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ANAPHORA AND DYNAMIC BINDING*

1. INTRODUCTION

It is widely held that what has come to be known as Discourse Representation Theory (DRT) has shed some interesting new light on our understanding of certain complicated anaphoric phenomena in natural language. In the present paper, I would like to address three important questions that to my mind have not found as of yet an adequate answer within that framework. I will first present these questions impressionistically. Later on in this introduction, I will discuss them at more length. They are the following:

(1)a. Are the truth conditions imputed to donkey sentences by standard DRT generally right?

b. It is arguably desirable to integrate the treatment of NP's within standard DRT with the theory of generalized quantifiers. How can we best do that?

c. Standard DRT gives rise to the so called "proportion problem". The literature swarms with "solutions" to it. Which is the best one?

By "standard DRT" I mean an approach that shares the following assumptions:

(2)a. Indefinites lack a quantificational force of their own. They are treated like variables.

b. Determiners like *every* and *most* are quantificational elements

* This paper evolves from one which was originally presented with the title "Anaphora and Dynamic Logic" at the 1989 Amsterdam Colloquium on Formal Semantics. Subsequently, it circulated as an ITLI prepublication and various versions of it have also been presented at the University of Edinburgh and at the University of Stuttgart. I am indebted to those audiences as well as to many other people for comments and criticisms. In particular, I am indebted to R. Cooper, P. Dekker, D. Dowty, J. Groenendijk, H. Kamp, N. Kadmon, M. Krifka, F. Landman, M. Rooth, M. Stokhof and two L&P referees. I. Heim's detailed and pointed criticisms were also extremely helpful to me. I know that problems and possibly errors are still likely to be there in spite of so much good advice and they are my fault alone. This research was partially supported by the *Dyana* project (EBRA 3715) and by NSF Grant n. BN55-9007804.

Linguistics and Philosophy **15**: 111–183, 1992.

and are unselective. They bind all variables free in their domain.

c. Adverbs of quantification like *always*, *often*, etc. are also unselective quantificational elements.

d. Quantificational elements create tripartite structures of the form Q [A][B], where A is the restriction of Q (or its left argument) and *b* is the (nuclear) scope of Q (or its right argument).

e. *If* and *when* clauses form the restriction of a (possibly null) adverb of quantification.

The joint effect of these assumptions is a notion of semantic scope ("accessibility") distinct from the notion of syntactic scope (based on C-command). This extended notion of binding enables one to analyse donkey pronouns as bound variables. A different strategy, stemming from the work of Cooper (1979), Evans (1980) and others has also been actively pursued in connection with donkey anaphora. According to it, donkey pronouns (and other kinds of discourse anaphora) are not bound variables but go proxy for descriptions whose content can be systematically retrieved from the context. Pronouns of this sort have come to be known as E-type pronouns.

To anticipate the main outcomes of the present work, it will be argued that a solution to the questions in (1) will lead us to abandon (2a) and (2b) and to qualify (2c). We will come to the conclusion that (a′) indefinites are existentially quantified terms, (b′) determiners like *every* bind just the argument of the head noun they are in construction with (as in the classical view), and (c′) adverbs of quantification are not "unselective" but "polyadic" (in a sense to be made precise). We will also propose a way of dealing with anaphora that integrates the extended binding of DRT with the E-type strategy.[1]

The questions in (1) are not only interesting in their own right but also because of the angle they provide on some very basic semantic issues. This can be appreciated most clearly by looking at the two main ways in which the assumptions in (2) have been implemented. The first way exploits construal rules. Surface structures are mapped into logical forms by a series of rules that move constituents, insert quantifiers, copy indices, etc. These rules create easy to interpret logical forms, for which straightforward Tarski-style satisfaction conditions are provided. A clear illustration of this first way of implementing standard DRT can be found in

[1] This is in the same spirit as Kratzer (1989b).

Heim (1982, Chapter 2). The second way exploits the idea that the meaning of a sentence is not just its content but its context change potential, namely the way in which a sentence can change the context in which it is uttered. The different behavior of indefinite NP's and quantificational elements is captured in terms of the different contribution they make to context changes. A clear illustration of this second way of implementing standard DRT can be found in Heim (1982, Chapter 3). I will refer to first perspective as "static", as it adopts the classical view of meaning as truth-conditional content, while I will refer to the second as "dynamic". On what I am calling the static approach, all the action (or most of it) takes place in the map from surface structure to logical form. On the dynamic approach all the action (or most of it) takes place in the way meanings are set up.[2] Choosing between these two perspectives is difficult. Two related questions that are at stake are the following. (i) Is choosing between the static and the dynamic perspective merely a matter of methodological taste? (ii) Assuming that there is a level of logical form at which scope and anaphoric links are explicitly represented, does it enhance our understanding of the properties of this level to add a set of construal rules that deal specifically with donkey anaphora? I will try to make a case for a negative answer to both of these questions and to argue there is something to be gained from "complicating the semantics" (i.e. viewing meaning more dynamically) over "complicating the syntax" (i.e. using rules of construal).[3]

In the rest of this section, I will flesh out more the questions in (1) and discuss their current status in DRT.

1.1. *Truth Conditions of Donkey Sentences*

Classical DRT follows Geach's recommendation in assigning to donkey sentences such as (3a) the truth conditions given in (3b):

(3) a. Every man that has a donkey beats it

b. $\text{Every}_{x,y}$ [x is a man $\wedge$ y is a donkey $\wedge$ x has y][x beats y]

(3b) is interpreted as a quantification over pairs: every x and y that satisfy

[2] The derivation of logical form is of course "dynamic", but in an obvious, uninteresting sense. Rules that derive a level of representation from another always change their input into something else. There is no need to look at donkey anaphora to learn this truism.

[3] My arguments expand those leveled by Heim (1982 Chap. 3) against Heim (1982, Chap. 2).

the restriction, satisfy the nuclear scope.[4] In this way, the indefinite *a donkey* gets universal force. While this seems to work well in many cases, the viability of this line of analysis for donkey sentences in general can be and has been challenged on (at least) two counts which are worth discussing in light of our current understanding of the problem.

A first question that can be asked is whether the pronoun *it* in (3a) carries a uniqueness presupposition. This issue has been taken up within DRT most extensively in Kadmon (1990), who argues that donkey pronouns do carry such a presupposition. According to her, (3a) tells us something only about men that have a unique (relevant) donkey. Heim (1982) had criticized this view on the basis of examples such as:

(4) Every man that bought a sage plant bought another five with it.

But Kadmon argues that there are principled reasons why uniqueness presuppositions are suspended in sage plant sentences. Informally, her idea is that (4) is appropriate in a context where it follows from the common ground that no one could have bought a single sage plant (because, for example, it is known that they were sold in half dozen cartons). In such contexts, it just won't matter which particular sage plant the pronoun *it* will denote. Any sage plant will do. This is what suspends the uniqueness presupposition: the choice of the value of the pronoun doesn't make a difference to truth-conditions.[5] If Kadmon is right then one could maintain that donkey pronouns are generally associated with a kind of uniqueness.

However, Heim (1990), building on a point made by Rooth, argues that Kadmon's approach runs into problems in connection with examples like:

(5) No father who has a teenage son lends him the car on weekends.

Here there clearly is no presupposition that we are talking about fathers who have just one son. So according to Kadmon, (5) should be felicitous only in contexts where the choice of a value for the pronoun *him* does not make a difference to truth-conditions. Yet, this does not seem to be so. If, for example, there is a father that has more than one teen age son and lends the car only to one of them, the sentence will come out as true

[4] The representations in (1b) can be understood either as the Heimian logical forms of her (1982, Chap. 2) or equivalently as linearized versions of Kamp's (1981) boxes.
[5] See Kadmon (1990, pp. 316 ff.) for details.

or false depending on which son we pick.[6] This is a context in which (5) can be uttered felicitously, contrary to Kadmon's claim. So if donkey pronouns were generally associated with uniqueness presuppositions, we would be left with no account as to why such presuppositions should be suspended in sentences like (5). While issues are more complicated than this, we have here enough of an argument to follow Heim (1990) and others in concluding that in donkey sentences like (3)–(5) there is no systematic uniqueness presupposition associated with pronouns.[7] Specific contexts may, of course, trigger one, as a purely pragmatic effect of more or less accidental properties of the context.

In conclusion, it seems that a Geachean analysis does stand up against the allegation of missing a systematic presupposition of uniqueness in donkey sentences. There is, however, a second order of considerations on the basis of which Geachean truth-conditions for donkey sentences can be challenged, that I think carries more weight. Consider the following examples:

(6) a. Every (most, etc.) person who has a credit card, will pay his bill with it (Cooper)

b. Every (most, etc.) person who has a dime will put it in the meter (Pelletier and Schubert 1989)

c. Every (most, etc.) person who has a hat will wear it to go to the stadium

It is intuitively clear that an analysis of any of the sentences in (6) along Geachean lines is just plainly untenable. For example, in the case of (6a) it would wrongly require that people pay with all of their credit cards. The right truth conditions of (6a) seems to be roughly the following:

(7) Every person who has a credit card will pay with one of his/her credit cards.

Here the indefinite *a credit card* appears to be clearly linked to the pronoun *it* while having existential force. Let us call the reading to which these

[6] See Heim (1982, pp. 142 ff.)

[7] Other researchers that have independently argued against the existence of strong uniqueness presuppositions in donkey sentences are Lappin (1989) and Neale (1991).

donkey sentences give rise to "∃-readings".[8] Let us use "∀-readings" for the Geach-style truth-conditions in (3b). The first relevant observation is that there are donkey sentences like (6) that do not naturally have, it would seem, a ∀-reading but do have a ∃-reading. The second relevant observation is that there are sentences that seem to allow both ∀-readings and ∃-readings. The classic (3a) is a case in point. The ∃-reading of (3a) can be made salient by imagining it uttered in the following context (pointed out to me by P. Casalegno):

(8) The farmers of Ithaca, N.Y. are stressed out. They fight constantly with each other. Eventually, they decide to go to the local psychotherapist. Her recommendation is that every farmer who has a donkey should beat it, and channel his/her aggressiveness in a way which, while still morally questionable, is arguably less dangerous from a social point of view. The farmers of Ithaca follow this recommendation and things indeed improve.

Sentence (3a) can be uttered truly in the context in (8), even if each farmer (a) does not beat all of his donkeys nor (b) there is a special donkey that each farmer beats all the times.

The third and final relevant fact in this connection is that there are sentences that seem to lack the ∃-reading. Heim gives the following example:

(9) Every man who owned a slave, owned its offspring

The existence of a single pair $\langle a,b \rangle$ such that *a* owns *b* but not *b*'s offspring seems sufficient to falsify (9). And it appears to be difficult to imagine a context where this wouldn't be sufficient, which suggests that the only natural reading of (9) is the ∀-reading.

So there are donkey sentences that naturally appear to have only the ∃-reading (like (6)), sentences that appear to have only the ∀-reading (namely (9)) and sentences that appear to have both (namely (3a)). The theory of anaphoric dependencies has to be brought in line with these facts. I am unable to detect any systematic factor that favours the presence

[8] It is worth noting that ∃-readings provide another instance of donkey anaphora that clearly lacks uniqueness presuppositions. This is so not only for singular indefinites, but also for plural ones. For example:

(a) Every man who has two quarters will put them in the meter

is not restricted to men who have just two quarters, nor requires people to put all of their pairs of quarters into the meter.

of one reading over the other. This is not to deny that some such factor may be eventually identified. However, elements that generally affect donkey sentences in other ways (such as genericity, or dealing with an individual-level vs. a stage-level predicate) do not appear to correlate in any systematic way with the availability of ∃-readings vs. ∀-readings, as far as I can tell.

Given this situation, perhaps the best one can do is to assume that ∃-readings and ∀-readings are both generally available, but certain sentences may strongly disfavour one of them due to specific properties of their meaning. This amounts to saying that, for example, a sentence like (9) does have a ∃-reading (in the sense that the grammar assigns such a reading to it). However, it follows from the common ground that the ∃-reading of (9) is false, and hence in processing (9) such a reading is automatically discarded. I think that this is comparable to what happens with the relative scope of quantifiers. For a sentence like "a student interviewed every professor", it is very hard or impossible to get the reading where *every professor* has wide scope over *a student* (in contrast with, e.g., "a mechanic inspected every plane"). Yet, at present our best bet remains to say that such a sentence does get both readings, as far as the grammar is concerned.

Be that as it may, it is a fact that the truth-conditions that classical DRT assigns to donkey sentences are inadequate for a significant class of cases. We are left with the question of how DRT should be modified so as to get ∃-readings of donkey sentences. The literature, with rare exceptions,[9] ignores ∃-readings. Yet they are there and do not seem to constitute in any way a marginal phenomenon.

1.2. *NP denotation*

In the theory of generalized quantifiers, NP denotations are analyzed as sets of sets. Some standard examples are the following:

(10) a. every man $\Rightarrow$ $\{X : MAN \subseteq X\}$ (where MAN is the set of men)
b. a man $\Rightarrow$ $\{X : MAN \cap X \neq \emptyset\}$
c. no man $\Rightarrow$ $\{X : MAN \cap X = \emptyset\}$

Many important empirical properties of NP's have been studied based on the predicament that they denote generalized quantifiers. A case in point

[9] An important one is Pelletier and Schubert (1989). The treatment I will propose owes much to that work. Also Kratzer (1989b) discusses ∃-readings. On Kratzer's approach, cf. Section 5.2. below.

is the discovery of conservativity as a universal characteristic of determiner meanings, where conservativity is defined as follows:[10]

(11) $D(X)(Y) \Leftrightarrow D(X)(X \wedge Y)$

I am assuming that (i) D maps sets into sets of sets, (ii) D(X)(Y) is semantically interpreted as $[\![Y]\!] \in [\![D(X)]\!]$ and (iii) ' $\wedge$ ' is interpreted here as set intersection. Another simple example of the fruitfulness of generalized quantifier theory is constituted by the analysis of NP coordination. If NP's are generalized quantifiers, a quite elegant analysis of coordinate structures such as those in (12) is available:

(12) a. Professor Jones, every student and a lecturer were present.
b. $[\![$Professor Jones$]\!] \cap [\![$every student$]\!] \cap [\![$a lecturer$]\!]$

The denotation of the complex subject in (12a) can be straightforwardly built up as shown in (12b). This fits well in a general analysis of the crosscategorial character of coordinating boolean operators that bypasses many of the problems that an account based on, for example, a transformation of conjunction reduction is faced with.[11]

How does this line of inquiry fit with DRT? It is not obvious. In DRT, indefinites are assimilated to free variables, while universally quantified NP's are split into two components. In an NP like *every man*, the common noun part contributes, essentially, a free variable, while the determiner is viewed as an unselective binder that binds not only the variable associated with the common noun but also other indefinites that the NP may contain. Now the very heart of the generalized quantifier approach is the idea that all NP's get (or can get) a uniform denotation. The question is whether this uniformity can be at all achieved within DRT. We can easily raise the type of NP denotations to that of sets of sets in simple cases. For example, *a man* could be analyzed as follows:

(13) a. $\{X : x \text{ is a man and } x \text{ is in } X\}$
b. $\lambda P[\text{man}(x) \wedge P(x)]$ (using Montague's IL)

The set term in (13a) (or (13b)) will denote a set of sets relative to a value

[10] See e.g. Barwise and Cooper (1981), Keenan and Stavi (1986). There are some alleged counterexamples to the conservativity universal. Some involve *only*, which however can be argued to be an adverbial element. Others involve certain readings of *many* and *few*. I am not convinced that such readings are really there. At any rate, even if such counterexamples turned out to be genuine, still there would be an overwhelmingly strong tendency for determiners to be conservative. Most universals in linguistics express general tendencies and scales of markedness rather than absolute constraints.
[11] See e.g. Gazdar (1980), Partee and Rooth (1983) or Keenan and Faltz (1985).

assignment to the free variable x which occurs in it. The problem comes when we try to do the same with universally quantified NP's:

(14) a. every man $\Rightarrow$ {P: for every x, if x is a man, then $x \in$ P}
b. every man who has a donkey $\Rightarrow$ {R: for every $\langle x, y\rangle$, if x is a man, y a donkey and x has y, then $\langle x, y\rangle \in$ R}
c. every man who lent a book to a student $\Rightarrow$ a set of 3-place relations

This example should illustrate clearly the nature of the problem. A universal NP will have to be a generalized quantifier of varying adicity, depending on how many indefinites occur free in its left argument. Now, it is not clear how to get this in an elegant way, but, more to the point, it wouldn't help us much with coordination. Consider:

(15) $[_{NP}$ $[_{NP}$ A woman] and $[_{NP}$ every man who has a donkey]]

Here we are coordinating an indefinite (which is a set of sets) with a universal NP (which is a set of 2-place relations, in this case). As they are of different types, our simple analysis in terms of generalized boolean operators is not available to us. So what do we do, assuming we don't want to go back to conjunction reduction?

I use coordination facts merely to illustrate what I take to be a general issue that DRT raises. There are some valuable insights that DRT has brought into focus. But in doing so, it has also backed away from some of the good things that basic Montague Grammar (of which generalized quantifier theory is a direct offspring) had given us. The question is whether we can regain those good things and integrate them with the insights of DRT. I believe that this is possible, in fact much headway has already been made,[12] and would like to defend a particular way of doing so.

1.3. *Proportions*

If we analyse *most* on a par with *every* as in DRT, we run into the proportion problem:

(16) a. most farmers that have donkey beat it
b. $\text{most}_{x,y}$ [man(x) $\wedge$ donkey (y) $\wedge$ x owns y][x beats y]

[12] See e.g. Rooth (1987), Pelletier and Schubert (1989) and Groenendijk and Stokhof (1990) and references therein. My proposals owes to all of this work and is specifically cast within a version of the system develop by Groenendijk and Stokhof.

The natural way to interpret the logical form in (16b) would be to say that it is true just in case most of the pairs that satisfy the antecedent, satisfy the consequent. But this yields the wrong truth-conditions. It would predict that (16a) is true in a situation with 9 farmers that own one donkey each and don't beat it and 1 farmer that owns 50 donkeys and beats them all. This is contrary to what our intuitions tell us.

The problem seems to stem from the fact that that *most* in (16b) is taken to quantify over pairs. As *most* is assumed to be an unselective binder, it quantifies symmetrically on all the variables free in its scope. In contrast with this prediction, (16a) seems to amount to a quantification over donkey owning farmers. I.e. *most* in (16a) appears to quantify asymmetrically over the variable that corresponds to the head noun.

Problems of a related nature also arise with conditionals. Consider:

(17) usually if a farmer owns a donkey, he beats it
$\Rightarrow$ most farmers that own a donkey beat it

It seems that on its most prominent reading, (17) would be false in the situation described in the previous paragraph. This suggests that (17)'s most prominent reading is one where we quantify asymmetrically over the subject.

There are interesting differences between relative clauses and if/when clauses with respect to this issue, differences which have been discussed widely in the literature.[13] In sentences like (16a) what one quantifies over is completely determined structurally by the head of the NP. (16a) just has no reading on which we count pairs rather than farmers.[14]
Things are different for if/when clauses. If/when clauses occupy the restriction of a (possibly null) adverb of quantification, but which of the indefinites occurring in them is actually being quantified over varies from case to case. Consider the following examples:

(18) a. If a painter lives in a village, it is usually pretty. (Kadmon)
$\Rightarrow$ most_x[x is a village that a painter lives in][x is pretty]

b. In this department when a student gives a paper to a professor, she expects her to comment on it promptly.

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[13] Useful discussions can be found in Kadmon (1990) and Heim (1990). See also the references therein.

[14] Barbara Partee pointed out to me the following as a possible counterexample:

(a) Most men who sighted a dog, called the police

This sentence gives the feeling that most sightings are followed by calls, and sightings involve man-dog pairs. Still I think that in a situation where 9 men sighting one dog each and do not call the police while 1 men sees 50 dogs and makes 50 calls, the sentence would be false.

$\Rightarrow$ most_{xyz}[student(x) $\wedge$ professor(y) $\wedge$ paper(z) $\wedge$ x gives z to y] [x expects y to comment on z promptly]

c. If a woman has a son with a man, she usually keeps in touch with him. (Heim)
$\Rightarrow$ most_{xy}[man(x) $\wedge$ woman(y) $\wedge$ x has a son with y][x keeps in touch with y]

The prominent reading of (18a) is one where we quantify over villages (i.e. the object), in that the sentence is not falsified by the existence of one ugly village inhabited by many painters. In (18b) we seem to quantify over student-teacher-paper triplets (i.e. all of the indefinites). Finally, on the preferred reading of (18c), we quantify over man-women pairs (not over woman-man-son triplets). In each case I give the logical forms that express the dominant reading. The reader ought to be able to construct suitable scenarios to test these intuitions.

The factor that seems to influence most directly which indefinites are selected by the adverb of quantification appears to be what the topic is, i.e. the theme-rheme structure of the discourse. Consider the following example:

(19) Dolphins are truly remarkable. When a trainer trains a dolphin, she usually makes it do incredible things.

Here we are talking about dolphins. Sentence (19) is true iff most dolphins that are properly trained do incredible things. The presence of a dumb dolphin that was trained by scores of trainers and fails to perform, doesn't make (19) false. Thus in (19) we are not quantifying over trainer-dolphin pairs or over trainers. See what happens, though, if we change the topic of the discourse.

(20) Trainers from here are absolutely remarkable with all sort of animals. For example, if a trainer from here trains a dolphin, she usually makes it do incredible things.

The relevant reading of (20) would be true iff most trainers from here that train a dolphin make it do wonderful things. The presence of a trainer who is unsuccessful with scores of dolphins wouldn't affect the truth of (20).

To summarize, the main observations about proportions seem to be the following. Quantificational determiners bind only the variable associated with their head nouns. The evaluation of a sentence containing an NP like *most men that own a donkey* requires counting donkey owning men, not man-donkey pairs. Adverbs of quantification restricted by a when/if clause are more flexible. They do not necessarily bind all of the indefinites in their restriction. Rather, they are free to associate with (i.e. directly bind) one or more or possibly all the indefinites present in their restriction. Which indefinites are selected by a quantificational adverbs is a function of theme/rheme structure. The indefinites that end up bound by the adverb constitute in some sense what the sentence is about, i.e. the theme or topic of discourse. Classical DRT does not predict this distribution of readings. It wrongly predicts (in fact, it is designed to predict) that every quantificational element (be it a determiner or an adverb) binds uniformly all the indefinites in its restriction. [15]

1.4. *The Plot*

In view of this situation, some objectives naturally present themselves. First, we should investigate how ∃-readings are to be obtained. Second, we should investigate how generalized quantifiers can be fit into the picture. And third we should get proportions right. My plan is the following. I will first present a minimal set of modifications of classical DRT that can meet these tasks. My proposal will employ construal and accomodation rules which are a straightforward modification of those proposed by Kadmon (1990). I will then indicate what I take to be some shortcomings of this approach. Having done that, I will develop an alternative which does away with construal rules in favour of a dynamic notion of meaning. My proposal is close to much work on dynamic semantics [16] but is most directly based on Groenendijk and Stokhof (1990). I will argue that this alternative doesn't suffer from the shortcomings of the previous approach. Finally, I will discuss how my proposal can be supplemented so as to obtain, next to ∃-readings, ∀-readings of donkey sentences.

2. Modifying DRT

Our initial strategy in pursuing the goals outlined in Section 1 will be quite conservative. We stick as much as possible to the assumptions of classical DRT. In particular, we maintain the view that quantification is basically unselective. Logical forms of the form $Q_{x_1}, \ldots, x_n[A][B]$ are going to be true if Q-many tuples $\langle u_1, \ldots, u_n\rangle$ that satisfy A (relative to an assign-

[15] These same conclusions concerning the facts are reached by Kadmon (1990), Heim (1990) and Krifka (1991), among others.

[16] See e.g. Heim (1982, Chap. 3), Rooth (1987), Pelletier and Schubert (1989), among others.

ment that maps x_1 into u_1 and ... x_n into u_n), also satisfy B. They correspond to the quantified molecular formulae of Heim (1982, ch. 2) and to boxes of the form $\boxed{\square \Rightarrow \square}$ of Kamp (1981). Logical forms of the form [A][B] (not headed by quantifiers) are going to be interpreted conjunctively. They correspond to the molecular cumulative formulae of Heim (1982, Chap. 2) and to conditions belonging to the same box of Kamp (1981). We will now proceed to modify the construal component of the theory adapting Kadmon (1990) to our tasks.

2.1. *A Kadmon-Style Approach*

Let us start by considering the case of quantificational determiners. The first step is to ensure that they only bind the variable associated with the head noun. To accomplish this, we will want to close existentially all other variables introduced by indefinites contained within the head noun. Accordingly, a sentence like (21a) will be mapped onto the logical form in (21b).

(21) a. most men that have a dime will put it in the meter
b. $\text{most}_x[\text{man}(x) \wedge \exists y[\text{dime}(y) \wedge x \text{ has } y]][x \text{ puts } y \text{ in the meter}]$

This guarantees that *most* quantifies asymmetrically over dime owning men. However, we now have to deal with the problem that the occurrence of y in the nuclear scope of the structure in (21b) remains unbound. To avoid that, we can assume (following again Kadmon) that the material existentially closed in the restriction is "accommodated" (i.e. copied into) the nuclear scope. So we get:

(22) $\text{most}_x[\text{man}(x) \wedge \exists y[\text{dime}(y) \wedge x \text{ has } y]]\ \exists y[\text{dime}(y) \wedge x \text{ puts } y \text{ in the meter}]$

The only difference between (22) and Kadmon's proposal is that Kadmon argues that the existentially closed variables in structures like (22) are associated with a uniqueness presupposition. We have seen that this view runs into problems. By dropping it, (21a) gets the desired $\exists$-reading.

Let us call the existential closure of the material in the restriction of a determiner "D(eterminer)-closure". A question that arises is whether D-closure applies uniformly to all determiners or only to the quantificational ones (i.e. *every*, *most*, *no*, etc.). Consider an example involving a non quantificational determiner, like:

(23) A man that had a dime put it in the meter.

If we apply D-closure to (23) and then accommodation, we get:

(24) $[\text{man}(x) \wedge \exists y[\text{dime}(y) \wedge x \text{ has } y]]\ \exists y[\text{dime}(y) \wedge x \text{ has } y \wedge x$ $\text{puts } y \text{ in the meter}]$

The x stays free and gets eventually existentially quantified by the text-level rule of existential closure (or some variant thereof). Alternatively, we can assume that indefinites are exempted from D-closure, which would mean that (23) gets mapped onto:

(25) $[\text{man}(x) \wedge \text{dime}(y) \wedge x \text{ has } y]\ [x \text{ puts } y \text{ in the meter}]$

Here both x and y remain free till the text level existential closure rule applies and there is no need to appeal to accommodation.

As far as examples like (23) are concerned, both of these approaches yield the same results. There are cases, however, which distinguish them. In particular, the view that D-closure applies to indefinites runs into problems in cases like the following:

(26) A man that has a house with a lawn must mow it regularly.

Here if we apply D-closure and then accommodate, we would get:

(27) a. $\text{man}(x) \wedge \underline{\exists y[\text{house}(y) \wedge \exists z[\text{lawn}(z) \wedge z \text{ belongs to } y]]} \wedge x$ $\text{mow } z$

b. $\text{man}(x) \wedge \exists y[\text{house}(y) \wedge \exists z[\text{lawn}(z) \wedge z \text{ belongs to } y]] \wedge$ $\exists y[\text{house}(y) \wedge \exists z[\text{lawn}(z) \wedge z \text{ belongs to } y] \wedge x \text{ mow } z]$

Formula (27a) represents the preaccommodation stage. The innermost brackets in (27a) are created by an application of D-closure to the embedded NP *a house with a lawn*, while the outermost by an application of D-closure to the higher NP *a man that has a house with a lawn*. We then accommodate, by copying the underlined material and obtain (27b). The problem here is that the last occurence of z in (27b) would remain unbound in spite of accommodation.[17] This strongly suggests that indefinites must be exempted from D-closure.

So the line on determiners that we are lead to follow is that quantifi-

[17] One referee points out that a formula truth-conditionally equivalent to (27a) where $\exists z$ is moved to the immediate left of $\exists y$ would give the right result. But accommodation as a syntactic copying process is sensitive to the syntactic shape of formulae, not to their truth-conditional content. And so to get the desired results we would actually need a rule that raises $\exists z$ to the relevant site. In other words, $\exists y\ [\text{house}(y) \wedge \exists z[\text{lawn}(z) \wedge z \text{ belongs to } y]]$ and $\exists y \exists z\ [\text{house}(y) \wedge \text{lawn}(z) \wedge z \text{ belongs to } y]$ while truth-conditionally equivalent turn out to have different binding potentials, once embedded in this syntactic view of how logical forms are manipulated.

cational determiners undergo an obligatory rule of D-closure, followed by accommodation of the material within the domain of D-closure. Indefinites, however, must be prevented from undergoing D-closure.

Let us turn now to the case of if/when clauses, for which a more flexible approach is needed. Essentially, we want to be able to close the indefinites that are not selected as topics. Consider for example (18a) above, repeated here as (28):

(28) If a painter lives in a village, it is usually pretty

Here we want to existentially close the NP *a painter*. In order to do so, we must assign to *a village* wider scope so as to get:

(29) $\text{usually}_x[\text{village}(x) \wedge \exists y[\text{painter}(y) \wedge y \text{ lives in } x]][x \text{ is pretty}]$

Let us call this kind of existential closure A(dverbial) closure, for lack of a better name. A-closure is related to D-closure but distinct from it, as it applies in different environments and is optional, while D-closure is obligatory. If no indefinite undergoes A-closure, we get a completely symmetric reading (correponding to the case quantification of Lewis (1975)). Also if a pronoun in the scope of the adverbs refers to an indefinite which has undergone A-closure, we will have to resort to accommodation. I refer to Kadmon (1990) and Heim (1990) for discussion of such cases.

So to summarize, we have posited a rule of D-closure that applies obligatorily to quantificational determiners (and only to quantificational determiners) and a rule of A-closure that applies optionally to (any number of) indefinites within an if/when close. Moreover, we avail ourself of accommodation whenever we need to link a pronoun to an existentially closed indefinite.

We now only need to note that it is straightforward, in fact trivial to tack onto this theory an interpretation of NP's as generalized quantifiers. Consider for example (22), repeated here:

(22) $\text{most}_x[\text{man}(x) \wedge \exists y[\text{dime}(y) \wedge x \text{ has } y]]\exists y[\text{dime}(y) \wedge x \text{ puts } y \text{ in the meter}]$

Interpreting *most* plus its restriction as a generalized quantifier (i.e. a set of sets) is easy. Assume, for example the following standard analysis of *most*:

(30) $\text{most }(A)(B) = 1 \text{ iff } |A \cap B| > |A \cap B^{-}|$
(where, for any set A, $|A|$ is the cardinality of A and A^{-} is the complement of A)

Most in (22) can be interpreted as in (30) and its left and right arguments are interpreted in the obvious way, namely:

(31) a. $A = \{u : [\![[\text{man}(x) \wedge \exists y[\text{dime}(y) \wedge x \text{ has } y]]]\!]^{x/u} = 1\}$
b. $B = \{u : [\![\exists y[\text{dime}(y) \wedge x \text{ puts } y \text{ in the meter}]]\!]^{x/u} = 1\}$

This works quite generally for every NP, including indefinites. For example the portion of (25) corresponding to the subject, repeated here, can be interpreted as shown:

(32) a man that has a dime $\Rightarrow \{A : [\![\text{man}(x) \wedge \text{dime}(y) \wedge x \text{ has } y]\!]^g = 1 \text{ and } g(x) \in A\}$

The set in (32) is well defined, relative to an assignment g. So on the present modified version of DRT, all NP's end up having a uniform type and we can, thus, adopt a simple theory of NP-conjunction. We do not run into the difficulty illustrated in (14) above, which was generated by the assumption that determiners were unselective. On the present approach, while binders are underlyingly, so to speak, unselective, the construal rules make sure that determiners always end up binding just one variable (effectively eliminating their unselective character) and thus they can all be interpreted as monadic quantifiers. Accomodation ensures that anaphora works out right.

So with Kadmon's help, we have met our goals by modifying rather minimally the basic DR-theoretic framework. We now can obtain $\exists$-readings in a way that gets proportions right. And, as an extra bonus, princess DRT can get married with prince Generalized Quantifier and live happily ever after. As much as I like happy endings, I am afraid I must play devil's advocate and invite the interested parties to consider some problematic premises of this union.

2.2. *Problems*

I see essentially two difficulties with the line pursued in the previous section. The first is of a conceptual nature. The other has, instead, empirical consequences.

2.2.1. *Conceptual Issues*

The conceptual worries that the approach of Section 2.1 gives rise to are easy to state. The first stems from the observation that we had to employ obligatory construal rules (like D-closure) that apply selectively to some determiners (the quantificational ones). All recent developments within linguistic theory are united in striving to eliminate obligatory, construction specific transformations. Yet it is not clear at this point how to dispense with D-closure on independently motivated syntactic grounds. A natural route to explore would be to build D-closure as part of the lexical meaning of the relevant determiners. But it is hard to see how to do that (and get the facts right) if we stick to the simple Tarski-style semantics that we are adopting.

A second consideration has to do with the fact that the approach of Section 2.1. relies heavily on accommodation (viewed, again, as a copying rule on logical forms). It seems plausible to maintain that accommodation, which involves additional operations besides standard interpretive rules, should come at a cost. Consider for example the way in which the descriptive content of a definite is typically accommodated. Imagine you are talking to a couple of who you don't know whether they have children or not. At some point during the conversation they say something like "Our children will visit us soon". You then infer that they have children and accommodate that information in the common ground. There is a clear intuition in this case that an inferential process, however fast and semi-conscious, is taking place. Contrast this with the interpretation of the pronoun *it* in "most farmers that have a donkey beat it". Here the claim is that a similar inferential process, triggered by the intention to be able to interpret the pronoun, should be taking place. But this is not confirmed by our intuitions at all. The anaphoric dependencies under consideration appear to be totally unmarked and easy to interpret.

2.2.2. *A Wrong Prediction.*

Consider the contrast in (33):

(33) a. Most farmer that have a donkey$_i$ beat it$_i$

b. *Most farmer that don't have a donkey$_i$ want to have it$_i$

Sentences (33a) and (33b) differ only in virtue of the presence of negation. According to the assumptions we are making their logical form, before accommodation, would respectively be:

(34) a. $\text{most}_x[\text{former}(x) \wedge \exists y[\text{donkey}(y) \wedge x \text{ has } y]][x \text{ wants to have } y]$

b. $\text{most}_x[\text{farmer}(x) \wedge \neg\exists y[\text{donkey}(y) \wedge x \text{ has } y]][x \text{ wants to have } y]$

Accommodation should then apply uniformly to (34a) and (34b), as they are structurally parallel. In both cases, accommodation is motivated by the need to find an antecedent for the rightmost occurrence of y, which interprets the pronoun *it*. If accommodation applies to (34b) in the usual manner copying the existentially closed material onto the nuclear scope of *most*, we get either (35a) or (35b), depending on whether we include negation or not:

(35) a. $\text{most}_x[\text{farmer}(x) \wedge \neg\exists_y[\text{donkey}(y) \wedge x \text{ has } y]]$
$\neg\exists_y[\text{donkey}(y) \wedge x \text{ has } y \wedge x \text{ wants to have } y]$
a′. Most farmers that don't have a donkey don't want one
b. $\text{most}_x\ [\text{farmer}(x) \wedge \neg\exists y[\text{donkey}(y) \wedge x \text{ has } y]]$
$\exists y[\text{donkey}(y) \wedge x \text{ has } y \wedge x \text{ wants to have } y]$
b′. Most farmers that don't have a donkey have a donkey they want to have

In either case, we get the wrong result. (35a) has the same truth-conditions as (35a′) and (35b) as (35b′). So the present theory predicts that (33b) should be either synonymous with (35a′) or with (35b′), contrary to fact.

It is of course possible to add a further stipulation that blocks accommodation in the presence of negation. But one would be left totally in the dark as to why this should be so. In standard DRT, one would say that indefinites, being variable-like, are inherently open while negation, being an operator, closes existentially all the variables free in its scope, making them unavailable for subsequent reference. But in the variant of DRT we were lead to adopt this account is no longer available to us. Indefinites in the restriction of a quantificational determiner are existentially closed and in this respect (33a) and (33b) become fully parallel.

The point is not limited to negation but to other quantificational determiners as well:

(36) a. *Most farmers that have no donkey$_i$ want to have it$_i$
b. *Most farmers that have every donkey$_i$ beat it$_i$

Accommodation should be blocked in these cases, but we cannot justify this blockage in terms of accessibility considerations, since plain indefinites are equally unaccessible to the pronoun in these structures.

I think that this is a general problem with many current attempts to extend accommodation from presuppositions to anaphora resolution.[18] Presupposition accommodation is not problem free, but its rationale and modus operandi have a certain amount of plausibility. With pronouns, the accommodation strategy boils generally down to making accessible something that structurally is not. It is quite difficult to see why this

[18] Cf. Heim (1990), Roberts (1987), Kadmon (1990).

process should apply in certain environments but not others, which runs the risk of voiding the theory of any predictive power.

2.3. *A Second Attempt*[19]

There are several variants of the theory of Section 2.1. that one can try to get around the empirical problems that I have illustrated. In particular, in the approach we have sketched existential closure precedes accommodation. One might try stipulating the opposite, namely that accommodation precedes existential closure. Let us illustrate how (33a) would work out, if we adopt this variant. We start out with an intermediate logical form of the following sort:

(37) most [farmers$_i$ that t_i have a donkey$_j$] [t_i beat it$_j$]

Here, the first occurence of t_i is the trace of the relative clause operator, the second occurence of t_i is the trace of the subject that has been scoped out. The brackets mark the restriction and the scope of *most*, respectively. At this point, we accommodate (= copy) the material in the restriction (perhaps leaving the head *farmers* behind) into the scope, thereby obtaining:

(38) most [farmers$_i$ that t_i have a donkey$_j$] [that t_i have a donkey$_j$ [t_i beat it$_j$]]

Finally, we apply existential closure to both restriction and scope:

(39) $\text{most}_{x_i}[\text{farmers}(x_i) \wedge \exists x_j[\text{donkey}(x_j) \wedge x_i \text{ has } x_j]]$ $\exists_{x_j}[\text{donkey}(x_j) \wedge x_i \text{ has } x_j \wedge x_i \text{ beat } x_j]$.

This variant seems to be prima facie better off with the problem of negation. The intermediate logical form we would begin with in the case of a negative sentence would be something like:

(40) most [farmers$_i$ that not [t_i have a donkey$_j$]][t_i beat it$_j$]

Here, negation has been scoped out and adjoined to S, under the assumption that scoping is the first step in the derivation of logical form. If we accommodate, we get:

(41) most [farmers$_i$ that not [t_i have a donkey$_j$]] [not [t_i have a donkey$_j$][t$_i$ beat it$_j$]]

Existential closure then applies. But it will also have to apply inside the

[19] This approach is my reconstruction of suggestions by I. Heim (p.c.).

scope of negation (cf. Heim (1982, pp. 143 ff)), effectively preventing *a donkey* from anteceding the pronoun *it*.

These changes ought to carry parallel changes in the treatment of if/when clauses. In Kadmon's approach, one applies A-closure to portions of the restriction. If a pronoun in the main clause refers back to material which has undergone closure, accommodation takes place. In this second attempt, we are, however, assuming that accommodation precedes and feeds existential closure. We can work things out, however, as follows. Suppose we are interested in the subject-asymmetric reading of (42).

(42) Usually (in those circumstances) if a man$_i$ has a dime$_j$, he$_i$ will put it$_j$ in the meter

We can first let the adverb of quantification select its topic (or topics) by coindexing it with the relevant indefinites. So we get:

(43) usually$_i$ [a man$_i$ has a dime$_j$] [he$_i$ will put it$_j$ in the meter]

Let's call this process of coindexation "T(opic)-selection". We then accommodate, like before, by copying the restriction onto the scope:

(44) usually$_i$ [a man$_i$ has a dime$_j$] [a man$_i$ has a dime$_j$ [he$_i$ will put it$_j$ in the meter]]

Finally, we apply existential closure to both the restriction and the scope of the quantificational adverbs, obtaining (45a), which is interpreted as (45b):

(45) a. usually$_i$ $\exists j$[a man$_i$ has a dime$_j$]$\exists j$[a man$_i$ has a dime$_j$ [he$_i$ will put it$_j$ in the meter]]

b. most$_{x_i}$ $\exists x_j[\text{man}(x_i) \wedge \text{dime}(x_j) \wedge x_i \text{ has } x_j]$ $\exists x_j[\text{man}(x_i) \wedge \text{dime}(x_j) \wedge x_i \text{ has } x_j \wedge x_j \text{ is pretty}]$

So, on this second attempt, we have three extrinsically ordered transformations: T-selection (which is optional), followed by accommodation (which is obligatory), followed by $\exists$-closure. $\exists$-closure becomes now completely obligatory and applies in four distinct environments: (i) the restriction of determiners, (ii) the portion of the restriction of quantificational adverbs that is not T-selected, (iii) the scope of operators and (iv) the text level. This gives us descriptively the right results. But at what cost? On the Kadmon-style approach, accommodation was motivated by the impossibility of interpreting pronouns, after accessibility relations had been established. So a link with an independently needed (if problematic) process of presupposition accommodation was maintained, which made the appeal to accommodation, in a way, more principled. But on the approach we are considering here, such a link appears to be completely lost. We can no longer argue that accommodation is triggered by the fact that the pronoun would otherwise lack an accessible antecedent, for at the moment we accommodate, accessibility has not yet been determined. So talk of accommodation in the case at hand is at best vague and metaphoric and at worst just plain misleading. We are effectively introducing (on top of $\exists$-closure, which is a series of tranformations having the same structural change (insertion of a quantifier) but disjoint structural descriptions) a second contruction specific, obligatory transformation on logical forms. We are getting rid of the problem with negation, but at the cost of adding another stipulation. It is hardly surprising that we can reach descriptive adequacy by availing ourself of a sufficiently unconstrained apparatus that manipulates logical forms.

The question is whether we can gain a better understanding of what is going on. The possibility that such an understanding may come by departing from the standard Tarski-style semantics we have been so far assuming is not to be a priori discarded.

3. A Dynamic Approach

In the present section we are going to recast the theory of Section 2.3. in a dynamic setting. The reader should be able to use that theory as a guide into the new one. I will be extremely informal, at the cost of being occasionally imprecise. I will partially remedy this in the appendix, where the key notions to be introduced below will be presented more explicitly.

3.1. *The Basic Idea*

We are going to build on the view articulated in Stalnaker (1979), among others, that the semantic contribution of a sentence is not just that of presenting a content, but also that of changing the information of the interpreter through that content. One aspect of the context changing role of sentences is that of placing constraints on stretches of discourse yet to come. For example, to use the metaphor of Kartunnen (1976), a sentence can introduce discourse referents which can be picked up in subsequent discourse. It can also shut off discourse referents that were thus far available.

A simple way of thinking of this particular aspect of context change is the following. Let S′ be the standard truth-conditional content of a sentence S. The context changing character of S can be thought of as $[S' \wedge p]$, where p is a propositional variable. "p" in $[S' \wedge p]$ acts as a place holder for possible continuations of S. One can think of $[S' \wedge p]$ as the set of alternatives that remain open after S has been uttered. Let us use this as our (partial) formal rendering of the context change potential of S.[20] Discourses are made up by piecing sentences together, which will involve composing the corresponding context change potentials. The simplest possible form of discourse is stringing sentences one after the other. We utter S_1 then we add S_2, and so on. So let us begin by figuring out how simple sequences of sentences of this kind are to be interpreted. For example, if we utter S_1 and then we continue with S_2, the meaning of the result must be obtained by composing $[S_1' \wedge \mathrm{p}]$ with $[S_2' \wedge \mathrm{p}]$. What is the most obvious way of doing so? Something like the following comes to mind:

(46) $$[S_1' \wedge p] + [S_2' \wedge p] = [S_1' \wedge p][S_2' \wedge p] = [S_1' \wedge S_2' \wedge p]$$

We fit the second context change potential into the slot for possible continuations of the first context change potential. The result is shown in (46). This process can be iterated indefinitely.

Let us make this idea more concrete. Take a sentence like "a man walked in". Kartunnen's idea about indefinites (formally developed in DRT) is that indefinites introduce a discourse referent. In the present set up, the way to implement Kartunnen's idea is by assigning to the sentence in question the following context change potential:

(47) $$\underline{\exists x[\mathrm{man}(x) \wedge \mathrm{walk}(x)} \wedge p]$$

The underlined portion of the formula in (47) is what correspond to the truth-conditional content of the sentence in question. "p" is the place holder for possible continuations. The thing to note is that the scope of the existential quantifier encompasses "p", i.e. is extended to the possible continuations of "a man walks in". So imagine, for example, continuing the discourse with the sentence "he was tall", whose context change potential would be something like $[\mathrm{tall}\ (x) \wedge p]$. By applying the rule for discourse sequencing in (46), we get:

(48) $$\exists x[\mathrm{man}(x) \wedge \mathrm{walk}(x) \wedge p] + [\mathrm{tall}\ (x) \wedge p]$$

$$= \exists x[\mathrm{man}(x) \wedge \mathrm{walk}(x) \wedge \mathrm{tall}(x) \wedge p]$$

In this way, the pronoun "he" ends up getting bound by the indefinite "a man", in spite of the fact that the former is not in the syntactic scope of

[20] This is actually only one, highly simplified aspect of context change potentials. $[S' \wedge p]$ corresponds to what Heim (1982, Chap. 3) notates as $S'+$.

the latter. This provides us with a nice and conceptually simple reconstruction of the notion of "live discourse referent", one that is compatible with the classical view of indefinites as existentially quantified terms.

This view is also compatible with a simple Montague-style way of specifying the meaning of a phrase in terms of the meaning of its components. Roughly put, in a Montague-style semantics, sentences denote truth-values (at an index) and the meaning of subsentential components is what they contribute to the determination of sentence values. Thus for example, if t is the type of sentences, then the type of predicates like *man* or *run* can be taken to be $\langle e, t\rangle$, the type of a determiner like *a* can be taken to be $\langle\langle e,t\rangle, \langle\langle e, t\rangle, t\rangle\rangle$ (i.e. a relation between predicates) and so on. Accordingly, a determiner like *a* can combine with a predicate like *man*; the result *a*(*man*), which is of type $\langle\langle e, t\rangle, t\rangle$ (viz. a generalized quantifier), can in turn combine with a predicate like *run* resulting in something which will be true or false, namely *a*(*man*)(*run*). This, which is all very familiar, can be varied on in a number of ways, depending, among various things, on how intensionality is dealt with. But these variations are all going to be informed by the same basic methodology. Now the proposal sketched above amounts to saying that the semantic type of sentences is not t but rather that of context change potentials. Let cc be such type. Having made this adjustment, the meaning of subsentential components can be derived in much the same way as before, by looking at their contribution to context change potentials. Thus, the type of predicates like *man* or *run* is naturally set to $\langle e, cc\rangle$, i.e., that of a function from individuals to context change potentials. Let us call things of type $\langle e, cc\rangle$ dynamic predicates. The characteristic of dynamic predicates will be that they will contain a place holder for subsequent discourse. Thus, for example, the dynamic meaning for *man* or *run* can be simply taken to be:

(49)a. $\underline{\lambda x[\mathrm{man}(x)} \wedge p]$ b. $\underline{\lambda x[\mathrm{run}(x)} \wedge p]$

The static aspect of the meaning of these predicates is underlined. By the same token, the meaning of a determiner like *a* can be taken to be that of a function that maps pairs of predicates into a context change potential (i.e. $\langle\langle e, cc\rangle\langle\langle e, cc\rangle, cc\rangle\rangle$). Thus, for example, the meaning of *a* can be taken to be roughly:

(50) $\lambda P \lambda Q\, \exists y[P(y) + Q(y)]$

P and Q in (50) range over dynamic properties and + is the operation for conjoining context change potentials defined in (46). So, by combining *a* with *man* we get:

(51) $$\begin{aligned} \text{a(man)} &= \lambda P \lambda Q\, \exists y[P(y) + Q(y)](\lambda x[\text{man}(x) \wedge p]) \\ &= \lambda Q\, \exists y[\lambda x[\text{man}(x) \wedge p](y) + Q(y)] \\ &= \lambda Q\, \exists y[[\text{man}(y) \wedge p] + Q(y)] \end{aligned}$$

The result, of type $\langle\langle e, cc\rangle, cc\rangle$, can be thought of as a dynamic generalized quantifier, which can be combined further with predicates like *run*:

(52) $$\begin{aligned} \text{a(man)(run)} &= \lambda Q\, \exists y[[\text{man(y)} \wedge p] + Q(y)](\lambda x[\text{run}(x) \wedge p]) \\ &= \exists y[[\text{man}(y) \wedge p] + \lambda x[\text{run}(x) \wedge p](y) \\ &= \exists y[[\text{man}(y) \wedge p] + [\text{run}(y) \wedge p]] \\ &= \exists y[\text{man}(y) \wedge \text{run}(y) \wedge p] \end{aligned}$$

The last step in this derivation follows from the definition of "+". We have thus derived in a straightforwardly compositional way the context change potential of "a man runs". The ordinary truth conditions of "a man runs" are, in a way, still there. But now we also have these place holders in the right place, which will enable us to deal with longer stretches of discourse and the cross-sentential bindings that arise at that level, of which the example in (48) is a simple illustration.

3.2. *Formalizing the Basic Idea*

It turns out that we can make the ideas sketched in Section 3.1 more precise by using Montague's IL. This might be useful, as it should facilitate comparisons of the dynamic framework we are setting up with classical Montague semantics. In fact, we can simplify things even further. In Montague's IL propositions are analyzed as sets of worlds. But our primary concern here is anaphora and variable binding. So for our purposes it really suffices to identify "propositions" just with sets of verifying assignments, as we are not dealing directly with modal notions. This is not the standard notion of proposition (for one thing, only two propositions are available for closed formulae). But for our purposes, it will do. So if ϕ is a formula, let us assume that the proposition it expresses (namely $^\wedge\phi$) is just the set of assignments with respect to which ϕ is true (the satisfaction set of ϕ). I.e. '$^\wedge$' is abstraction over assignments. Conversely, if p is a proposition (a satisfaction set), $^\vee p$ informs us that p is true relative to the current assignment. I.e. '$^\vee$' is application to the current assignment. Let us call the resulting system (which is just like IL except that assignments to variables play the role of worlds) D(ynamic) T(ype) T(theory). Eventually, we will want to bring intensionality back into the picture. There are various ways of doing so. Perhaps the most straightforward and routine one is to view indices as pairs of worlds and assignments. However, I will not deal with intensionality in the present paper.[21]

We have now two tasks. First, show how context change potentials can be represented within IL thus modified. Second, show how the operations of discourse sequencing and existential quantification on context change potentials can be formalized.

Given a formula ϕ, we can represent in DTT the corresponding context change potential (which we will denote as "$\uparrow \phi$") as follows:

(53) $\uparrow \phi = \lambda p[\phi \wedge {}^{\vee}p]$

So the $\uparrow$-operator attaches the slot for subsequent discourse to formulae. $\lambda p[\phi \wedge {}^{\vee}p]$ is a function that accepts all and only the propositions that are compatible with ϕ's truth. Its type will be $\langle\langle s, t\rangle t\rangle$, which we will abbreviate as *cc*. Conversely, given a context change potential A, we may want to extract the corresponding truth-conditional content (which we will denote as "$\downarrow$ A"), i.e. wipe out the place holder that A contains. We can do that by filling the place holder in A with something uninformative, like a tautology. So, where T is a tautology, we get:

(54) a. $\downarrow \mathrm{A} = \mathrm{A}({}^{\wedge}\mathrm{T})$

b. example: $\downarrow \lambda p[\phi \wedge {}^{\vee}p] = \lambda p[\phi \wedge {}^{\vee}p]({}^{\wedge}\mathrm{T}) = [\phi \wedge {}^{\vee\wedge}\mathrm{T}]$
$= [\phi \wedge \mathrm{T}] = \phi$

The $\downarrow$-operator maps a context change potential A into the corresponding static meaning, by vacuously saturating A's slot for subsequent discourse.

With this much apparatus, let us now turn to discourse sequencing and existential quantification over context change potentials discussed in the previous section. They can both be viewed as a kind of function composition:

(55) a. $\mathrm{A} \mathbin{\underline{\wedge}} \mathrm{B} = \lambda p[\mathrm{A}({}^{\wedge}\mathrm{B}(p))]$

b. $\underline{\exists} x\mathrm{A} = \lambda p \exists x[\mathrm{A}(p)]$

I adopt the convention that if "c" is a classical connective or quantifier, "$\underline{c}$" is the corresponding connective or quantifier as defined over context change potentials. To see how the definitions in (55) work, let us consider an example. The example is still somewhat abstract, but it will become more concrete shortly. Let us assume that we start off with the context change potential in (56):

[21] A version of the idea to analyse indices as encoding information about worlds and about assignments is the one adopted in Groenendijk and Stokhof (1990). The approach I favour is outlined in Chierchia (1990).

(56) $\lambda q[\text{man}(x) \wedge \text{walkin}(x) \wedge {}^{\vee}q]$

Now let us quantify over x in (56) and let us consider what definition (55b) gives us.

(57) $\underline{\exists} x \lambda q[\text{man}(x) \wedge \text{walkin}(x) \wedge {}^{\vee}q]$
$= \lambda p \exists x[\lambda q[\text{man}(x) \wedge \text{walkin}(x) \wedge {}^{\vee}q](p)]$
$= \lambda p \exists x[\text{man}(x) \wedge \text{walkin}(x) \wedge {}^{\vee}p]$

This is what we want. For imagine now conjoining (57) with the context change potential of, say, $\underline{\text{tall}(x)}$ namely $\lambda p\ \underline{\text{tall}(x) \wedge {}^{\vee}p}]$. The result is given in (58):

(58) a. $\lambda p \exists x[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}p] \,\underline{\wedge}\, \lambda p[\text{tall}(x) \wedge {}^{\vee}\text{p}]$
b. $\lambda q[\lambda p \exists x[\text{man}(x) \wedge \text{walkin}(x) \wedge {}^{\vee}p]({}^{\wedge}\lambda \text{p}[\text{tall}(x) \wedge {}^{\vee}p](q))]$ def. of $\underline{\wedge}$
c. $\lambda q[\lambda p \exists x[\text{man}(x) \wedge \text{walkin}(x) \wedge {}^{\vee}p]({}^{\wedge}[\text{tall}(x) \wedge {}^{\vee}q])]$ λ-conv.
d. $\lambda q \exists x[\text{man}(x) \wedge \text{walkin}(x) \wedge {}^{\vee\wedge}[\text{tall}(x) \wedge {}^{\vee}q]]$ λ-conv.
e. $\lambda q \exists x[\text{man}(x) \wedge \text{walkin}(x) \wedge \text{tall}(x) \wedge {}^{\vee}q]$ ${}^{\vee\wedge}$-canc.

The occurrence of 'x' in $\underline{\textit{tall}(x)}$ in the top line of (58) is not in the syntactic scope of the existential quantifier. Yet in the reduced form it is. This reflects the intuition that active discourse referents can reach into subsequent discourse. The key step in the reduction in (58) is the conversion from (c) to (d), which has the appearance of an improper λ-conversion as a free variable in the argument ends up being bound. This impropriety is only apparent though. The trick here is that the cap operator '${}^{\wedge}$' abstracts over assignments, thereby semantically binding the variable x. "${}^{\wedge}\text{tall}(x)$" is the set of assignments that satisfy "tall(x)". Consequently, the value of "x" in "${}^{\wedge}\text{tall}(x)$" is not fixed to a particular individual (just like it isn't in "$\lambda x[\text{tall}(x)]$") and everything works out fine.

It may be worth pointing out that the definitions in (55) are formally quite natural. (55a) is just and intensionalized form of function composition. (55b) is a pointwise extension of existential quantification to a functional type (similar to the one of generalized Boolean operators – cf. e.g. Partee and Rooth (1983)).

The next step is to create a Montague-style compositional translation map into DTT that systematically assigns to sentences their context change potential, along the lines sketched in Section 3.1. I will not do this in full detail, limiting myself to a schematic illustration of how it can be done by means of the following table.

(59) a.	predicates	translation	type
	man	$\lambda x \uparrow \text{man}(x)$	$\langle e, cc\rangle$
		$= \lambda x \lambda p[\text{man}(x) \wedge {}^{\vee}p]$	
b.	determiners	translation	type
	a	$\lambda P \lambda Q \underline{\exists} x[{}^{\vee}P(x) \,\underline{\triangle}\, {}^{\vee}Q(x)]$	$\langle\langle s, \langle e, cc\rangle\rangle,$ $\langle\langle s, \langle e, cc\rangle\rangle, cc\rangle\rangle$
c.	NP's	translation	type
	a man	$\lambda P \lambda Q \underline{\exists} x[{}^{\vee}P(x) \,\underline{\triangle}\, {}^{\vee}Q(x)]$ $({}^{\wedge}\lambda x[\uparrow \text{man}(x)])$ $= \lambda Q \underline{\exists} x[\uparrow \text{man}(x) \,\underline{\triangle}\, {}^{\vee}Q(x)]$	$\langle\langle s, \langle e, cc\rangle\rangle, cc\rangle$
d.	S's	translation	type
	a man walks	$\lambda Q \underline{\exists} x[\uparrow \text{man}(x) \,\underline{\triangle}\, {}^{\vee}Q(x)]$ $({}^{\wedge}\lambda x[\uparrow \text{walk}(x)]))$ $= \underline{\exists} x[\uparrow \text{man}(x) \,\underline{\triangle} \uparrow \text{walk}(x)]$ $= \lambda q \exists x[\text{man}(x) \wedge \text{walk in}(x)\ {}^{\vee}q]$	cc

The reader should be able to see that this is just PTQ-semantics, with cc replacing t everywhere.

The notion of context change potential we are working with can be perhaps best understood by working out what something like "$\lambda q \exists x[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}q]$" actually denotes. Suppose the sentence "a man walks in" is uttered in a given context, represented by an initial assignment to variables g. Uttering the sentence "a man walks in" in g has the effect of changing g to $g[u/x]$, where u is a man that walks in. All possible continuations of "a man walks in" must be satisfied by such a modified assignment. This is precisely what the value of "$\lambda q \exists x[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}\text{q}]$" gives us:

(60) $[\![\lambda q \exists x[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}q]]\!]^{g} = \{\mathbf{q} : g[u/x] \in \mathbf{q}$, where u is a man and u walks$\}$
(I am taking the liberty here of representing characteristic functions as sets. Cf. Appendix III)

This captures the idea that an indefinite changes the initial context by activating a discourse marker and attaching a certain amount of information to it. By continuing "a man$_1$ walks in" with "he$_1$ is tall", we check whether the satisfaction set of " he$_1$ is tall" is in (60). This amounts to checking whether $g[u/x]$ is in $\{g : g(x)$ is tall$\}$, which will be the case iff u is tall. If this is so, we can go on. Otherwise, the discourse "A man walks in. He is tall" cannot be further continued.

All this is just a way of recasting the basic insights of DRT as operations on meanings (in a way which is very close to file change semantics). Such insights have been now couched within a version of Intensional Logic. This enables us to use a familiar PTQ style interpretive procedure, which eschews rules of construal (other than scoping). Moreover, indefinites are treated in the standard Frege-Russell way, as existentially quantified terms. Such quantifiers are however open, in the sense that the operation of discourse sequencing allows us to push their binding potential beyond their syntactic scope.

So far we have only considered indefinites. We have yet to provide a treatment of what in DRT are called the "quantificational" determiners like *every*, *no* or *most*. To this task we now turn.

3.3. *Dynamic Generalized Quantifiers*

A (dynamic) determiner like *a* is a relation between (dynamic) properties. Assuming that all determiners have a uniform type, we may ask how one can arrive at a general characterization of other determiners. The task is the following. On the basis of an interpretive procedure like the one sketched in the previous section (where S's denote *cc*'s, predicates denote dynamic properties, etc.), we want to arrive at a general interpretation of quantificational determiners which yields ∃-readings in donkey anaphora contexts while avoiding the proportion problem. Here is the time to look back at the theory of Section 2.3. There we analyzed as sentences like (61a) as in (61b):

(61) a. Every farmer that has a donkey beats it
  b. Every farmer that has a donkey has a donkey and beats it

This was accomplished by a rule that actually copied (parts of) the restriction into the nuclear scope. We can now reproduce the same treatment without resorting to a copying rule. On a generalized quantifier approach, restriction and scope of a quantifiers are properties. In the case of (61a) they are the (dynamic) property of being a man that has a donkey and the (dynamic) property of beating it, respectively. We can now stipulate that the meaning of *every* is given by the following equation:

(62) every (man that has a donkey) (beat it) =
  every (man that has a donkey)(has a donkey *and* beat it)

If the underlined "and" in (62) is the dynamic one, indefinites will be able to bind across it, which is just what is called for. In this way what was previously a lexically governed copying rule on logical forms becomes part of the characterization of the meaning of the relevant determiners.

Let us make this idea more precise. In the schema in (62), the *every* on the left hand side of '=' and the one on the right cannot be quite the same, as the former is defined in terms of the latter. The *every* on the left of '=' has the same type as dynamic *a* and thus relates two dynamic properties. But from an intuitive point of view, the every on the right of '=' needn't be anything as fancy. It can just be taken to be the ordinary "every", which in generalized quantifier theory is analyzed as the subset relation (i.e. every $(X)(Y) = X \subseteq Y$). So in order for the right hand side of the equation in (62) to be well-defined, the arguments of *every* on the right of '=' have to be sets. But in general in our semantics, predicates are interpreted as dynamic properties. So we need to go from dynamic properties to sets. This is easy, for dynamic properties are really just sets with an additional place holder for discourse continuations. And we can wipe that place holder out by means of the $\downarrow$-operator. So a slightly more explicit version of the right hand side of the equation in (62) will be:

(63) every ($\lambda x \downarrow$ [x is a farmer that owns a donkey])($\lambda x \downarrow$ [x is a farmer that owns a donkey *and* x beats it])

So '$\downarrow$' gets us from dynamic properties to sets, but only after the restriction and the scope have been dynamically conjoined, which will give a chance to any indefinite occurring in the restriction to bind pronouns in the scope. We are almost there. The final relevant observation is that we want every sentence to denote context change potentials. I.e. we want to put back in the place holder that we had taken out in order to do our ordinary quantification. This can be done by using '$\uparrow$'. So we get:

(64) every+ (man that has a donkey)(beat it) =
$\uparrow$ every ($\lambda x \downarrow$ [x is a farmer that owns a donkey])($\lambda x \downarrow$ [x is a farmer that owns a donkey *and* x beats it])

Every+ is the dynamic counterpart of *every*, which is just a relation between sets. *Every+* maps pairs of dynamic properties into context change potentials (and thus has the same logical type of *a*), while *every* is the subset relation.

The schema in (64) can be generalized to all so called quantificational determiners. Such a generalization is given in (65a):

(65) a. $D^{+}(P)(Q) = \uparrow D(\lambda x \downarrow {}^{\vee}P(x))(\lambda x \downarrow [{}^{\vee}P(x) \mathbin{\triangle} {}^{\vee}Q(x)])$
where P and Q are of type $\langle s, \langle e, cc\rangle\rangle$

b. $\lambda P \lambda Q \exists x [P(x) \mathbin{\triangle} Q(x)]$

So we assume that quantificational determiners are treated as in (65a), while indefinite determiners are treated as in (65b). This corresponds to the DR-theoretic assumption that indefinites "introduce discourse referents" or "set up file cards", while quantificational determiners do not. Quantificational determiners introduce "box splitting" or "set up temporary files". The assumption that indefinites are special is what the present theory has in common with DRT: it is no more and no less stipulative here than it is in DRT. But in the present theory, while indefinites are special, all determiners and NP's come up naturally as having a uniform type and the proportion problem does not arise. A sentence like "most men that have a donkey beat it" is assigned by (65a) the truth-conditions "Most men that have a donkey are men that have a donkey and beat it" (cf. Appendix III, Example 2). We have done away with accommodation by building its effects into the meaning of determiners. But we needed a dynamic treatment of conjunction and existential quantification to get it to work.

A further consequence of this approach is worth noticing. On the basis of the definition in (64), the *cc* of a sentence like (61a) will be represented in DTT as follows:

(66) $$\begin{aligned}&\uparrow \forall x[[\text{farmer}(x) \wedge \exists y[\text{donkey}(y) \wedge \text{owns}(x, y)]]\\ &\rightarrow \exists y[\text{donkey}(y) \wedge \text{own}(x, y) \wedge \text{beat}(x, y)]]\\ &= \lambda p[\forall x[[\text{farmer}(x) \wedge \exists y[\text{donkey}(y) \wedge \text{owns}(x, y)]]\\ &\rightarrow \exists y[\text{donkey}(y) \wedge \text{own}(x, y) \wedge \text{beat}(x, y)]] \wedge {}^{\vee}p]\end{aligned}$$

The thing to observe in this connection is that the scope of $\forall$ doesn't include p, the place-holder for possible continuations. This entails that *every*, unlike *a*, will not, in general be able to bind beyond its syntactic scope. Moreover, an indefinite inside the restriction or scope of *every* will be limited in its binding potential by the scope of *every*. This accounts for the following grammaticality judgements.

(67) a. *Every man$_i$ walked in. Mary saw him$_i$.

b. *Every man who has a donkey$_i$ is happy. It$_i$ is a great companion

In this sense, the determiners defined in terms of (61) are "closed", as opposed to indefinites, which are open. The net effect is that we end up with a notion of "accessibility" (= semantic scope) that coincides exactly with the one of standard DRT.

It may be appropriate to make a few observations as an interim comparison between what we now have and the theory developed in Section 2.3. We have first (in Section 3.2.) reconstructed within a version of intensional logic the idea that the contribution of indefinites is that of setting up a discourse referent (with a certain amount of information attached to it). Second, in the present section we have given a general characterization of the closed determiners (those that in DRT are the "quantificational" ones). Our characterization of such determiners is based on the same intuition that was at the basis of the theory in 2.3, but is now done in semantic terms. Thus a lexically governed transformation on logical forms has been turned into a semantic constraint on lexical meaning. But there is something more than that to the dynamic approach. It can be argued, I think that the definition in (65a) has a "naturalness" which the corresponding accommodation rule lacks and and captures a generalization which the corresponding accommodation rule misses. The naturalness of (65a) stems from the following observations. Static determiners are known to be conservative, where conservativity amounts to satisfying the condition (11) above, repeated here:

(11) $D(X)(Y) \Leftrightarrow D(X)(X \wedge Y)$

It should be intuitively clear that the definition in (65a) is just a generalization of conservativity to dynamic determiners. In fact, it can be proven that for any determiner D^+ defined as in (65a), the following analogue of conservativity follows:

(68) $D^+(A)(B) \Leftrightarrow D + (A)(A \triangle B)$ (cf. Appendix IV)

The generalization that (65a) captures is the following. It is a fact that determiners are conservative in the sense that in simple cases (not involving donkey pronouns), inferences such as (69) are valid.

(69) $D(\text{men})(\text{run}) \Leftrightarrow D(\text{men})(\text{men} \wedge \text{run})$

It seems plausible to maintain that the validation of (69) is a purely semantic property of determiners. Now, the schema in (65a) is the simplest possible hypothesis I can think of that (i) assigns ∃-readings to determiners in donkey anaphora contexts and (ii) enables us to derive the validity of (69) in the simple cases. Thus (65a) makes an empirical claim, namely that properties (i) and (ii) are universally related. In no language, it is claimed, one can find one of these properties without the other. No language can have a non conservative determiners and every language allows ∃-readings of donkey sentences. I don't know why the category DET should be so specialized. But given that this is a fact, (65a) is a compact way of stating it. In a theory like the one in 2.3., the validity of (69) (i.e., property ii) is taken to be a semantic fact about determiners, while the existence of ∃-readings (i.e., property i) is obtained by a seemingly unrelated copying rule. I think that being able to collapse these two properties in one non disjunctive semantic definition, besides being just more economical, may pave the way to a better understanding of what is going on.

3.4. *The Need for a Novelty Condition*

In classical DRT it must be assumed that the index of indefinites must be novel. This can be illustrated in many ways, one being, for example, that (70a) and (70b) do not share a reading:

(70) a. John likes a woman I know and Bill hates a woman I know
b. John likes a woman I know and Bill hates her.

If indefinites are just variables and the two indefinites in (70a) can be assigned the same index, then (70a) would end up being interpreted just like (70b). This undesirable result can be avoided by assuming that indefinites are subject to a novelty condition, which says, roughly, that each indefinite must pick a fresh variable. A similar assumption, it seems, must be made in the reelaboration of DRT we have developed. An example that shows this is the following:

(71) Every man that knows her and marries an Italian is happy

No independently needed constraint will prevent *her* and *an Italian* from being coindexed in (71). If they happen to be and if we use the definition in (65b) for *every* we predict that (71) has a reading that is roughly equivalent to the following:

(72) Every man that knows her and marries an Italian marries an Italian he knows and is happy

To see how this comes about, one must apply (68) to (71). A first application gives us that (71) should be equivalent to:

(73) every$^+$(man that knows her$_i$ and marries an Italian$_i$)(man that knows her$_i$ and marries an Italian$_i$ $\triangle$ is happy)

But since (68) is fully general it must hold also of (73). It follows then that (73) should be equivalent to:

(74) every$^+$(man that knows her$_i$ and marries an Italian$_i$)(man that knows her$_i$ and marries an Italian$_i$ $\triangle$ man that knows her$_i$ and marries an Italian$_i$ $\triangle$ is happy)

Here *an italian*$_i$, being dynamic, binds the second occurence of her$_i$ in the nuclear scope. By working out the truth-conditions of (74), we see that they are those given in (72). So if no constraints are added, we predict that (72) is a possible reading of (71), which is wrong. The way to block this, is to use a fresh variable each time that we use an indefinite, i.e. to adopt some version of Heim's novelty condition. There are a number of ways to do that. But choosing among them is immaterial to our purposes. So I will follow here a controversial but widespread practice, namely that of simply stating that I will be assuming in what follows some version of the novelty condition.[22]

3.5. *Adverbs of Quantification*

It is now time to turn to adverbs of quantification, which we will be able to discuss only in a general, partly programmatic way. We will use again the theory developed in Section 2.3 as our guide. The basic generalization we arrived at is that adverbs of quantification form tripartite structures where if/when clauses, if present, provide the restriction. Moreover, adverbs of quantification can select one or more or possibly all of the indefinites in an if/when clause as "topics", i.e. as what is actually quantified over.

To see how to do this in way that eschew rules of accommodation, let us consider a simple example, say:

(75) Always, when a cat has blue eyes, it is intelligent (Pelletier and Schubert (1989))

In the case at hand, there is only one indefinite that can play the role of topic, which means that *always* must quantify over it. We are assuming, though, that indefinites are already existentially quantified. The context change potentials of the when-clause and of the main clause will be respectively:

(76) a. a cat has blue eyes $\Rightarrow \lambda p \exists x[\text{cat}(x) \wedge \text{has blue eyes }(x) \wedge {}^{\vee}p]$
b. it is intelligent $\Rightarrow \lambda p[\text{intelligent}(x) \wedge {}^{\vee}p]$

What we would like to do is wipe out the existential quantifier in (76a) so as to obtain something that the adverb of quantification can bind. It turns out that the open character of indefinites enables us to do so. We can define an operation that so to speak compositionally replaces '$\exists$' with a 'λ' turning a context change potential into a (dynamic) property that can act as the restriction for *every*. Informally the operation that does the trick involves adding an equation of the form $x = u$ to (76a), so as to obtain:

(77) $\underline{\exists} x \uparrow [\text{cat}(x) \wedge \text{ has blue eyes }(x)] \mathbin{\underline{\wedge}} \uparrow x = u$

[22] The version of the novelty condition I favour is the one developed, following a proposal by Barwise, in Rooth (1987), which exploits partial assignments. Cf. also Krifka (1991) and Appendix V.

$$= \lambda p \exists x[\text{cat}(x) \wedge \text{has blue eyes } (x) \wedge x = u \wedge {}^{\vee}p]$$

In this way, we introduce a free variable "u" in the when-clause, which can be bound by a quantificational adverb. In a generalized quantifier framework this means that we can abstract over "u" in (77), obtaining a property that can act as the left argument of the determiner-function. The result of abstracting over u in (77) is:

(78) a. $\lambda u \lambda p \exists x[\text{cat}(x) \wedge \text{has blue eyes } (x) \wedge x = u \wedge {}^{\vee}p]$
b. $\lambda x \uparrow [\text{cat}(x) \wedge \text{has blue eyes } (x)]$

The dynamic property in (78a) is equivalent to (78b). At this point, having obtained the desired restriction, there are no obstacles to interpreting *always* just like *every*, which gives us:

(79) $\text{every}^{+}(\lambda x \uparrow [\text{cat}(x) \wedge \text{has blue eyes } (x)])(\lambda x \uparrow \text{intelligent } (x))$

This yields precisely the truth-conditions we want for (75).[23]

What is the basic idea, then? Simply this: adverbs of quantification are (modalized versions of) determiner meanings: *always* is just (a modalized counterpart of) *every*, *usually* of *most*, *never* of *no*, etc. However, determiners come with heads, that wholly determine their restriction. Adverbs of quantification do not. They may lack a structurally projected restriction altogether (as in "John always bugs me"). Or if they do, as when there is an if/when clause, what they bind is left to various discourse factors to determine (topic selection). Topic selection is cast simply as a form of abstraction. The framework we adopt enables us to abstract over variables that are existentially quantified, because of the open character of existentially quantified NP's.

It is easy to see that the same operation wouldn't work for closed determiners, like *every*. Consider the following variant of (75).

(80) *When every cat_i has blue eyes it_i is intelligent

The *cc* of the when clause according to the procedure set up in 3.4 would be:

(81) $\lambda p[\forall x[\text{cat}(x) \wedge \text{has blue eyes } (x)] \wedge {}^{\vee}p]$

The universal quantifier cannot reach into subsequent discourse. The variable "p" in (81) is not in the scope of '$\forall$'. Consequently if we were to add an equation of the form $x = u$ to (81), the latter occurrence of x could

[23] Dekker (1990b), to whom this idea is due, appropriately calls this operation "existential disclosure".

not be bound by '∀'. This accounts for the impossibility of the anaphoric link in (80). It is only indefinites that we can abstract over in this way.

If more than one indefinite is present, we are free to choose any one of them as a topic, since we are free to pick any variable by means of the operation described in (77). So, for example, in the case of (82a), we can choose either the variable associated with the subject (obtaining the subject asymmetric reading) or on the variable associated with the object (obtaining the object asymmetric one). In fact we can choose more than one indefinite, as in (82b).

(82) a. When a painter lives in a village, it is usually pretty
b. When [a $\text{woman}_1]_T$ has a child_2 with [a $\text{man}_3]_T$, she usually keeps in touch with him

In (82b), I am marking the indefinites that are naturally interpreted as topics by means of the feature 'T'. For each NP's so marked we introduce an equation of the form $x_n = u$. The result is:

(83) $[[\text{a woman}_1]_T \text{ has a child}_2 \text{ with } [\text{a man}_3]_T \mathbin{\triangle} \uparrow u = x_1 \mathbin{\triangle} \uparrow v = x_3]$

This process introduces the free variables that the adverb of quantification can bind. In a generalized quantifier framework, this means that adverbs of quantification should be interpreted as polyadic quantifiers. Ordinary determiners are monadic, that is relations between properties (extensionally, sets). Polyadic quantifiers are relations between n-place relations (extensionally, sets of n-tuples). As an illustration, I provide in (84) the dyadic counterpart of some of the standard determiners:[24]

(84) a. every $(R)(K) = R \subseteq K$
b. most $(R)(K) = |R \cap K| \geqslant |R \cap K^-|$
c. no $(R)(K) = R \cap K = \emptyset$
where R and K are sets of ordered pairs (i.e., 2-place relations) and K^- is $(U X U) - K$

As the reader can see, these are the same functions as those we had in the monadic case, only generalized to sets of ordered pairs. Consequently, dyadic (and polyadic) quantifiers can be dynamicized in the same way as the monadic ones, i.e. using the schema in (65a) (cf. Appendix VI).

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[24] For more discussion, cf. e.g., van Benthem (1989). A strong case for polyadic quantification in natural language has been made in Srivastav (1990a,b). Her treatment of correlatives in Hindi (and crosslinguistically) is very relevant to the issues discussed here, and I believe it may provide a crucial testing ground for the claim that adverbs of quantification are polyadic rather than something like quantifiers over cases a la Lewis.

Notice that I am not saying that determiners are or can be polyadic. I am saying that surface syntax in this case is a good guide as to what happens in the semantics. Determiners combine with nouns which denote (1-place) properties. As such, they are semantically relations between properties (i.e., monadic quantifiers). Adverbs of quantification are not in construction with a head. They are quantificational elements whose restriction is determined by discourse factors. As any number of arguments can be selected as topics, adverbs of quantification turn out to be semantically polyadic counterparts of the determiners.

So, going back to (83), the free variables we introduced in it are abstracted over. The result will be the two-place (dynamic) relation in (85a). Such a relation provides the restriction of *usually*, which is simply taken to be the diadic counterpart of *most*. A semi formal version of what this gives us is provided in (85b) along with a characterization of its truth-conditional import in (85c):

(85) a. $\lambda x_1 \lambda x_2 \lambda p[\text{woman}(x_1) \wedge \text{man}(x_2) \wedge \exists x_3[\text{child}(x_1) \wedge \text{has with}(x_1, x_3, x_2) \wedge {}^{\vee}p]]$

b. $\text{most}^+(\lambda x_1 \lambda x_2[x_1 \text{ is a woman, } x_2 \text{ a man and } x_1 \text{ has a child with } x_2])\ (\lambda x_1 \lambda x_2[x_1 \text{ keeps in touch with } x_2])$

c. Most pairs $\langle a, b\rangle$ such that a is a woman, b a man and a has a child with b, are such that a is a man, b a woman, a has a child with b and a keeps in touch with b

So, I am assuming that the indefinites within an if/when clause can be freely marked as topics and abstracted over. The adicity of the adverbs of quantification and the number of indefinites that are selected as topics have to match for the sentence to be interpretable.The idea that adverbs of quantification have a flexible adicity is natural in view of the fact that not being associated with a head, they are freer than determiners in selecting their variables.

It can, of course, happen that all the indefinites in an if/when clause are selected as topics. This will give us the effects of Lewis' case quantification which in standard DRT is taken as basic (i.e. what arises if no accommodation takes place). In our framework this amounts to abstracting over all the indefinites in an if/when clause, an option we expect given the free, discourse governed character of topic selection.

There are several issues concerning adverbs of quantification that need to be fleshed out further. While I will not be able to do that properly, I would like to give the reader an indication of the line that I think would be fruitful to explore.

I am not being very explicit as to the syntax of topic selection. I am simply assuming that indefinites can be marked by a feature "T", which is then interpreted as abstraction. But there are a number of syntactically more sophisticated options that eventually one would want to explore. For example, rather than T-marking, one could imagine that topic selection takes the form of LF-movement to a clause initial topic position. The viability of this (and related) hypothesis depends on general assumptions about the syntax of topic positions, an issue we cannot do justice to within the limits of the present work.

Another issue of importance has to do with possibility of having if/when-clauses without indefinites; for example:

(86) When John is in the bathtub, he usually sings

A widespread assumption which is relevant to the analysis of (86) is that verbs have a Davidsonian argument, ranging over eventualities.[25] This argument can be bound by adverbs of quantification. Within the present set up we can maintain that a when-clause like the one in (86) has the *cc* in (87a):

(87) a. $\underline{\exists} o\, [\uparrow \text{in the bathtub}\, (j, o)]$ (where 'o' ranges over eventualities or occasions)

b. $\lambda o' [\underline{\exists} o\, [\uparrow \text{in the bathtub}\, (j, o)] \vartriangle \uparrow o = o'] = \lambda o\, [\uparrow \text{in the bathtub}\, (j, o)]$

The occasion-variable in (87a) can be abstracted over in the usual way, resulting in (87b). This provides us with a suitable restriction for the quantificational adverb. So (86) ends up meaning something like "most occasions where John is in the bathtub, are occasions where John is in the bathtub and sings". The details of this analysis will depend on specific assumptions concerning tenses and tense sequencing. Its outcome is quite close to what one finds in early analyses of quantificational adverbs (such as, e.g., Stump (1981)), which, however, could not deal with donkey-type dependencies. I assume that while occasions can be quantified over by adverbs of quantification, they don't have to be. Whether they are or aren't will depend on whether or not they are selected as topic.

A number of authors[26] have explored (and are exploring) the hypothesis that adverbs of quantification uniformly quantify over eventualities or, perhaps, situations. The kind of situation semantics one would need to do the job has to be sufficiently flexible as to get us asymmetric readings

[25] Cf. e.g., Davidson (1967) or Parsons (1991) among many others.
[26] Berman (1987), Chierchia (1988), Heim (1990), among many others.

of conditionals, weak readings, as well as an analysis of well known, hard to crack cases such as:

(88) a. When a formal system is complete it is usually compact
b. When a cardinal meets someone, he blesses him

The problem for a situation/event-based analysis of (88a) is that (88a) shouldn't come out as meaning "most occasions in which a formal system is complete are occasions in which it is compact", for being complete appears to be a non occasion bound property (an individual-level property, in Carlson's (1977) terms). The problem with (88b) is that the truth-conditions of (88b) seem to require that if a cardinal meets another cardinal two blessings should take place. But if we analyse it as "every situation when a cardinal meets someone is a situation where he blesses him" we seem to predict that in case two cardinals meet one blessing would suffice for the truth of (88b). I haven't seen yet a situation based analysis of adverbs of quantification that does all this, namely accommodating asymmetric readings and weak readings while handling satisfactorily sentences like those in (88). This is not to say that such an analysis, once worked out, might not provide us with an interesting alternative to the present one. For more discussion of the issues involved see Section 5.1. below.

A further issue I'd like to touch upon briefly concerns sentences with adverbs of quantification lacking an overt restriction (i.e., an if/when clause). Since adverbs of quantification do need a restriction to be interpretable, such a restriction will have to be somehow provided. Now, we have been assuming so far that the topic can be selected from within the if/when clause. But there is no reason to rule out the possibility that the topic can be selected also from the main clause. That this option must be allowed is particularly clear by looking at generic sentences with adverbs of quantification:

(89) a. A quadratic equation has usually two solutions
= most quadratic equations have two solutions (subject as topic)
b. John usually likes a good work out
= most good work outs (that John has) are appreciated by him (object as topic)
c. A cat usually plays with a mouse (before eating it)
= most cats play with most mice before eating them
(subject and object as topics)

So, our basic mechanism of topic selection would have to be extended as to allow it to select portions of the main clause as topic (= restriction of the quantificational adverb). But this fits with the basic line we are taking and should be feasible in a principled manner. It is worth noticing, in this connection, that the topic needn't be provided by indefinites. Cf.

(90) Usually this kind of dog is very easy to train

In (90) the topic appear to be the definite NP "this kind of dog". This sentence is naturally understood as quantifying over instances of the relevant kind ("most instances of this kind of dog are easy to train"). I believe that many case of definites as topics can be treated along these lines (i.e. as quantifications over instances or parts). But again this is not something we can pursue here.[27]

It should be also recalled that in certain circumstances, focal stress determines the restriction of the quantificational adverbs. For example:

(91) a. Usually JOHN invites Sue
= most occasions where someone invites Sue are occasions where John invites Sue

b. Usually, John invites SUE
= most occasions where John invites someone are occasions where John invites Sue

Capitalization in (91) indicates focal stress. Shifts of focal stress such as those in (91) seem to affect systematically truth-conditions, as the example illustrates. These cases have been studied by Rooth (1985, 1991), where he argues that focus sets up in systematic, predictable ways a range of relevant alternatives, from which the restriction of the quantificational adverb is drawn. An analysis along the lines proposed by Rooth is nicely compatible with what we are proposing here.

Finally, there are also cases where the extralinguistic context may provide the restriction. Consider:

(92) John always sings

If we utter (92) pointing at John while he is walking to school, (92) can be naturally interpreted as saying something like "when John walks to

[27] This includes the cases of free relatives, indirect wh-questions (Berman (1990), Lahiri (1991)) and gerunds Portner (1991)).

school, he always sings". If we utter it while pointing at John in the bathtub, (92) is likely to be interpreted as something like "when John is in the bathtub, he always sings". And so on. In this cases, the topic (= restriction) has to be indexically specified.

While this list is far from being exhaustive, it is nonetheless indicative of the kind of phenomena that will have to be dealt with in extending the present theory. I think that these extensions can be accomplished in a principled and relatively simple manner. But we must leave them for another occasion.

3.6. *Summary and Comparisons*

Let us try to summarize the global gestalt of the theory we have developed. We have adopted a version of Stalnaker's (and others') insight that sentences denote context change potentials, which we have cast within (a slight modification of) Intensional Logic. We have given, then, a PTQ-style semantics for subsentential constituents. In particular, we have uniformly treated determiners as relations between properties. We have adopted from classical DRT the idea that indefinites are "open" (i.e. they set up discourse referents that can be picked up in subsequent discourse), while other determiners are closed (i.e. they shut off discourse referents active up to now). But we have done so while sticking to a standard analysis of indefinites as existentially quantified terms. We have given a general characterization of determiner meanings in terms of the schema D(A)(B) = D(A) (A *and* B), a dynamic version of conservativity. This has the effect of assigning to indefinites ∃-readings in donkey anaphora contexts. Adverbs of quantification are viewed just as polyadic (and possibly modalized) counterparts of determiners. Since they lack a head, what they bind is not (or not completely) determined by structural factors, but by discourse factors. The way in which they can bind is by a process of topic selection, which amounts to abstracting over indefinites. This process of abstraction over something which is existentially quantified is made possible by the open character of indefinites.

The theory we have developed is by and large descriptively equivalent to the version of DRT developed in Section 2.3. Yet I think there are several reasons to prefer the dynamic approach over the static one. I will mention three.

First, the main thrust of the dynamic approach is the elimination of lexically governed, extrinsically ordered, obligatory transformations on logical forms in favour of lexical stipulations on meaning. This is reminiscent of a similar change that occurred in syntax with the replacement of the *Aspects* model (Chomsky (1965)) with the one developed in *Remarks on Nominalization* (Chomsky (1970)). The definition of determiners based on conservativity corresponds to the obligatory "accommodation" rule of the theory in Section 2.3. We have argued, however, that this is not just a technical variant, as it embodies a specific empirical claim: weak readings are linked to conservativity and since the latter is universal, the former must be universal too. According to our theory, therefore, there cannot be a language that disallows weak readings of determiners. On the basis of our strawman theory of Section 2.3, instead, the universality of conservativity and the universality of weak readings of determiners have to be stipulated independently of each other.

A second major feature of the dynamic approach, related to the first, is the elimination of various rules of existential closure, in favour of the view that indefinites are always existentially quantified and yet, in a precise sense, open, i.e., capable of reaching beyond their syntactic scope. This open character they have enables them to be selected as topics by adverbs of quantification. This arguably leads to a simpler characterization of the behavior of indefinites. Before we had at least 4 rules of existential closure: (a) text-level closure (b) closure in the scope of quantifiers and operators (c) closure of the restriction of quantificational NP's and (d) closure of arbitrary portions of if/when clauses. All these get replaced by the assumption that indefinites are existentially quantified NP's whose open character permits them to function as topics for adverbs of quantification. DRT leaves indefinites open and closes them by rule. I am proposing to keep indefinites closed and open them by rule. My claim is that this enables us to cut down on the number of unrelated stipulations one needs. I have tried to make my case by showing that the best available straw man theory needs four separate rules of existential closure vs. one rule of topic selection.

A third and final major difference between the dynamic approach we have developed here and the one based on DRT is the following. Classical DRT assumes unselective binding as basic. I.e. it assumes that quantifiers are all underlyingly unselective. That is what is hard wired into the formalism.[28] This is bound to make it more difficult to deal with cases where

[28] In recent unpublished work, Kamp and Reyle remedy to this original sin by assuming that "box-splitting" operators may have the following form:

(a) $\boxed{\square \Rightarrow_x \square}$

Where, intuitively, x is the variable that $\Rightarrow$ operates on. This makes "box-splitting" operbinding in natural language appears to be selective, as with determiners and with asymmetric readings of if/when clauses. Those cases will call for something special. Per contra, the basic assumption we are making is the standard one, namely that quantifiers are selective, i.e., typed as to their adicity. This will lead us to expect selective binding phenomena to be the norm in natural language. I believe that the available evidence supports the latter view. What determiners bind is wholly determined structurally. And adverbs of quantification appear to be selective too: they select their topics. They have more freedom than determiners, as they are not in construction with a head and yet they appear to be selective. The proportion problem is a manifestation of this issue. If our basic quantificational device has the form $Q(\phi)(\psi)$, where Q quantifies a la Lewis over cases (i.e., assignments to variables), then quantification will be inherently symmetric. If our basic quantificational device has the form $Q(\lambda x\phi)(\lambda x\psi)$, then quantification will be inherently asymmetric. All variables are on a par in ϕ but not in $\lambda x\phi$, where x is singled out by 'λ'. If we analyse basic quantifiers as $Q(\lambda x\phi)(\lambda x\psi)$, we will need special stipulations in order to get the effects of symmetric quantification. This is the sense in which the proportion problem completely dissolves in the present dynamic approach. And this is quite independent of the particular semantics for determiners we have proposed. It depends solely on the logical type we are assuming quantifiers to have.

These considerations suggest that linguistic theory may have something to gain from the adoption of a dynamic approach.

Before leaving this section, I wish to point out briefly the main differences between the present dynamic approach and others currently available. In particular, I want to point out the main novelties with respect to the framework of Groenendijk and Stokhof (1990), to which the present approach is most directly linked. From a technical point of view the version of intensional logic I am adopting is just a trivial variant of the one developed by Groenendijk and Stokhof. The main changes are in how one deals with quantification in English using that logic. There are two main differences here: the general characterization of conservative determiners (Groenendijk and Stokhof give a non conservative definition of *every* and do not take a stand on other determiners) and the view of adverbs of quantifications as polyadic counterparts of determiners. Similarly, with respect to Heim (1982, ch. 3) the main difference is in giving

ators selective and paves the way to a treatment of determiners as monadic operators. A higher order version of this language, would probably be fully equivalent to DTT, although detailed comparisons remain to be done. I suspect, however, that if one leaves indefinites up the idea that quantification is basically symmetric, with the necessary adjustments that this entails in the treatment of quantificational adverbs.

4. On ∀-Readings of Donkey Sentences

It is now time to discuss how ∀-readings fit into this picture.[29] The basic empirical generalization we had reached is that both ∃-readings and ∀-readings are generally available in donkey anaphora contexts, but sometimes only one of them will be salient due to idiosyncratic, poorly understood properties of the context. The question we need to say something about, albeit rather speculatively, is how ∀-readings come about.

4.1. *Are Determiners Lexically Ambiguous*?

A priori, one could maintain that the ambiguity between ∃-readings and ∀-readings is just a lexical one. Determiners like *every* and *most* could be held to have two readings one where the indefinites have existential force (which is the one we have adopted so far) and one where they get universal force. This second one would assign to a sentence like, say, (93a) the reading in (93b):

(93) a. most men who have a donkey beat it:
  b. For *most* x such that x is a man who has a donkey for *every* donkey x has, x beats it

This type of analysis (which was first formulated, as far as I know, in Root (1986) and Rooth (1987)) amounts to articulating the quantificational contribution of a determiner in two components, which are italicized in (93b). The first component determines the quantificational force of the (argument corresponding to the) head and is a direct reflex of the lexical meaning of the determiner. The second component is always a universal quantification that applies to all the indefinites which are present in the restriction of the determiner. This approach, which can be varied on in a number of ways (cf. e.g., Heim (1990, pp. 162 ff.)), could be reproduced within our dynamic framework without any particular problem. Recall that indefinites, in spite of not being assimilated to variables in the present framework, can act like variables in virtue of being open. Thus they can

open (i.e., variable-like), one will face most of the problems that our straw man extension of DRT faces.

[29] The line we will explore is compatible with either the static or the dynamic appoach and it therefore doesn't help choosing between them.

be bound as per the schema in (93). So strong readings of donkey sentences can be obtained in a dynamic setting by developing an analysis along the lines in (93) as readily as in other frameworks (and would be inherited by adverbs of quantification which are simply viewed as polyadic counterparts of determiners).

There are, however, several reasons which make me skeptical as to the ultimate viability of this account. I will briefly mention three of them. The first is that the schema in (93) is formally quite complex: it involves two separate quantifications and it results in determiners which are not dynamically conservative (in the sense of definition (68) above). If we analyze *every* as in (93), it is clear that "every man who has a donkey beats it" does not come out equivalent to "every man who has a donkey is a man who has a donkey and beats it". So to claim that determiners can also have the reading in (93) is to claim that they all have a non conservative reading. We can no longer say "determiners are conservative" in an unqualified form. A general and, I believe, useful research strategy in current linguistics is to try to formulate properties of grammar in a maximally general form. The ambiguity hypothesis goes in the opposite direction: it limits dramatically the generality of the conservativity constraint.

The second reason for being weary of the viability of the lexical ambiguity hypothesis has to do with the existence of a systematic gap in the distribution of ∀-readings. No downward entailing determiner (like *no*, *neither*, etc.) has a ∀-reading. For example, (94a) lacks the reading we would expect on the basis of the schema in (93):

(94) a. No father with a teenage son lends him the car on weekdays
b. For no father x that has a teenage son
for every teenage son y that x has, x lends y the car on weekdays

(94b) says that no father lends the car to all his sons. But (94a) says that no father lends his car to any of his son, which is stronger. Allowing only for the ∃-reading is a general characteristic of downward entailing determiners. So we have two lexical properties of determiners, downward entailingness and availability of ∃-readings only, that appear to be systematically, in fact (I suspect) universally related. The question is why. Such a sweeping correlation surely can't be accidental. Yet I see no account of it stemming from the lexical ambiguity hypothesis. Nothing in the schema in (93) would prevent it from applying to a downward entailing determiner. On the basis of the lexical hypothesis, each determiner has the option of choosing an ∃-reading or a ∀-reading. The distribution of ∃-

readings with respect to other lexical properties of determiners is thus expected to be completely random. Yet this isn't so.

The third reason that militates against the lexical ambiguity hypothesis is rather straightforward. The availability of ∀-readings next to ∃-readings is universal. If it was a matter of lexical ambiguity, one would expect there to be languages where this ambiguity is resolved. That is one would expect to find languages where, say, the *every* which has the ∃-reading and the one which has the ∀-reading are realized as different words or morphemes. I am not aware of any language where this is so. This is surprising if the availability of these two types of readings genuinely is to be ascribed to lexical ambiguity.

On the basis of these considerations I am lead to believe that a different explanation must be sought for the availability of ∀-readings. I think that such explanation may derive from the way in which anaphora between positions that are structurally not accessible to one another is dealt with.

4.2. *Anaphora in unaccessible domains*

Dynamic binding comes with a notion of scope, namely accessibility, as does DRT. Descriptively, dynamic binding is possible between an antecedent α and a pronoun β under the following conditions:

(95) a. α can dynamically bind β iff the first closed operator (= quantificational NP, adverb of quantification, negation) that C-commands α, C-commands β.

This characterization of accessibility is not a separate statement in the theory but simply a consequence of how context change potentials are assigned.[30] Now it has been often noted that well-formed anaphoric links between an antecedent α and a pronoun β are sometimes possible even if α is not accessible to β. Here is a sample of the relevant cases:

(96) a. Every man except John gave his paycheque$_i$ to his wife. John gave it$_i$ to his mistress (Karttunen)
b. Morrill Hall doesn't have a bathroom$_i$ or or it$_i$ is in a funny place (Partee)
c. It is not true that John doesn't have a car$_i$. It$_i$ is parked outside
d. John doesn't have a car$_i$ anymore. He sold it$_i$ last month

This list is by no means exhaustive. A striking characteristic of the type of anaphoric links exemplified in (96) is that they appear to be sensitive

[30] Cf. Heim (1982, pp. 196 ff.) or Chierchia and Rooth (1984) for discussion.

to pragmatic factors, such as context, common ground and presuppositions, in a way that plain donkey anaphora (and, for that matter, C-command anaphora) is not. For example, a sentence like (96d) contrasts minimally with:

(97) *John doesn't have a car$_i$. Paul has it$_i$ (vs. "Paul has one" or "Paul does")

The only difference between (96d) and (97) is the presence of the adverbial *anymore*, which presupposes that John used to have a car. This presupposition suffices to license the anaphoric link in (96d). Similar considerations apply, mutatis mutandis, to the other examples in (96).

How do we deal with the kind of anaphora illustrated in (96)? A priori, there are at least two directions one can explore. One is to extend dynamic binding further.[31] The other is to fall back on the view that pronouns can go proxy for descriptions whose content can be reconstructed from the context. The latter is the E-type strategy.

If one extends dynamic binding, one will have to deal with a number of problems. For example, this extended form of binding must be licensed by and highly sensitive to pragmatic factors, while the version of dynamic binding we currently have does not appear to be similarly constrained. Moreover, it is just plain unclear, at present, how such extensions would go. Consider (96d) again. Notice that it doesn't mean something like the following (which is what we would obtain by assigning to the indefinite *a car* wide scope):

(98) There is a car that John doesn't have anymore. He sold it last month

Sentence (98) is compatible with John still having a car, while (96b) is not.

While I have no conclusive evidence that a successful extension of dynamic binding is not viable, I will explore here some consequences of adopting a mixed approach to anaphora, i.e. one that deals with cases like (96) not in terms of dynamic binding but in terms of (some version of) the E-type strategy. This amounts to assuming that there are three types of anaphoric links in the grammar of English: (i) syntactic binding (= coindexing under C-command) (ii) dynamic binding (= coindexing in accessible domains) and (iii) E-type links. Mixed approaches of this kind

[31] This possibility is explored in Groenendijk and Stokhof (1990) and Dekker (1990a), where attempts to deal with some of the cases discussed below in terms of dynamic binding are made.

have been proposed and defended elsewhere in the literature (cf. e.g. Kratzer (1989b)).

One might object that trying to cope with anaphora in terms of a uniform mechanism (be it some version of dynamic binding or some version of the E-type approach) might be a priori desirable. But I find that this objection has no force, certainly not a priori. Anaphora is a highly differentiated set of phenomena. Different kinds of anaphora seem to have different properties (e.g. different degrees of sensitivity to the common ground). A uniform mechanism that deals with highly differentiated set of data generally will have to be more complicated than a mechanism that deal with a limited and uniform subset of them. It is by no means a priori clear that one complicated theory is to be preferred to two relatively simpler, interactive subtheories.

How is all this relevant to our immediate concern (namely the availability of ∀-readings)? Well, if there is an independent pronominalization strategy that must be assumed (which I am asking the reader to grant, at least for the sake of argument), it is conceivable that ∀-readings derive from this other strategy, rather than from a lexical ambiguity of determiners. This would explain right off the bat some of the puzzles that the lexical ambiguity hypothesis leaves open. For example, the fact that no language uses different morphemes for ∃-readings vs. ∀-readings would follow immediately from the fact that the "ambiguity" is in the pronouns (or, better yet, in the pronominalization strategy), rather than in the determiners. Moreover, one could maintain in an unconditional form the conservativity universal, for the availability of ∀-readings could be accounted for without resorting to determiners that are non conservative.

In order to see whether the hypothesis that ∀-readings come from the E-type strategy is tenable, we have to flesh out more explicitly how such strategy works. This is a difficult task, that can be pursued in more than one way.[32] In what follows I will sketch a possibility. While I believe that there are some merits to the specifics of the proposal I will make, it should be kept in mind that the general viability of my main hypothesis (namely that ∀-readings come about via the E-type strategy) is independent of it.

4.3. *On the E-type Strategy*

For the present purposes, it suffices to adopt the view that E-type pronouns are functions from individuals to individuals, where the nature of

[32] Works such as Lappin (1989) or Neale (1991), among others, are relevant here. The line I will propose is, however, somewhat different.

the function is contextually specified. Versions of this view have been defended in Cooper (1979), and Engdahl (1986).[33] Let me illustrate informally how it works with the examples in (96).

(99) a. Every man except John put his paycheque in the bank. John gave f(John) to his mistress
f: a function from individuals into their paycheques

b. Either Morrill Hall doesn't have a bathroom or f(Morrill Hall) is in a funny place
f: a function from places into bathrooms located in those places

c. It is not true that John doesn't have a car. f(John) is parked outside
f: a function from people into their cars

d. John doesn't have a car anymore. He sold f(John) last month
f: a function from people into the car they used to have

So the idea is that in these cases the common ground sets up a function from individuals into individuals and such a function is what is used in interpreting the pronoun.[34] A question that arises in this connection and that has been widely discussed is whether, besides this pragmatically driven construal of E-type pronouns, they also involve a syntactically instantiated and semantically significant link between the pronoun and its antecedents. I would like to side with those who claim that they do. I will assume, in particular, that E-type pronouns are coindexed with their antecedents (as indicated in (96)) and that such a coindexing determines the interpretation. Syntactically such a coindexing plays the usual role, namely that of guaranteeing sameness of gender and number specifications. Semantically, however, it is interpreted differently from coindexing in accessible domains. I think that what E-type linking does is constraining the function that interprets the E-type pronoun, by determining its range. So, for example, the coindexing in (96a) between *it* and *his paycheque* forces the function to have the set of paycheques as its range. Similarly, the coindexing in

[33] Also Heim (1990) discusses such a view, even though she eventually discards it.

[34] I am using the notion of "individual" rather liberally here. After all, paycheck sentences come in all sort of guises. One reviewer points out the following example:

(a) Every man except John wrestles with [the question of the meaning of his life]$_1$. John thinks he has solved it$_1$.

Here we want *it* to be interpreted as a function from people into questions. This tolerance of it-anaphora for all sort of antecedents is well known and totally independent of our specific proposal. It is something that any theory of anaphora has to deal with. Note also that assuming that individuals come in many sorts by no means excludes the possibility that certain phenomena may be sensitive to certain sortal distinctions.

(96b) between *it* and *a bathroom*, forces the function to have the set of bathrooms as its range. And so on. The generalization that emerges is the following:

(100) In a configuration of the form $NP_i \ldots it_i$, if it_i is interpreted as a function, the range of such functions is the (value of the) head of NP_i.[35]

I propose to use something along these lines as a characterization of an E-type link. Such a link ends up being largely pragmatically determined, but not totally so, as it comes with an interpretive principle that constrains its meaning. So E-type pronouns are interpreted as variables ranging over functions, where the common ground determines their values, modulo the constraint in (100).

One consequence of adopting something like (100) is that it enables us to explain the ungrammaticality of sentences like (101).

(101) *Every donkey owner beats it

This sentence does appear to make salient a function from donkey owners into the donkeys they own. Yet such function cannot be used in interpreting the pronoun *it*, as attested by the ungrammaticality of (101). The reason is that in order to be licensed as an E-type pronoun, *it* needs an antecedent. The only possible antecedent in (101) is the NP *every donkey owner*. But coindexing with such NP (besides being ruled out by the binding theory) would force *it* to be interpreted as function whose range is the set of donkey owners, not the set of donkeys, whence the ungrammaticality of (101) on the intended interpretation. If E-type links were a purely pragmatic phenomenon, it would be hard to see why (101) should be ungrammatical.

What does the E-type strategy yield in donkey anphora contexts? If we interpret the donkey pronoun as an E-type pronoun, the logical form of a typical donkey sentence such as (102a) will be something like (102b) (putting aside the dynamic interpretation as it is irrelevant in the case at hand).

(102) a. Every man who has a $donkey_i$ beats it_i

b. $\forall x[[\text{man}(x) \wedge \exists y[\text{donkey}(y) \wedge \text{has}(x, y)]] \rightarrow \text{beat}(x, f(x))]$

[35] This is actually a simplification. Certain cases of anaphora that arguably falls within the domain of E-type linking (such as Geach's Hob-Nob sentences) may require an elaboration of this idea. I think that such elaboration can be successfully worked out, but space prevents us from getting into this question here.

Principle (100) forces the function in (102b) to be donkey-valued. Now, one natural way to interpret the function in (102b) is as a map from each man into the donkey he owns. This is natural, however, only if the common ground makes it clear that each of the relevant men owns just one donkey, or that each man has one donkey with contextually specified characteristics that make it in some sense unique (say, we are talking about the most stubborn among the donkeys each man has, or something of the sort). If the context provides such a relativized uniqueness presupposition for donkeys, then the interpretation of the function in (102b) is straightforwardly determined.

But this is not the only possibility. It is also conceivable that the context lacks such a strong form of relativized uniqueness. In fact, the poorer the common ground, the less likely it is that one will be able to assume a form of uniqueness. Still, in some obvious sense, the sheer utterance of a sentence like (102a) does make a donkey-valued function salient. But it won't be a function from that maps each men into *the* donkey he owns. It will have to be a function that maps each man into *one* of the donkeys he owns. It will be, thus, a choice-function. And, consequently, it won't in general be unique. This type of contexts will make salient not just one function but a family of functions, all of which are a priori good candidates for interpreting (102b). How is it plausible to maintain that (102b) is interpreted in these cases? I think that the logic of the situation suggests pretty clearly that we want to say that (102a) is true just in case it is true relative to every possible assignment of the variable f to the functions that the context makes salient. This yields the $\forall$-reading of (102a).

We can look at the problem in slightly different, though equivalent terms. (102b) is a formula that contains a free variable. I am assuming that formulae with free variables are true iff they are true relative to every possible assignment to such variables. This is one of the standard truth-definitions one finds in elementary logic textbooks. I am simply integrating this standard truth-definition with another pretty standard view that the context in some sense supplies values for free variables. In particular, I am assuming that the range of values for free variables of this sort is not totally free, but is constrained by principle (100) and by the common ground. More specifically, the common ground may narrow down the range of possible candidates to one function or to a set of functions. The latter situation typically will obtain when the choice of the function won't make a difference to the truth-value of the sentence in question. This provides us with the intuitive rationale for adopting this particular definition of truth.

The reader familiar with Kadmon (1990) will have recognized her ideas in what I just presented. My own implementation of Kadmon's ideas, however, is not aimed at rescuing a form of uniqueness in donkey anaphora (which I do not believe holds in general), but rather at formulating one way of making the E-type strategy precise.[36] What emerges is something which is equivalent to the number-neutral definite readings of E-type pronouns (such as those advocated in Lappin (1989) or Neale (1991)), but arguably simpler than other available proposals, in that it is based solely on principle (100).

It may be worth noticing that while very flexible, the version of the E-type strategy we have presented still rules out correctly a number of cases like (101) above. It also accounts for the following well-known type of contrast, due to B. Partee:

(103) a. *I lost ten marbles and found nine of them. It is under the sofa
b. I lost ten marbles and found all but one_i. It_i is under the sofa

The reason why (103a) is out is simply that E-type pronouns need a syntactic antecedent and in (103a) there is none that can play this role (the syntactic features of the NP's in the first sentence do not match the features of the pronoun *it*). In (103b), instead, we do have a possible antecedent for *it*.

The present theory can also arguably explain the oddity of sentences like (104).

(104) *Every man_i walked in. I saw him_i.

To see what may be wrong with (104), consider first the cc of the first sentence in (104). Assuming that there is a Davidsonian argument, there are two possibilities, namely:

(105) a. $\uparrow \forall x[\text{man}(z\text{x}) \rightarrow \exists o[\text{walk in } (x, o)]]$
b. $\underline{\exists} o \uparrow \forall x[\text{man}(x) \rightarrow \text{walk in } (x, o)]$

If a function is made salient by uttering the first sentence in (104), it will be a something like a function from occasions into men that walked in at that occasion. So, we might interpret the second sentence as follows:

(106) $\underline{\exists} o' \uparrow [\text{saw}(\text{I}, f(o), o')]$

[36] One of the referees suggests that my proposal as a reconstruction of Kadmon's ideas is inaccurate, in that for Kadmon the situation where more than function is available arises only when it is not just the case that which function we pick doesn't make a make any difference to the *truth-value* of the sentence (as I am assuming) but when it doesn't make a difference to the *truth-conditions* of the sentence, given the relevant common ground. This is true, but I am not presenting Kadmon's ideas here. I am developing my own proposal (which is inspired by Kadmon's work).

f a function from occasions into men that walked in at that occasion

Now if we adopt (105b) as the logical form of the first sentence in (104), it means that we are looking at the event introduced by the first sentence as one at which all the men walk in, i.e. we are lumping the walk-ins of various men into one single event. But then a function from occasions to groups of men will be more salient than one from occasions to single men. This may be at the basis for the ungrammaticality of (104) relative to the grammatical (107):

(107) Every man$_i$ walked in. I saw them$_i$.

If, on the other hand, we take (105a) as the logical form for the first sentence in (104), the variable o in (106) remains unbound. This means that the context must specify a value for it. Failing that, the sentence will be uninterpretable. It is also possible for the context to specify not just one occasion, but a range of occasions. In such a case, as we have argued, (106) would be interpreted as its universal closure, i.e. roughly as:

(108) $\underline{\forall} o \underline{\exists} o' \uparrow [\text{saw}\,(\text{I}, f(o), o')]$
where $o \in \text{D}$, for some contextually specified D.

This requires some overarching set of relevant occasions that are known to be what we are talking about. The expectation is that in contexts of this sort a sentence like (104) ought to be acceptable. And indeed in cases where some set of iterated occasions is made salient, sentences isomorphic to (104) become acceptable, as it has often been pointed out in the literature (cf. e.g. Roberts (1987)). For example:

(109) Every soldier walked to the podium. The queen greeted him and handed him the medal.

My intuition is that contexts like those that go naturally with (109) are marked, require some extra work. This might be due to the fact that the preferred interpretation for sentences like (104) (or (109)) is of the form given in (105b) rather than (105a). I.e. the Davidsonian argument is generally interpreted as having wide scope relative to its clausemate NP's. It follows then that the sheer utterance of the first sentence in (104) will make immediately salient just one eventuality, not a range of eventualities. The existence of a prominent range of relevant eventualities can be inferred, which requires extra work, or can derive from other special features of the context.

I realize, of course, that this cursory remarks cannot be wholly convincing, especially in the absence of a more careful discussion of the role of eventualities. Still, I think they suggest a line of inquiry that may be worthy of pursuit.

Another consequence of the present approach is that it explains why downward entailing operators like *no* lack a ∀-reading, which was one of the problems that the lexical ambiguity hypothesis encountered. To see how it goes, consider again (110a) and its E-type interpretation given in (110b).

(110) a. No father with a teenage son$_i$ lends him$_i$ the car on weekdays
b. $\forall x[[\text{father}(x) \wedge \exists y \text{ teenage son of } (y, x)] \rightarrow \neg\text{lend the car on weekdays } (x, f(x))]$

Suppose that we are in a context where f is interpreted as a function from fathers into one of their teenage sons. In such contexts, (110b) will be true iff it is true relative to all such functions. Therefore, if a father lends the car to one of his sons, but not to another, the sentence is predicted to be false. Thus we get truth-conditions that are equivalent to those we get by interpreting (110a) via the ∃-reading. This is completely general, I believe. With downward entailing determiner, ∃-readings (obtained via the dynamic binding strategy) and readings obtained via the E-type strategy turn out to be equivalent, which is a welcome result.

These considerations seem to lend support to the hypothesis that ∀-readings come about not by means of dynamic binding but in terms of a different and arguably independently needed strategy of pronominalization, namely the E-type strategy.

5. Some Comparisons

The topics I have dealt with in the present paper are at the heart of an intense ongoing debate. Even if I were to limit myself to a consideration of the most influential positions that have been advocated, there is no hope that I will be able to draw comprehensive comparisons between them and the approach I have presented here. There are, however, two recent papers (Heim (1990) and Kratzer (1989b)) which I find very insightful and that have a particularly substantial overlap with the concerns of the present work. Even though I will not be able to do full justice to them, I think it is appropriate to indicate where the main substantive differences between those theories and mine are to be found.

5.1. *Heim* (1990)

In this paper, Heim explores and defends a theory of donkey anaphora which doesn't exploit dynamic binding, but solely relies on the E-type strategy. In her previous work, Heim had been one of the most articulate critics of the E-type approach. The bulk of her criticisms was twofold:

(i) The E-type strategy relies on a purely pragmatic link between pronouns and their antecedent, which leads to inadequacies.
(ii) Such a strategy also leads to exceedingly strong uniqueness conditions on pronouns.

Problem (i) is exemplified by contrasts such as (111), discussed above and repeated here:

(111) a. every man who has a donkey beats it
b. *every donkey-owner beats it

Problem (ii) is exemplified by "sage plant" sentences like:

(112) every man who bought a sage plant bought five others with it

In her 1990 paper, Heim tries to obviate to these shortcomings of the E-type approach in two ways:

(i) by establishing a formal link between E-type pronouns and their antecedents,
(ii) by introducing quantification over situations.

Heim's approach to (i) bears analogies with some current proposals on VP-anaphora. It is based on a transformation (part of the map from Surface Structure into Logical Form) that adjoins to a pronoun its antecedent as follows:

(113) $\underset{1}{X}\quad \underset{2}{S}\quad \underset{3}{Y}\quad \underset{4}{NP_i}\quad \underset{5}{Z} \Rightarrow 1\quad 2\quad 3\quad 4+2\quad 5$
conditions: 4 is a pronoun and 2 is of the form $[_S NP_i\ S]$

Let's illustrate its workings by means of an example. Take a classic donkey-sentence, like (114a). Its structure, after Quantifier Raising (QR), will be something like (114b).

(114) a. every man that owns a donkey beats it
b. [every man$_1$ that **[a donkey$_2$ that [t$_1$ own t$_2$]]**][t_1 beats it$_2$]]

Tansformation (113) applies to (114b) (where term 2 has been marked in boldface) and yields:

(115) [every man_1 that [a donkey_2 that [t_1 own t_2]][t_1 beats [it_2 [*a* $donkey_2$ *that* [t_1 *own* t_2]]]]]

The structures so generated are then interpreted as definite descriptions. In particular the constituent italicized in (115) is interpreted as shown in (116a), using the general rule given in (116b).

(116) a. [it_2 [a donkey_2 that [t_1 own t_2]]] $\Rightarrow \iota x_2[\text{donkey}(x_2) \wedge \text{own}(x_1, x_2)]$

b. $[\![[[\text{it}\ [\text{DET}\,\alpha]_i\,\beta]]\!]^g$ = the unique a such that $a \in [\![\alpha]\!]^g$ and $[\![\beta]\!]^{g[a/t_i]} = 1$ (undefined if there is no such a)

The point of this is to provide an explicit way to reconstruct the relevant descriptive content that enables one to interpret pronouns. Examples like (111b) are ruled out on this approach simply because they do not meet the structural description for the transformation in (113).

The second main aspect of Heim's proposal is to relativize the descriptive content reconstructed by (113) to appropriate situations so as to avoid too strong uniqueness presuppositions. The notion of situation Heim uses is borrowed from Kratzer's (1989a) work on conditionals: a situation is simply part of a world. Situations are primitive objects partially ordered by a part-of relation ('$\leq$'), where worlds are maximal elements with respect to $\leq$. Predicates have an extra argument ranging over situations. For example:

(117) a. $\text{man}(s, x)$

b. $\text{beat}(s, x, y)$

Formula (117a) says that x is a man in s and (117b) that x beats y in s. Within this set of assumptions, one can maintain that indefinites are existentially quantified NPs and that adverbs of quantifications quantify over situations. Let us flesh Heim's proposal out a bit more, by considering first how conditionals are treated. Then we will turn briefly to relative clause variants of donkey sentences.

A conditional like (118a) is assigned the truth conditions in (118b).

(118) a. If a man owns a donkey, he is happy

b. every minimal situation s in which there is a man and a donkey owned by that man is part of a situation s' where the man in s is happy.

It may be useful to reconstruct how the truth-conditions in (118b) are arrived at. Sentence (118a) is mapped onto the following logical form:

(119) always_s if [a $\text{man}_{s,1}$ [a $\text{donkey}_{s,2}$ [t_1 owns_s t_2]]]$_{s'}$[he_1 is $\text{happy}_{s'}$]

This is then transformed by (113) into (120a), which is interpreted as shown in (120b).

(120) a. always$_s$ if [a man$_{s,1}$ [a donkey$_{s,2}$ [t_1 owns$_s$ t_2]]]$_{s'}$[he$_1$ [a man$_{s,1}$ [a donkey$_{s,2}$ [t$_1$ owns$_s$ t_2]] is happy$_{s'}$]

b. $\forall s[\exists x_1 \text{ man}(s, x_1) \wedge \exists x_2 [\text{donkey}(s, x_2) \wedge \text{own}(s, x_1, x_2)]] \rightarrow \exists s'[s \leqslant s' \wedge \text{happy}'(s', \iota x_1[\text{man}(s, x_1) \wedge \exists x_2 [\text{donkey}(s, x_2) \wedge \text{own}(s, x_1, x_2)]])]]$

The quantifiers over situations in (120b) are understood as ranging over minimal situations, which is what enables us to achieve the effects of quantifying over n-tuples. Descriptions are relativized to situations and thus we are never going to get overly strong uniqueness conditions. In particular, the sage-plant example will work fine: we quantify over minimal situations in which a person buys a sage plant; each such situation must be part of a larger one in which the person buys five more.

What about asymmetric readings of conditionals? To make a long story short, the strategy that Heim pursues is roughly the following. Instead of quantifying over minimal situations in which, say, a man owns a donkey, one can quantify over smaller situations. For example, one can quantify over situations in which there is a man that are part of situations in which that man owns a donkey. This will get us the effects of quantifying over donkey-owning men and thus will get us the subject asymmetric reading. Or we can quantify over minimal situations in which there is a donkey that can be extended to situations in which the donkey is owned by a man. This amounts to quantifying over donkeys and will get us the object-asymmetric reading. I give a sketchy illustration of the object-asymmetric reading of (121a) in (121b–c).

(121) a. If a man owns [$_T$a donkey], it gets beaten

b. Logical form: always$_s$ [a donkey$_{s,1}$ $_{\mathbf{s}}$[a man$_{s,2}$ [t_2 owns t_1]]] $_{s'}$[it_1 gets beaten]

c. Truth-conditions: $\forall s[\exists x_1[\text{donkey}(s, x_1) \wedge \exists s''[s \leqslant s'' \wedge \exists x_2 [\text{man}(s'', x_2) \wedge \text{owns}(s'', x_2, x_1)]]] \rightarrow \exists s'[s \leqslant s' \wedge \text{beaten}(s', \iota x_1[\text{donkey}(s, x_1)])]]$

(121c) says that every situation s with a donkey in it that is part of a situation where that donkey is owned by a man is also part of a situation where the donkey in s gets beaten. The key step in the derivation of this reading is to allow for S nodes to be indexed by situations (cf. the s in boldface in (121b)) and to set up an interpretive procedure whose effect is to map structures like (121a) into formulae like (121c) (I refer to Heim's paper for details).

Let me now turn briefly to Heim's treatment of relative clause cases of donkey anaphora. Here too we face the task of avoiding too strong uniqueness presuppositions in sage-plant sentences. The strategy that Heim adopts is common to much work on this topic and was discussed above in Section 3.5. The idea is that sentences such as those in (122a) involve in fact two nested quantifications:

(122) a. most people that owned a slave also owned his offspring
$\Rightarrow$ for most people that owned a slave: for every slave they owned they also owned his offspring
b. No parent with a teenage son will lend him the car
$\Rightarrow$ for no parent with a teenage son: there is a teenage son to which he or she lends the car

The main quantificational force is the one standardly associated with the determiner that heads the NP containing the relative clause. Each indefinite inside a relative clause is either universally or existentially quantified over (depending on the determiner heading the NP containing the relative clause). Heim provides a version of this approach using again quantification over situations. I give here only informally an example of her implementation:

(123) most people that owned a slave also owned his offspring
$\Rightarrow$ for most people that owned a slave: every minimal situation s where they owned a slave is part of a situation s' where they also owned the offspring of the slave they owned in s.

Here uniqueness presuppositions are again relativized to suitably constructed minimal situations and hence they do not yield any counterintuitive result.

Heim argues that if one compares classical DRT (which has to make heavy use of accommodation) with her version of the E-type only approach, the E-type approach comes out better. In fact, Heim's theory constitutes one of the most thoroughly worked out attempts to dispense with dynamic binding. I now turn to discuss the main areas where her theory and mine differ and point out some reasons why I find the mixed approach developed in the present paper preferable. I will begin with empirical differences and then I'll turn very briefly to more conceptual ones.

A first thing to notice is that Heim doesn't discuss weak readings of donkey sentences at all. If, as I have argued, such readings are there, it remains to be seen how they could be analyzed in terms of the E-type strategy. Prima facie, it is not obvious how to proceed.

A second thing to notice is that Heim, as she explicitly admits, has no account for symmetric predicates in conditionals, such as:

(124) a. If a cardinal meets someone he blesses him.
b. If a man shares an apartment with another man, he shares the housework with him. (van Eijck)

The problem for Heim's theory here is that the minimal situation we have to consider is one with two cardinals for (124a) and one with two men for (124b). Thus we don't have at our disposal any suitable description to identify the referents of the pronouns in the consequent. The theory developed in the present paper, per contrast, makes the right predictions in this connection.

A third interesting empirical difference between Heim's theory and mine has to do with the asymmetric readings of conditionals. Heim is committed to claiming that asymmetric readings of conditionals always trigger certain uniqueness presuppositions (following on this Kadmon 1990). To see why, consider yet again the following sentence:

(125) If a man owns a donkey, he beats it.

Consider the subject asymmetric reading of (125). In order to get such reading in Heim's theory, we must quantify over minimal situations in which there is a man. Think now what description can we use to pick the reference of the pronoun *it* in the the consequent. It can only be something like "the donkey that the man in s owns". So donkeys have to be unique relative to donkey owners. My intuitions do not sustain this claim. I don't get such uniqueness effect, or at least not systematically. Let me try to substantiate my intuitions a bit. Consider the discourse in (126)

(126) In Italy, most donkey owners own more than one donkey. The most famous donkey owner is the avvocato Gianni Asinelli: he owns more than half of the donkeys in the country and treats them well. Yet, in spite of his good example, *usually in Italy, if someone owns a donkey. he beats it.*

I think that the underlined sentence makes perfect sense and in fact describes a possible state of affairs. I believe that Heim's theory would predict it to be necessarily false or uninterpretable. For the presence of Gianni Asinelli makes the sentence false on the symmetric reading. The majority of pairs that satisfy the antecedent do not satisfy the consequent. The sentence is only true in one of its asymmetric readings. But this would force either each man to own just one donkey or each donkey to be owned by just one man. But of course neither of these need to obtain for (126) to be true. On this basis, I conclude that Heim's approach does not quite succeed in getting rid of all the overly strong uniqueness presuppositions that an E-type only approach to donkey anaphora gives rise to.

There are also a number of less immediately data driven differences between the two theories. I will briefly mention three of them. The first concerns the treatment of NP's, which doesn't seem to be uniform in Heim's theory. Indefinites are treated as ordinary existential quantifiers. Quantifiers like *most* and *every* instead appear to be binary quantifiers over individuals and situations. This suggests that indefinites and quantifiers like *every* will be of different types, which generally spells trouble when it comes to dealing with coordination.

A second thing to note is that Heim is forced to adopt a complicated schema to give the semantics for closed quantifiers, a schema which corresponds to our (93) above and is open to the problems discussed in Section 4.5. And finally, while Heim's theory does away with accommodation, it adopts something which is closely related to it, namely a transformation on logical form such as (113). If the line on E-type pronouns I have sketched above turns out to be tenable, such a transformation on logical form can be dispensed with. These are the main reasons that make me hope and believe that the line explored in the present paper is more on the right track than Heim's.

5.2. *Kratzer* (1989*b*)

Kratzer, building on work by Diesing (1988), argues that stage-level and individual levels predicates differ in argument structure and that this difference has far reaching consequences for a theory of anaphora. In particular, she claims that this difference in argument-structure sheds light on the proportion problem. I will not be able to discuss here every aspect of Kratzer's proposal. I will try, however, to indicate where the main empirical differences between my approach and hers lie. I will begin by summarizing the aspects of Kratzer's proposal that are most directly relevant to the problems we are concerned with in the present paper. In doing so, I will have to presuppose some familiarity with the government and binding framework, that Kratzer adopts.

The difference between individual-level and stage-level predicates was systematically studied in Carlson (1977) and has to do with contrasts such as those in (127) and (128).

(127) a. There is a fireman available
      b. *There is a fireman altruistic

(128) a. Firemen are available
b. Firemen are altruistic

As (127) illustrates, in there-sentences only certain adjectives can occur felicitously. Intuitively, those are adjectives that express a transient or episodic property of entities. These adjectives are stage-level predicates. Adjectives like "altruistic" express instead a more or less stable or tendentially permanent property of entities and are accordingly classified as individual-level predicates. This difference manifests itself in a different manner in the sentences in (128). (128a) has a reading where the bare plural subject is understood as being existentially quantified. On such a reading (128a) is roughly equivalent to "some firemen are available". This is the most prominent (though not the only) reading of (128a). In contrast, (128b) cannot be interpreted in a parallel fashion. It cannot mean something like "some firemen are altruistic". (128b) has only a generic, quasi-universal reading, roughly paraphrasable as "most firemen are altruistic" or "typically, firemen are altruistic". So individual-level predicates select the quasi-universal or generic reading of bare plurals.

This distinction doesn't apply just to adjectives but to all predicates. For example, "attack" is a stage-level predicate. This can be seen from the fact that (129) has an episodic reading:

(129) Italian hooligans attacked us

Accordingly the bare plural subject in (129) is understood existentially. Per contrast, "love" is individual-level. The only reading of (130) is generic

(130) Italian hooligans loved to attack old ladies

The bare plural subject here is understood quasi-universally. I refer to Carlson (1977) for further discussion.

The main novelty of Kratzer's proposal consists of the claim that this distinction is reflected in argument structure. Stage-level predicates have an extra argument for spatio-temporal locations, individual-level ones don't. So, for example, (131a) has the argument structure in (131b):

(131) a. John is available
b. $\text{available}'(j, l)$

l is a variable ranging over space-time locations. (131b) says roughly that John is available at l. A sentence involving individual-level predicates like (132a) has, according to Kratzer's proposal, the argument structure given in (132b):

(132) a. John is altruistic
b. altruistic′(j)

Kratzer's proposal is in the same spirit as Davidson's (1967) approach to action-sentences. But Kratzer claims that only stage-level predicates have an extra Davidsonian argument.

One of the main argument in support of this claim is based on the paradigm in (133)–(134)

(133) a. When John is happy, he sings
b. When a fireman is happy, he sings
(134) a. *When John is altruistic, he is a good fireman
b. When a fireman is altruistic, he is a good fireman

Kratzer sticks to the main assumptions of classical DRT, concerning these sentences. So she assumes that indefinites are free variables and that in (133)–(134) there is an implicit adverb of quantification. Putting this together with the hypothesis that predicates differ in argument structure along the lines just indicated, (133a) is assigned the logical form given in (135a) and (134a) the one given in (135b).

(135) a. always_1 [happy′(j, l)][sing′(j, l)]
b. always [altruistic′(j)][good fireman′(j)]

This suggests a natural explanation for the contrast in (133)–(134). In (133a) the space-time location provides a variable for the adverb of quantification to bind. But in (134a) there is nothing for such an adverb to bind. The quantification in (134a) is vacuous, whence its deviance. Per contra, in (134b) the indefinite subject provides a variable for the adverb of quantification to bind, and this is why (134b) is grammatical.

In order to explain why individual-level predicates select the universal reading of bare plurals, Kratzer (elaborating on Diesing's work) adopts the following widely shared assumptions from the syntactic literature. Predicates have at most one external argument (cf. Williams (1981)), i.e., at most one of their arguments can be realized outside of their maximal projection. For verbs, this means that only one of their arguments is realized outside of V^{max}. Kratzer then conjectures that the space-time argument of stage-level predicates is always the external one. This entails that the surface subject of these verbs must be generated inside the VP. In languages like English, the VP-internal subject is then moved to its S-structure position (that is, Spec of IP). Individual-level predicates lack this extra argument and thus have the option of selecting one of their other arguments as the external one. This means that in English stage-level predicates and individual-level predicates will have different S-structures. Stage-level predicates will have in the VP a trace coindexed with the subject in Spec of IP. Individual-level predicates in general won't. Kratzer then assumes that there is a rule that closes existentially material in the VP. This rule is meant to replace the rule of existential closure of classical DRT which applies at the discourse level and guarantees that all indefinites not in the scope of a suitable binder are interpreted as being existentially quantified.

To see what consequences these assumptions have, let us consider a specific example. Consider a sentence with a stage-level predicate such as

(136) Firemen are available

Such a sentence will have roughly the structure in (137)

(137) $[_{IP}$ firemen$_3$ are $[_{VP}$ t_3 available$]]$

How are these structures interpreted? There is evidence coming from raising (cf. May (1977)) which suggests that in cases like these, NP's can either be interpreted in situ or reconstructed back into the position of the trace. If it is reconstructed back into the trace-position, the variable associated with *firemen* (which is taken to be just an indefinite) will be caught by the VP-level rule of existential closure. This will yield the existential reading of (136). If instead it is left in situ, it becomes possible to bind the variable associated with *firemen* with a generic operator. This will result in the generic interpretation of (136). The interesting point in this connection is that individual-level predicates don't have this option, for they originate outside of the VP and thus there is no position within the VP into which they can be reconstructed. Consequently, they can only get a generic interpretation. This accounts for the difference in quantificational force associated with stage-level vs. individual-level predicates.

The assumption that VP's are always existentially closed has far reaching consequences. It entails that no indefinite within the VP can, in the terminology of the present paper, act as a dynamic binder. Consider for example the following discourse.

(138) Mary has a dog. It is a beagle.

Unlike what happens in classical DRT, the pronoun *it* here cannot be understood as being bound by the indefinite *a dog*, for the variable associated with the latter will be existentially closed within the minimal VP containing it. Thus a different pronominalization strategy is called for. Kratzer assumes that in cases such as these one falls back on a version of the E-type strategy. The pronoun is understood as a description of some sort.

Kratzer notices, further, the contrast in (139).

(139) a. ?When Pedro has a donkey, he beats it
b. When Mary knows a foreign language, she knows it well

The ungrammaticality of (139a) is predicted by Kratzer's theory. The indefinite in (139a) occurs within the VP and thus it is existentially closed. Since the predicate is individual-level, there is no variable for the implicit quantificational adverb to bind. This is a welcome result. But why is then the structurally parallel sentence (139b) grammatical? Something must allow the object of *know* (but not the object of *have*) to escape existential closure. That something, Kratzer proposes, is scrambling. Scrambling is a process that moves an NP and adjoins it to IP. In languages like German such a process occurs at S-structure, while in languages like English it occurs, according to Kratzer, at Logical Form (and thus it is "invisible"). The factors that influence scrambling are still poorly understood. But Kratzer argues that the verbs that allow overt scrambling of their objects in German are the same that pattern like *know* in structures like (139b). This provides an interesting empirical support in favour of her hypothesis. So the possibility for an indefinite within a VP to bind something outside of its S-structure scope is tied to its scrambability.

Kratzer's main hypothesis that stage-level and individual-level predicates differ in argument structure is, I think, compatible with the approach we have developed. There are reasons, however, to doubt the ultimate viability of the some aspects of Kratzer's proposals. I will now try to flesh out what they are.

Let us begin by considering Kratzer's treatment of conditionals. It will suffice for my purposes to discuss two cases involving individual-level predicates. Consider the following example from Kratzer:

(140) Usually when a house has a barn, it has another one next to it

This is a sage-plant sentence. The object of the when-clause is existentially closed, so we quantify over houses with a barn. The problem is how the second *it* in the main clause is going to be interpreted. As dynamic binding is not available, we have to resort to the E-type strategy. The problem is to do so without imposing too strict uniqueness requirements. We can't resort to quantification over situations as Heim does, for we are dealing with an individual-level predicate. Kratzer proposes that the second *it* in the main clause is interpreted as a variable and that the relevant descriptive content associated with it is accommodated within the nuclear scope of *usually*. The result of this process will be something like:

(141) $\text{Usually}_x\,[\text{house}(x) \wedge \exists y\,[\text{barn}(y) \wedge \text{has}(x,y)]]\ \exists y, z[\text{barn}(z) \wedge \mathit{barn}(y) \wedge \mathit{has}(x,y) \wedge y \neq x \wedge \text{next to}(z,y)]]$

The accommodated part is italicized. The result of accommodation is to bring the variable associated with the second occurrence of *it* inside the scope of ∃ which existentially closes the VP of the main clause. Thus, y in the nuclear scope will be caught by ∃. The truth-conditions one gets as a consequence of this are the weak ones.

There is a question as to how this form of accommodation fits within a general theory of definites. Be that as it may, the point is that (140) is predicted not to have asymmetric reading, for the object of *have* cannot be scrambled, according to Kratzer. I believe that this prediction is wrong. While this may be difficult to detect for (140), there are fully parallel examples where this is quite clear. The following illustrates:

(142) Usually, when a father has a teenage son, he doesn't lend him the car on week-days.

Here quite clearly every pair $\langle x, y\rangle$ where x is a father and y one of x's sons counts for the truth of (142). The logical form that Kratzer's approach would get us is:

(143) $\text{Usually}_x\ [\text{father}(x) \wedge \exists y[\text{teenage son}(y) \wedge \text{has}(x,y)]]\ \exists y[\mathit{teenage\ son}\ (y) \wedge \mathit{has}(x,y) \wedge \neg\text{lend the car etc.}\ (x,y)]]$

The italicized part is accommodated as in example (143). The point is that the truth-conditions we get in this case are too weak. According to them, we are comparing the number of fathers with a teenage son, with the number of fathers which lend a car to one of their teenage sons. But this is not right for (142). It is unclear how to get the right predictions for both (140) and (142) in Kratzer's terms.

There is a parallel prediction that Kratzer makes which is also, in my opinion, not quite borne out by the facts. When-clause with verbs like *know* (which allow for scrambling of their objects) are expected to allow for a subject asymmetric reading (if the object is not scrambled) and for a symmetric reading (if the object is scrambled) but to disallow an object asymmetric reading, for there is no way to lower the subject inside the scope of existential closure. I do not think that this is true in general. Consider the following discourse.

(144) I teach in a department of linguistics where there are students who speak many foreign languages. And the interesting thing is that when a student of mine knows a language other than English, rarely he or she learned it in high-school.

I think that the last sentence of the discourse in (144) would be true in the following circumstances. I have 50 students. 30 are native speakers of (or have near native fluency in) languages other than English or French (i.e., one is a native speaker of Yoruba, one of Icelandic, etc.). They all learned French (and only French) in high school. What makes the relevant sentence of (144) true in this context is that few languages that a student of mine knows were learned in highschool. But this is precisely the object asymmetric reading, which Kratzer claims to be absent. On the other possible readings, it is easy to see that the sentence in question would be false.

This seems to show that Kratzer's treatment of conditionals runs into empirical difficulties. I believe that her treatment of donkey anaphora in relative clauses also runs into difficulties, but I will not pursue them here. I'll rather address a different type of problem, pointed out in De Hoop and De Swart (1989). Consider:

(145) a. *When John dies, he is unhappy
b. *When John destroys this house, he destroys it thoroughly
c. *When John kills this rabbit, he kills it cruelly

These sentences are all ungrammatical, just like Kratzer's examples involving individual-level predicates, like:

(146) *When John knows French, he knows it well

Yet all of the predicates in (145) are stage-level. Thus, according to Kratzer they will contain a variable ranging over space-time locations. Hence, the ungrammaticality of (145) cannot be blamed on a constraint against vacuous binding.

Various hypotheses come to mind in this connection. What is it that (145) and (146) have in common? They all characterize situations which in a sense cannot be naturally iterated. This can be seen by the oddity of (147a–d) contrasted with the naturalness of (147e–f):

(147) a. ??John died twice
b. ??John destroyed this house twice
c. ?? John killed this rabbit twice
d. ??John knew French twice
e. John was in New York twice

f. John kissed Mary twice

This suggests, as De Hoop and De Swart point out, that when-clauses (when they are in construction with adverbs of quantification) dislike eventualities that are not naturally iterable. It can be viewed as a kind of plurality presupposition: for a when-clause to be felicitous it must be possible for there to be more than one eventuality of the relevant type satisfying the when-clause.

Whether something along these line ultimately works out or not, it is likely to be the case that whatever accounts for the ungrammaticality of the sentences in (145) will also account for the ungrammaticality of Kratzer's (146). This seems to undermine one of the main argument for treating the stage-level vs. individual-level contrast as a difference in argument structure.

To summarize, it emerges from these considerations that Kratzer's proposal is at the same time too innovative and too conservative with respect to classical DRT. It is too innovative in that the existential closure at the VP level undermines too much of the accessibility relation. It leaves too little to dynamic binding and it puts on the E-type strategy a burden that it can't carry without giving rise to serious empirical problems (at least, at our present level of understanding of the E-type strategy). Kratzer's proposal is also too conservative, in that it adheres too closely to the classical DR-theoretic principle that indefinites are free variables, which, as I have tried to argue, is the ultimate source of the proportion problem. As far as I can see, all of the problems considered in this section are handled adequately by the theory presented in this paper.

6. Conclusions

In this paper I have argued for an approach to donkey sentences that assigns them weaker truth-conditions than those that standard DRT assigns them. I have also provided some arguments in favour of an approach to anaphora that integrates dynamic binding with the E-type strategy. I have suggested that the stronger truth-conditions that donkey sentences also have are due to the latter pronominalization strategy. Using an extensional version of the dynamic logic investigated by Groenendijk and Stokhof, I have developed a theory of adverbs of quantification which accommodates symmetric and asymmetric readings of if/when clauses. I have also provided a general way to define dynamic determiners in terms of their static counterparts that preserves the conservative character of the latter. Determiners and adverbs of quantification turn out to be closely related, and in fact can be viewed as different instantiations of the same functions. Finally, I have tried to chart out some of the empirical differences with other approaches and indicated where I think the present proposal appears to be more on the right track.

One of my goals was to explore the everlasting issue of "complicating the syntax" vs. "complicating the semantics". While I don't think I have any a priori dislike for construal rules, I fail to see in what way the kind of rules necessary to deal with donkey anaphora enlighten our understanding of how logical form works. One can achieve descriptive adequacy, as there is no phenomenon that a sufficiently liberal set of construal rules is inherently unable to describe. Much like there is no phonological phenomenon that could not in principle be described, say, within the system of Chomsky and Halle's "The Sound Pattern of English". But if one is after a better understanding of what is going on, a dynamic approach appears to be of some use. At least, I hope to have shed some light on where the tradeoffs are.

APPENDIX

I. *The Syntax of DTT*

The set Type of types is the same as the one in Montague's IL:

DEFINITION 1. $e, t \in$ Type; if $a, b \in$ Type, $\langle a,b\rangle$, $\langle s, a\rangle \in$ Type

We assume, further, that for any type a, we have a set Var_a of variables of type a and a set Cons_a of constants of type a. We also assume that we have a set DM of discourse markers and that $\mathrm{DM} \subseteq \mathrm{Var}_e$. The definition of the set ME_a of meaningful expressions of type a, for any type a, is the same as for Montague's IL. So, the syntax of DTT differs from IL only in that it contains discourse markers.

II. *The Semantics of DTT*

A model M for DTT is a pair of the form $\langle \mathrm{U}, \mathrm{F}\rangle$, where U is a domain of individuals and F an interpretation function that interprets the constants (respecting the types). For each type a, the set of objects of type a is defined as follows:

DEFINITION 2.

(i) $\mathrm{D}_e = \mathrm{U}$

(ii) $D_t = \{0, 1\}$
(iii) $D_{\langle a,b\rangle} = D_b^{D_a}$
(iv) $D_{\langle s,a\rangle} = D_a^{\Omega}$, where $\Omega = U^{DM}$ (the set of assignments to discourse markers)

An assignment to variables g is a function from $\bigcup_{a\in \mathrm{Type}} \mathrm{Var}_a - \mathrm{Dm}$ into D_a. An interpretation for an arbitrary well formed expression α, $[\![\alpha]\!]^{M,g,\omega}$ relative to a model M, an assignment function and an assignment to discourse markers ω is specified recursively as follows (I omit throughout making explicit reference to M and give only the key clauses in the definition).

DEFINITION 3.

(a) If $a \in \mathrm{DM}$, $[\![\alpha]\!]^{g,\omega} = \omega(\alpha)$
If $\alpha \in \mathrm{Var}_a - \mathrm{DM}$, $[\![\alpha]\!]^{g,\omega} = g(\alpha)$
$\alpha \in \mathrm{Cons}_a$, $[\![\alpha]\!]^{g,\omega} = F(\alpha)$
(b) $[\![\exists\alpha\phi]\!]^{g,\omega} = 1$ iff either $\alpha \notin \mathrm{Dm}$ and for some $e \in D_a$, $[\![\phi]\!]^{g[e/\alpha],\omega} = 1$ or $\alpha \in \mathrm{DM}$ and for some $e \in U$, $[\![\phi]\!]^{g,\omega[e/\alpha]} = 1$.
(c) $[\![\lambda\alpha\beta]\!]^{g,\omega} = h$, where h is that function $D_a^{D_b}$ such that for any $e \in D_a$, if $\alpha \notin \mathrm{DM}$, then $h(e) = [\![\beta]\!]^{g[e/\alpha],\omega}$ and otherwise, $h(e) = [\![\beta]\!]^{g,\omega[e/\alpha]}$.
(e) $[\![{}^{\vee}\alpha]\!]^{g,\omega} = [\![\alpha]\!]^{g,\omega}(\omega)$.

III. *Dynamics in DTT*

Within DTT a logic for context change potentials can be defined as follows:

DEFINITION 4.

(i) If ϕ of type t, $\uparrow \phi = \lambda p[\phi \wedge {}^{\vee}p]$
(ii) If A is of type cc, $\downarrow A = A({}^{\wedge}\mathrm{T})$

THEOREM 1.

(a) $\downarrow\uparrow \phi = \phi$
(b) $\uparrow\downarrow \mathrm{A} \neq \mathrm{A}$

DEFINITION 5. For any discourse marker x and any A, B of type cc:

(a) conjunction: $\mathrm{A} \mathbin{\triangle} \mathrm{B} = \lambda p \mathrm{A}({}^{\wedge}\mathrm{B}(p))$
(b) negation: $\underline{\neg}\mathrm{A} = \uparrow \neg \downarrow \mathrm{A}$
(c) disjunction: $\mathrm{A} \mathbin{\underline{\vee}} \mathrm{B} = \underline{\neg}[\underline{\neg}\mathrm{A} \mathbin{\triangle} \underline{\neg}\mathrm{B}]$

(d) implication: $A \underline{\rightarrow} B = \underline{\neg} A \underline{\vee} [A \vartriangle B]$
(e) ∃-quantification: $\underline{\exists} x A = \lambda p \exists x [A(p)]$
(f) ∀-quantification: $\underline{\forall} x A = \underline{\neg}\, \underline{\exists} x\, \underline{\neg}\, A$

This logic is due to Groenendijk and Stokhof (1990). The only difference is in the treatment of implication. By defining the determiner *every* as $\lambda P \lambda Q \underline{\forall} x[{}^{\vee}P(x) \underline{\rightarrow} {}^{\vee}Q(x)]$ and adopting the definition of implication in (d), we obtain the ∃-readings of donkey sentences, while on Groenendijk and Stokhof's definition of implication, with the same definition of *every* one obtains ∀-readings.

Example 1. The denotation of $\lambda q \exists x[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}q]$.
(Throughout, I replace characteristic functions with the corresponding sets)

(a) $[\![\lambda q \exists x[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}q]]\!]^{g,\omega}$
(b) $\{\mathbf{q} \in D_{\langle s,t\rangle} : [\![\exists x[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}q]]\!]^{g[\mathbf{q}/q],\omega} = 1\}$ by Definition 3(d)
(c) $= \{\mathbf{q} \in D_{\langle s,t\rangle} : \text{for some } u \in D_e,\ [\![[\text{man}(x) \wedge \text{walk in}(x) \wedge {}^{\vee}q]]\!]^{g[\mathbf{q}/q],\omega[u/x]} = 1\}$ by Definition 3(b)
(d) $= \{\mathbf{q} \in D_{\langle s,t\rangle} : \text{for some } u \in D_e,\ u \text{ is a man that walks and } [\![{}^{\vee}q]\!]^{g[\mathbf{q}/q],\omega[u/x]} = 1\}$ by the semantics of '$\wedge$' and Definition 3(a)
(e) $= \{\mathbf{q} \in D_{\langle s,t\rangle} : \text{for some } u \in D_e,\ u \text{ is a man that walks and } \omega[u/x] \in \mathbf{q}\}$ by Definition 3(e).

Example 2. Most men that have a donkey beat it.

(a) men that have a donkey
$\Rightarrow \lambda x[\uparrow \text{man}(x) \vartriangle \underline{\exists} y[\uparrow \text{donkey}(y) \vartriangle \uparrow \text{have}(x,y)]]$
(b) beat it $\Rightarrow \lambda x \uparrow \text{beat}(x,y)$
(c) most men that have a donkey beat it
$\Rightarrow \text{most}^{+}({}^{\wedge}\lambda x[\uparrow \text{man}(x) \vartriangle \underline{\exists} y[\uparrow \text{donkey}(y) \vartriangle \uparrow \text{have}(x,y)]])$
$({}^{\wedge}\lambda x \uparrow \text{beat}(x,y))$
(d) $\uparrow \text{most}\ (\lambda u \downarrow {}^{\vee\wedge}\lambda x[\uparrow \text{man}(x) \vartriangle \underline{\exists} y[\uparrow \text{donkey}(y) \vartriangle \uparrow \text{have}(x,y)]](u))$
$(\lambda u \downarrow [{}^{\vee\wedge}\lambda x[\uparrow \text{man}(x) \vartriangle \underline{\exists} y[\uparrow \text{donkey}(y) \vartriangle \uparrow \text{have}(x,y)]](u) \vartriangle {}^{\vee\wedge}\lambda x \uparrow \text{beat}(x,y)(u)])$
Definition of most+
(e) $\uparrow \text{most}(\lambda u \downarrow [\uparrow \text{man}(u) \vartriangle \underline{\exists} y[\uparrow \text{donkey}(y) \vartriangle \uparrow \text{have}(u,y)]])$
$(\lambda u \downarrow [[\uparrow \text{man}(u) \vartriangle \underline{\exists} y[\uparrow \text{donkey}(y) \vartriangle \uparrow \text{have}(u,y)]] \vartriangle \uparrow \text{beat}(u,y)])$ ${}^{\vee\wedge}$-cancellation, λ-conv.
(f) $\uparrow \text{most}(\lambda u[\text{man}(u) \wedge \exists y[\text{donkey}(y) \wedge \text{have}(u,y)]])$

$(\lambda u[\text{man}(u) \wedge \exists y[\text{donkey}(y) \wedge \text{have}(u, y) \wedge \text{beat}(u, y)])$
Definition of $\uparrow$, $\downarrow$, $\underline{\exists}$ and $\triangle$.

IV. *Conservativity*

We want to show that if a dynamic determiner D^+ is defined as follows

DEFINITION 6.

$$D^+(P)(Q) = \uparrow D(\lambda u \downarrow {}^\vee P(u))(\lambda u \downarrow [{}^\vee P(u) \triangle {}^\vee Q(u)])(=65))$$

it satisfies dynamic conservativity, where dynamic conservativity is defined as follows

DEFINITION 7

$$D^+(P)(Q) = D^+(P)(P \triangle Q), \text{ where}$$
$$P \triangle Q = {}^\wedge\lambda u[{}^\vee P(u) \triangle {}^\vee Q(u)]$$

We assume that the free variables in P are disjoint from the set of active quantifiers in Q (see Groenendijk and Stokhof (1991) for a general discussion of this restriction). We start by noticing that if a *cc* A meets the constraint just mentioned, the following holds:

THEOREM 2. $A = A \triangle A$ (Groenendijk and Stokhof 1991)

We can now proceed to prove the result. All the following formulae are equivalent:

(a)	$D^+(P)(P \triangle Q)$	
(b)	$D^+(P)({}^\wedge\lambda v[{}^\vee P(v) \triangle {}^\vee Q(v)])$	Def. of $P \triangle Q$
(c)	$\uparrow D(\lambda u \downarrow {}^\vee P(u))(\lambda u \downarrow [{}^\vee P(u) \triangle {}^{\vee\wedge}\lambda v[{}^\vee P(v) \triangle {}^\vee Q(v)](u)])$	Def. 6
(d)	$\uparrow D(\lambda u \downarrow {}^\vee P(u))(\lambda u \downarrow [{}^\vee P(u) \triangle [{}^\vee P(u) \triangle {}^\vee Q(u)]])$	${}^{\vee\wedge}$-canc., λ-conv.
(e)	$\uparrow D(\lambda u \downarrow {}^\vee P(u))(\lambda u \downarrow [{}^\vee P(u) \triangle {}^\vee P(u) \triangle {}^\vee Q(u)])$	associativity of $\triangle$
(f)	$\uparrow D(\lambda u \downarrow P(u))(\lambda u \downarrow [{}^\vee P(u) \triangle {}^\vee Q(u)])$	Theorem 2
(g)	$D^+(P)(Q)$	Def. 6

This establishes the result.

V. *The Novelty Condition*

Assume that the set Ω contains all the total and *partial* functions from DM into U (this entails switching to a partial version of IL. Cf. Muskens (1989)). Furthermore, we define $\omega[u/x]$ as follows.

DEFINITION 8. If $\omega(x)$ is defined, then $\omega[u/x]$ is undefined.
If $\omega(x)$ is undefined, then $\omega[u/x] = \omega \cup \{\langle x, u\rangle\}$.,

Definition 8 will ensure that a formula of the form $\exists x\phi$ is defined only relative to a context ω such that $\omega(x)$ is undefined (i.e., x has to be novel relative to to the initial context ω). The existential quantifier will add x to the domain of ω.

VI. *Polyadic Quantification*

Let D be a static polyadic determiner. Its dynamic counterpart D^+ is defined as follows:

DEFINITION 9.

$$\begin{aligned} &D^+(R)(K) = D(\lambda u_1, \ldots, \lambda u_n \downarrow {}^{\vee}R(u_1) \ldots (u_n)) \\ &(\lambda u_1, \ldots, \lambda u_n \downarrow [{}^{\vee}R(u_1) \ldots (u_n) \triangle {}^{\vee}K(u_1) \ldots (u_n)]) \end{aligned}$$

where R and K are of type $\langle s, \underbrace{\langle e, \ldots \langle e,}_{n\text{-times}} cc\rangle \ldots\rangle$

References

Barwise, J. and R. Cooper: 1981, 'Generalized Quantifiers in Natural Language', *Linguistics and Philosophy* **4**, 159–220.

Berman, S.: 1987, 'A Situation Based Semantics for Adverbs of Quantification', in J. Blevins and A. Vainikka (eds.), *University of Massachusetts Occasional Papers in Linguistics* **12**, GLSA, Amherst.

Berman, S.: 1990, 'Towards the Semantics of Open sentences: WH-phrases and Indefinites', in M. Stokhof and L. Torenvliet (eds.), *Proceedings of the 7th Amsterdam Colloquium*, ITLI, University of Amsterdam.

Carlson, G.: 1977, *Reference to Kinds in English*, Indiana University Linguistic Club, Bloomington, Indiana. Also published in 1979 by Garland, New York.

Chierchia, G.: 1988, 'Dynamic Generalized Quantifiers and Donkey Anaphora,' in M. Krifka (ed.) *Genericity in Natural Language*, University of Tübingen.

Chierchia, G.: 1990, 'Intensionality and Context Change', ms., Cornell University.

Chierchia, G. and M. Rooth: 1984, 'Configurational Notions in DRT', in C. Jones and P. Sells (eds.) *Proceedings of NELS* **14**, GLSA, Amherst.

Chomsky, N.: 1965, *Aspects of a Theory of Syntax*, MIT Press, Cambridge, Mass.

Chomsky, N.: 1970, 'Remarks on Nominalization', in R. Jacobs and P. Rosenbaum (eds.) *Readings in English Transformational Grammar*, Blaisdell, Waltham, Mass.
Cooper, R.: 1979, 'The Interpretation of Pronouns' in F. Heny and H. Schnelle (eds.) *Syntax and Semantics 10*, Academic Press, New York.
Davidson, D.: 1967, 'The Logical Form of Action Sentences', in N. Rescher (ed.), *The Logic of Decision and Action*, University of Pittsburgh Press.
Dekker, P. (1990a) "The scope of Negation in Discourse" in M. Stokhof, J. Groenendijk and D. Beaver (eds) *Quantification and Anaphora I*, Dyana Deliverable R2.2A, University of Edinburgh.
Dekker, P. (1990b) "Existential Disclosure", paper presented at the Third Symposium on Logic and Language, Réfvulop, Hungary. To appear in the proceedings of the conference.
De Hoop, H. and De Swart, H.: 1989, 'Over Indefiniete Objecten en te Relatie tussen Syntaxis en Semantiek', *Glot* **12**.
Diesing, M.: 1988, 'Bare Plural Subjects and the Stage/Individual Contrast' in M. Krifka (ed.), *Genericity in Natural Language*, University of Tübingen.
Engdahl, E.: 1986, *Constituent Questions*, Kluwer, Dordrecht.
Evans, G.: 1980, 'Pronouns', *Linguistic Inquiry*, **11**(2), 337–362.
Gazdar, G.: 1980, 'A Cross-categorial Semantics for Coordination', *Linguistics and Philosophy* **3**, 407–409.
Groenendijk, J. and M. Stokhof: 1990, 'Dynamic Montague Grammar', in L. Kalman and L. Polos (eds.) *Papers from the Second Symposium on Logic and Language*, Akademiai Kiado, Budapest.
Groenendijk, J. and M. Stokhof: 1991, 'Dynamic Predicate Logic', *Linguistics and Philosophy* **14**, 39–100.
Heim, I.: 1982, *The Semantics of Definite and Indefinite Noun Phrases*, Ph.D. Dissertation, University of Massachusetts, Amherst. Published in 1989 by Garland, New York.
Heim, I.: 1990, 'E-type Pronouns and Donkey Anaphora', *Linguistics and Philosophy* **13**(2), 137–178.
Kadmon, N.: 1990, 'Uniqueness', *Linguistics and Philosophy* **13**(3), 273–24.
Kamp, H.: 1981, 'A Theory of Truth and Semantic Representation', in J. Gorenendijk, T. Janssen and M. Stokhof (eds.) *Formal methods in the Study of Language*, Mathematical Centre, Amsterdam.
Karttunen, L.: 1976, 'Discourse Referents' in J. McCawley (ed.) *Syntax and Semantics* **7**, Academic Press, New York.
Keenan, E. and L. Faltz: 1985, *Boolean Semantics for Natural Language*, Kluwer, Dordrecht.
Keenan, E. and J. Stavi: 1986, 'A Semantic Characterization of Natural Language Determiners', *Linguistics and Philosophy* **9**, 253–26.
Kratzer, A.: 1989a, 'An Investigation of the Lumps of Thought', *Linguistics and Philosophy* **12**(5), pp. 607–53.
Kratzer, A.: 1989b, 'Individual-level vs. Stage-level Predicates', unpublished manuscript, University of Massachusetts, Amherst.
Krifka, M.: 1991, 'A Compositional Semantics for Multiple Focus Constructions', unpublished manuscript, University of Texas, Austin.
Lahiri, U.: 1991, 'Quantificational Variability in Embedded Interrogatives', paper presented at SALT 1, Cornell University.
Lappin, S.: 1989, 'Donkey Pronouns Unbound', *Theoretical Linguistics* **15**.
Lewis, D.: 1975, 'Adverbs of Quantification', in E. Keenan (ed.) *Formal Semantics*, Cambridge University Press, Cambridge, U.K.
May, R.: 1977, *The Grammar of Quantification*, Ph.D. Dissertation, MIT, Cambridge, Mass.
Muskens, R.: 1989, *Meaning and Partiality*, Ph.D. Dissertation, University of Amsterdam.
Neale, S.: 1991, *Descriptions*, MIT Press, Cambridge Mass.
Partee, B. H. and M. Rooth: 1983, 'Generalized Conjunction and Type Ambiguity', in R.

Bäuerle, C. Schwartze and A. von Stechow (eds.) *Meaning, Use and Interpretation of Language*, De Gruyter, Berlin.
Parsons, T.: 1991, *Events in the Semantics of English*, MIT Press, Cambridge, Mass.
Pelletier, J. and L. Schubert: 1989, 'Generically Speaking', in G. Chierchia, B. H. Partee and R. Turner (eds.), *Properties, Types and Meaning*, vol 2, Kluwer, Dordrecht.
Portner, P.: 1991: 'Gerunds and Types of Events', paper presented at SALT 1, Cornell University.
Roberts, C.: 1987, *Modal Subordination, Anaphora and Distributivity*, Ph.D. Dissertation, University of Massachusetts, Amherst.
Root, R.: 1986, The Semantics of Anaphora in Discourse, Ph.D. Dissertation, University of Texas, Austin.
Rooth, M.: 1985, *Association with Focus*, Ph.D. Dissertation, University of Massachusetts, Amherst.
Rooth, M.: 1987, 'NP Interpretation in Montague Grammar, File Change Semantics and Situation Semantics', in P. Gardenförs (ed.), *Generalized Quantifiers*, Kluwer, Dordrecht.
Rooth, M.: 1991, 'Indefinites, Adverb of Quantification and Focus', unpublished manuscript, AT&T Bells Labs, Murray Hill, N.J.
Srivastav, V.: 1990a, *WH-dependencies in Hindi and the Theory of Grammar*, Ph.D. Diss., Cornell University.
Srivastav, V.: 1990b, 'The Syntax and Semantics of Correlatives', forthcoming in *Natural Language and Linguistic Theory*.
Stalnaker, R.: 1979, 'Assertion' in P. Cole (ed.), *Syntax and Semantics 9 – Pragmatics*. Academic Press, New York.
Stump, G.: 1981, *Formal Semantics and Pragmatics of Free Adjuncts and Absolutes*, Ph.D. Dissertation, Ohio State University. A revised version was published in 1985 by Kluwer with the title *The Semantic Variability of Absolute Constructions*.
van Benthem, J.: 1989, 'Polyadic Quantifiers', *Linguistics and Philosophy* **12**, 437–64.
Williams, E.: 1981, 'Argument Structure and Morphology', *The Linguistic Review*, **1**, 81–114.

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