19. DOMAIN RESTRICTION IN DYNAMIC SEMANTICS*

1. INTRODUCTION

In natural language, quantification is normally restricted quantification. Since Aristotle, the tripartite nature of quantifiers and other operators has been recognized, as given schematically in (1):

(1)   [Operator, Restriction, Nuclear Scope]

The operator is taken to have two arguments, the first, or **Restriction**, restricting the domain over which the second, or **Nuclear Scope**, is evaluated.

It is also widely recognised that domain restriction is often given in part or in whole by the context of utterance. Another way of saying this is that domain restriction is often presuppositional, in that rather than explicitly asserting the intended domain restriction, the speaker presupposes that hearers will restrict the domain of an operator in the intended way on the basis of their information about the context of discourse.

Domain restriction affects several types of operators, as illustrated in examples (2)–(7):

(2)   Quantificational Determiner:
   a.   Everyone who ate rhubarb pie after dinner developed a rash.
   b.   The dinner guests had rhubarb pie for dessert. Everyone developed a rash.

(3)   Adverb of Quantification:
   a.   If it was sunny out, Jessie generally ran in the park.
   b.   On sunny days, Ali worked in the garden. Jessie generally ran in the park.

(4)   Modal:
   a.   If I can afford to buy plants, I might buy a Reine des Violettes rose bush, (though I'm not sure if I want one).
   b.   I hope to earn enough money next summer to purchase some plants for the garden. If so, I will definitely order some dwarf

apple trees. I might buy a Reine des Violettes rose from that place in California, too.

(5) Tense/Reference Time:

a. When Alice called her to dinner, Gertrude gladly put aside her papers and left her desk.

b. Alice called Gertrude to dinner shortly after dusk. Gertrude gladly put aside her papers and left her desk.

(6) Focus-sensitive *only*:

a. Out of all the delicious food that his mother prepares, Max only eats HAMBURGERS.

b. Max's mother is a wonderful cook, but all that delicious food is wasted on him since he has very narrow taste in food. Max only eats HAMBURGERS.

(7) Focus-sensitive negation:

a. Though (I'm sure) Maria saw an animal, she DIDN'T see a POSSUM.

b. There were plenty of animals at the nature center when I took Maria yesterday. But she DIDN'T see a POSSUM.

In each of these examples, the domain of the operator in the (a) version is explicitly restricted within the sentence in which it occurs. In (b), a similar restriction is at least partly suggested instead by the discourse context. (2) involves a quantificational determiner, *every*: The domain of a quantificational determiner in a language like English is always at least partly restricted by the content of the Common Noun (CN) phrase with which it combines. In (a), assuming that it is clear which dinner is under discussion, the entire restriction seems to be explicit. In (b), on the other hand, the second sentence tells us only that the domain of *every* is restricted to people; but it is perfectly clear from the context that it should be further restricted to include only those people that had rhubarb pie for dessert at the dinner.

Examples (3a) and (4a) display the well-known phenomenon of domain restriction by an adverbial *if*-clause (Farkas and Sugioka (1983), Kratzer (1977), among others), with adverbs of quantification and modals, respectively. Again, though there is no adverbial in the corresponding sentences in (b), the same domain restriction is perfectly clear from prior context. In both (4a) and (4b), *I might buy a Reine des Violettes rose bush from that place in California*, the operator *might* is restricted

to range over those worlds (situations) in which the speaker has enough money to buy plants. Our understanding of (4b) seems to be:

(4) c. If I earn money next summer, I will order some dwarf apple trees.
If I earn enough money next summer, I might buy a Reine des Violettes rose.

One might also regard the Reichenbachian Reference Time used in the determination of the temporal location of a denoted event to be a species of domain restriction on an operator over times (intervals) or events. I think this view is compatible with work by Dowty (1982, 1986) and Partee (1984), who each treat Reference Time as closely akin to domain restriction, though neither calls it that. Dowty offers a theory in which the Reference Time for an utterance, an interval within which that utterance is true, is defined by prior context. Partee notes that her treatment of temporal semantics within Discourse Representation Theory reflects aspects of both the Priorian and the Reichenbachian views of time: Reichenbachian, because the Event Time for the event denoted by an utterance is determined relative to some Reference Time; Priorian, because the Event Time is specified to be a sub-interval of the Reference Time, and where the Reference Time is a past interval this entails that there is past time where the event in question took place.[1] In (5a), the adverbial *when*-clause explicitly gives the Reference Time for the matrix clause, while in (5b), that Reference Time is only implicit, given by the probable nature of the discourse' that of a narrative sequence of events.

Rooth (1985) offers an elegant account of the semantics of the English focus-sensitive operator *only* in terms of domain restriction. Roughly, the semantics of the adverbial form of this operator, in an utterance of the form *NP only VPs*, specifies that the sole property that the denotation of NP has is that denoted by the VP. This is much too strong as it is, but Rooth argues that the focal structure of the VP conventionally specifies a more limited domain, which Rooth calls the **p-set**, in which the uniqueness of the VP property is asserted. In the main clause of (6a), which is the same as the second sentence in (6b), the capital letters indicate prosodic prominence. Assuming that this correlates in a regular way with the focus of an utterance, along lines suggested in Selkirk (1984), there are three possible foci in this clause, narrow focus on the direct object, a slightly broader focus on the VP, and sentential focus. On the narrowest construal of focus, the p-set of the VP *only eats HAM-*

BURGERS is determined on the basis of its intensional logic translation by replacing the focused constituent with a variable, to obtain λy[eats(x)(y)]; the p-set is that set of properties obtained by providing some value for x, i.e. the set of properties of eating something. The p-set restricts the domain of *only*. The domain can be explicitly narrowed even further with an adverbial as in (6a), where we are led to consider only those properties of eating some kind of food that Max's mother prepares; much the same effect is achieved implicitly with prior context in (6b).

The negation operator is also focus-sensitive, as argued by Jackendoff (1972), among others. It is usually taken to be a one-place operator, but Kratzer (1989) argues that it is actually two place, with the domain restriction given by the focal structure of the utterance in which the negation occurs, as with *only*. Hence, the logical form for an utterance such as (8), with narrow focus on the NP *a possum*, would be as in (9):

(8)   Maria didn't see a POSSUM.

(9)   NOT (Maria saw x) (Maria saw a possum)

Kratzer motivates this analysis within (her version of) situation semantics, where in order to ensure that the operator will be persistent, i.e. will give the same truth conditions for an utterance when evaluated in successively larger situations, we must guarantee that (8) only has a truth value in those situations which are large enough to contain all those situations in which the first argument of (9) is true, i.e. in which Maria saw something. Given such a "large-enough" situation, we then check to see if the second argument is true in that situation. If it is not, then (8) is true in that situation; otherwise false. In (7a), this domain is further restricted explicitly by the adverbial clause to specify that what Maria saw was in animal. In (7b), this same additional restriction is suggested by prior discourse.

At some level, (2)–(7) all display the tripartite operator structure discussed in (1). For some of these operators, the content of the first argument, or restrictive term, is at least partly given by an explicit aspect of the structure of the sentence uttered – the remainder of the NP for quantificational determiners, the tense for the operator over times or events, the focal structure of the utterance for the focus-sensitive operators *only* and negation. But for other operators, the adverbs

of quantification and modals, the first argument is not always expressed explicitly.[2] Suppose we assume that the logical structure of these operators with only implicit restriction is as in (10);[3]

(10)   λQ[Operator, R, Q]

We see the tripartite structure familiar from (1). Here Q, the variable which is the nuclear scope of the operator, holds the place which will be saturated by the (over) syntactic argument of the operator. The value of the restrictive clause, the free variable R, must be given by context.

One common way of spelling out the role of context in semantic interpretation is via Stalnaker's (1979) notion of **common ground**. A common ground is a set of propositions, the assumptions which the speaker and hearer have in common (or behave as if they have in common) about the way the world is. Stalnaker equates the common ground with the participants' presuppositions. Heim's (1982) and Kamp's (1981) theories of dynamic interpretation can be seen as elaborating Stalnaker's notion of common ground to include not only propositional information about the "world", but also certain kinds of information about the discourse itself. These theories, like Groenendijk and Stokhof's (1989, 1990, 1991) theory of Dynamic Montague Grammar, are **dynamic** in that the information about the discourse and the propositions expressed is constantly updated, even in the course of interpreting a single uttered sentence. Hence, in a dynamic semantics, contextual update is an intimately interwoven aspect of the process of truth conditional interpretation, and one cannot assume that Φ & Ψ will be logically equivalent to Ψ & Φ.[4]

My goal in this paper is to contribute towards the characterization of domain restriction, and, in doing so, to further illuminate the nature of the interaction between semantic interpretation and the common ground. I want to argue that domain restriction is presuppositional, and hence is always dependent not just on the structure of the utterance in question, but also on the common ground of the interlocutors. As a corollary to this, domain restriction will be seen to be dynamic, in much the same way as the determination of available anaphoric antecedents. If this characterization is correct, then attempts to characterize domain restriction for particular operators via purely structure-driven algorithms are misguided. Conversely, whatever aspects of context are relevant to the determination of the intended domain restriction for a given utter-

ance should be reflected in the way that we realize the notion of context in our theories.

In the next section, I will try to make these ideas more concrete by addressing domain restriction in two kinds of examples. Then in Section 3 I will return to the more general question of the nature of domain restriction and what it says about the interaction between semantic interpretation and the common ground.

2. DOMAIN RESTRICTION DEPENDS ON NON-LINGUISTIC ASPECTS OF CONTEXT

Here I will consider two kinds of domain restriction where it has been argued elsewhere that the available domain restrictions are determinable on the basis of structure-based algorithms, whether the syntactic structure of individual utterances, or the overt structure of the discourse in question. I will argue that the determination of domain restriction in each case crucially involves assumptions about the common ground of the interlocutors, and hence that the purely structure-based accounts are inadequate.

2.1. *Modal Subordination*

Consider again (4b), here extended by a further (underlined) clause:

(4) b′ I hope to earn enough money next summer to purchase some plants for the garden. If so, I will definitely order some dwarf apple trees. I might buy a Reine des Violettes rose from that place in California, too, though I'm not sure yet how it would look with the other roses.

The domain restriction here appears to be the same as in (4b); but the additional clause illustrates the anaphoric reflex of the phenomenon of modal subordination. Roberts (1987, 1989) argued that modal subordination is just a special case of contextual domain restriction. It is special in that it provides an antecedent for a pronoun which would otherwise be problematic. The pronoun it in (4b′) appears to have as its antecedent the indefinite NP a Reine des Violettes rose from that place in California in the prior clause, but these two NPs are in the scopes of different modals. Our understanding of (4b′) seems to be:

(4) c′ If I earn enough money next summer, I will order some dwarf apple trees.
If I earn enough money next summer, I might buy a Reine des Violettes rose.
However, I'm not yet sure if I bought a Reine des Violettes rose, how it would look with the other roses.

My argument in Roberts (1987, 1989) was that with each succeeding modal, if its domain restriction isn't explicitly given the hearer **accommodates** this domain restriction in a Discourse Representation Structure, on the basis of prior context. *Accommodation* is a notion originally due to Lewis (1979); according to him, if a speaker presupposes something that is not explicit in discourse, the cooperative hearer behaves as if it were already in the common ground. In this example, in the interest of giving the utterance a relevant interpretation, the conversational participants behave as if the relevant, contextually given domain restriction were explicitly given by the speaker.

As discussed in Heim (1982, 1990), Roberts (1987, 1989), and Kadmon (1987), there is an explicitness requirement on the accommodation of antecedents for pronouns: in Discourse Representation Theory terms, one can't in general accommodate material containing an individual-type discourse referent which then serves as antecedent for a pronoun, if that material wasn't licensed by a prior utterance which contained an explicit NP "antecedent". Intuitively, if a hearer has no idea what kind of thing the speaker is referring to, either by virtue of some antecedently uttered NP with a definite "content" or by means of deixis, then the hearer can't hope to determine the intended, familiar antecedent of a pronoun, since pronouns themselves have no content (or almost none – there is some question about the semantic role of gender and number in pronouns). In the case of accommodation in such a theory, the prior, explicit NP, which I'll call the **licensing NP**, is not the true antecedent, since its discourse referent is not accessible (in Kamp's (1981) sense of *accessibility*) to that of the pronoun. For example, the discourse referent for the NP a Reine des Violettes rose is not accessible to the pronoun it in (4b′), since the former but not the latter is under the scope of *might*. However, the utterance of the full NP means that we are talking about these roses; such talk, by making the content of the NP salient, fulfills a necessary function in licensing the anaphora, though it is not sufficient – we must also accommodate the content of the clause in which

the licensing NP occurs to restrict the domain of *would*, so that there is a directly accessible discourse referent antecedent for the pronoun (see Roberts, 1989).

Groenendijk and Stokhof (1989) propose another kind of account of modal subordination within the framework of Dynamic Montague Grammar (DMG), an account which they call *anaphoric*.[5] The foundation of this account is the dynamic version of lambda abstraction, shown in (11):

(11)   **Dynamic Lambda Abstraction:**

$A d\beta = \lambda x\{x/d\}\beta$

x: a variable of unspecified type

d: a discourse marker of the same type as x

{x/d}: a state switcher

The expression *d* here is a **discourse marker**, a special sort of constant whose value is given relative to the state in which the entire expression is interpreted. The expression {x/d} is a **state-switcher**; if the entire lambda expression is interpreted in a state *s*, then the interpretation of the state switcher guarantees that β is evaluated in a state just like *s* except that *d* will be assigned the value of *x* in *s*. In the ordinary case, this will be equivalent to substituting *x* for *d* throughout β. The interpretation of a state switcher has much the same effect as varying an input assignment function with respect to the value of the variable of quantification. The difference is that in DMG we can keep track of the state-switchers so that anaphoric values can be carried across discourse. This gives nearly the same truth conditions as if the scope of any existential quantifiers were not sententially bound, but could extend up to the scope of any operators which have scope over them. The dynamic lambda expression $\lambda x\{x/d\}\beta$ *not only takes an argument of the type of* x *to make an expression of the type of* β, it also introduces a state-switcher, {x/d}, which will effectively fix the value of the discourse maker *d* in subsequent discourse to be the value of the argument.

Groenendijk and Stokhof use this dynamic lambda abstraction to account for the anaphora licensed by modal subordination in the discourse in (12):

(12)   A tiger might come in. It would eat you first.

They treat the modal auxiliary *might* as synonymous with the adver-

bial *possibly*, the latter translated into Dynamic Intensional Logic (DIL) as (13):[6]

(13) $AD\lambda p [\Diamond \downarrow VD \wedge {}^{\vee}p]$ DIL translation of *possibly*

D: a discourse marker of type $\langle s, \langle\langle s, t\rangle ,t\rangle\rangle$

(13) involves a discourse marker D of type $\langle s, \langle\langle s, t\rangle ,t\rangle\rangle$, i.e., whose denotation will be a function from states to sets of propositions. Since this is the type of utterance meanings in Dynamic Montague Grammar, I'll call D an **utterance type discourse marker.** The translation of *might* also involves dynamic lambda abstraction. So the modal will not only take the meaning of *a tiger comes in* as its argument, but in so doing it will make that meaning available in subsequent discourse as the potential binder of utterance type discourse markers.

This is shown in (14), the DIL translation of *A tiger might come in*:[7]

(14) a. $\lambda p'[\Diamond \exists x\{x/d\}(\text{Tiger}(d) \wedge (\text{Come}(d)) \wedge$
            $\{^{\wedge}\lambda p[\exists x\{x/d\}(\textbf{Tiger}(d) \wedge \textbf{Come}(d)) \wedge {}^{\vee}p]/D\} {}^{\vee}p']$

    b. $\lambda p'[\Diamond \exists x(\text{Tiger}(x) \wedge \text{Come}(x)) \wedge$
            $\{^{\wedge}\lambda p[\exists x\{x/d\}(\textbf{Tiger}(d) \wedge \textbf{Come}(d) \wedge {}^{\vee}p]/D\} {}^{\vee}p']$

    p, p′: variables of type $\langle s, t\rangle$

    x: a variable of type e

    D: a discourse marker of type $\langle s, \langle\langle s, t\rangle ,t\rangle\rangle$

    d: a discourse marker of type e

In DMG, the DIL translation of a clause has an argument place for the interpretation of subsequent utterances, here the variable *p′* which is bound by the lambda operator. The first conjunct of the expression within the scope of the abstraction reflects the content of the clause. The indefinite has introduced existential quantification and a state switcher. Given the semantics for DIL, such existentials can in effect extend their scope across discourse, since the state switcher will fix the value of *d* in subsequent clauses; but in this case, that extension is blocked by the possibility operator in whose scope the indefinite occurs, so (14a) is logically equivalent to (14b), with ordinary existential quantification in the first conjunct. However, when a clause serves as argument to an operator like *possibly* in (13), the dynamic lambda abstraction in effect makes the logical form of that entire clause available to serve as an antecedent for utterance type discourse markers in subsequent discourse, by introducing the state switcher in bold print in (14a/b). This switcher

fixes the value of the utterance type discourse marker D to be the interpretation of the material under the scope of the possibility operator in the original utterance, *a tiger came in*. The state switcher has scope over any occurrences of the variable D in subsequent utterances, i.e. the value of D is fixed for the rest of the discourse. Further, whenever D occurs in the discourse, its value involves the state switcher over individual type discourse markers, {*x/d*}, which occurred under the scope of *possibly* in the original clause; but now this individual type state switcher isn't blocked by a higher operator, so that it will effectively "bind" subsequent occurrences of *d* in discourse within the "scope" of D.

(15) gives the translation of *It would eat you first*:

(15)   λp[□[∨D ⇒ eat-you-first(d)] ∧ ∨p]]

The implicit domain restriction on the modal operator is given here as the utterance type discourse marker D. I have underlined the tripartite structure of the quantified utterance, for comparison with (1); the antecedent of ⇒ is the restrictor of î, and the consequent is its nuclear scope. Dynamic conjunction of (14) and (15) leads to the reduced translation of (11) in (16a), which is logically equivalent to (16b):

(16) a. λp [◇ ∃x{x/d}(Tiger(d) ∧ Come(d)) ∧
     {**^λp[∃x{x/d}(Tiger(d) ∧ Come(d)) ∧ ∨p]/D**} □ [∨D ⇒
     eat-you-first(d)] ∧
     {**^λp[∃x{x/d}(Tiger(d) ∧ Come(d)) ∧ ∨p]/D**} ∨p]

b. λp [◇ [∃x{x/d}(Tiger(d) ∧ Come(d))] ∧
     □[{∃x{x/d}(Tiger(d)∧Come(d))∧∨p} ⇒ eat-you-first(d)] ∧
     {**^λp[∃x{x/d}(Tiger(d) ∧ Come(d)) ∧ ∨p]/D**} ∨p]

In the second conjunct of (16a), the domain restrictor D in (15) is "bound" by the state switcher in bold print. In the equivalent (16b) we can more readily see what the effect of this on the interpretation will be: The translation of *a tiger came in*, from the state switcher, has been substituted for the free domain restrictor D in the underlined translation of *it would eat you first*. The translation of *a tiger came in*, as we saw above, itself contains a state switcher (in bold print in (16b)); given the semantics for the state switcher and for the material-implication-like symbol '⇒', all the instances of the type *e* discourse marker *d* in

both the antecedent and consequent of the second conjunct will be in effect bound by the same existential quantification, as in standard donkey sentences. The truth conditions for (16b) are (pretty nearly) equivalent to those of (17) (modulo the semantics of necessity, which Groenendijk and Stokhof don't discuss):

(17)   ◇ ∃x(Tiger(x) ∧ Came(x)) ∧ $\overset{\Box}{\underset{i}{\land}}$ ∀x((Tiger(x) ∧ Came(x)) →
      Eat-you-first(x))

This account provides the appropriate propositional domain restriction on the modal, so that it will range only over possible worlds (or states or situations) in which it's true that a tiger came in; it also provides the means of satisfying the familiarity presupposition of the pronoun *it* (Heim, 1982). So, for this type of example, the proposal gets much the same empirical coverage as the account in Roberts (1987, 1989), but instead of accommodating domain restriction it treats it as anaphoric in a very syntactic sense: The utterance of the first sentence in (11) fixes a value for a variable-like discourse marker which then serves as domain restrictor for the modal in the second. Of course, there may be many such utterance type discourse markers whose values are fixed in a given discourse, and this theory does not provide us with the means to determine which "antecedent" should bind a given domain restrictor. But that is just an instance of the larger problem of anaphora resolution, a problem which none of the theories of dynamic interpretation claims to solve. These are only theories which place certain restrictions on when anaphoric relations are licit. It is left to a theory of pragmatics to resolve which "antecedent" a speaker probably has in mind for a given variable/ discourse marker.

There are two kinds of problems with this account. The first is that it doesn't provide information about enough of the prior context, and the second is that it doesn't put restrictions on where the subsequent utterance type discourse markers can occur in discourse. To see the first, we need to look at other kinds of examples, including those, like (18), with conditionals:

(18) a. If a cat has a flea bite, he scratches it.
     b. Generally, it itches for days.

Let us assume that *generally* in (18b) has a logical form like that of a

modal or adverb of quantification (see Gerstner and Krifka (1987), Wilkinson (1991)) for versions of this approach). Here, the restrictive clause for this operator will be taken by hearers to be *a cat has a flea bite*, so that the final logical form should be roughly as in (19):

(19)   [generally, a cat has a flea bite, it itches for days]

Given this logical form, *generally* will only range over states (or situations) in which the proposition denoted by the restrictive term is true, and the indefinite *a cat* will introduce a state switcher that can bind it.

Groenendijk and Stokhof don't discuss how to interpret such examples, but let's assume, given their treatment of *possibly* in (11), that they might proceed as follows: First, we need an interpretation of conditionals like (18a) which fixes values of utterance type discourse markers for both the antecedent and the consequent, so that a speaker might subsequently refer back to either. If we view conditionals as involving a one-place connective *if . . . then*, then by analogy with the treatment of *possibly* in (13) we might give this connective the translation in (20a), which is logically equivalent to (20b) by the definition of dynamic lambda abstraction:

(20)   a. $AD_1\ AD_2\ \lambda p\ [\downarrow[^\vee D_1 \Rightarrow\ ^\vee D_2] \wedge\ ^\vee p]$
       b. $\lambda X\{X/D_1\}\lambda Y\{Y/D_2\}\lambda p[\downarrow[^\vee D_1 \Rightarrow\ ^\vee D_2] \wedge\ ^\vee p]$
       p: a variable of type $\langle s, t\rangle$
       X, Y: variables of type $\langle s, \langle\langle s, t\rangle, t\rangle\rangle$
       D: a discourse marker of type $\langle s, \langle\langle s, t\rangle, t\rangle\rangle$

I have used capital letters for the utterance type variables X and Y to differentiate them from individual variables. The antecedent and consequent of the conditional will serve as the arguments to this expression. (21) gives the translation of the antecedent of (18a), (22) for the consequent, and (23) for the whole conditional:

(21)   DIL translation of *a cat has a flea bite*:
       $\lambda p[\exists x\{x/d_1\}\ \exists y\{y/d_2\}(cat(d_1) \wedge bite(d_2) \wedge have(d_1, d_2)) \wedge\ ^\vee p]$

(22)   DIL translation of *he scratches it*:
       $\lambda p\ [scratch(d_1, d_2) \wedge\ ^\vee p]$

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(23)   DIL translation of (18a), *If a cat has a flea bite, he scratches it*:
       a. $\{^\wedge(21)/D_1\}\{^\wedge(22)/D_2\}\ \lambda p[\downarrow[^\vee D_1 \Rightarrow\ ^\vee D_2] \wedge\ ^\vee p]$
       b. $\lambda p[\{^\wedge(21)/D_1\}\{^\wedge(22)/D_2\}\downarrow[^\vee D_1 \Rightarrow\ ^\vee D_2] \wedge\ \{^\wedge(21)/D_1\}$
          $\{^\wedge(22)/D_2\}^\vee p]$
       c. $\lambda p[[(21) \Rightarrow (22)] \wedge \{^\wedge(22)/D_2\}^\vee p]$
       d. $\lambda p\ [\neg[\exists x\{x/d_1\}\ \exists y\{y/d_2\}(cat(d_1) \wedge bite(d_2) \wedge has(d_1, d_2)) \wedge$
          $\neg[scratch(d_1, d_2)] \wedge \{^\wedge(21)/D_1\}\{^\wedge(22)/D_2\}^\vee p]$

(23a)–(d) are all equivalent, but I think (c) is easiest to grasp. The first conjunct inside the abstraction gives the content of the conditional, which just gets spelled out more fully in (d); in the second conjunct, we find that each of the clauses of the conditional is now a potential binder for utterance type discourse markers in subsequent discourse.

Given the translation for (18b) in (24), with a free discourse marker as domain restrictor, and dynamic conjunction of (23) and (24), we derive the intended translation of the entire discourse (18) in (25), where the antecedent of the conditional "binds" the free domain restrictor of *generally*.

(24)   DIL translation of (18b), *Generally, it itches (for days)*:
       $\lambda p\ [Gen[^\vee D_1 \Rightarrow itch(d_2)] \wedge\ ^\vee p]]$

(25)   DIL translation of (18):
       a. $\lambda p[[(21) \Rightarrow (22)] \wedge \underline{\{^\wedge(21)/D_1\}\{^\wedge(22)/D_2\}\{Gen[^\vee D_1 \Rightarrow}}$
          $\underline{itch(d_2)]]]} \wedge \{^\wedge(21)/D_1\}\{^\wedge(22)/D_2\}^\vee p]$
       b. $\lambda p[[(21) \Rightarrow (22)] \wedge \underline{[Gen[(21) \Rightarrow itch(d_2)]]} \wedge \{^\wedge(21)/D_1\}$
          $\{^\wedge(22)/D_2\}^\vee p]$

The two state switchers in the underlined second conjunct of (25a), fixed to the antecedent and consequent of the preceding conditional, are both available to serve as antecedents for the domain restrictor. As it happens the restrictor is arbitrarily indexed 1, so that it takes the antecedent of the conditional as its anaphoric antecedent. (25a) is hence equivalent to (25b). Filling in the value for (21) in (25b) will show that the state switcher in (21) provides an antecedent for the discourse marker d_2 of the pronoun *it*.

However, we cannot in general derive sufficient information from a

single clause to adequately restrict an operator's domain. For example, consider (26):

> (26) a. If a man asks a woman to dinner, he prepares a nice meal.
>
> b. Generally, she enjoys it.

We can readily see the problem here without translating into DIL. The intuitive domain restriction for (26b) is *a man invites a woman to dinner and he prepares a nice meal*. This is necessary both because of the sense conveyed by the discourse, and because the antecedents for the pronouns in (b) come from different clauses of the conditional. But the approach we developed for (19) gave us only two independent state switchers, forcing a choice between the antecedent and the consequent of the preceding conditional.

Of course, we might try a different approach to the semantics for the conditional. Suppose we were able to 'make the translation of a conditional trigger a state switcher like (27) having scope over subsequent discourse, with Φ the proposition expressed by the antecedent of the conditional and Ψ the proposition expressed by the consequent:

> (27) $\langle \wedge [\Phi;\Psi]/D \rangle$

Now D is "bound" to the dynamic conjunction of the antecedent and consequent of the conditional. As Jeroen Groenendijk (p.c.) pointed out to me, this would follow without stipulation from the Conservative semantics for operators suggested in Chierchia (1990). But though this provides a descriptively adequate account of examples like (26), there are other kinds of problems which can be given (various) technical solutions but point to a deeper underlying problem. For example, consider (28):

> (28) a. If a cat has a flea bite, he scratches it.
>
> b. If his skin gets irritated, it itches for days.

Here, it is the conditional antecedent of (b) which has a pronoun whose NP antecedent seems to be *a cat* in (a). To account for such cases, we might conjoin an utterance meaning type discourse marker to the antecedents of all conditionals. But how many such conjuncts would be enough? Consider (29):

> (29) a. If Andy met a leprechaun, he'd be delighted.
>
> b. Leprechauns sometimes have a pot of gold.
>
> c. If Andy was really lucky, the leprechaun might let him have some of it.

(29c) seems to mean (29c′):

> (29) c′. If Andy met a leprechaun and the leprechaun had a pot of gold and Andy was really lucky, the leprechaun might let him have some of the pot of gold.

There is no connection between the antecedent of (29a) and the non-factual *leprechauns have a pot of gold* under the scope of the existential adverb of quantification *sometimes* in (29b), so there is no way to build up a complex clause meaning, like the Chierchia-type interpretation of the consequent of (28a), which could then be the antecedent of an utterance meaning type discourse marker conjoined with the antecedent of (29c). So in order to get the correct interpretation on the anaphoric approach to modal subordination, we would have to say that there were two distinct utterance meaning type discourse markers, both free, conjoined with the antecedent of (29c). But, of course, even this would not be enough in principle, for we can make up examples like (30):

> (30) a. If Audrey met a sorcerer, she'd be delighted.
>
> b. Sorcerers often have leprechaun companions.
>
> c. Leprechauns sometimes have a pot of gold.
>
> d. If Audrey was really lucky, she might get the sorcerer to get the leprechaun to let her have some of it.

Making sense of such a discourse, which involves satisfying the familiarity presuppositions of any definite NPs such as definite descriptions or pronouns, requires keeping track of all the nonfactual propositions entertained in discourse, storing discourse markers for the hypothetical or fictional "referents", and drawing in this information as required to build what Roberts (1987, 1989) called a **hypothetical common ground**. A *hypothetical common ground* is a set of propositions, familiar to both speaker and hearer, which they hold to be compatible (i.e. simultaneously true in some possible world) but not necessarily true in the actual world. This is the kind of understanding we develop when we entertain hypotheses and consider their consequences, as opposed to asserting/asserting to them, or when we consider an explicitly fictional situation. Such a hypothetical common ground may be quite complex – we can embroider our suppositions densely. And, as (29) and (30) illustrate, it needn't be built up in a strictly cumulative way from clause to clause. But in order to satisfy the explicitness requirement on accom-

modation providing antecedents for pronouns (which applies to (29c) and (30d)), the accommodation of propositions which provide those antecedents must be triggered by prior utterances containing licensing NPs for the definites. The number of propositions required to provide a satisfactory hypothetical common ground for an utterance is in principle limited only by the limitations on how many anaphors we can keep track of in one utterance. And hence an approach involving utterance type discourse markers will be very awkward, at best.

Again, this is not to say that an account of modal subordination must capture the entire process of resolving the intended domain, any more than a syntactic or semantic theory of anaphora must tackle the whole thorny issue of anaphora resolution – determining which accessible antecedent is intended by the speaker. The point, instead, is that there is no solely structure-determined algorithm for making available potential "binders" for a free restrictive term, such as R in (10).

Recall that Stalnaker equated the speaker's and hearer's common ground with their presuppositions. Modal subordination, on the view I've sketched, is presuppositional; the cooperative hearer accommodates relevant non-factual propositions to the hypothetical common ground for evaluation of the proposition under the scope of a modal. This accommodation is **local** in Heim's sense, i.e., the presuppositions involved are only accommodated under the scope of an operator, whether a modal or an adverb of quantification, and do not become a part of the principal, factual common ground for the discourse as a whole. For example, in (4) the proposition that the speaker will earn enough money to purchase plants does not become part of the common ground, but only serves as a hypothetical assumption restricting the domain of *might*. It's illuminating to compare modal subordination with indirect proof in formal logic, where we may temporarily assume an auxiliary premise, usually represented by indenting the line on which the premise occurs, and consider what would follow from it; as long as we are within the indented portion of the proof, we may continue to assume that the proposition is true and we may existentially instantiate any entities introduced within that indented section. But once we have dropped the auxiliary premise and moved back to the left-most margin, we can no longer assume the truth of the auxiliary premise or continue to instantiate those entities introduced existentially therein. In local accommodation in natural language discourse, once the discourse has returned to the factual mode we can no longer refer anaphorically to an NP within the preceding

nonfactual context; contrast the (31b) with (31c), each taken to follow (31a) in discourse:

(31) a. If I had a garden, I'd plant an apple tree.
     b. It would bear fruit in a few years.
     c. #It was damaged in the late frost last year.

In (31b), local accommodation of *I plant an apple tree* to restrict the domain of *would* provides an antecedent for *it*, i.e. the discourse marker for *an apple tree*. But the pronoun in the factual (31c) does not have access to this nonfactual proposition, so it cannot "instantiate" *an apple tree*. Besides the restrictions on anaphora to NPs introduced in locally accommodated propositions, there is one other aspect of such accommodation which is of interest here: it is relatively free, only requiring in general that the proposition in question be consistent with any other locally accommodated propositions, so that the resulting hypothetical common ground is consistent and the hypothetical context set non-empty. That is, a speaker may invite us to entertain the consequences of any consistent set of propositions, whether or not actually true.

This contrasts with **global accommodation**, where the presupposition is (permanently) added to the factual common ground; in effect, it becomes like another logical premise from which we can deduce conclusions, instantiate individuals, etc. Once we have established the truth of a proposition in discourse, either because it has been asserted and assented to or has been globally accommodated, then the interlocutors may freely assume its truth, including the existence of any individuals referred to therein; this licenses, as well, anaphoric reference both to the individuals referred to and to the proposition itself. For example, suppose that you and I have just begun a phone conversation. After greetings, I interrupt to say: "Sorry – I have to go. Someone's knocking on the door." We haven't been talking about a door, but as a cooperative hearer, given the common information that all standard houses have a door, that I probably have good reason to know whether my house has one, that I'm not lying (at least about the door), etc., you will accommodate that there is a door to my house, represented in the factual common ground for our conversation by a discourse referent d, and you will assume that d is the intended antecedent for the definite description. d is now globally available – we can go on to refer to it freely in subsequent assertions, as when you reply: "Sounds like they're breaking it down!"

Another characteristic of global accommodation, already alluded to, is that it requires not only that the hearer assent to the truth of the proposition in question, but that the resulting common ground be consistent. That is, as with assertions, a proposition is only added to the common ground as the result of consensus (or at least feigned consensus) on the part of all participants; this is crucial to the maintenance of the common ground as "mutual knowledge",[8] developed cooperatively to improve our mutual information about the way things are in the world we are exploring (or, as Stalnaker puts it, to help us discover exactly which possible world we in fact inhabit). But this makes global accommodation require more reflection than local accommodation, which requires only consistency, because as responsible participants interested in the truth we require some basis for giving our assent. The proposition in question must be at least plausible in, the real world, and further, we generally require some evidence, or at least the promise that such evidence is available – for example, confidence that the speaker is a responsible interlocutor who would not make an assertion without basis. In the door case, I had to assume that you have good information about the structure of your house, in this case a pretty trivial assumption. But there are other cases where assent is less automatic. Consider the following examples; (32) is due to Jerry Morgan (p.c.) and (33) to Fred Landman (p.c.):

(32) a. Last night I dreamed I got a red Porsche for my birthday.
     b. I drove it all over the countryside and loved every minute of it.
     c. This morning I woke up and much to my surprise found it parked in my driveway.

(33) a. The author claims that Vulcan exists after all.
     b. It has circled around Mercury for ages without us ever noticing it.

(32c) is a factual assertion involving the use of a pronoun whose antecedent is an indefinite under the scope of a modal; the pronoun therefore doesn't refer to any entity whose existence has already been explicitly asserted. Making sense of (32c) in the absence of further prior context, which involves finding a way to satisfy the familiarity presupposition of the pronoun, requires the hearer to accommodate that the speaker believes that the speaker did in fact get a red Porsche for

his birthday. Assenting to (32c) would presuppose that the speaker did get a Porsche, and hence require accommodating this proposition to the actual common ground. The speaker in this example seems to blur the edges between reality and the dream world; to assent to it, one must either believe that dreams can be prophetic or that they can come true literally – that is, that the car the speaker dreamed about is the car parked in his driveway. Understanding (33b), on the factual reading where the speaker is not simply continuing to report about the author's claims, requires that the hearer accommodate that the speaker agrees with the author that Vulcan really exists after all; assenting to it would presuppose that Vulcan exists.

Compare these examples with the cases of modal subordination which Groenendijk and Stokhof discuss. In their examples, a salient nonfactual proposition serves as a hypothetical common ground, paralleling the effect of local accommodation, whereas in (32) and (33) a salient nonfactual proposition is added to the actual common ground. The latter examples, then, might be taken *prima facia* as an argument that nonfactual propositions are globally available in discourse. But unlike anaphora to accessible antecedents in discourse, these examples require considered assent in order to make them felicitous and not just comprehensible. In cases where this assent is withheld, the result is infelicity.

We can see this quite vividly with anaphors whose antecedents are propositions. Consider the anaphor *so*.[9] In example (4b), repeated below, it appears to be a propositional anaphor, so that we might plausibly take its type to be the same as that of utterance meanings in Dynamic Montague Grammar, i.e. that of D. Sentence adverbial *so* in (34b) appears to serve a similar function, though it also contributes something like a causal or lawlike relation between the proposition it takes as its "antecedent" and the main clause it modifies.

(4b)   I hope to earn enough money next summer to purchase some plants for the garden. If so, I will definitely order some dwarf apple trees . . .

(34) a. John has a cat.
     b. So, he has cat hair in his house.

It has been suggested to me (Nicholas Asher (p.c.)) that *so* does not merely take a propositional antecedent, but may have to refer to an entire argument. However, I think this isn't the case. Consider:

(35) a. Suppose John had a cat (which he doesn't).
b. He'd have cat hair in his house.
c. I'm allergic to cat hair.
d. So, I hope he doesn't get a cat.

(34b) seems to mean something like 'because it's true that John has a cat, John has cat hair in his house'. (35d) might be paraphrased 'Since (b) and (c), I hope John doesn't get a cat,' where I take the domain of the modal in (b) to be restricted by the proposition hypothetically assumed in (a). I don't see that *so* refers to an argument in either case, but only to some proposition in the common ground (which proposition may be the conjunction of two or more assertions). So, in its adverbial use *so* seems to mean something like 'given the truth of the proposition(s) in question'; it sets up the kind of causal or lawlike relation between its antecedent and the main clause that we often see in conditionals. And although the adverbial is more than a simple anaphor (unlike *so* in (4)), it still makes crucial reference to some salient and accessible proposition.

Now consider the following:

(36) a. If Steven sang LaBamba, you couldn't keep from laughing at him.
b. So, don't encourage him.

We can take (36b) to mean (b'), but not (b") or (b'''):

b'. Given that if Steven sang LaBamba you couldn't keep from laughing at him [and you don't want to laugh at him], don't encourage him.
b". #Given that Steven sang LaBamba [and you don't want to laugh at him], don't encourage him.
b'''. #Given that Steven sang LaBamba and you didn't keep from laughing at him [and you don't want to laugh at him], don't encourage him.

In (36b), only the entire, asserted (and hence, factual) conditional (36a) is available to serve as an antecedent for *so*, and not either the antecedent or the consequent, which are nonfactual. The intuitive explanation for this seems to be that we do not consider nonfactual propositions as adequate reason or motivation for behavior prescribed in an imperative, since only facts can be taken to motivate the prescribed behavior in the actual world.

A similar kind of restriction occurs in cases where the antecedent of an anaphor is the nominalized correlate of an event. Consider (37)–(39):

(37) a. An earthquake might hit San Francisco.
b. That would upset me. It would be frightening.

(38) a. An earthquake hit San Francisco in 1989.
b. That upset me. It was frightening.

(39) a. An earthquake might hit San Francisco.
b. That upsets me. It is frightening.

In (37), the utterance in (a) is non-factual in mood, talking about an event which is as yet only a possibility. The subject of (b), under the scope of *would*, seems to refer to an earthquake hitting San Francisco, i.e., a nominalization of the proposition denoted by the nuclear scope of the modal *might* in (a). In (38), the utterance in (a) is factual, describing a real event. The subjects of the factual sentences in (b) refer to an earthquake hitting San Francisco in 1989, the fact corresponding to that event. Notice that in (38b) it is acceptable to say "That fact upset me," whereas in (37b), one cannot say "That fact would upset me." In (39), after the same nonfactual utterance as in (37a), one can utter the same sentence as in (38b), and even substitute "That fact upsets me," but the meaning is not the same. (39b) means that the *possibility* of an earthquake hitting San Francisco (where a possibility is a kind of fact) upsets the speaker and is terrible, not the *fact* (or event) of an earthquake hitting San Francisco.

Suppose that the antecedents of pronouns like *that* and *it* in the (b) sentences are nominalizations of the intentions of prior utterances. These intensions would be of the same type as the discourse marker D that was used by Groenendijk and Stokhof in the account of modal subordination. It seems that we can readily accommodate discourse referents for the nominalized counterparts to accessible propositions in discourse. In Groenendijk and Stokhof's theory, the accessibility of the propositions might be guaranteed by having propositions introduce state-switchers over subsequent discourse, binding an utterance type discourse marker. Nominalization would be an operation on utterance type discourse markers, semantically denoting a function from propositions to individuals. But Groenendijk and Stokhof's anaphoric account of modal subordination suggests that non-factual propositions such as that denoted by the nuclear scope of a modal operator, e.g. in (36) or in (37a)/(39a),

are as readily available to license anaphora as factual propositions denoted by utterances like (38a). Their account would predict that the speaker could mean by (36) that (36b'''), or by (39b) that an earthquake hitting San Francisco upsets her and is frightening, since any proposition denoted by an argument to a modal thereby becomes available throughout the following discourse.

This is the second problem for the anaphoric approach to domain restriction in modal subordination, and it is the heart of the difference between that proposal and the approach in Roberts (1987, 1989): the anaphoric theory predicts global accessibility of nonfactual propositions. That is, it makes the content of nonfactual clauses available globally in subsequent discourse via state switchers operating on utterance type discourse markers, without predicting restrictions on which discourse makers in subsequent discourse may be bound by the state switchers. Nothing would prevent the state switchers introduced by nonfactual clauses from binding utterance type discourse markers in factual contexts, as naturally as any non-opaque NP antecedent binds its anaphor across discourse.

But the accommodation approach in Roberts (1987, 1989) can account for the difference between cases like (32) and (33) on the one hand, and (36) and (39) on the other. In this theory (see also Thomason, 1990), accommodation must be triggered by presuppositions. In modal subordination, the hearer accommodates the speaker's presupposition of an appropriate domain restriction for a modal operator, going back in discourse to find pragmatically appropriate non-factual material. Further, whatever propositions are accommodated must simultaneously satisfy any other outstanding presuppositions, such as familiarity presuppositions of definite NPs and the requirement for a Reference Time. In (32), the only plausible antecedent for *it* (given the event types involved, and our knowledge about such event types) is *a red Porsche*; so in order to make sense of the utterance we must assume that the speaker presupposes that the dream has come true. In (33), there are two possible readings of (33b), one factual and the other modally subordinate. Whether we take (b) as factual or not will depend on what we take the speaker's intentions to be. We will probably attend to his tone of voice and other indicators of his attitude towards the author's claim about Vulcan, and if this information is unclear we may consider the continuation of the discourse or even ask a question about what he intends before making a final determination. Of course, given a general requirement on common

grounds that they be consistent, i.e. that the associated context set be non-empty, any accommodated proposition must be consistent with the common ground to which it is added. In (32), if the common ground includes the proposition that dreams may be prophetic or come true or at least that we don't know whether they can, then the accommodation required for (32c) is consistent with the common ground; so we have no trouble understanding what the speaker must have in mind, whether or not we assent to it. Similarly, in the limited context provided for (33) we have no information about the speaker's beliefs about Vulcan, so presumably no propositions about its existence or non-existence are in the common ground. But consider what happens when we embed this discourse as follows:

(33')a. I'm quite sure that the existence of Vulcan is just a myth, a figment of the popular imagination.

    b. The author claims that Vulcan exists after all.

    c. It has circled around Mercury for ages without us ever noticing it.

In this context, the only possible reading of (33'c) is the modally subordinate interpretation, where the speaker continues to report the author's claims.[10]

The requirement of a consistent common ground is what rules out the relevant interpretations of (36) and (39), since in each of these cases as well, the truth of the conditional clauses or nuclear scope is incompatible with the common ground suggested by the discourse itself. For example, (36) has a conditional, followed by an imperative. One interpretation of the conditional is as discussing a possible future event, and the imperative, evidently dealing with measures designed to prevent such an event, reinforces this interpretation of the conditional. But we don't use a future conditional to talk about events that we're sure will happen or have happened; hence the speaker implicates that she doesn't know the truth of these propositions, which implies that she doesn't presuppose them. This implication is incompatible with globally accommodating the propositions, especially on a view of accommodation where it must be triggered by a speaker's presupposition. Similarly, in (39), *might* (with no perfect auxiliary) indicates that the speaker is talking about a future possibility, and therefore implicates that the speaker doesn't know (or presuppose) the truth of the nuclear scope of the modal; therefore, we

cannot interpret *so* as refering to a presupposed proposition introduced by the nuclear scope of *might*.

I take the problems outlined to constitute a convincing argument against the anaphoric approach to modal subordination, and in favor of the accommodation approach. And I believe this helps to illuminate the nature of domain restriction – it is inherently pragmatic, since the hearer must accommodate the speaker's intended domain, using clues from prior discourse and simultaneously satisfying any other presuppositions.

2.2. *Focus-Sensitive Operators: Only and Negation*

As we saw in (6), the focus sensitive operator *only* also requires domain restriction in the normal case. As a preliminary to considering how the intended domain is recovered, we need to characterize those aspects of an utterance which are relevant to focus. Consider (40):

(40) John likes HAMBURGERS.

In line with work from Jackendoff (1972) to von Stechow (1982, 1988) to Rooth (1985), let's say that each constituent of an utterance has two parts, the **content** and the **presupposition skeleton**. The content is simply the constituent itself or its intensional logic translation. The presupposition skeleton is derived by replacing any focused subconstituents by variables. The set consisting of the content and presupposition skeleton is called the **focal structure** of the constituent. The focal structure for some of the constituents in (40) is given in (41), on the assumption that we have narrow focus on the direct object. Since *hamburgers* is focused, it is replaced by a variable, x, in the presupposition skeleton of any constituent in which it occurs:

(41) DO: presupposition skeleton: x
      content: hamburgers'

    VP: presupposition skeleton: $\lambda y[like'(x)(y)]$
      content: $\lambda y[like'(hamburgers')(y)]$

    S: presupposition skeleton: $like'(x)(j)$
      assertion: $like'(hamburgers')(j)$

Rooth (1985) offers two versions of a domain restriction theory of the semantics of *only*. In one, the theory he develops in detail, each utterance receives a single intensional logic translation, which is then

compositionally assigned two denotations in parallel, one the usual compositional truth conditional interpretation, and the other, the utterance's **p-set**. As I suggested in the introduction, the utterance's p-set is the set of alternative ways of satisfying its presupposition skeleton, a set of intensions of the appropriate type. P-sets are compositionally determined using a recursive definition, under the assumption that focus correlates with prosodic prominence; if a constituent contains no prosodically determined focus, then its p-set is the same as its content.

In the other theory, which Rooth only mentions in passing, each utterance receives two intensional logic translations, one the usual translation (the content in (41)), and the other its presupposition skeleton. These two translations then function in much the same way as the two interpretations in the first theory. Kratzer (1991) argues that the second theory, which she calls a **Representational in Situ Theory of Focus**, is the correct one. If this is correct, it is independent evidence for an intermediate level of interpretation where the focal structure of utterances is represented, and hence, a level of representation necessary for the proper account of domain restriction.

Whichever form of Rooth's account is correct, there is evidence that the determination of the focal structure of sentential utterances cannot be determined apart from the context of utterance, i.e., it cannot be determined on the basis of sentential structure, including prosodic structure, alone. The point is illustrated by (42):[11]

(42) A: Boy, some people around here are pretty particular about what they'll eat for breakfast. Did you hear that John only eats BAGELS for breakfast?

    B: You've got it wrong: ZELDA <u>only eats Bagels for breakfast</u>, not JOHN.

Note that in the context given, B may put prosodic prominence on *bagels* as well as on *Zelda*, but this is not required for felicity. Consider her utterance as I have given it, with no prominence in the VP. Given Rooth's prosodic means of determining where the focus of a constituent is located, only the subject of (42B) is focused; there is no focus in the VP. The predicated presupposition skeleton for that VP is given in (43), the logical form of the operator *only* and its arguments is in (44), and the resulting truth conditions are paraphrased in (45)(where *eat'* is shorthand for the relation of eating-(something)-for-breakfast):

(43)   λy[eat'(bagels')(y)]

(44)   only' (λy[eat-for-b'fast'(bagels')(y)]) (λy[eat'(bagels')(y)])

(45)   The only property that Zelda has in the singleton set {λy[eat'(bagels')(y)]} is the property λy[eat'(bagels')(y)].

But this is pretty weak, surely weaker than intended by B. Kadmon and Roberts (1986) argued on the basis of examples involving the relative scope of quantifiers that the focal structure of a given utterance cannot be determined directly on the basis of its prosodic structure. Rather, we claimed, the prosodic structure puts conventional restrictions on the types of context in which the utterance may felicitously occur. It is on the basis of the actual context of occurrence that the focal structure of the utterance is determined. This determination involves not only structural information about the utterances in the discourse, but also pragmatic information about what we called the **information structure** of the discourse, involving speech act relations among the succeeding utterances and their overall relevance to the speaker's plans and goals.

(42) seems to provide independent evidence in favor of that general view of focal structure. In it, the presupposition skeleton of A's utterance of *John only eats BAGELS for breakfast* is as given in (46), and the logical form of the operator *only* in that utterance is as in (47)(these are the same as predicted by Rooth):

(46)   λy[eat(x)(y)]

(47)   only'(λy[eat(x)(y)]) (λy[eat'(bagels')(y)])

A predicates the property denoted by (47) of John. B then corrects A. The focus on *ZELDA* indicates that it is the correct replacement for the incorrect *JOHN*, i.e., that it is Zelda that has the relevant property, and that John does not. The VP is without accent. It is generally acknowledged that such VPs are *given* in some sense of that much overused term. That is, the lack of accent introduces the presupposition that the property in question is already under discussion. That property, then, is not (44), but (47). If we take this as denoting the property predicated of Zelda by B, we derive the interpretation given in (48), i.e., that the sole type of thing (food) that Zelda eats for breakfast is bagels.

(48)   The only property that Zelda has in the set of properties of eating something (some kind of food) for breakfast is the property of eating bagels.

This is clearly how we understand B's utterance.

Note that the role of contextually given domain restriction in this example is quite different from that which it is generally assumed to play. That is, in the usual case, contextually given domain restriction consists in further narrowing a domain already specified within the utterance itself, a contextual role which can generally be relegated to indices. But in any reasonably realistic model for this discourse, the domain specified partly by the context, (46), is broader than that which would be specified by (43) on the basis of B's utterance alone, as indicated in (49),[12]

(49)   {λy[eat'(x)(y)] | x ∈ D & food'(x)} ⊃ {λy[eat'(bagels')(y)]}
        D: domain of the model

This supports the view that in such cases, domain restriction is not simply refined by the context. Nor is it entirely given by the utterance itself. The prosodic structure of B's utterance plays a crucial role in leading us to understand the intended domain restriction. But we also need information about the focal structure of the predicate made salient by A's prior utterance, and about the relevance of B's utterance to A's. Consider the following:

(50)   A: Sadie is tough to feed. If you give her anything besides a bagel, she won't touch it.

        B: No – ZELDA only eats bagels, not SADIE.

To derive the intended interpretation of B's utterance in (50), we have to know that the property *only eating BAGELS* is salient in discourse. But we cannot determine this on the basis of the form of any VP in the prior discourse. Rather, the lack of pitch accent on the predicate *only eats bagels* in B's utterance alerts the hearer that B presupposes the salience of the predicate. Given knowledge of the interpretation of A's utterances, the hearer finds that this presupposition is satisfied by A's utterances, the predicate in (47), since A's utterances would entail that this predicate is true of Sadie (but not that, e.g., the only thing that Sadie does is eat bagels, which would involve the predicate denoted if we give *only eats bagels* VP focus).

Similar examples can be constructed involving focus-sensitive negation, e.g. (51) and (52):

(51) A: Maria didn't see a POSSUM.
      B: It wasn't MARIA that didn't see a possum, it was GEORGE.

(52) (context: a contest where whoever sees the most mammals wins)
      A: Maria isn't very observant. Even though she walked right by a possum, she didn't report it.
      B: It wasn't MARIA that didn't see a possum, it was GEORGE.

In (42), (50), (51) and (52), the hearer must reconstruct the focal structure for the relevant constituents of the utterances involving contrastively stressed subjects on the basis of information about salience and the focal structure of prior utterances, as well as entailments, relevance, plausibility, and other pragmatic factors; I take it that all these kinds of information are available in the common ground of the discourse in question. Hence, for focus-sensitive operators as for modals, it is not solely the form of the containing utterance, or even the form of prior utterances, which determines the intended and readily accessible domain restriction.

2.3. Summary

We have seen that for modal subordination the anaphoric DMG account proposed by Groenendijk and Stokhof isn't adequate because it is bound to the logical structure of individual preceding clauses (or sequences of preceding clauses) in the discourse; this approach amounts to anaphora-to-a-clause, and is hence too much driven by grammatical aspects of preceding utterances. And in determining the proper domain restriction for focus-sensitive utterances, we cannot rely solely on the prosodic structure of the utterance itself or even on that structure plus information about the prosodic or focal structure of prior constituents, but must consider at least entailments and implicatures generated by prior utterances, and is probably also more global information about the focal structure for the discourse as a whole. (see Kadmon and Roberts, 1986). Both cases argue that we cannot depend on a purely structure-driven account, even

where we include aspects of the superficial structure of the discourse (succession of utterances, structure of prior utterances, etc.). Similar arguments can be offered for other operators which do not (necessarily) have conventionally given restrictive terms, such as adverbs of quantification.[13]

However, purely semantic information would also be inadequate to account for the possibilities in domain restriction. In modal subordination, the requirement of explicitness of the antecedent precludes developing an account in which a restrictive variable in the LF of an operator is assigned a propositional value from context. And with respect to focus-sensitive *only*, Kratzer's argument for the second version of Rooth's theory is another argument that semantic interpretation alone does not lead to an adequate theory of the interpretive possibilities. Again, similar arguments can be offered for other types of operators without conventional restrictive terms.

In cases where the domain of an operator is in part conventionally restricted, such as the quantificational NP in (2b), I think it has long been generally acknowledged that pragmatic factors are central in augmenting this restriction. The examples we have examined here suggest that this is a more general fact about domain restriction: even if, e.g., temporal or conditional adjunct clauses play the conventional role in restricting the domain of modal or adverbial operators that has been claimed for them, this restriction may be further augmented in a way parallel to that in the nominal cases. And even if the focal structure of an utterance conventionally gives the restrictor for a focus-sensitive operator, this is not to say that the focal structure itself is solely conventionally given. Therefore, in determining possible values for the restrictive term of an operator in discourse, we need both syntactic and semantic information about the utterance itself and about prior utterances, and also a variety of kinds of information usually described as "pragmatic" (i.e., information in the common ground), including various kinds of implicatures and inferences.

Since contextual information plays such a central role in domain restriction, we will expect domain restriction to be dynamic in the sense defined by Groenendijk and Stokhof: If we treat a sequence of utterances in discourse as a sequence of conjuncts, as is the default assumption for simple discourses in all dynamic theories, and if the determination of possible values for the restrictive term of an operator Op in an utterance β is partly given by preceding context, then it may be the case

that the equation in (53) does not hold.[14] This is the case in the discourses central to my argument in Sections 2.1 and 2.2.

(53) $[[[β \ldots Op \ldots]]] / α \; (\&) \; \_\_\_ = [[[β \ldots Op \ldots]]]/ \_\_\_ \; (\&) \; α$

Of course, simply observing that a phenomenon is G&S dynamic is not explanatorily adequate. Rather, this fact should fall out of our theory of the phenomenon. One view of context change, from Karttunen (1973) to Gazdar (1979), to Heim (1982, 1983), evolved as an explanation of pragmatic presupposition and its effect on interpretation. The treatment of the restrictive term of certain operators as a variable whose value is fixed by context reflects the view that in these cases domain restriction is essentially presuppositional, carrying a familiarity presupposition in the sense of Heim (1982). If this is correct, we might expect independent evidence that domain restriction is presuppositional, which would both support this treatment and explain the observed dynamicity. It is to this that we turn in the following section.

3. DOMAIN RESTRICTION IS PRESUPPOSITIONAL

In the previous section, I assumed that the notion of context relevant for the analysis of domain restriction is that of the common ground of the participants in a discourse. I noted that domain restriction is a dynamic phenomenon, and that the common ground is a dynamic notion of context, so we know that this notion is sufficient for our purposes, at least in this respect. But there are other notions of context which are also dynamic. What evidence is there that the common ground is the correct notion? A full argument would go beyond the bounds of the present work, since it would involve, among other things, arguing for the common-ality (in some sense) of the information in question. But there is one other way in which the notion of common ground is adequate for our purposes, while some other dynamic notions of context would not serve: The former is intended to reflect the presuppositions of the discourse participants, and it has been argued (most recently by Heim (1983, 1991)) that it can serve as the foundation of a theory of presupposition projection. In this section I will briefly argue that we need such a theory of context for the analysis of domain restriction because this phenomenon is basically presuppositional.

In the full range of types of domain restriction, exemplified for English

in (2)–(9), the type of presuppositions involved are **speaker's presup-positions**. Such presuppositions, unlike the presuppositions of an utterance, do not necessarily arise in a conventional manner, and need not even be explicit, so long as an attentive and rational hearer could rea-sonably be expected to recover them on the basis of contextual information. If cooperative, such a hearer then accommodates these presuppositions to the relevant (hypothetical) common ground. If we assume a logical form like (10) (repeated below) for those examples where the domain restriction is not even partly conventionally-given, as in at least some examples of modal subordination or focus-sensitive operators (see (50) in Section 2.2), then we are committed to the speaker's presuppositions of domain restriction being also utterance presupposi-tions in those cases.

(10)   λQ[Operator, R, Q]

This is because the free variable R in (10), like other definites, has a conventional familiarity presupposition (see Heim, 1982). But in cases where the domain restriction is partly given conventionally, as by the CN of a quantificational determiner, the additional pragmatic domain restric-tion may reasonably be taken to be non-conventional, at least in the absence of arguments that there is (e.g.) always some implicit variable, say conjoined with the explicit domain restriction.

It is important to note that there are examples involving all types of English operators in which the intended domain is apparently the entire relevant type of entity in the model, be it individuals, worlds, proper-ties, or times/events. Ordinary quantifiers like *everyone* can be taken to quantify over all persons in some examples. Kratzer (1980) argues that the strict implication interpretation of conditionals arises when her modal base and ordering source, functions which give the sort of information I'm calling domain restriction, are empty, and hence, when the modal ranges over all possible worlds. In (54), the domain might plausibly be the set of all properties:[15]

(54)   Consciousness only EXISTS.

And if we take a Priorean approach to tense, there are certainly temporal examples where the intended domain restriction for tense might be taken to be 'the past' or 'the future'; (55) seems to be one:

(55)   John was born, and he will die.

Such examples suggest that these maximal domains are always familiar and frequently salient. Another way of saying this is that there is no such thing as a completely null context – the maximal domain for all types of operators is always accessible. As in anaphora resolution, where plausibility and perhaps other factors[16] play as important a role as logical accessibility, the retrieval of the intended domain depends on plausibility as well as on familiarity and salience. In examples where the relevant maximal domain is not plausible as the intended domain for an operator, if the operator has no explicit restrictive term, then felicity requires that there be some other salient and familiar domain restriction to satisfy the familiarity presupposition of the free variable R.

If domain restriction is presuppositional, we would expect that this requirement can be filtered out in certain intrasentential contexts, the filter constructions of Karttunen (1973), which do not always project presuppositions to the entire preceding context. This prediction is corroborated in the behavior of domain restriction for modal operators, when the operators in question occur in a filtering construction such as the consequent of a conditional. (56a) would be infelicitous uttered out of the blue.[17]

(56) a. Margaret would plant an apple tree.
     b. If Margaret had a garden, she'd plant an apple tree.
     c. If Margaret would plant an apple tree, what would Stephen do?
     d. Margaret would plant an apple tree but Stephen would plant a peony.
     e. Margaret wouldn't plant an apple tree.
     f. Would Margaret plant an apple tree?

In such circumstances, the utterance of (56a) might prompt the hearer to ask when or under what circumstances the planting would take place. That is, its utterance presupposes the familiarity of a set of propositions which determines a set of possible worlds or situations during all of which I plant an apple tree. (56b) as a whole does not carry this presupposition; the consequent does, but it is satisfied by the antecedent. This is not to say that the proposition expressed by the antecedent is the sole proposition in the relevant restricted domain; rather, it suggests the correct set of propositions, of which it is one.

In constructions which Karttunen called "holes", in which the presuppositions of sub-constituents are projected to the whole construction,

---

the domain presupposition of *would*, and hence the infelicity out of the blue of (56a) is projected, as we see in (56c)–(56f). In these examples, (56a) is the antecedent of a conditional, or one conjunct of a conjoined structure, or embedded under negation, or appears in yes/no question form, and in each, the presupposition that certain restricted circumstances are under consideration survives the embedding.

With focus-sensitive operators, demonstration of a familiarity presupposition associated with the restrictive argument is considerably more complex, since in the canonical examples, such as (57), prosody serves to suggest what that value might be:

(57)   Reginald only votes for HIMSELF.

The familiarity presupposition would be that there's some familiar set of properties. In this example, if focus is taken to be on the direct object alone, then that NP (or its discourse referent or denotation) is taken to be "new" information and the unaccented remainder of the VP is taken to be "old" information. I take it that the sense of *new* and *old* here is different than Heim's *novelty* and *familiarity*, since, as is well-known, in certain contexts definite NPs may receive novelty accents, while indefinites may remain unaccented;[18] rather, the old/new distinction here appears to have to do with the salience in context of an entire constituent and of its relationship to the rest of the utterance. In view of its prosodic structure, (57) is felicitously uttered iff the set of properties of voting for something is salient, suggesting exactly the sort of set which we need for domain restriction. Hence, Rooth's procedure for determining the value for the restrictive term is adequate in this case by virtue of the function of the prosody. But if (57) is taken to have VP focus, this tells us nothing about salient sets of properties. If there is no other contextually given domain restriction, the utterance means that this is literally the only property Reginald has, a highly implausible claim. Given this implausibility, the utterance is only felicitous in a context where the type of property in question is already understood. Keeping in mind these caveats on the judgement of felicity for the examples involving focus-sensitive operators, their presup-positions are also projected in "holes", such as the question example in (58):[19]

(58)   Does Reginald only vote for HIMSELF?

Examples like those in (59), involving Reference Time, also display presuppositions:

(59) a. I'll help you.
  b. Whenever you need a hand, I'll help you.
  c. I won't help you.

(59a) asserts that there's some familiar future interval or event during which an event of me helping you will take place. To be felicitous, it must be uttered in a context in which there is understood (i.e., in the common ground) some salient future event during which the speaker's offer of help is in effect (e.g., an event in which the addressee might reasonably be thought to benefit from assistance). As with domain restriction for modals (unless anaphora is licensed by accommodation) and unlike the familiarity presupposition for pronouns, there is no explicitness requirement on domain restriction for a temporal operator. (59a) could be uttered by someone to a friend who's just learned that she's lost her job. They both realize without saying so that this will mean considerable hardship during the period of unemployment, and this period serves as the understood domain restriction. Embedding (59a) in a filtering construction may lead to a failure to project the presupposition to the entire sentence, as in (59b), which is acceptable out of the blue. And, as with the other examples just considered, the presupposition in (59a) is projected through holes, as in (59c).

The felicity requirement which we find in these examples and the filtering effect of certain contexts are among the hallmarks of presupposition. Once we recognize the presuppositional nature of domain restriction, at least for those cases where the restriction isn't conventionally given by a constituent which is an argument of the operator in question, it is clear that the kind of information we need to determine what constitutes a possible domain restriction in a particular instance is just the kind of information that we expect to retrieve from the common ground, given its definition. The perspective which I've adopted here harkens back to Grice's view that the theory of meaning should be developed within the broader context of a theory of cooperative behavior, in the interest of both empirical adequacy and explantoriness. In order to fulfil this desideratum, semantic theories must reflect the intimate interaction between the process of truth conditional interpretation and the emerging understanding of the conversational participants, as encoded in a dynamic common ground. Thomason (1990) sketches the broad outlines of a general pragmatic theory along Gricean lines which, while it doesn't address questions of dynamic interpretation, takes accommodation of information into the common ground not as an ad hoc

embarrassment to the theory, but as a central component of what it is to cooperate, and hence as something we expect in a cooperative endeavor like building a common ground.

I believe that when we place the project of truth conditional interpretation in the larger context of a Gricean theory of meaning, we will see that accommodation is bound to play a role in the former, even if indirect, and that its use might well contribute what is needed for the development of a more adequate theory of presupposition, and hence of domain restriction. Presuppositions, both in general and in the case of domain restriction, often arise non-linguistically. Whether they are evoked conventionally, by a free variable in a structure like (10), or are non-conventional speaker's presuppositions only implicitly suggested by the context of one's remarks, as in the contextual enrichment of the quantifier's conventional restriction in (2b), they cannot be determined in a purely structure-driven way (whether by the structure of the utterance in question or by that of the discourse in which it occurs).

(2b)   The dinner guests had rhubarb pie for dessert. Everyone developed a rash.

Domain restriction for all sorts of operators essentially involves accommodation of pragmatic presuppositions, based on knowledge of the common ground, plus inferences drawn on the basis of the common ground and of the (partial) meaning of the current utterance. This provides a unified characterization of domain restriction for all kinds of operators, and it explains the dynamicity of domain restriction, as observed in the examples considered in Section 2.

Once again, I want to emphasize that use of the pragmatic information in question is not motivated solely by the resolution of intended domain restriction; i.e., this is not just a question of determining the speaker's meaning$_{nn}$ in Grice's terms. Rather, an adequate theory of domain restriction will predict that certain readings are simply impossible in certain contexts (cf. especially the discussion of the Landman/Morgan examples in Section 2.1). The type of pragmatic theory I assume here can make this prediction, while one which uses only structural and/or semantic information cannot.

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NOTES

* This paper is an extension of a talk which I gave at the Third International Symposium on Logic and Language, in Révfülöp, Hungary, in August 1990. I am grateful to the organizers of that conference, the members of the Research Institute for Linguistics of the Hungarian Academy of Sciences, and particularly László Pólos, for providing me with the occasion for those remarks, as well as to the participants for the lively discussion of issues in dynamic semantics. In developing the ideas presented here, I have benefitted from discussions with David Dowty and the members of his spring, 1990 seminar on dynamic Semantics, Nirit Kadmon, and Kate Welker. I received particularly helpful comments at the Révfülöp conference from Nick Asher, Greg Carlson, Jeroen Groenendijk, and Barbara Partee. And I am grateful to Barbara Partee and Martin Stokhof for comments on an earlier draft of this paper.

1 In this theory, the event itself is treated as a variable, which, though it doesn't have its own quantificational force, will in effect be bound by a quantifier over discourse (as with indefinite NPs in Discourse Representation Theory).

2 Whether the adverbial *if*-clause in examples such as (3a) and (4a) constitutes an explicit argument, or is simply taken as binding an implicit argument, is beside the point here, since *if*-clauses are optional. See Stump (1981, 1985) for relevant discussion.

3 When the restrictor argument is not given by a phonetically realized constituent of the utterance in question, there are two possible ways to treat the missing argument. One might assume that there is a variable in a syntactic argument position at some level(s) of syntactic representation. Or one may assume only that there is a presupposition associated with operators that there is some intended domain restriction, without any syntactic argument necessarily present in the LF for the utterance. Choosing among these alternatives poses very interesting questions, but I have nothing to say about them here, and so far as I can see, the question which concerns me, of how to determine the possible values of the domain restrictor, is independent of this issue. If one prefers to regard the relevant domain restrictors as non-realized syntactic arguments, then these operators take two syntactic arguments, but one will be a variable, which must be given a value relative to a given context.

4 This last conjunct is basically Groenendijk and Stokhof's (1988) defining characteristic of a dynamic semantics.

5 This account is omitted in Groenendijk and Stokhof (1990), a later version of the cited paper.

6 Note that this translation of the modal adverbial does not provide for a restrictive term. I regard this as an inadequacy; cf. Roberts (1987, 1989) and example (19) below with *might* substituted for *generally*. But I presume this could be remedied straightforwardly, so I'll ignore it here.

7 I'm ignoring tense here.

8 In fact, it is probably more accurate to say that we strive to maintain the fiction of the common ground as mutual knowledge, since true mutual knowledge is notoriously difficult, if not impossible, to actually achieve. The common ground might more realistically be described as a set of mutual beliefs. In addition, each participant strives to maintain her own facsimile of the common ground. Given the epistemic difficulties, observance of careful procedures for maintaining the most accurate facsimiles possible

becomes all the more crucial for effective communication. One such procedure might be the source of the "explicitness requirement" on licensing NPs for pronouns.

9 Hankamer and Sag (1976) argue that the *so* in (i) and (ii), which they analyze as a VP adverb, is a Surface Anaphor – that is, one which is derived from a non-anaphoric constituent at Deep Structure by a substitution rule:

(i) Is the moon out? – I believe so.

(ii) I didn't ride a camel, but Ivan must have done so, and now our office is infested with its fleas.

The main argument for this is that in examples such as (ii), the antecedent of *its* must be *a camel Ivan rode*, even though no NP of that sort appears on the surface. However, one might reconsider the conclusions which they draw from this "missing antecedent" test in the light of contemporary theories of anaphora in discourse; in discourse, a pronoun doesn't require an antecedent, but only a) a licensing NP (to satisfy the explicitness requirement), and b) that the existence of the entity "referred to" be entailed by prior discourse. Further, the *so* under consideration in (4b) and below is not the same as Hankamer and Sag's, either in distribution or in permitting what they call "pragmatic control" – a non-constituent antecedent. See the examples in the text below.

10 A similar phenomenon occurs in (33'):

(33') a. The author claims that Vulcan exists after all.

   b. It has circled around Mercury for ages without us ever noticing it.

   c. It has fascinated mythologists for ages, so these farfetched new claims shouldn't surprise us.

In (c), the speaker evidently withholds assent to the existence of Vulcan, serving a disambiguating function after the fact. This example also shows that the anaphora in (33b) doesn't by itself require the modally subordinate reading, since we can sometimes refer to non-existent but mythical entities quite readily, as in (33'c).

11 I'm grateful to Jeroen Groenendijk and Barbara Partee (p.c.) for suggesting an improvement in my original example.

12 In view of this, Rooth's term *domain selection* might be preferable to *domain restriction*, since the latter tends to suggest a narrowing of an already partly specified domain.

13 I believe it can be shown that in the retrieval of intended Reference Time, no theory which relies solely on the tense and/or aktionsarten of successive utterances (e.g., those of Kamp, 1979; Kamp and Rohrer, 1983; Hinrichs, 1981, 1986; Partee, 1984; Dowty, 1986) will be adequate across the range of types of discourses. Again, such theories rely too much on the form of the discourse and narrow aspects of interpretation, without taking into account crucial discourse-functional relations among the utterances involved. However, demonstrating this in the present context presupposes arguments that Reference Time is properly viewed as domain restriction, which would take me beyond the bounds of the present paper.

14 α in these examples is the utterance of another clause or sentence. The notation is borrowed from phonology: "[[β]]/α (&) __ " means 'the interpretation of β in the context following utterance α'.

15 Except, as Barbara Partee (p.c.) points out, those properties derived from *exists* by disjunction.

16 See, e.g., Grosz and Sidner (1986) on discourse segments.

17 There are a series of rather formulaic utterance-types containing *would* which can be used out of the blue, e.g. (i):

(i)   (to a waiter) I'd like an ice cream cone, please.

The use of the circumstantial modal in such examples appears intended to be a polite weakening of one's demand. The weakening effect of epistemic modals has been observed elsewhere (see the discussion in Landman (1986)), but I haven't yet looked at enough examples like (i) to know what connection, if any, there may be to the epistemic phenomenon.

18 See, e.g., Selkirk (1984) for some examples; Prince (1981) for more discussion of given/new.

19 Testing with negation is delicate in this type of example, partly due to the fact that negation itself (per Kratzer) is focus-sensitive, and partly because of interference from the metalinguistic negation discussed by Horn (1985).

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20. THE EXPRESSION OF QUANTIFICATIONAL NOTIONS IN ASURINI DO TROCARÁ: EVIDENCE AGAINST THE UNIVERSALITY OF DETERMINER QUANTIFICATION

1. INTRODUCTION[1]

The aim of this brief paper is to examine the means employed in Asurini do Trocará for the expression of quantification.[2]

In describing the phenomena of quantification in the language under investigation, I will make use of the distinction discussed in Partee *et al.* (1987) between D-quantification and A-quantification. The former is associated with determiner-like elements whose scope is restricted to NPs in specific positions, while the latter involves other categories such as adverbs, auxiliaries and affixes which take scope over the predicate/argument structure, and hence are unselective quantifiers (Lewis, 1975).

It will be demonstrated in this exposition that Asurini quantifiers such as *all*, *many*, *two* do not form a syntactic constituent with the noun, because they do not belong to the functional category of determiners. They are instead members of other categories such as adverb, verb and noun. These facts lead me to conclude that Asurini lacks D-quantification as well as NPs functioning as generalized quantifiers.

The data to be presented here bear upon two important hypotheses about quantification in natural languages: (a) it is evidence against Barwise and Cooper's (1981) proposal that all languages have "essentially quantificational" NPs, a claim questioned by Partee (1987); and (b) it supports Jelinek's proposal that languages with pronominal arguments, where NPs do not occur in argument positions, also show a lack of Determiner Quantification.

2. ASURINI AS A PRONOMINAL ARGUMENT LANGUAGE

Jelinek (1984, 1985, 1989) argues that in pronominal argument languages, the Projection Principle is satisfied through the pronominal affixes/clitics

E. Bach, E. Jelinek, A. Kratzer and B. H. Partee (eds.), *Quantification in Natural