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AN OUTLOOK ON GENERIC STATEMENTS

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Much of our knowledge of the world is "stored" or "represented" by such claims as:

1 a. Birds fly
  b. Professors are intelligent
  c. Dogs chase cats
  d. A swan mates for life

Such statements (amongst others) are called *generic statements*, and are judged true despite the existence (and knowledge of the existence) of exceptions or counterinstances. For whatever reason -- perhaps considerations of time, space, and ease or efficiency of storage, recall, and manipulation -- people tacitly know such claims as (1a-d) rather than longer, more complex statements that explicitly state the conditions under which exceptions might occur. And they explicitly espouse claims such as (1a-d) rather than the longer, more complex ones. At the same time, people nonetheless manage perfectly well to use these sorts of claims, assign truth values to them, and draw inferences from them, despite what might be thought to be logical shortcomings in them. In the realm of knowledge representation in computer science, there have been three strategies for implementing these abilities which people have in their manipulation of generic statements: (a) Default logic (b) Prototype theory (c) Modal logic. We will not attempt to discuss any of these approaches in detail, instead contenting ourselves with only the following observation: each of these theories takes generic sentences to have a simple "logical form", and locates instead the unusual features concerning exceptions, etc., in the underlying logic. For example, a default logic might assign

1 a´. $(\forall x)(Bird(x) \rightarrow Fly(x))$

as the "logical form" (= how it is to be represented) of (1a), but invoke some way of preventing the automatic inference from (1a´) and "Bird(fred)" to "Fly(fred)" -- for instance, should it also be known that "Emu(fred)", the inference would be blocked. This is done either by restricting Universal Instantiation -- so that from (1a´) we cannot infer "Bird(fred)→Fly(fred)", or by blocking Modus Ponens -- so that from "Bird(fred)→Fly(fred)" and "Bird(fred)" we cannot infer "Fly(fred)". These default logics, and non-monotonic logics generally, are fraught with logical and (especially) conceptual difficulties; and this should give us reason to investigate the other direction: that generic statements do *not* have this simple logical form, that it is considerably more complex, but the underlying logic is ordinary.

"Generic statements" is a category which includes a wide variety of different types of derived object predications, in which most of the relevant manifestations/instances of the kind manifest the property. Despite this similarity, we shall not consider such sentences, and instead will concentrate on those I-generics wherein the sentence can agguably be taken as predicating something of a kind -- as in (3a,b).

Within this group we can make various further distinctions. One important distinction is whether the "generic NP" is a bare plural as in (3b) or an indefinite singular as in (3a). It is our view that sentences with bare plurals always are to be taken as having reference to a kind, with that use of the bare plural. Thus sentence (3b) should have, in its logical form representation, some term that denotes the kind, cat. We remain agnostic on the ontological nature of kinds -- whether they are platonic entities or mathematical functions, to name two possibilities -- and instead use an operator, μ, which converts a predicate (such as **cat´**) into a name of the kind. μ(**cat´**), then, denotes the kind, cat, and it will show up in the logical form representation of (3b). On the other hand, sentence (3a) is to be treated quite differently. One might first note that it is ambiguous: one reading amounts to saying, of some cat or other, that it has the property of being (usually) intelligent, while the other reading amounts to saying that cats as a species (typically) have the property of being intelligent. The first reading is arguably a habitual statement about the cat in question, and we are not considering such statements; the second reading is generic, and is the reading in which we are interested. In this second, generic, reading of (3a) there is some temptation to say that the indefinite *a cat* functions like *cats* in (3b) -- as a name of μ(**cat´**). We wish to resist this temptation, and instead translate or represent it as an existentially quantified NP. Indeed, one of our goals is to be able to uniformly and compositionally translate *all* indefinite NPs as existentially quantified NPs; some, however, such as this second reading of (3a), will regain their generic import by having their logical form representation be evaluated in an unusual way.

Another distinction that one can make is whether the predicate in question is *episodic* or *non-episodic*. (We prefer this terminology to stative/non-stative. For central examples the two distinctions agree, but we think that there can be examples in which they do not.) For example:

5. Episodic
   a. Cats usually land on their feet
   b. A cat often scratches furniture
6. Non-episodic
   a. Cats are usually intelligent
   b. A cat likes catnip

In the episodic cases, the tendency or frequency of the occurrence of certain events or episodes --

statements. These types differ from one another in both their syntax and in their semantic import. We will not attempt to distinguish all these different types nor all the distinct understandings they might give rise to (for a survey, see Krifka (1987), whom we follow in the main); but on the other hand there are some which we definitely wish to *exclude* from consideration in this paper. One major cleavage we might notice is that between (what we call) *direct kind predications* and (what we call) *derived object predications*. Examples of each:

2. Direct kind predications:
   a. The dodo is extinct
   b. Humped-back whales are scarce
3. Derived object predications
   a. A cat is (usually) intelligent
   b. Cats land on their feet

On an intuitive level, direct kind predications make the claim that the *kind* (indicated by the subjects of (2a,b)) has a certain property -- being extinct, or being scarce. But there is no sense in which any individual instance of the kind has that property. On the other hand, derived object predications appear to do two things: they first predicate a property (being intelligent or landing on their feet) of a kind, and secondly they allow this property to "trickle down" to the instances of the kind (individual cats, in the (3a,b) examples). Alternatively, one could look at it in the reverse direction: a derived object predication gathers together a number of statements about individual objects having a certain property and expresses this by making an apparent predication to a kind. We shall not take a definite stand at this stage on which of these outlooks is correct, although it will be seen that our view favours the second way. For us, properties like being intelligent or landing on one's feet "really" apply only to individuals, and so their apparent application to kinds as in (3a,b) is to be explained as a kind of "shorthand". Further details will follow later.

In this work we will not consider further any direct kind predications, but instead will focus exclusively on derived object predications. To use the terminology of Krifka (1987), we will be interested solely in I-generics. Another type of statement, which is sometimes classed with I-generics, is *habituals* such as:

4. Habituals
   a. John smokes cigarettes
   b. John often eats a large breakfast

Here the subject is an ordinary individual, but some property is claimed to hold "at most (relevant) times" of this individual. Often this is put that most of the relevant time-slices or *stages* of the individual manifest the property; and this way of putting the matter makes such habituals resemble cat-foot-landings or cat-furniture-scratchings -- is being remarked upon, while in the non-episodic cases there are no events, but rather there is a state which is claimed to be frequent (amongst the reference class, cats) -- being intelligent or liking catnip. The episodic/non-episodic distinction plays an important role in various areas of formal semantics, and we shall show below that it is similarly important in the study of generics. One thing we might preliminarily remark upon here is that episodic predications involve events or episodes, and these happen over a (more-or-less) restricted, definite time; and therefore, even though it has not been explicitly mentioned, the time at which the event occurs is available for anaphoric reference, for finding an appropriate time at which to semantically evaluate other sentences, and for use in inferences involving "what occurred after what".

Yet another distinction that can be made within the class of I-generics is whether or not the statement has an explicit restrictive adverbial clause. By this we do not mean the occurrence or absence of frequency adverbials such as *usually* and the like (vide (3a)), but rather *if* and *when* clauses such as:

7. Restrictive Clauses
   a. When a cat drops to the ground, it usually lands on its feet
   b. Often, when cats have blue eyes, they are intelligent

Intuitively speaking, sentences like (7a) (which is episodic and therefore implicitly "mentions" events) tell us to consider all those events of a cat dropping to the ground, and to check the extent to which they are immediately followed by the event of that cat's landing on its feet. If this usually happens (or maybe: if it usually happens as a matter of nomic necessity), then the sentence is true; otherwise it is false. Our terminology for this is: look at the *reference ensemble* consisting of all the *situations* described by the restrictive clause and evaluate the truth of the main clause in the relevant situation. The frequency adverb (which may occur either in the main clause as in (7a) or as an explicit sentence modifier as in (7b)) then tells us what proportion or frequency is called for in order to make the entire sentence true. Still speaking intuitively, the interpretation of sentences like (7b) is similar but yet different from that of (7a). The difference is due to the fact that it is non-episodic, and therefore there are no events, no set of situations, described in the restrictive clause to "bundle up" and with which to evaluate the main clause. Rather, it creates, intuitively, a *reference ensemble of objects* by giving a restriction on the objects we are supposed to be considering: here, those cats that have blue eyes.

Once one decides to consider generics with explicit restrictive clauses, there is yet another pair of distinctions that can be made within them, one having to do with the relative order of the main and restrictive clauses and the other having to do with whether the pronoun is in the main clause or in the restrictive clause. The following examples illustrate the options:

8 a. When a cat falls to the ground, it lands on its feet. [restriction first, pronoun in main clause]
b. When it falls to the ground, a cat lands on its feet. [restriction first, pronoun in restriction]
c. A cat lands on its feet when it falls to the ground. [main clause first, pronoun in restriction]
d. *It lands on its feet when a cat falls to the ground. [main clause first, pronoun in main clause]

The (8d) option is ruled out by more general restrictions on anaphora. It should be noted that the same results are generated if the episodic predicate in (7) were replaced by a non-episodic predicate or if the indefinite singular were replaced by a bare plural (and suitable adjustment made to the number feature of the verbs and pronouns).

Summarizing then, we have indicated a variety of distinctions one might make within the class of generic statements. We are going to exclude direct kind predications and habituals from discussion, and concentrate on derived object predications. Within this subclass of generics, we have distinguished those that have: indefinite singulars vs. bare plurals, episodic vs. non-episodic predicates, and those that have restrictive clauses vs. those that don't. This gives us eight classes of generics of the sort in which we are interested. But furthermore, those which are modified by restrictive clauses can be further subdivided into: pronoun in main clause vs. in subordinate clause, and restrictive clause first vs. main clause first. A final remark is that if the main clause is first, the pronoun cannot occur in it. This yields 16 subtypes of generics of the sort in which we are interested. A classification tree might help keep them straight:

<< FIGURE 1 HERE >>

Typical examples of these 16 types are:

9. a. When a cat falls to the ground, it lands on its feet
b. When it falls to the ground, a cat lands on its feet
c. A cat lands on its feet when it falls to the ground
d. A cat lands on its feet
e. When a cat has blue eyes, it is intelligent
f. When it has blue eyes, a cat is intelligent
g. A cat is intelligent when it has blue eyes
h. A cat is intelligent

The remaining sentences, (9i-p) are generated from (9a-h) in order by replacing *a cat* by *cats*, *it* by *they*, *its* by *their*, and making the verbs be plural.

Our goal is to find a central one of these 16 types, give an explicit account of its syntax and semantics, and show how this account can be carried over and extended to the other 15 types -- with sentence, from clause to clause -- we continually "update" the context with which we are supposed to evaluate the next sentence or clause. The details are rather intricate, involving a simultaneous recursive definition of what it is for a sentence to be true in a context and how the truth or falsity of a sentence in a context alters the context to form a new one. These details can be found in the Appendix of Schubert and Pelletier (1988); here we merely say, as we go along, those portions which are relevant to the purposes at hand.

Two things at the outset should be remarked, however. First, the *context transformation function* that constructs a new context upon "processing" a sentence in an old context is a *function*. This means that there is a unique new context, generally indicated by a "resetting" of the values of (existentially quantified in the just-processed sentence) variables and by a specification of certain event times. Sometimes, however, for instance when we wish to consider *all* instances where a restrictive clause Φ is true, we will need to gather together the results of all the possible context transformation functions (that agree with the text up to that point), and consider what happens in most, or all, or some, etc., of them. For this purpose we invoke the notion of a *legitimate Φ-alternative*: a new context that could have been generated by *some* context transformation function from the old context in the "processing" of Φ. Intuitively, the legitimate Φ-alternatives are all the ways Φ might have been true (in the world under consideration) and thereby changed the context. We use $f(\Phi,i,w,[\![\ ]\!])$ to designate the set of contexts which are legitimate Φ-alternatives (legitimate, that is, from the point of view of the original context, and the time and world of evaluation; formal details can be found in Schubert & Pelletier 1988, Appendix). Secondly, in sentences with a restrictive clause, we use one of a family of "quantificational conditionals" to represent their logical form. These quantificational conditionals are each of the form $\rightarrow_B$, where B is one of "A", "U", "O", "S", "N", "G", standing respectively for *always, usually, often, sometimes, never,* and *generally*. The idea is that when there is such a frequency adverb either in the main clause or as an explicit sentence adverb, the relation between the restrictive clause and the main clause will be symbolized with the appropriate one of these conditionals, and when there is no explicit adverb we will use the "G" subscript. (As will be seen, we view the lack of explicit quantificational adverb as indicating a nomic, lawlike statement, rather than the "more statistical" statement with such an adverb.)

Our truth conditions for statements with quantificational conditionals is (B is any of our suitable modifications to the syntax and semantics. We cannot hope, in a short paper such as this, to adequately carry out this task. Instead, our goal here is to give some indications as to the formal machinery required, and to the problems encountered, in carrying this out. We will state our opinions at various places, and sometimes claim that other theorists are incorrect, without much justification. And we will present answers and proposed solutions with no consideration of alternative possible answers. In other words, we are giving an *outlook* on generic statements. The reader interested in further details is directed to Schubert & Pelletier (1987, 1988).

We choose as our central, starting type, generics with indefinite singular subjects in the restrictive clause (so, the pronoun is in the main clause), which is given first, and which uses an episodic VP. That is, we start with generics of type (9a) (which we repeat):

10 a. When a cat falls to the ground, it usually lands on its feet.

As we remarked above, such sentences (at least without the explicit adverb *usually*) are ambiguous between a generic and a non-generic reading. We presume that in the non-generic case, the *when*-Φ adverbial picks out a time interval at which Φ is true, and the sentence then asserts that the main clause happens "at the end of, or shortly after" that interval. The *it* of the main clause is "bound" to the occurrence of *a cat* in Φ in the following way. We envisage a procedure whereby the semantic rules of evaluation operate on a *sequence* of sentences, and within a sentence, on a sequence of clauses.

We start the text with a *context* in mind, which specifies such things as the extensions and intensions of predicates, the denotation of names, the values of indexicals, assignments of values to variables, and so on. The "processing" of each sentence (or clause) will successively alter this context in certain specified ways; one of these ways is to make available (for use in evaluating later sentences and clauses) a value which satisfies an existentially quantified NP, and which makes true the sentence or clause in which that NP occurred. Another way is to make available the time at which an event is said or presumed to take place. We use $[\![\ ]\!]$ to indicate a context; $[\![\Phi]\!]=1$ just in case Φ is true and is 0 otherwise; $[\![\ ]\!]^{i,w}$ is a context in which the values of the time parameter (i) and the world parameter (w) are made explicit. $[\![\ ]\!]_{x:d,i:r}$ is a context just like $[\![\ ]\!]$ except that the value of the variable *x* is made to be d and the value of the (time) variable *i* is made to be r. Finally, $\Phi[\![\ ]\!]$ is the new context which is "generated" from having "processed" (or evaluated) Φ in the initial context $[\![\ ]\!]$. So the picture is that as we go from sentence to sentence in the text -- and within a frequency adverbs except "G"):

$[\![\Phi \rightarrow_B \Psi]\!]^{i,w}=1$ iff for B-many of the $[\![\ ]\!]' \in f(\Phi,i,w,[\![\ ]\!])$, $[\![\Psi]\!]'^{i,w}=1$

$[\![\Phi \rightarrow_G \Psi]\!]^{i,w}=1$ iff for "most" $\langle w',[\![\ ]\!]'\rangle \in W \times C$ such that $[\![\ ]\!]' \in f(\Phi,i,w,[\![\ ]\!])$, $[\![\Psi]\!]'^{i,w'}=1$

(W is set of worlds, C of contexts, and "most" is to be interpreted in terms of some probability distribution favouring worlds w´similar to w with regard to the "inherent" or "essential" nature of things. We leave open exactly what this means; for comments see Schubert & Pelletier 1988.)

Let us now turn to our sentence (10a). Ignoring various fine points about tense, we would represent it as (we use restricted quantification in a standard manner):

10a´. $[\ (\exists x: C(x))D(x) \rightarrow_U L(x)\ ]$

Note that the consequent, L(x), has an unbound occurrence of *x*. Our proposed semantics treats this by evaluating L(x) *in the context generated from having evaluated the antecedent*, and in this antecedent, each time that it is true (that is, in each context for which there is a cat which drops to the ground) the modified context will contain that value of *x* which made it true. This value is then carried over to use in evaluating the consequent, and so the cat that drops to the ground which is used to satisfy the antecedent is used as value of *x* in the consequent to see whether it lands on its feet. As noted above, in the U-quantificational conditional, we do this for all contexts generated by evaluating the antecedent and determine whether most of them satisfy the consequent *each using its own value for x*. Similarly, evaluating of the antecedent supplies a value for a (hidden) time variable telling when the dropping took place; and the consequent is evaluated "at the end or shortly after" the interval indicated by this value.

As can be seen from this analysis, what is essential is (i) that there be a restrictive clause to evaluate prior to the evaluation of the main clause, (ii) that this clause contain an indefinite NP from which we get a value of the variable used in the consequent, (iii) that this restrictive clause occur prior to the main clause (so that it gets evaluated first), and (iv) that the VP in the restrictive clause be episodic so as to have an event time according to which to evaluate the main clause (if there were a non-episodic VP there would be no such time interval). The other 15 types of generic statements violate one or more of these conditions; and so it is now incumbent upon us to show how the indicated analysis can be carried over to them also.

The first way we will try to generalize this is by considering sentences of type (9i) -- those like (9a) except with bare plurals. For example:

10 i. When cats fall to the ground, they usually land on their feet.

Here we envisage a meaning postulate which relates episodic formulas about kinds to episodic formulas about *realizations* of those kinds (i.e., to objects); and then those realizations will be available as referents for anaphoric pronouns, such as the *they* in the consequent of (10i). Such a postulate is needed in any case to account for inter-sentential anaphora between sentences mentioning kinds and succeeding sentences that use pronouns like *they*. Our suggestion is:

(MPa) For P an episodic object-level predicate and k a kind,

$$\Box[P(k) \leftrightarrow (\exists x: R(x,k))P(x)]$$

where R is the "realization" relation between objects and kinds. Our translation of (10i) then is:

10i´. $D(\mu(\text{cat})) \rightarrow_U L(x)$

to which we apply (MPa) to the kind term, $\mu(\text{cat})$, and we get

10i´´. $(\exists x: R(x,(\mu(\text{cat})))D(x) \rightarrow_U L(x)$

which makes an existentially-quantified sentence available in the antecedent, and we can use the method outlined for (10a´) in its evaluation. Here we will find "realizations" of the kind, cat, which drop to the ground, and see whether most of them land on their feet.

We now consider sentences of the (9e) form -- non-episodics with indefinites -- such as:

10e. When a cat has blue eyes, it is usually intelligent.

We take its logical form to be akin to (10a´):

10e´. $(\exists x: C(x))H(x) \rightarrow_U I(x)$

where H: x has blue eyes. As indicated above, the problem here is to make sense of "most time intervals at which a cat has blue eyes" -- aren't there infinitely many of them? We note that the problem also arises already in clearly episodic habitual sentences such as *When John has a headache, he is usually irritable*. Here too there are infinitely many overlapping time intervals, even if there is (intuitively) just one headache-episode. The puzzle carries over to all episodic sentences. Our opinion is that what is called for is some method according to which we "order" these cases. For example, one might have in mind some systematic or random method of enumerating blue-eyed cats kept as pets (or encountered in one's experience, etc.) and determining the proportion of intelligent cats amongst those surveyed. We will not explore this, but rather simply assume that such phrases as "for most persons *x* and time intervals *i* such that *x* has a headache at time *i*" or "for most cats *x* and time intervals *i* such that *x* has blue eyes at *i*" *can* be explicated in a technically satisfactory way. On that assumption, the truth conditions of sentences like (10e) are identical to those episodic ones we have already considered.

Turning now to sentences of the form (9m), non-episodics with bare plurals in the restrictive clause, such as:

10m. When cats have blue eyes, they are usually intelligent

we find that (MPa) does not so readily apply as it did in our consideration of sentence (10i), since a non-episodic predicate like *have blue eyes* does not easily induce an existential reading on a bare plural subject.. However, perhaps we can bring it to bear indirectly. Consider the following puzzling phenomenon. In the (a) sentences of (11)-(13), no episodic interpretation seems available, yet a *when* clause can induce an (intuitively) episodic reading:

11 a. People are overweight
   b. When people are overweight, they often diet or exercise
12 a. Dogs have fleas
   b. When dogs have fleas, they should wear flea collars
13 a. Wisdom teeth are a nuisance
   b. When wisdom teeth are a nuisance, it is best to have them pulled

From a compositional semantics point of view, it should not be possible for one and the same clause to acquire a meaning in one syntactic context which it entirely lacks in another. Accordingly, we draw the conclusion that we are not dealing with instances of one and the same clause in the (a) and (b) sentences. It can be formally arranged so that there is opportunity for the insertion of an operator, say E, into the semantic representation of non-episodic sentences when they are embedded within a *when* clause. Thus we can arrange it so that the translation of (11a) is O(μ(person)) whereas the translation of the when clause is E(O(μ(person)). How does the presence of E help us? Suppose we assign a formal meaning to E which makes E(P) intuitively express something like "is/are exhibiting (enjoying, manifesting) the property of being P". The idea is that this should convert a non-episodic to an episodic predicate. Accordingly, the E-operator would allow us to apply (MPa) to exactly the same effect as in episodic *when* sentences with a bare plural in the *when* clause. All we need to stipulate is that (MPa) applies also to non-episodic predicates operated upon by E.

10m´. $[\ E(H(\mu(cat)) \rightarrow_U I(x)\ ]$

10m´´. $[\ (\exists x{:}\ R(x,\mu(cat)))E(H(x)) \rightarrow_U I(x)\ ]$

where (10m´) is the initial translation of (10m) and (10m´´) is the result of applying (MPa). Assuming that E(P) has the same truth conditions when applied to an *object* as P does, this translation quantifies over blue-eyed cats (cats enjoying the property of having blue eyes) as desired.

To handle cases where the pronoun is in the restrictive clause, we need to do something more radical. Consider (10b) for example

10b. When it drops to the ground, a cat usually lands on its feet

Obviously, the *it* of the antecedent should somehow refer to (instances of) *a cat* of the consequent. It will be recalled that our strategy before, when the pronoun was in the main clause, was to evaluate the restriction first and find the class of legitimate alternatives (by looking to the recursive truth conditions of the antecedent). But here it seems that we need already to look at the embedded parts of the truth conditions of the consequent in order to find a referent for *a cat*. (We emphasize "the embedded parts", since (a) we don't want to find a cat that has landed on its feet....but rather just a cat, and (b) there might be further embeddings such as the referent of *it* in *When it drops to the ground, the owner of a cat usually screams*, where we need to "look inside of" the subject phrase for a referent.) So our account needs to have some way of generating possible "semantic bindings" (values of variables) for the variables introduced into the logical form representation of the main clause. We then wish to use these possible values to restrict the alternative contexts (interpretations) which satisfy the restrictive clause; and then we wish to use the contexts generated from the restrictive clause to evaluate the consequent clause.

Here in (10b), we would like to use the possible values of the variable *x* (which was generated in translating *a cat* into the logical form language) to restrict the possible values of *it* in *it drops to the ground*, and then use these contexts to evaluate the main clause of (10b), seeing whether in most of these contexts the relevant cat lands on its feet at the relevant time. We use the term "legitimate anchorings" to designate the main clause bindings to be used in restricting *when* clause contexts. Legitimate anchorings are thus partial variable assignments whose domain is (a subset of) the variables existentially (or definitely, by *the*) quantified in the main clause, and which assign denotations that satisfy the NP which introduced those variables. Quantificational conditionals will have a third argument (besides the antecedent and consequent), namely the list of variables they "control", i.e. those variables over which iteration is to be considered. (We need this because it is possible that bindings might not be independently iterated for all main clause NPs (*a tree* in *A cat usually runs up a tree when a dog chases it*); and an NP may be within the scopes of several nested quantificational conditionals, any of which may control it (e.g., *If a person ocasionally contributes to a charity when he receives an appeal, he will usually receive further appeals*; here *a charity* may be controlled by *occasionally* or by *usually*, depending on whether *further appeals* is understood as *further appeals from charities* or as *further appeals from that charity*). So generally there can be more than one controlled variable. We will write the list of controlled variables as an argument to the subscript of the quantificational conditional, and will sometimes use $\underline{x}$ to indicate such a list of controlled variables.

Under this new plan, pronouns can no longer be translated simply as free variables, since the generation of alternative bindings in the antecedent requires that it appear as a quantified term. We therefore use such representations as (The x: neut(x)) for *it*, etc. Technically, legitimate anchorings are defined much the same way as legitimate Φ-alternatives, and the details need not detain us here; let us just use $g(\underline{x},\Psi,i,w,[\![\ ]\!])$ to indicate the class of legitimate anchorings of (the list of variables) $\underline{x}$ as occurring in Ψ, evaluated at i,w, in context $[\![\ ]\!]$. So, in evaluating, in the context $[\![\ ]\!]^{i,w}$, the new quantificational conditionals, in which the arrow's B-subscript is allowed to take a list of controlled variables, we wish to define a new class of relevant legitimate contexts. The members of this class are the contexts given by: (a) the legitimate antecedent alternative contexts, $[\![\ ]\!]'$, using the pronoun (which lets in a large number of contexts--any thing which could be referred to by *it* and which satisfy the rest of the antecedent), (b) plus those bindings of the variables indicated in B's subscript which are given by the legitimate anchoring function applied to the list, the consequent, and the previous context, (c) and then delete any of these which do not meet the condition that $[\![x]\!]'=g(x)$ for all $x \in \underline{x}$. So the truth conditions of a quantificational conditional statement would be:

$$[\![\Phi \rightarrow_{B(\underline{x})} \Psi]\!]^{i,w}=1 \text{ iff for all/most/many/some/no.. } [\![\ ]\!]' \text{ meeting conditions (a)-(c), } [\![\Psi]\!]'^{i,w}=1$$

That is, we find contexts which are legitimate Φ-alternatives, add further binding possibilities by looking at all the legitimate $\underline{x}$-anchorings within Ψ, and restrict our attention to just those wherein the Φ-alternatives' pronouns are replaced by an appropriate value given by the legitimate anchorings. We then say that the quantificational conditional is true iff B-many such contexts make the consequent true. We use the same stragegy to account for reference to times, either explicit or implict with episodic predicates. We will not further discuss this slight complication. Thus our sentence (10b) would be given a representation

10b′. $[\ (\text{The x: neut(x)})D(x) \rightarrow_{U(x)} (\exists x\text{: } C(x))L(x)\ ]$

and the semantic rules of evaluation would make this true in exactly the same cases that (10a′) is true, namely that in most contexts in which a cat drops to the ground it lands on its feet.

Bare plurals can be handled in much the same way as singular indefinites here. There is a slight notational problem, in trying to indicate which bare plural translations are controlled by which quantificational conditionals. One answer to this would be to use term subscripts, but we will use the somewhat *ad hoc* device of optionally changing a term like μ(cat) to the equivalent "quantified" term, (The x: x=μ(cat)). Then in the definition of legitimate anchorings, we say that when the embedding conditional controls x, an expression of the form (The x: Φ)Ψ, where Φ is kind-level will extend the anchorings for *x* to each d realizing the unique kind satisfying Φ. And now the account just given will, when taken in conjunction with the proposals for the sentences (10i) and (10m) also apply to (10j) and (10n). Thus for example, (10n) would be translated as

(10n′) $[\ (\text{The x: Plur(x))E(H)(x)} \rightarrow_{U(x)} (\text{The x: x=}\mu\text{(cat))I(x)}\ ]$

(wherein the representation of *they* is as indicated, in keeping with our requirement that pronouns must be given some quantificational treatment, and "co-referentiality" is a matter of "using the same (bound) variable". The strategy of legitimate anchorings and the operator E, together with application of (MPa) yields the correct reading for this.

For those restricted generics with the pronoun in the restriction but where the main clause is first (sentences (10c), (10g), (10k), (10o)), we envisage that the syntactic rules creating these structures will map them onto the same semantic representation as the rules which created those in which the restriction was first (sentences (10b), (10f), (10j), (10n)), and so we have no need for a different "pronoun resolution method" for those cases where the anaphor precedes the pronoun and for cases where the pronoun precedes the anaphor.

Of our 16 sentences, we are therefore left with those four that do not have a restrictive clause. It is our opinion that such generics are not "basic", and instead are to be evaluated with a "missing" or "suppressed" *when* clause; and it is our view that this missing clause is to be supplied somehow by a "pragmatic component" which can look at the previous discourse, at characterizing properties of the subject, at presuppositions associated with verbs and stress patterns, etc. Semantics is required only to find a place to put such a missing clause, not to know algorithmetically how to fill it. So in a sentence like (10d), *A cat usually lands on its feet*, normal context probably makes it be that the cats involved drop to the ground; but it could be that context has picked out some bizarre experiment wherein cats are being contrasted with dogs in some unusual way. But all we wish is to insist on from the semantic point of view is that it be translated as

(10d′) [$(\lambda\mathcal{P})\mathcal{P}$(The x: neut(x)) $\rightarrow_{U(x)}$ (∃x:C(x))L(x)]

where the $\mathcal{P}$ is some kind of "pragmatic variable" to be supplied. $\mathcal{P}$ normally has an occurrence of (The x: neut(x)) in it, corresponding to the pronoun *it*. Once $\mathcal{P}$ is supplied, the sentence is evaluated as before, with the pronoun in the restriction. A sentence like (10h) would be similarly translated, and evaluated in accordance with the method relevant to (10f). The sentences with bare plurals, (10l) and (10p) would be translated using the methods for (10j) and (10n). (10p), for example, becomes

(10p′) [$(\lambda\mathcal{P})\mathcal{P}$(The x: plur(x)) $\rightarrow_{U(x)}$ (The x: x=μ(cat))I(x)]

and once the "pragmatic variable" is replaced by a specific value, it is evaluated just like (10n′).

Thus ends our tale of I-generics. At places it may look complex, but no more so than the phenomena warrant, we believe. The general outlook presented here seems a satisfactory method of "unifying" all the apparently distinct semantic facts associated with I-generics. It will be noticed that some of the ideas here are similar to ideas of Heim and generally to those of Discourse Representation Theory, others to ideas of Krifka, ter Meulen, Chierchia, Carlson, Lønning, Link, Groenendijk and Stokhof. We thank them all for these ideas, and hope that this convergence of ideas from these different scholars shows both that progress has been made in this difficult area of formal semantics and that pursuing this general outlook further would be worthwhile.

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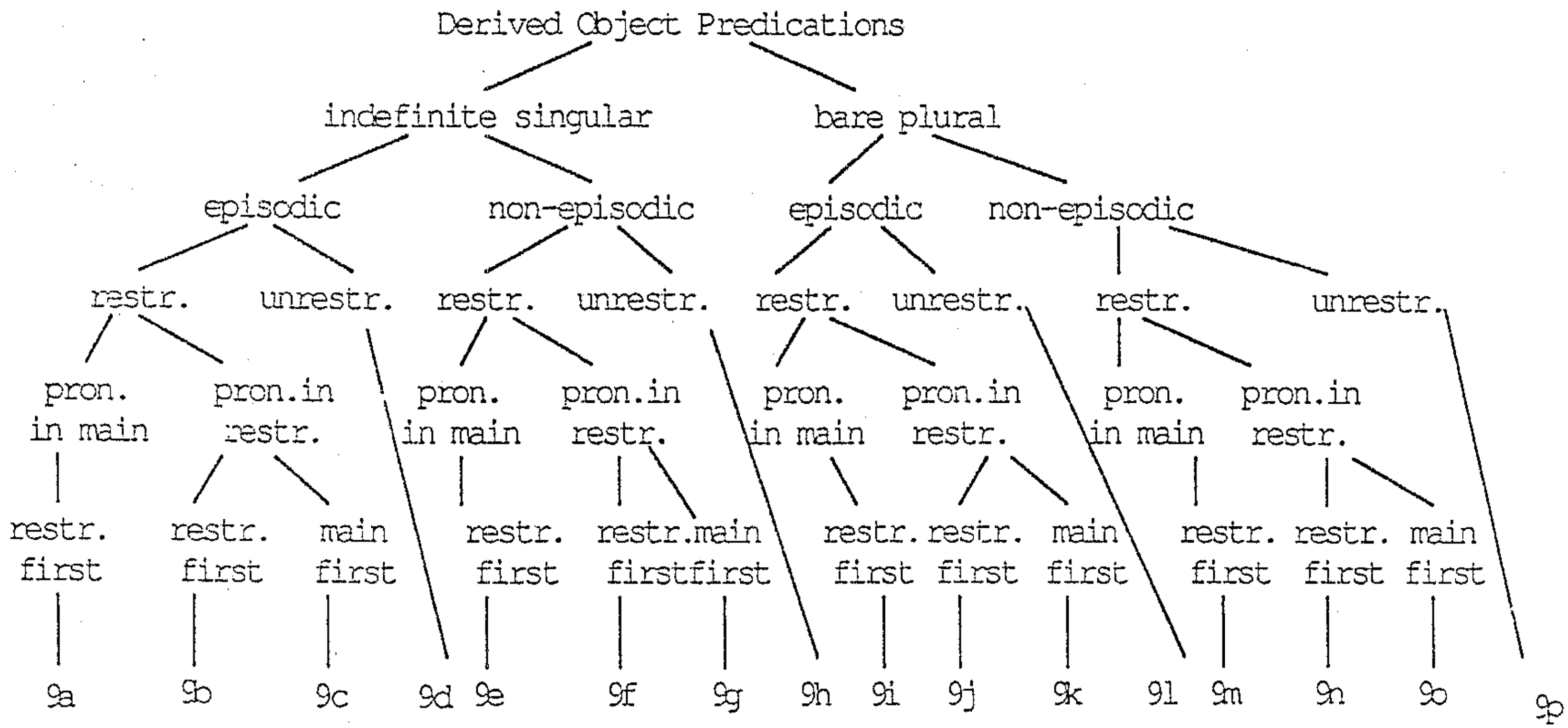

Fig. 1: Types of Derived Object Predications