of the bare plural as a name, the need for a generic operator, and the organization of entities into the subtypes of objects, stages, and kinds, and the subsequent taxonomy of predicates based on these subtypes. Through the use of these notions I believe a fairly good understanding of atemporal *when* has been uncovered.

This does not all come to us free, however, for there are questions raised by this analysis which have yet to be addressed, and the investigation of which may well lead to conclusions incompatible with those reached here.

One problem concerns the relationship between atemporal and temporal *when*, as well as the relationship between the temporal and atemporal senses of the adverbs of quantification. There is no syntactic justification I am aware of for the separation of these rather systematically into two distinct lexical items. One possibility which appears at first promising is that the systematic ambiguity of these items arises from a corresponding ambiguity in the realization function. Recall that kinds have realizations at two levels – objects and stages. Might we then not treat *when* in the following example as in essence quantifying over *stages* rather than objects, thus giving rise to its temporal reading?

(111) Dogs are mean when they are angry.

I believe such an analysis to be workable, but exactly how much is to be gained from this is in question, as *when* also appears with non-generic main clauses, without a corresponding pronoun in the subordinate clause, and seems to clearly call for an analysis which relates the events in time.

(112) John was a dentist when the war broke out.

If we are to work within the framework established here, it is quite clear to me that we would in the end still have to analyze at least some instances of *when* in a more or less standard temporal fashion.

Perhaps the whole question of the exact relationship between temporal and atemporal uses of *when* and the adverbs is best put in another light. The analysis presented rests upon our ability to make a distinction between what was assumed to be two different instances of *when*, a distinction that is not marked morphologically or syntactically in English. Our assumption that such a cleavage is viable is based in part on the ambiguity of an example like (113).

(113) Dinosaurs were regularly attacked by prehistoric insects when they were warm-blooded.

In (113), we may be speaking of a period of time in which dinosaurs were so plagued, or we may be explaining which dinosaurs were attacked. It is proposed here that the ambiguity of (113) arises from a lexical ambiguity having to do with the word *when*. At least two other lexical items – *if* and *unless* – would likewise have to receive similar schizoid analyses, which would be used to account for the ambiguities of (114).

(114) Dinosaurs were regularly attacked by prehistoric insects if/unless they were warm-blooded.

However, there remain other uses of *when* which do not appear to be strictly temporal in nature, but are quite clearly not accounted for by the analysis proposed here, nor any natural extension I can imagine. Consider the examples of (115).

(115a) Restaurants are bad places to eat when the head waiter is a greedy person.

(115b) My doctor refuses to operate when the patient is well into his nineties.

(115c) This arises when the subordinate clause would not be thought of as denoting an event.

(115d) When four is added to nine, the result is an odd number.
(115e) Hemingway is easiest to read when he speaks of adventure.
(115f) How can you even think that, when I have already proven that point of view wrong?

The examples of (115) would not be analyzed as containing atemporal *when*, nor do standard types of temporal analyses (such as Hornstein (1977)) shed much light on these, either. These example stand at the "middle ground" between temporal and atemporal *when*, and serve to obscure what may at first sight seem a fairly sharp distinction. If we are to distinguish atemporal *when* as we have done here, how many more instances of *when* must be distinguished? I do not know. Perhaps in the end no distinctions at all are required; perhaps a dozen.

That we can produce examples such as those of (115) does not indicate without controversy that a spurious distinction has been made. Nor does the fact that we must distinguish different senses of a word which, in some vague way at least, appear to be related to one another militate against the approach taken here. Both of these objections overlook the empirical nature of the inquiry. We cannot decide a priori that one approach is to be preferred to another (except in the intuitive sense that guides much of our research, often in a fruitless direction). Rather, careful analyses must be presented, and adequacy judged on those grounds; an esthetically pleasing analysis must in the end submit to considerations of adequacy in accounting for the data.

Both objections, too, overlook the usual dilemma that appears to be part and parcel with doing lexicography. How many instances of the English word *for* are there? Are all the following distinct?

(116a) I am *for* the Lions today.
(116b) What is this gizmo *for*?
(116c) This is *for* you.
(116d) John headed *for* the door.
(116e) Smith is in *for* (replacing) Jones.
(116f) He was here *for* the parade.
(116g) *For* us to go now is forbidden.

This list can be extended virtually at will. Similarly, the list of words for which a like array of uses can be produced can be extended virtually at will. Partitioning a lexical item for semantic analysis is, quite clearly, not a peculiarity of the analysis presented. In fact, it is quite standard procedure. The appropriateness of the partition depends upon what

understanding may be gained from its being made. My claim here is that much has been gained from looking at *when* in the way we have.

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NOTES

[1] I wish to thank Emmon Bach, Robin Cooper, Peter Culicover, Terence Parsons, Barbara Partee, and two anonymous reviewers for discussion and comments which contributed to the finished product. None are responsible for errors of fact or judgment, nor do any necessarily agree with my conclusions.

[2] One reviewer notes that analogous words in other languages behave similarly, so we are not dealing with some peculiarity of English, in spite of the fact that all data is English.

[3] Most *NP*'s like *this dog* may be interpreted as referring to a kind or type of dog. This reading is to be ignored unless it is expressly stated that it is the one we are interested in.

[4] Examples such as (13a) and (13c) are dealt with in Carlson (1978); (13b) lacks a generic reading because, I postulate, the singular indefinite must be turned into a plural indefinite in such contexts by syntactic rule. See Bennet (1978) for some discussion. Even if these reasons are not the correct reasons, the argument presented here is unaffected.

[5] I do not know if predicate nominal plurals are to be treated in this way. The definite singular generic ("the dog") also serves the purpose here attributed to the bare plural.

[6] I follow Bennett (1974) rather than Montague (1974) in treating *CN*'s and *IV*'s as denoting sets of entities, and not individual concepts.

[7] See Carlson (1978) for discussion of the inability of the singular indefinite generic to undergo such attribution, (e.g. *An owl is common).

[8] This, I believe, is the case even if the predicate nominal attributes something quite temporary (John is *a pain*). Though I couch matters in temporal terms, I do not wish to convey the impression that the stage/individual distinction in the predicates is based solely on temporal criteria; clearly other matters must come into play, though it is not evident to me what all relevant matters there are.

[9] A possible exception might be equative sentences such as (i) and (ii).

(i) Fido and Rover are my dogs.
(ii) ?Dogs are my dogs.

However, not just any *NP* may appear as subject of (i), either, even though it is on the object level. Indefinites seem to be forbidden, which may bear on the unacceptability of (ii).

(iii) ?Some dogs are my dogs.

[10] Nor "those dogs are widespread, these dogs are widespread..." Plurality seems not to be the key ingredient for an *NP* to have *widespread* predicated of it (unlike such predicates as "arrived together", "be similar", and other group predicates).

[11] Here, as elsewhere, the formulae are represented schematically in hopes of achieving heightened comprehensibility. We further imagine there to be appropriate rules of syntax and a model-theoretic interpretation for the formulae. Most of what is presupposed here is explicitly presented in Carlson (1978). Those portions that are not there presented are my responsibility, and I will and can provide explicit rules for what I leave unformalized in this paper.

[12] The opacity is an automatic consequence in the MG framework, where the intensions of the arguments are what is operated on by the function in all cases; extensionality must be explicitly stated as a result, and not intensionality. This, by the way, is one major reason why I choose to derive generics from stage-level predicates, rather than the other way around. If stage-level predicates were derived from generics, we would have to invent some operator which "extensionalized" a basically intensional verb, an operation I do not know to have any independent motivation in the semantics. "Intensionalizing" operators, however, abound.

[13] By this account, subject position of generics appears not to be an intensional context, a claim that contradicts the observations of many. I continue to hold that it is not, but that the apparent intensionality arises from failure to predicate something of stages. Further discussion may be found in Carlson (1978) Chap. 7, and Chap. 5.

[14] There may be some exceptions in such examples as "pennies in this jar" and "quarters I gave to bums yesterday".

[15] It has been pointed out to me that this stipulation is perhaps better made not as a meaning postulate, but as part of the meta-linguistic definition of an individual.

[16] One reader objects, as a much more accurate paraphrase is: "Wolves are intelligent *if* they have blue eyes". But what is the analysis of *this*? Doubtless, it is very nearly the same as the analysis of (37) (if not identical), and (37) is what we are trying to elucidate. The quantification is included in (40) because there is a familiar, ready analysis for it.

The observation does raise an important point, however, which I choose not to deal with at any length here, and that concerns the relationship that holds between *if* and *when*. The closeness of this relationship is evident in English, as well as in many other languages (e.g. Japanese and German). One strong hypothesis suggested to me is that in fact *when* is simply an alternative form of *if*. However, I do not believe this suggestion is at all tenable if interpreted in its most general form in light of such differences as illustrated below.

(i) I'd be happy if/*when I were just a bit richer.
(ii) John is willing to date Sally if/?when she is intelligent.
(iii) I will go if/?when you will go.

The contexts in which *when* would be an alternative form of *if* must receive a general characterization in order for this hypothesis to be tenable. It may even be fruitful to look at *if* being an alternative form of *when*.

However one may wish to go about characterizing the relationship, it is evident that there is a question of interest and importance here which has bearing on the conclusions arrived at in this paper.

[17] The restricted quantification implicit in (44) is necessary for a proper analysis of *most*. See Cushing (1976).

[18] Also previously noted and discussed by Dahl (1971).

[19] Note, by the way, that the predicate here is true of exactly as many cats as the predicate *have four legs* is true of. In addition, I do not believe that the repetition of the word *cats* can be held strictly accountable, as the example "Cats that have four legs are cats", though somewhat devoid of information, is not strange in the same way as (55b). What is wrong here remains a puzzle to me.

[20] The sentence "Dogs are expensive only when they are rare" seems to make sense. I believe that *rare* may have a use that predicates something of objects, though I have not been able to analyze it to my satisfaction (e.g. "John is a rare person"; cf: "John is a widespread person").

[21] An account of (64b) is proposed in Carlson (1978).

[22] This rule binds only one free variable in each clause. One referee objects that this rule precludes the possibility of examples where it appears more than one variable must be bound, as (i).

(i) *People* beat *donkeys* when *they* own *them*.

However, there are other sources for pronouns in *when* clauses than being bound by S When. See Cooper (1976) and Carlson (1978) for discussion. (i) simply has the semantics of (ii) or (iii), either of which, I believe, I can provide an account for.

(ii) People who own donkeys beat them.

(iii) People beat donkeys that they own.

[23] The word *kind* itself cannot be held accountable, for the same lack of paraphrase appears if the *NP* "One dog" is used on the meaning "one type or kind of dog".

[24] I mean to include the possibility of an underlying subject fulfilling this qualification to account for examples like:

(i) John is usually regarded by people (*cf*: by Joe) as a pain in the neck.

By limiting the *NP* quantified over to subject position, I am making the claim that *NP*'s in object position and other locations in the sentence are not quantified over. I believe there is no motivation for extending the domain beyond subject position, though it remains possible for future evidence to convince me otherwise.

[25] Some characteristics, of course, have not been accounted for under this analysis, such as its relationship to *if*. In addition, this analysis does not capture a seemingly causal relation between the clauses that has been pointed out to me. Compare:

(i) Country songs are popular when they are loud./Country songs that are loud are popular.

(ii) ?Country songs are loud when they are popular/Country songs that are popular are loud.

I see no reason in principle why these observations cannot be accommodated within the confines of the line of analysis pursued here, or a compatible extension. Whether or not this may be done in practice remains unresolved, of course.

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