

PROCEEDINGS FROM

Semantics
and
Linguistic
Theory
I

CORNELL WORKING PAPERS IN LINGUISTICS

No. 10 • Fall 1991

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Proceedings of the First Semantics and Linguistic Theory
Conference

SALT I

Held at Cornell University, April 19-21, 1991

Published under Cornell University Working Papers in Linguistics
Number 10, Fall 1991

Edited by Steven Moore and Adam Zachary Wyner

The Cornell Working Papers in Linguistics is an informal publication of the Department of Modern Languages and Linguistics at Cornell University. Usually, the Working papers serve as a forum for presentation and rapid dissemination of current research by the faculty and students of the DMLL. However, this is a special edition of the series in which the proceedings of the Semantics and Linguistic Theory conference appear. All correspondence may be addressed to Working Papers in Linguistics, DMLL, 203 Morrill Hall, Cornell University, Ithaca, New York, 14853.

Due to the irregular schedule of publication, we cannot offer subscriptions. Brochures describing current issues as well as back issues will be sent to those on our mailing list.

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Introduction

The first annual Semantics and Linguistic Theory (SALT) conference met at Cornell University April 19-21, 1991. The conference attendees decided to publish proceedings in "working papers" style so as not to compete with other journals in the field. We hope that this volume satisfies all the goals and requirements.

A few authors did not submit their papers -- some of them are being published elsewhere. In any case, we list the papers not in the proceedings so that those interested can contact the authors for information:

Greg Carlson, *University of Rochester*,
CASES OF REALLY DIRECT REFERENCE: PERCEPTION AND OSTENSION?

Paul Dekker, *University of Amsterdam*,
CASES IN DYNAMIC PREDICATE LOGIC

Irene Heim, *Massachusetts Institute of Technology*,
PRESUPPOSITION PROJECTION AND ATTITUDE VERBS

Howard Kurtzman, *Cornell University*, and Maryellen MacDonald, *MIT*,
INTERPRETATION PREFERENCES FOR QUANTIFIER SCOPE AMBIGUITIES

Utpal Lahiri, *Massachusetts Institute of Technology*,
QUANTIFICATIONAL VARIABILITY IN EMBEDDED INTERROGATIVES

Robert May, *University of California at Irvine*,
STRICT AND SLOPPY INFERENCE

Martin H. van den Berg, *University of Amsterdam*,
ANAPHORA, GERNERALIZED QUANTIFIERS AND PLURALITY

Thomas Ede Zimmermann, *University of Stuttgart*,
DO WE BEAR ATTITUDES TOWARDS QUANTIFIERS?

Many people helped to make the conference a success. Crucial funding and other support was provided by the Department of Modern Languages and Linguistics and the Cognitive Studies Program. We especially thank the many volunteers who helped with registration, food, and all the other important details. We are grateful to the Cornell Working Papers in Linguistics for allowing us to use their name, procedures and experience in publishing this volume. We also thank the Department of Modern Languages and Linguistics for help in assembling the final product. Finally, thanks most of all to the authors herein for their time and effort in submitting these papers.

Steven K. Moore, *Cornell University*
Adam Zachary Wyner, *Cornell University*

The Syntax and Semantics of Nominals

John Bowers
Cornell University

Though syntacticians have devoted considerable effort to elucidating the mapping between S-structure and LF, relatively little attention has been paid to the mapping between S-structure/LF and lf (=logical form, i.e. truth conditional semantics or 'real' semantics). It will be argued in this paper that recent extensions of standard X'-theory to so-called 'functional' (non-lexical) categories provide the crucial link between the syntactically motivated representations of LF and the semantically motivated representations of lf. Specifically, it will be claimed that there is a small set of functional categories in nominals, parallel to those that have been posited for sentences, which are strongly motivated on both syntactic and semantic grounds. What this means is that given a semantically motivated logic for natural language, positing these functional categories provides, on the one hand, syntactic representations that correctly account for the syntactic properties of nominals and, on the other hand, a universal and maximally 'transparent' compositional mapping of syntactic representations onto the representations of lf, using only a limited range of semantic operations such as functional application and type-shifting.

The logic assumed here is a property theory of a kind that has been argued for on independent linguistic grounds by Chierchia (1984, 85, 89) and Chierchia and Turner (1988). It is a multisorted first-order language with four basic sorts p , u , π , e (the universal sort), standing for propositions, individuals, properties and entities, respectively, plus the predication relation $\cup : \pi \rightarrow \langle e, p \rangle$ and its inverse. The syntactic representations assumed here are those licensed by a 2-level version of X'-theory with only binary branching which applies uniformly to both lexical and functional categories. It will be argued that the minimal set of categories needed to characterize nominal structures is: D(eterminer), Nm, N(oun). The category D has been argued for on syntactic grounds by (among others) Abney (1987) and Bowers (1987). The category Nm, intermediate between D and N, generalizes the category NBR proposed by Ritter (1989) for Hebrew and the category Q proposed by Mallen (1989) for Spanish; it is parallel in form and content to the category Pr, intermediate between I and V, proposed by Bowers (1988, 89, 91).

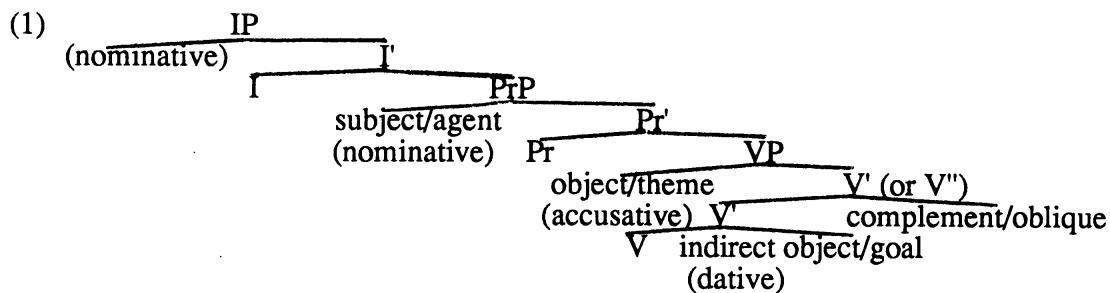
The main syntactic claims of this paper are: (1) nominals universally have the following structure: $[DP \dots [D' D [NmP \dots [Nm' Nm [NP \dots [N' N \dots]]]]]]$; (2) possessive NPs are either base-generated in $[Spec, D]$ or moved there from $[Spec, Nm]$, the canonical position for 'subjects' of nominals, or from $[Spec, N]$, the canonical position for 'objects' of nominals; (3) strong determiners in the sense of Milsark (1974) and Barwise & Cooper (1981) belong to the category D, while weak determiners are APs which are X'-adjuncts licensed by Nm; (4) action nominals derive from underlying structures with real subject or object arguments in $[Spec, Nm]$ and $[Spec, N]$ and the head Noun raises to Nm^0 , parallel to the raising of V to Pr^0 in sentences (Bowers (1989, 90), Larson (1988)); (5) result nominals and basic Nouns, in contrast, neither have real subject and object arguments nor do they undergo raising to Nm^0 .

The main semantic claims of this paper, intimately interrelated with the syntactic claims, are: (1') NPs denote properties and are therefore translated in lf as expressions of type π ; (2) the category Nm^0 , like the category Pr^0 , is universally translated as ' \cup ', the predication operator; (3') X'-adjuncts are uniformly translated as modifiers, hence weak quantifiers do not change the type of the expressions they modify; (4') the members of D, in contrast, following the theory of generalized quantifiers (Montague (1970), Barwise & Cooper (1981)), map properties onto sets of properties, thereby changing the type of their NmP complements; (5') if there is no lexical determiner in D, then D is automatically interpreted as the existential quantifier \exists .

Before discussing and justifying these claims in detail, it is first necessary to summarize the results of my previous work on predication and the structure of propositions (Bowers (1991)). The analysis of nominals proposed in this paper is tightly integrated with the analysis of sentences proposed there. Indeed, the strong parallelism between sentential and nominal structure that results from my analysis of nominals constitutes a crucial piece of evidence in its support.

1. The Syntax of Sentences

It is claimed in Bowers (1991) that the universal canonical D-structure of sentences (apart from order) is the following:



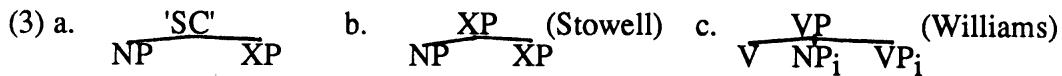
Embodied in this structure are a number of claims having to do with (1) predication; (2) direct objects; (3) indirect objects and complements. I discuss each of these topics in turn.

1.1. Predication

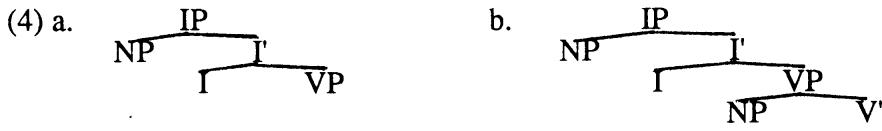
A major unresolved question in the generative framework is whether main clause (MC) and small clause (SC) predication can be unified in purely structural terms. In (2) are exemplified a range of constructions that might reasonably be characterized as 'small clauses', some with PRO subjects, others analogous to ECM constructions:

- (2) a. I consider [John crazy].
 b. We regard [them as fools].
 c. She put the book [PRO on the table].
 d. The lions eat the meat [PRO raw].
 e. With [Mary sick], nothing is getting done.
 f. f. John ate breakfast [PRO naked].

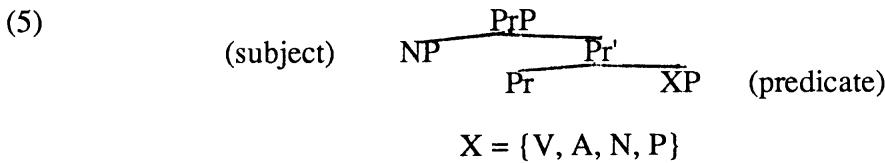
In (3) are illustrated a number of proposed structures for SCs:



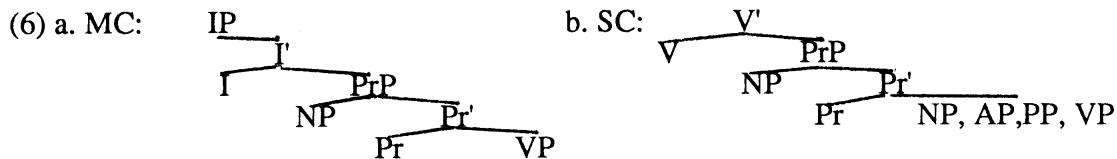
Clearly, none of these structures have anything in common with the standard structure for main clauses, regardless of whether the internal subject hypothesis is assumed or not:



Suppose, however, there is a functional category 'Pr' intermediate between I and V, which projects its own phrasal categories just like other lexical and functional categories. Predication can then uniformly represented as follows:



Whether we have MC or SC predication simply depends on whether the category PrP is a complement of I or V:



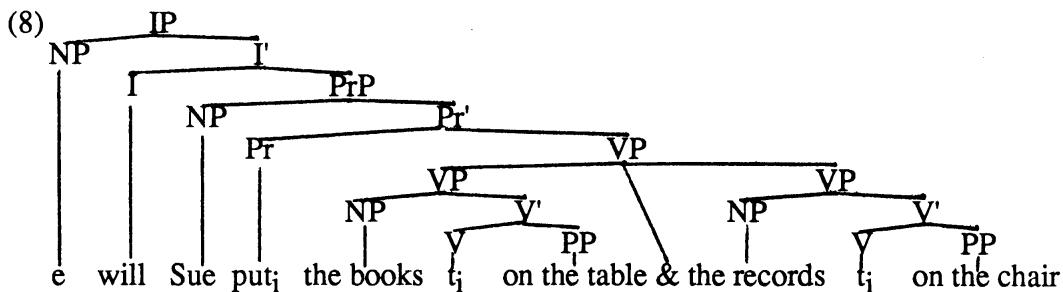
Not only does hypothesizing the category Pr unify MC and SC predication, providing a purely structural characterization of the predication relation, but it also solves a related problem, namely, what category to assign SCs to: it is simply the maximal projection of Pr. Moreover, it does so within the limitations of a uniform 2-level version of X-bar theory, unlike other proposals such as Fukui (1986), and without invoking the use of base-generated adjuncts, as in Stowell (1981) (illustrated in (3) b.) and Koopman and Sportiche (1985, 87). A further bonus of this theory is that it solves a minor but significant mystery of English grammar, namely, how to categorize the element *as*, which appears in SC constructions such as (2) b. It can simply be regarded as a visible realization of the category Pr. Finally, as will be discussed in §2, the category Pr provides the syntactic basis for uniform semantic theory of predication.

I now summarize briefly some empirical arguments that support positing a universal syntactic category Pr. One such argument can be derived from the fact that constituents consisting of a direct object and complements of various kinds can, quite generally, be conjoined:

- (7) a. Mary considers John a fool and Bill a wimp.
 b. John regards professors as strange and politicians as creepy.
 c. Sue put the books on the table and the records on the chair.
 d. Harriet gave a mug to John and a scarf to Vivien.
 e. I expect John to win and Harry to lose.
 f. We persuaded Mary to leave and Sue to stay.
 g. You eat the fish raw and the beef cooked.
 h. I convinced John that it was late and Bill that it was early.
 i. They told Sue who to talk to and Virginia when to leave.

Clearly, such structures are impossible to generate under the standard analysis of VP. In the theory proposed here, on the other hand, they are easily analyzable as instances of

across-the-board extraction of V from a conjoined VP:



We know on the basis of comparative evidence that non-auxiliary verbs don't raise to I in English (Emonds (1978), Pollock (1989)). Hence, the ATB extraction of V required in these structures is only possible if there is an X^0 position between I and V which the extracted verb can be located in. The needed head position is, I suggest, Pr.¹ Independent evidence for this conclusion can be derived from RNR sentences (Larson (1990)) such as the following in which the raised constituent must be a VP containing a V-trace:

- (9) a. Smith loaned, and his widow later donated, a valuable collection of manuscripts to the library.
 b. Sue moved, and Mary also transferred, her business to a different location.
 c. I succeeded in convincing, even though John had failed to persuade, Mary not to leave.
 d. We didn't particularly like, but nevertheless ate, the fish raw.
 e. Most people probably consider, even though the courts didn't actually find, Klaus von Bulow guilty of murder.
 f. Flo desperately wants, though she doesn't really expect, the Miami Dolphins to be in the Superbowl.

Further evidence for the existence of Pr can be derived from the familiar observation that predicative expressions of different syntactic category can be conjoined:

- (10) a. I consider John crazy and a fool.
 b. Bill is unhappy and in trouble.
 c. I regard John as crazy and as my best friend.
 d. *I regard John as crazy and my best friend.

In the theory proposed here, such sentences are analyzable as conjoined PrP complements:

- (11) [PrP I [Pr' consider_i [VP John; [PrP[PrP t_j crazy] and [PrP t_j my best friend]]]]]

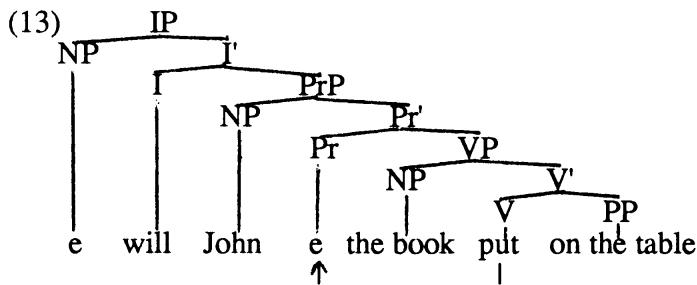
In any theory that treats SCs as projections of lexical categories (e.g. Stowell (1981)), on the other hand, such examples will incorrectly be ruled out as instances of the general prohibition against conjoining phrases of different categories. Notice, incidentally, that the contrast between (10) c. and d. provides further evidence that *as* is a lexical realization of Pr⁰, the former being exactly parallel to (11), the latter ruled out as a violation of the constraint on conjunction just mentioned.

1.2. Subjects and Objects

Modern research has revealed many formal syntactic similarities between subjects and objects, a number of which are listed below:

- (12) i. The subject c-commands everything else in clause; the object c-commands everything but the subject (Barss and Lasnik (1986)).
- ii. Both subject and object are assigned structural case (Chomsky (1981)).
- iii. Both subject and object can agree with the verb.
- iv. Both subject and object control PRO subjects of infinitive and SC complements.
- v. Both subject and object are possible non-θ positions (Postal and Pullum (1988)), hence landing sites for NP-Movement.

To account for this parallelism, I follow a line of thought that goes back to at least Chomsky (1955/75), Dowty (1982), Jacobson (1983) and Bowers (1983), namely, that the verb and its complements form a D-structure constituent which is predicated of the direct object. This notion is further developed in works such as Jacobson (1987), Bowers (1988, 89), and Larson (1988), which claim specifically that direct objects are generated in [Spec, V], parallel to the position of subjects in [Spec, Pr]. According to this view, a sentence such as *John will put the book on the table* would be represented as follows:



I assume that θ-roles are assigned locally to XPs that the verb M-commands, where by 'assigned locally' I mean assigned within the maximal projection of the X^0 category containing the verb. It follows that V-to-Pr movement is obligatory. I also assume that θ-roles are assigned compositionally (Fukui (1986), Grimshaw (1990)), going from innermost to outermost constituents. The argument structure associated with verbs is thus represented as follows:

- (14) $[[[_ \theta_3] \theta_2] \theta_1]$

where θ_3 is assigned to the complement of V in V'; θ_2 to the argument in [Spec, V]; and θ_1 to the argument in [Spec, Pr].

With regard to case theory, I assume that case is also assigned locally under M-command by X^0 categories. In languages such as English the Agr element of I (or possibly a higher Agr category, but in any case not Pr) assigns nominative case to the NP in [Spec, I]. Hence movement of the 'internal' subject in [Spec, Pr] to [Spec, I] is, in effect, obligatory, as proposed by Kuroda (1986), Fukui (1986), and others. Accusative case is assigned by V to the NP in [Spec, V] and dative case to NPs in complement position. It has been shown by Bailyn and Rubin (1990) that instrumental case in Russian

is assigned by Pr^0 .

If objects are generated in [Spec, V], then all movement operations apart from adjunction can be restricted to just two kinds: (i) head-to-head; (ii) spec-to-spec.

Movement is thus structure-preserving in the extremely strong sense that not only are categories only permitted to move to positions where categories of the same type are permitted, but categories can only move between functional positions of the same kind.

I turn now to empirical arguments that demonstrate the need for the category Pr, together with the assumption that objects originate in [Spec, V]. Modifying Travis (1988) somewhat, let us make the following fairly restrictive assumptions concerning the structure and licensing of adverb phrases: (i) AdvPs are X'-adjuncts licensed by an X^0 head; (ii) each head licenses one and only one type of AdvP. If it could be shown that there was an adverb type in the appropriate position for which there was no licensing head, and if it could be shown that Pr was a plausible licenser for adverbs of this type, then it could reasonably be concluded that Pr exists. Consider in this light the fact that certain manner adverbs in English can only occur in post-verbal position:

- (15) a. John learned French perfectly.
b. Bill recited his lines poorly.
c. Mary plays the violin beautifully.

- (16) a. *John perfectly learned French.
b. *Bill poorly recited his lines.
c. *Mary beautifully plays the violin.

while other manner adverbs occur in both positions:

- (17) a. John learned French immediately.
b. Bill recited his lines slowly.
c. Mary will play the violin soon.

- (18) a. John immediately learned French.
b. Bill slowly recited his lines.
c. Mary will soon play the violin.

These two types can cooccur with one another, but cannot be interchanged:

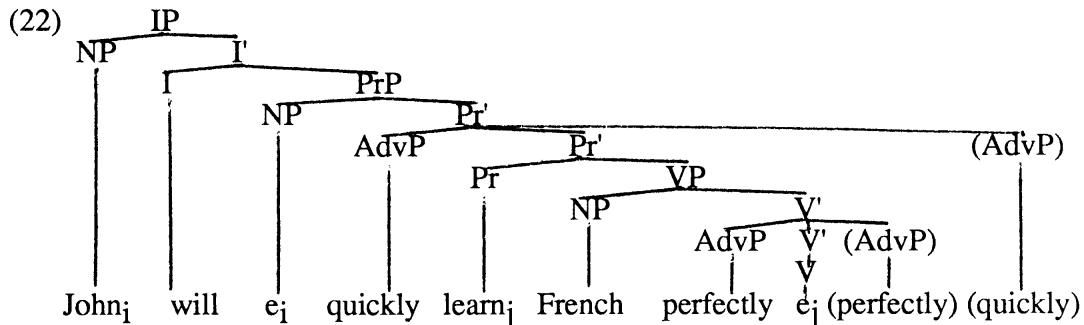
- (19) a. John immediately learned French perfectly.
b. John learned French perfectly (almost) immediately.

- (20) a. *John perfectly learned French immediately.
b. *John learned French immediately perfectly. (modulo Heavy-Constituent Shift)

This strongly suggests that they are licensed by different categories. The problem is that there are at least two further distinct adverb types in English (making a total of four), none of which can be interchanged:

- (21) a. Clearly, John will probably immediately learn French perfectly.
b. *Clearly, John will immediately probably learn French perfectly.
c. *Immediately, John will probably clearly learn French perfectly.
d. *Clearly, John will perfectly immediately learn French probably.
etc.

Since the only three categories available as licensors are V, I and C, either another licensor is needed or we must assume that the two types of manner adverb discussed above are both licensed by V. It is shown in Bowers (1991) that the latter assumption is untenable. But if adverbs such as *perfectly* are licensed by V and adverbs such as *immediately* by Pr, then their behavior follows immediately, as can be seen by examining the following structures:



The fact that *perfectly* can only appear in post-verbal position is now explained automatically by virtue of V-raising into Pr, which ensures that the verb is always to the left of the adverb, regardless of where it is generated in D-structure. Adverbs such as *quickly*, in contrast, can appear either as left Pr' adjuncts or as right Pr' adjuncts, hence either to the left or to the right of VP. The fact that the two adverb types can't exchange positions follows from the fact that they are licensed by different heads.

This analysis also makes a further correct prediction concerning the distribution of *perfectly*, namely, that it can appear either to the left or to the right of a complement:

- (23) a. John spoke French intimately to Mary.
 b. John spoke French to Mary intimately.

- (24) a. Mary jumped the horse perfectly over the last fence.
 b. Mary jumped the horse over the last fence perfectly.

This fact also rules out the possibility of analyzing *perfectly*-type adverbs as complements, since they would then be unable to cooccur with PP complements.

Consider, finally, the well-known fact that adverbs in English resist being placed between a verb and its direct object, though not between a verb and a PP-complement:

- (25) a. John spoke French intimately to Mary.
 b. *John spoke intimately French to Mary.
 c. John spoke to Mary intimately.
 d. John spoke intimately to Mary.

Following Stowell (1981), this restriction on the placement of adverbs in English is usually accounted for in the literature by means of the so-called "adjacency requirement" on case-assignment, which stipulates basically that accusative case can only be assigned by the verb to a NP that it is adjacent to. Apart from the inherent implausibility of restricting case-assignment in this way, there are at least two empirical arguments against such an approach. First, adjacency is not a general requirement for case-assignment, even in English, since adverbs can occur quite freely between the subject and the IO head that assigns it nominative case:

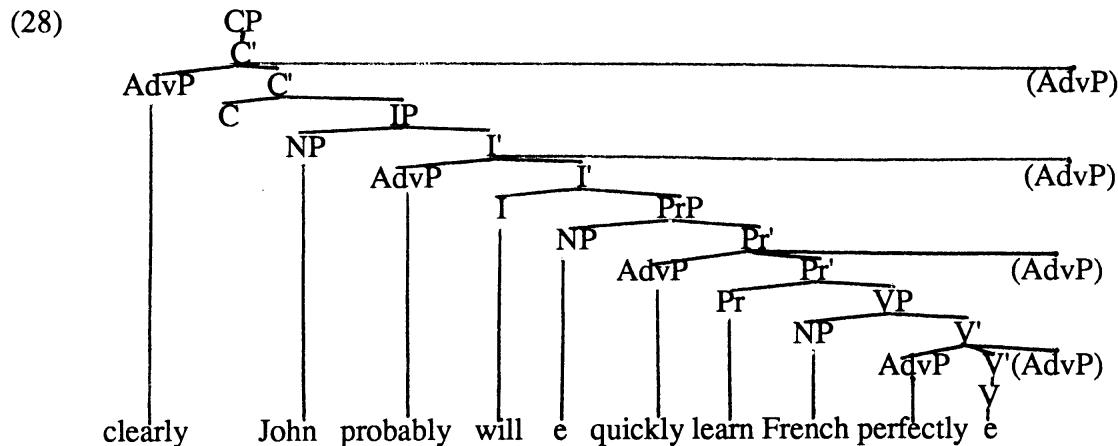
- (26) John certainly will win the race.

Second, the adjacency requirement simply doesn't hold in many languages, even in typologically quite similar languages such as French (see Bowers (1991), §3.2.1., for further discussion):

- (27) Jean parle souvent le français.

Hence all that remains of the adjacency requirement is a language-specific condition on assignment of just a single case, namely, accusative, hardly an explanatory theory.

In the theory proposed here, in contrast, this restriction on the occurrence of adverbs can be explained in purely structural terms. First of all, the fact that V-licensed adverbs such as *perfectly* cannot occur between the verb and its direct object follows immediately from the assumption that these adverbs are V'-adjuncts, together with the linked hypotheses that direct objects are in [Spec, V] and that the verb raises obligatorily into Pr^0 . These assumptions jointly ensure that there is simply no way of generating an adverb of this type between the verb and its object in English. Second, these same assumptions ensure that it is impossible to generate adverbs licensed by any other head between the verb and its object. Thus a Pr -licensed adverb, for example, will be generable either to the left of the raised verb or to the right of the whole VP complement of Pr^0 , but not in any other position. The possible positions for adverbs permitted by this theory are indicated in the following structure for (21) a.:



Finally, the fact that other complements of the verb cannot be ordered between the verb and the direct object:

- (29) a. *John spoke to Mary French.
 b. *Mary persuaded to leave John.
 c. *The lions ate raw the meat.
 d. *Sue gave to Bill a book.
 e. *Mary persuaded that he should rest Bill.

is also explainable in purely structural terms, given the analysis proposed here. In fact, all the ordering properties attributed to the adjacency condition on case assignment reduce to a single structural property of English, namely, that it is Spec-initial.

Another significant consequence of the claim that subjects and objects are structurally parallel is the following. Since Spec positions can in general be θ' -positions, it should be the case that object position, as well as subject position, is a possible θ' -position. In fact,

Postal and Pullum (1988) have argued that one of the crucial tests for a θ' -position, namely, occurrence of expletives, holds for object position as well as subject position. This in turn makes it possible, contrary to the current view, to have raising-to-object (RO), as well as raising-to-subject (RS), without violating the θ -Criterion. An important empirical argument in support of RO can be derived from the facts of so-called "quantifier floating" in English and other languages. The basic observation, due originally to Maling (1976), is that certain quantifiers can "float" to the right of the NP they modify under two conditions: (i) if the NP is a subject; (ii) if it is an object that has a predicative complement following it. Crucially, quantifier floating is not possible from objects that lack a predicative complement:

- (30) a. The men will all leave.
- b. We consider the men all fools/totally crazy.
- c. *I saw the men all.
- d. *The men were arrested all.
- e. *The men arrived all.

These facts can be elegantly explained under the following assumptions:

- (31) i. Floated quantifiers produced by leftward movement of NP (Sportiche (1988)).
- ii. Raising to object (RO) exists.
- iii. Q is adjoined only to PrP and IP.

As shown in (32) a., a stranded quantifier is always possible in subject position, since subjects always move from [Spec, V] to [Spec, Pr]; more importantly, the possibility of a stranded quantifier in object position also follows if RO exists, as shown in (32) b.:

- (32) a. [IP the men₁ [I' will [PrP all [PrP t₁ [Pr' leave₂ [VP t₂]]]]]]]
- b. [IP...[PrP we [p_{I'} consider₁ [VP the men₂ [V' t₁ [PrP all [PrP t₂ [Pr' e
fools]]]]]]]]]

Floating from an object which lacks a complement, as in example (30) c., is ruled out, because the object has not been moved. The fact that floated quantifiers are prohibited in post-verbal position in passives and unaccusatives, as shown by examples (30) d. and e., follows from assumption (31) iii., which prohibits Q from being adjoined to VP.

Finally, if this analysis is correct, then we would expect floating quantifiers to occur with PRO as well as trace, as is indeed the case:

- (33) a. I persuaded₁ [VP the men₂ [V' t₁ [IP all [IP PRO₂ to resign]]]]]
- b. The teacher ordered the two boys both to pay close attention.
- c. We put₁ [VP the students₂ [V' t₁ [PrP each [PrP PRO₂ [Pr' e in separate
desks]]]]]
- d. They returned the books all to their owners.
- e. We painted the chairs all red.
- f. The trainer fed the steaks all to the lions.

These observations lead to the conclusion that goal phrases and dative expressions such as those in (33) c., d., and f. must in general be SC complements with a PRO subject.

1.3. Indirect Objects and Complements

It has often been noted that there is a small class of verbs in English which, though transitive in form, cannot be passivized:

- (34) a. John went home/*Home was gone by John.
- b. Mary left the room angry/*The room was left angry (by Mary).
- c. John resembles Bill/*Bill is resembled by John.
- d. The package weighed 10 lbs./*10 lbs was weighed by the package.
- e. This book cost \$10/*\$10 was cost by this book.
- f. The book cost John \$10/*John was cost \$10 by the book.

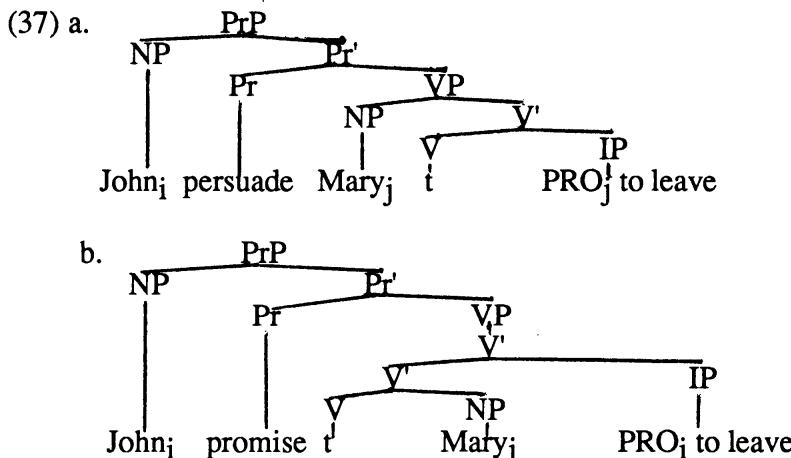
A related phenomenon (commonly referred to in the literature as "Visser's generalization", though the standard account is Bach (1979)) is the fact that transitive subject-control verbs lack passives:

- (35) a. *John is impressed (by Bill) as pompous.
- b. *The boys were made a good mother (by Aunt Mary).
- c. *The kids were failed (by Max) as a father.
- d. *The men were struck by the idea as nonsense.
- e. *The men were promised (by Frank) to leave.

Interestingly, it has been observed by Maling (1976) that the very same verbs that don't passivize also don't permit floated quantifiers associated with their objects:

- (36) a. *He impresses his friends all as pompous.
- b. *Aunt Mary made the boys all a good mother.
- c. *Max failed the kids all as a father.
- d. *The idea struck the men all as nonsense.
- e. *Frank promised the men all to leave.

Clearly, this can't be an accident, suggesting that there is a structural difference between direct objects and indirect objects. Let's assume the following structures for sentences with *persuade* and *promise*, respectively:



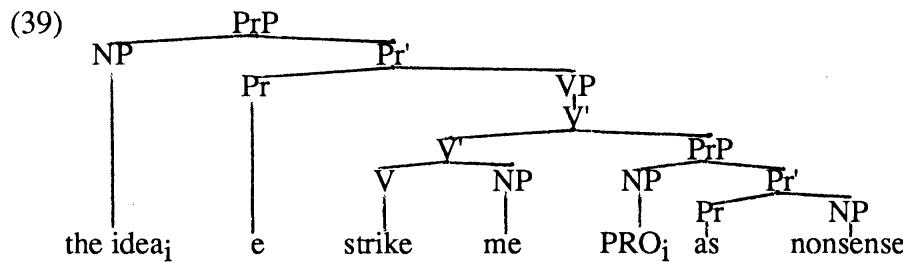
Recalling from the previous section that only spec-to-spec movement is permitted, Visser's generalization follows immediately, since only in the case of *persuade* is there an NP in

[Spec, V]. This analysis can also be used to explain the control properties of these verbs:

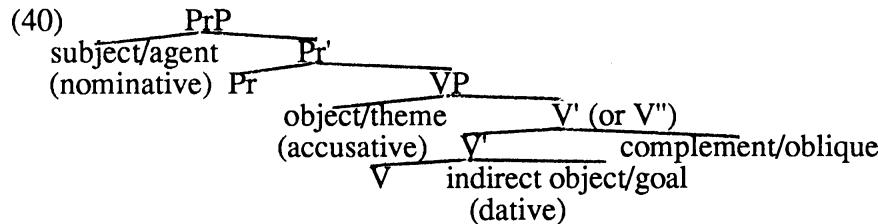
- (38) a. John_i persuaded Mary_j [PRO_{i/j}* to leave]
 b. John_i promised Mary_j [PRO_{i/*j} to leave]

Suppose that the basic constraint on control is simply that PRO must be controlled by the nearest c-commanding NP. The control properties indicated in (38) follow at once.

Maling's observation concerning quantifier floating is simply a corollary of this solution to the control problem, since only in (37) a. does the apparent object c-command the floating quantifier in the complement clause. The remaining examples in (35) are exactly like (37) b. in structure except that they contain a SC complement with a PRO subject. An example such as (36) d. would therefore be represented as follows:



At this point we have pretty much deduced the general argument structure (1) (repeated below), proposed at the outset:



Further support for the correctness of this structure can be derived from the fact that there are sentences containing all three arguments, a direct object, indirect object and SC or sentential complement:

- (41) a. They feed the meat_i to the lions PRO_i raw.
 b. John put the patient_i in bed PRO_i drunk. (cited in Roberts (1988, 708, n. 3))
 c. I sent John_i to the store PRO_i to get the paper.

As predicted, the direct object, rather than the indirect object, controls the PRO subject of the complement.

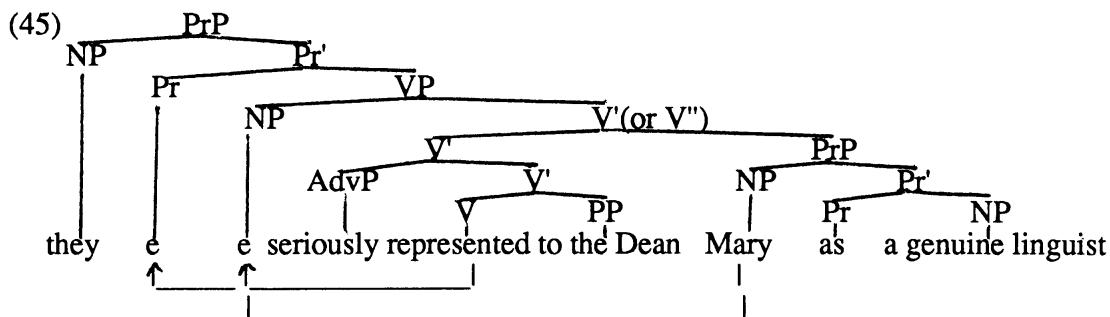
I conclude by discussing the interaction of RO with dative arguments and V-licensed adverbs. It has been argued that the latter both occur in positions subordinate to, and to the right of, the direct object. Therefore, if RO exists, the order of these elements must be as follows:

- (42) V-Object-(Adverb)-(Dative)-Complement

Remarkably, this prediction is borne out by the facts, as the following data shows:

- (43) a. *We proclaimed to the public John to be a hero.
 b. We proclaimed John to the public to be a hero.
 c. *We proclaimed sincerely John to be a hero.
 d. We proclaimed John sincerely to be a hero.
 e. *We proclaimed sincerely to the public John to be a hero.
 f. We proclaimed John sincerely to the public to be a hero.
- (44) a. *They represented to the Dean Mary as a genuine linguist.
 b. They represented Mary to the Dean as a genuine linguist.
 c. *They represented seriously Mary as a genuine linguist.
 d. They represented Mary seriously as a genuine linguist.
 e. *They represented seriously to the Dean Mary as a genuine linguist.
 f. They represented Mary seriously to the Dean as a genuine linguist.
- (45) a. *We proved to the authorities Smith to be the thief.
 b. We proved Smith to the authorities to be the thief.
 c. *We proved conclusively Smith to be the thief.
 d. We proved Smith conclusively to be the thief.
 e. *We proved conclusively to the authorities Smith to be the thief.
 f. We proved Smith conclusively to the authorities to be the thief.

Historically, one of the main objections to admitting RO as a possible operation in the theory of grammar was the fact that it appeared to be string vacuous. As the following derivation shows, this particular objection to RO no longer carries any force:



Returning finally to the impersonivizable verbs in (34), note that in each case there is at least some independent evidence in support of the view that the apparent direct object is really an underlying dative argument. The apparent object in examples (34) a. and b. is clearly a directional complement that idiosyncratically lacks a preposition, as revealed by related examples such as *John went to his/the home* (n.b. **John went his/the home*), *Mary went out/away from the room*, etc. The dative character of the apparent object in (34) c. shows up in related nominal forms such as *John's resemblance to Bill/the resemblance of John to Bill*. In the case of examples (34) d. and e. it seems more plausible to suppose that the measure expressions *10 lbs.* and *\$10* are predicates of a SC complement and example (34) f. further supports this hypothesis, since the (impersonivizable) dative object optionally occurs to the left of the measure expression.

2. The Semantics of Sentences

Classical theories of logical semantics assume just two basic types: the type of entities, designated by the symbol 'e', and the type of propositions, designated by the symbol 't'. All other types are derived from these two. Properties are not primitives in such a theory,

but rather are reconstructed as propositional functions (1-place predicates, or intransitive verbs), of type $\langle e, t \rangle$, which combine with entity expressions to form propositions. 2-place predicates, or transitive verbs, are expressions of type $\langle e, \langle e, t \rangle \rangle$, i.e. an expression that combines with an entity expression to form an intransitive verb (which in turn combines with an entity expression to form a proposition). In this way, expressions with any arbitrary number of arguments can be represented, as well as other types of expressions, such as sentence modifiers (of type $\langle t, t \rangle$), nominal modifiers (of type $\langle e, e \rangle$), and so forth. The only problem with adopting the classical type theory as a theory of natural language semantics is, as has frequently been noted, that the types provided by the semantics don't necessarily map onto the syntactically motivated categories of natural language in any simple or transparent fashion. Take, for example, a standard set of phrase-structure rules such as the following:

- (46) a. $S \rightarrow NP \ VP$
- b. $VP \rightarrow V$
- c. $VP \rightarrow V \ NP$

How do the types of classical semantics relate to the categories provided by these rules? The category S obviously corresponds to expressions of type t , while VP -expressions are uniformly of type $\langle e, t \rangle$. Verbs are of different types, such as $\langle e, t \rangle$ or $\langle e, \langle e, t \rangle \rangle$, depending on how many arguments they require. The relation between classical type theory and the syntactic representations proposed here, on the other hand, is quite opaque. The category PrP would of course correspond to the type t of propositions and the category VP to the type $\langle e, t \rangle$ of propositional functions. However, the intervening categories Pr and Pr' correspond to nothing at all in the semantics. Of course, one can always stipulate in an ad hoc fashion the relation between syntactic rules and semantic types, but considerations of learnability strongly suggest that the principles connecting syntax and logical form should be simple and universal. The strongest possible hypothesis would be that, aside from the syntactic and semantic properties of specific lexical items, the child must learn nothing concerning the relation between syntactic rules and categories and semantic types, the basic mapping being determined by principles of UG.

I turn now to a rather different approach to the logical semantics of natural language. Following Chierchia (1985, 1989), I will assume that the representations of logical form are drawn from a multisorted first-order language with four basic sorts: u , p , π , e (the universal sort), plus the predication relation $\cup : \pi \rightarrow \langle e, p \rangle$ and its inverse $\cap : \langle e, p \rangle \rightarrow \pi$. p is the type of propositions; π is the type of properties; and u is the type of basic entities. Since properties and propositions are basic types in this theory, there is no direct connection between them, as there is in the classical theory. Therefore in order to predicate a property of some entity to produce a proposition, it is first necessary to turn that property into a propositional function, i.e. a "Fregean" unsaturated structure that must combine with an entity expression to form a proposition. That is precisely the function of the predication operation ' \cup ', which maps property expressions onto propositional functions of type $\langle e, p \rangle$. (The inverse operation ' \cap ', which might be termed 'nominalization', maps propositional functions onto properties; it will not concern us further here.) This propositional function then combines with another expression to form an expression of type p , a proposition.

Given this ontology, there is a straightforward correspondence between the semantics of predication and the syntax of predication proposed in this paper. Assume that the semantic function of Pr is to map properties (expressions of type π) into propositional functions (expressions of type $\langle e, p \rangle$). In short, assume that the translation of Pr in lf is simply ' \cup '.

Assume in addition that phrases of category VP map onto expressions of type π , as do predicate APs, NPs and PPs. It follows that if r is the translation of a phrase of category YP, of type π (regardless of its syntactic category), then the translation of $[p_r' \text{ Pr } YP]$ is

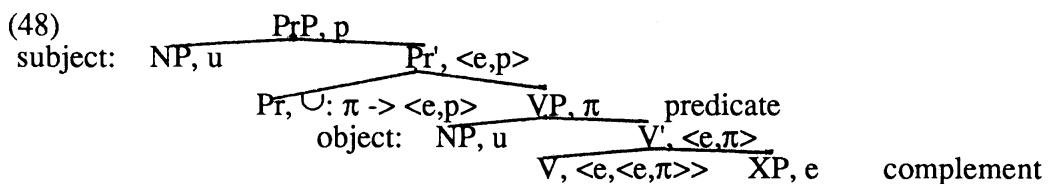
simply \cup_r , of type $\langle e, p \rangle$, and the translation of PrP is $\cup_r u$ (u an individual of any sort), of type p . There is thus a straightforward, one-to-one mapping between the categories of syntax and the types of their translations in logical form. Given a property semantics of this kind, it immediately becomes possible to assign a precise meaning in logical form to the hypothesized functional category Pr and to its X-bar projections Pr' and PrP.

Phrases of the category PrP involve what might be termed 'primary predication', to which we have now given a formally precise definition at the level of lf. Phrases of category VP, on the other hand, we have suggested are properties, expressions of type π . These property expressions can themselves contain one or more arguments and it was argued in §1.2. that the formation of PrP and the formation of transitive VP are formally parallel in that both involve combining a NP with some X'-phrase to form a new phrase of category XP. To account for this parallelism at the semantic level, I assume that a transitive V' is of type $\langle e, \pi \rangle$, what might be termed a 'property function', meaning that it must combine with some expression to form a property expression. I have suggested that the process by which transitive VPs are formed might appropriately be referred to as 'secondary predication'. Notice, however, that even though they are formally parallel in certain respects, there are fundamental differences between PrP and VP. A PrP is what Chomsky (1986) has termed a "complete functional complex" (CFC), meaning that it can stand on its own as a complete 'thought', or 'information unit', as it is termed in Chierchia and Turner (1988). A transitive VP, in contrast, is not a CFC in this sense. This difference is formally accounted for here by virtue of the fact that propositions are of type p , and therefore have truth-values, whereas transitive verbs, which are of type π , do not. The theory proposed here thus explains both the formal parallels between primary and secondary predication, as well as their fundamental differences.

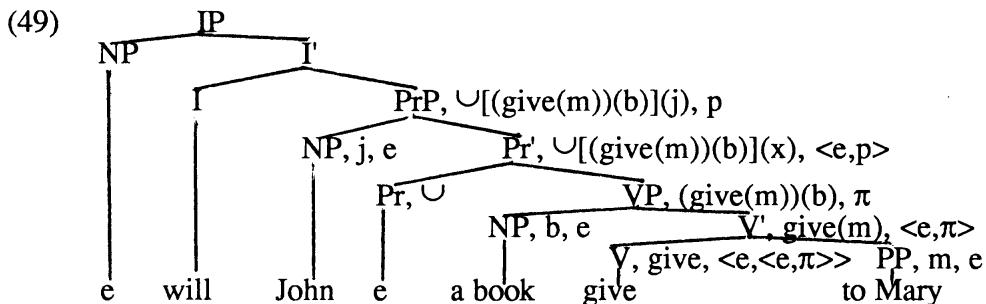
At this point, let me summarize the previous discussion by comparing the different types of entities assumed in the classical theory and Chierchia's property theory, along with the kinds of syntactic categories they naturally map onto:

(47) a.		b.	
entities: e		basic entities: u	predication (\cup): $\langle \pi, \langle e, p \rangle \rangle$
propositions: t		propositions: p	nominalization (\cap): $\langle \langle e, p \rangle, \pi \rangle$
properties: $\langle e, t \rangle$		properties: π	
		propositional functions: $\langle e, p \rangle$	
$S \leftrightarrow t$		$\text{PrP} \leftrightarrow p$	$\text{intr V} \leftrightarrow \pi$
$\text{IV} \leftrightarrow \langle e, t \rangle$		$\text{Pr}' \leftrightarrow \langle e, p \rangle$	$\text{trans V} \leftrightarrow \langle e, \pi \rangle$
$\text{TV} \leftrightarrow \langle e, \langle e, t \rangle \rangle$		$\text{Pr} \leftrightarrow \cup: \pi \rightarrow \langle e, p \rangle$	$\text{ditrans V} \leftrightarrow \langle e, \langle e, \pi \rangle \rangle$
$\text{TV/T} \leftrightarrow \langle e, \langle e, \langle e, t \rangle \rangle \rangle$		$\text{VP} \leftrightarrow \pi$	$\text{pred NP} \leftrightarrow \pi$

Putting the syntax proposed in §1 together with the semantics just discussed, propositions will universally have the following structure and type assignments:



A ditransitive sentence such as *John will give a book to Mary* will therefore have the following structure, translations and type assignments:



If any relation is semantic, it is surely the predication relation. Almost without exception, model theoretic accounts of predication have adopted the "Fregean" view that the act of predication consists of "saturating" or "completing" structures that are inherently "unsaturated" or "incomplete". (But see e.g. Aczel (1980), Bealer (1982), Jubien (1985), for an alternative, non-"Fregean" approach to predication.) At the same time, there appears to be strong semantic evidence (Chierchia (1984, 1985, 1989), Chierchia and Turner (1988) that properties in natural language cannot simply be identified with propositional functions, but must be able to function as individuals, as well. If the arguments discussed so far are correct, then it turns out, quite remarkably, that the syntactically motivated structures required to support a structural theory of predication match up in a simple, "transparent" fashion with the types of entities and operations required in a richer logical language of the sort envisioned by Chierchia. It will be demonstrated shortly that similar results can be achieved in the case of nominal structures, a remarkable, though surely not surprising result. A priori, it seems quite unlikely that the structural representations required to represent the syntactic phenomena of natural language will turn out to be related in random and essentially unpredictable ways to the types and operations required to support an explicit semantics for natural language. Probably, everyone would assent to the assumption that an adequate semantic theory must be compositional. The requirement of compositionality ensures that each syntactic rule or substructure be matched by a corresponding semantic rule or type. However, as Chierchia and Turner (1988, 277) note, "everything else being equal, one would prefer not to have to specify for any given grammar, the pairing of syntactic rules with the corresponding semantic one, on a case-by-case basis. One would like such a pairing to follow from general principles."

The considerations put forward thus far strongly suggest that the pairing of syntactic and semantic rules is in fact quite general and universal. I have argued, in particular, that the basic structural relations in sentences are universally specifiable by applying an extremely restricted version of X'-theory to a small number of lexical and functional categories. The pairing of syntactic categories with semantic types and of syntactic relations with semantic operations is, I claim, fixed within very narrow limits by the principles of universal grammar. Specifically, I have tried to show that the category 'Pr', whose translation is simply ' \cup ', along with its phrasal projections, provides a uniform account of the syntax and semantics of every kind of predication relation encountered in

natural language. Given this category and its translation in If, the structure and interpretation of the phrasal categories it can project are completely determined by the principles of X'-theory in the syntax and by the principle of functional application in the semantics.

Similarly, I have shown that expressions of the category VP, uniformly paired with properties (expressions of type π), have an asymmetrical structure, mirrored in the corresponding logical representations, which is precisely parallel to the structure of PrP. In particular, the so-called direct object asymmetrically c-commands the complements of the verb. Semantically, the V' constituent is an unsaturated expression (as is Pr') which yields a property expression when applied to the direct object constituent. I have tried to show that this remarkable parallelism between the internal structure of PrP and VP is empirically supported by a wide range of syntactic and semantic considerations.

The remainder of this paper will be devoted to demonstrating a similar transparency in the mapping between the syntactic representation of nominals and their translations in If. At the same time, it will be shown that there is a close parallelism between sentences and nominals, both in their syntax and in their semantics. The idea that sentences and nominals are fundamentally similar in underlying form has been of central importance in the generative tradition from its inception. The results of this paper confirm in the strongest possible way the essential correctness of that conjecture.

3. The Syntax of Nominals

Recent work by Abney (1987), Bowers (1987), and others has clearly established the necessity for a functional category D(et) in the nominal system. If, as has been claimed in this paper (and in more detail in Bowers (1991)), there is a functional category PrP in sentences, intermediate between IP and VP, then one might expect to find a corresponding intermediate category in nominals. Consider in this light gerundive nominals of the following sort:

- (50) a. $[\beta \text{ John's } [\alpha \text{ driving cars so recklessly}] \text{ is terrifying everyone}]$
- b. $[\beta \text{ This } [\alpha \text{ singing songs}] \text{ must stop at once}]$

It has been demonstrated by Abney (1987) and Bowers (1987), following Chomsky (1970) and Jackendoff (1977), that the α -phrases in (50) are verbal rather than nominal in nature. It follows, given the analysis of direct objects proposed in this paper, that there must be some head position for the verb to move to, if the correct order of the verb and secondary subject is to be generated. This position cannot be D, because in examples such as (50) b., D is already occupied by a demonstrative. It must be the case, therefore, that D has the option of selecting a PrP as its complement:

- (51) $[\text{DP this } [\text{PrP PRO } [\text{Pr'} \text{ singing}; [\text{VP songs } [\text{V'} \text{ t}_1]]]]]$

Consider next example (50) a. The possessive NP *John's* is the primary subject of *singing*, hence must originate in [Spec, Pr]:

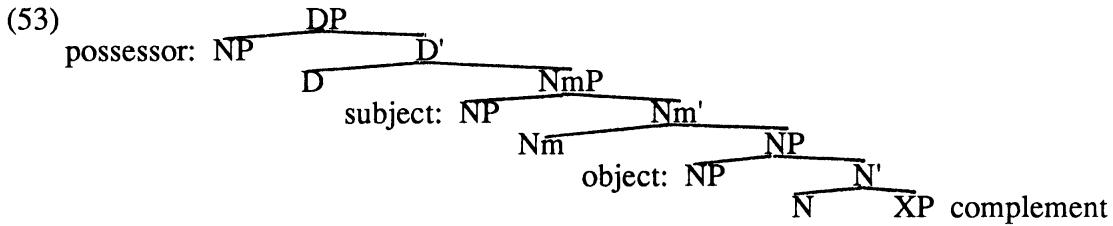
- (52) $[\text{DP}[\text{NP e}][\text{D'} [\text{D e}][\text{PrP John } [\text{Pr'} \text{ singing}; [\text{VP songs } \text{t}_1]]]]]$

Obviously subjects of gerundives do not remain in this position, since they cannot follow demonstratives, articles and other realizations of the category D in S-structure. Furthermore, we already know that [Spec, Pr] is not a position to which case is assigned. Hence a NP in that position must move to a position where it can receive case. The only

possible position it can move to is [Spec, DP], where it will, we assume, be assigned genitive case, thereby satisfying the Case Filter. Note the parallel between this movement and movement from [Spec, Pr] to [Spec, I].²

3.1. The category Nm.

Having established that D is capable of selecting the intermediate level functional category PrP and that there must be movement from [Spec, Pr] to [Spec, D], let us consider whether there might be a corresponding intermediate level functional category in pure nominal forms. The null hypothesis is that the structure of nominals is precisely parallel to that of sentences. Let us assume therefore that there is an intermediate functional category 'Nm' whose Spec position corresponds to the primary subject position in sentences and which takes as its complement the category NP. We would then have the following canonical D-structure representation for nominals:



It was shown in §1.2. that the existence of a special class of modifiers, licensed neither by V nor by I, could be used to justify positing the intermediate category Pr. I shall now show that the class of weak determiners, in the sense of Milsark (1974) and Barwise and Cooper (1981), provides a similar argument in support of the existence of Nm. It has been argued on syntactic grounds in Bowers (1975, 1987) that there are two classes of quantifiers in English. The first class, among which are *all*, *every*, *each*, *both*, *some*, *neither* and *any*, cannot cooccur with a genitive NP, unless it is postposed. These are the elements, I hypothesize, that belong to the category D. The second class, among which are the numerals and the quantifiers *many*, *few*, *several* and *much*, cooccur both with members of D and with genitive NPs:

- (54) a. those three books
 b. this one book
 c. the many books
 d. these few books
 e. John's three books
 f. all ten books
 g. every three days
 h. any five chairs

Remarkably, the membership of these two classes corresponds almost precisely to the class of strong and weak determiners, respectively, suggesting that there are systematic differences in syntactic structure corresponding to the semantic differences between them. The observations in Bowers (1987) provide independent support for this view. There it was shown that the class of elements that characteristically exhibit so-called "specificity effects" are just the determiners of Class I, i.e. the strong determiners, while the members of Class II typically do not exhibit such effects. It was argued that this difference can be explained in terms of the "Barriers" theory if it is assumed that the Class I, but not the Class II, determiners belong to the category D.

In order to be grammatical, a DP with a base-generated subject or object will have to move to [Spec, D] (if it is not already filled with a possessive) to be case-marked. Since there is only one case-marked position in nominals, the fact that only one argument can be overtly realized in S-structure follows immediately. Note the parallel between obligatory movement of arguments to [Spec, IP] in sentences and obligatory movement to [Spec, DP] in nominals, in both instances for case-theoretic reasons.

Which positions in the nominal are potential non-theta positions? Obviously [Spec, D] is. Apparently [Spec, Nm] is also a possible non-theta position, since the internal argument of unaccusatives also shows up in the genitive case: *the ball's movement*, *Mary's appearance*, etc.:

- (66) [DP Mary's [NmP t' Nm [NP t' appearance]]]

The Spec position in NP, on the other hand, is evidently not a non-θ position, as is shown by the well-known observation ((Chomsky (1971)) that raising constructions are impossible in derived nominal forms:

- (67) a. *[DP John's [NmP t'' Nm [NP t' appearance [t to have left]]]]
b. *Mary's belief [t to have disappeared]

whereas the corresponding control constructions are fine:

- (68) [DP John's [NmP t' Nm [NP attempt [PRO to leave]]]]

Notice that this explanation for the lack of raising constructions in nominals is only available if we extend the 'unaccusative' derivation of RS constructions proposed in Bowers (1991) to nominal structures as well. If *John* in (67) a. were moved directly from the complement to [Spec, Nm], no violation of the Theta Criterion would result. The offending trace in (67) a. must therefore be *t'*. In other words, RO is not permitted in nominals. In contrast, raising is possible in gerundives, as expected, since gerundives contain PrP rather than NmP:

- (69) a. Mary's happening to stumble across the truth was fortunate indeed.
b. I doubt whether Mary's being believed to have disappeared made much difference.

The second way in which the arguments of a noun can be expressed overtly in English is in a PP complement. Typically objects occur with *of* and agents with either *by* or *of*, the former being preferable, especially if there is more than one PP-argument, though in other languages such as Spanish any number of phrases with *de* (the equivalent of English *of*) are possible (cf. Mallen (1989), for extensive discussion). This yields data such as the following:

- (70) a. the enemy's destruction of the city
b. the destruction of/by the enemy
c. ?the destruction of the enemy of the city
d. the destruction of the city by the enemy
e. the movement of/*by the ball down the hill

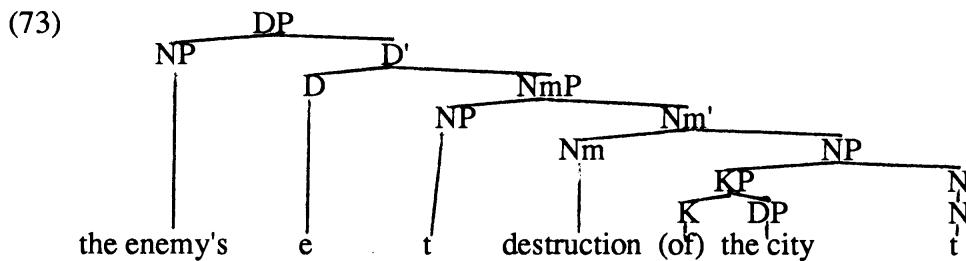
Note that the subjects of unaccusative nouns can also optionally appear with *of*:

- (71) a. the appearance of Mary
 b. the movement of the ball

It has been suggested that the *of* that marks the object in these examples is inserted to satisfy the Case Filter, assuming that Nouns are not case-assigners. An argument in support of this view is that together with assumption that [Spec, N] is an obligatory theta position, it explains why there are no ECM complements of the raising type in nominals:

- (72) a. *my belief of John to be the culprit
 b. *John's belief to be the culprit

If this analysis is correct, then *of* cannot itself be a prepositional case-assigner, since PPs only occur in complement position. I shall assume therefore, following Lamontagne and Travis (1987), that there is a functional category K (=case), whose head can be optionally realized as *of* in English in [Spec, N]:



If object NPs are case-marked in [Spec, N], then it follows that Nouns must raise to Nm, precisely parallel to the raising of Verbs to Pr in sentences.

This analysis is quite appealing, though there are some potential problems. Note first that an AP modifier of N' must somehow be prevented from being stranded by the raising of the head Noun, since unmodified APs can never occur to the right of an object PP: **the enemy's destruction of the city violent/the enemy's violent destruction of the city*. Second, there is a mass of empirical evidence (see Radford (1988), for an extensive summary of the arguments) suggesting that PP-arguments of the noun must be generated within N', while PP adjuncts must be adjoined to N'. One major piece of evidence in support of this conclusion is the fact that PP-arguments must precede PP-adjuncts:

- (74) a. student of Physics with long hair
 b. *a student with long hair of Physics

However, this observation is perfectly consistent with the existence of N-Raising, since an NP in [Spec, N] will always precede an N' adjunct in any case. As for the first problem, I will take care of it by showing that there are two types of Nouns: those that raise and those that don't. Nouns of the first type take a real object and only occur with Nm' modifiers, while nouns of the second type take an *of*-phrase which is really a PP-complement and can occur with both Nm' and N' modifiers. For nouns of the first type, the correct surface order is derived by N-to-Nm movement. For nouns of the second type, the problem simply doesn't arise.

3.3. Action nominals vs. result nominals

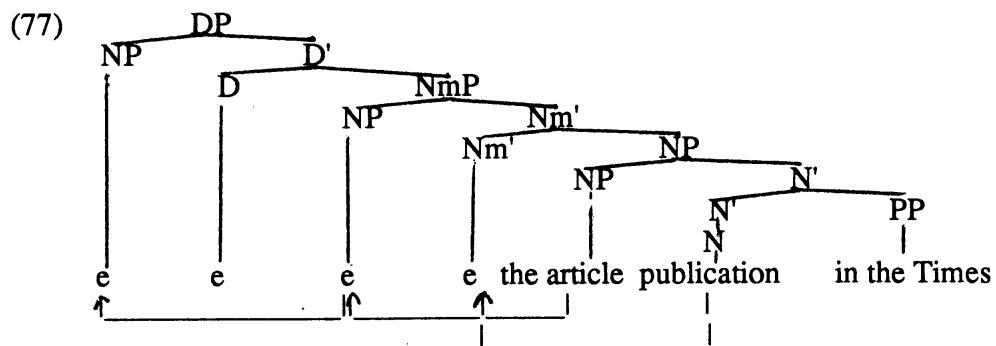
The idea that some nouns raise while others don't arise is suggested by the familiar observation that the secondary subjects of action nominals can generally occur as genitives,

while the secondary subjects of result nominals can't:

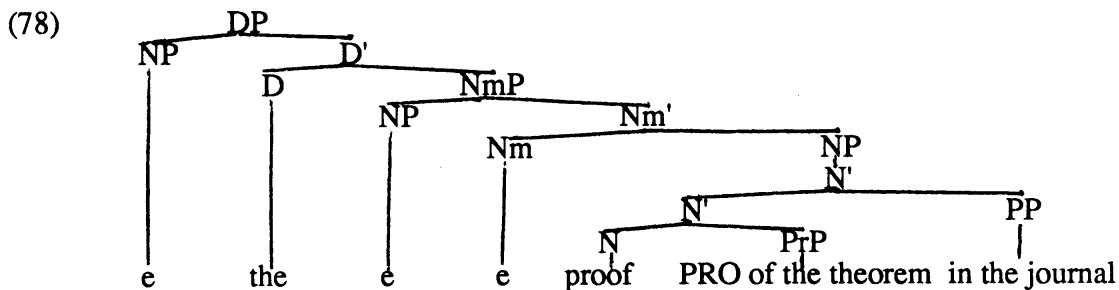
- (75) a. the destruction of the city/the city's destruction
 b. the publication of the article in the Times/the article's publication in the Times

- (76) a. the student of Chemistry/*Chemistry's student
 b. the proof of the theorem in the journal/*the theorem's proof in the journal

This contrast can be explained if we assume that the object of an action nominal is a real secondary subject, generated in [Spec, N], while the apparent object of a result nominal is actually a SC PP-complement of N. Example (75) b. would then be derived as follows:



If the secondary subject *the article* fails to be case-marked by *of*, then it must move successively into [Spec, Nm] and [Spec, D], producing the second phrase in (75) b. The structure of (76) b., in contrast, is as follows:



As is immediately apparent, NP-movement is impossible in this structure. I shall return shortly to the question of why the head noun also fails to move to Nm.

Now consider the adjectival modifiers that are possible with these nominalizations:

- (79) a. The rapid/*interesting publication of the article in the Times.
 b. The *rapid/interesting proof of the theorem in the journal.

The adjective *interesting* in (79) b. is an N'-modifier, as shown by the fact that it permits *one*-pronominalization:

- (80) John has an interesting proof of the theorem in this journal, but Mary has an even more interesting one in that journal.

The adjective *rapid* in (79) a., in contrast, does not permit *one*-pronominalization of any kind:

- (81) a. *We prefer rapid publication of the article in the Times to slow one in the Herald.
- b. *We were disappointed by the rapid publication of Mary's article and the slow one of John's.

As was shown earlier, *one*-pronominalization is a property of N'-modifiers, but not of Nm'-modifiers. Hence it can be concluded that AP modifiers of action nominals are Nm'-modifiers, whereas AP modifiers of result nominals are N'-modifiers. This analysis is confirmed by the fact that in the corresponding sentences a Nm'-modifier of an action nominal translates naturally into a Pr' adverbial modifier, whereas the same is not true for result nominals:

- (82) a. They rapidly published John's article in the Times.
 b. *John interestingly proved the theorem.

One crucial question remains: why does the head noun raise to Nm in action nominals but not in result nominals? Suppose that action nominals assign θ-roles in exactly the same way that verbs do, while basic nouns and result nominals simply do not assign θ-roles at all.⁶ The result would be that action nominals would have to raise to Nm for exactly the same reason that verbs obligatorily raise to Pr, namely, to assign a θ-role to the primary subject in [Spec, N] and [Spec, V], respectively. Basic nouns and result nominals, on the other hand, would not raise because they don't have any θ-roles to assign. This proposal predicts correctly some further differences between action nominals and result nominals. First, action nominals should be able to occur with PRO subjects, while result nominals should not. As Williams (1985) notes, presence of a PRO subject in nominals can be tested for by seeing whether a purpose clause is possible, since purpose clauses are known to be controlled by subjects. The result, as predicted, is that action nominals can occur with purpose clauses, hence must have PRO subjects:

- (83) the PRO destruction of the city [PRO to prove a point]

whereas result nominals and basic nouns cannot:

- (84) a. *those/John's proofs of the theorem [PRO to prove a point]
 b. *those/John's pictures of Mary [PRO to prove a point]

Second, since PRO is not case-marked, it can remain in [Spec, Nm], leaving the possessive position in [Spec, D] free to take a lexical NP. The existence of such phrases has been noted by Williams (1985):

- (85) yesterday's PRO destruction of the city [PRO to prove a point]

Finally, as Roeper (1987) observes, presence of a PRO subject blocks preposing of objects in action nominals:

- (86) *the city's destruction to prove a point

If this analysis is correct, then it can be concluded, not surprisingly perhaps, that action nominals are closer in structure to sentences (and hence to gerundive nominals) than result nominals are. Their interpretation is also different. Action nominals refer to events,

whereas result nominals refer to classes of individuals. How to represent this difference in formal semantic terms will be discussed in the next section.

4. The Semantics of Nominals

If the syntactic analysis of the previous section is correct, then there are three basic kinds of nominals whose semantics must be accounted for: (i) nominals with Class II quantifiers only; (ii) nominals with Class I quantifiers (with or without Class II quantifiers in addition); (iii) action nominals. Cases (i) and (ii), which apply to basic nouns and result nominals, I discuss together; case (iii) I discuss separately.

4.1. Strong and weak determiners

As a first approximation, Class I determiners have been identified as *strong*, in the sense of Milsark (1974) and Barwise and Cooper (1981), and Class II as *weak*. Milsark's original observation (the "definiteness restriction", or DR) was that NPs with weak determiners occur in post-copular position in this construction with an existential interpretation, while NPs with strong determiners, if possible at all, do not have an existential interpretation, but rather a "listing" interpretation or else one just identical to the corresponding non-existential sentence with the quantified NP in subject position:

- (87) a. There are many/few/two men in the garden.
- b. There is/are every/that/most man in the garden.
- c. Every/that/most man is/are in the garden.

Thus (87) a. is interpreted existentially, while (87) b. is either deviant or else interpreted just like (87) c. Barwise and Cooper (1981) tried to show that a determiner is weak just in case there are properties *p* and *q* in its domain such that *det p's are p's* is true and *det q's are q* is false. A determiner is strong if it is nonweak: it is positive strong if *det p's are p's* is true for all *p* in the domain of the determiner, negative strong if *det p's are p's* is false for all such *p*. However, Keenan (1988) argues that the semantic properties of those quantifiers that can occur in existential contexts should be derived from a basic property that he terms *existentiality*, since there are trivial determiners that are positive strong (e.g. *at least zero*, *zero or more*, *infinitely many or finitely many*, etc.) and negative strong (e.g. *fewer than zero*, *between seven and five*, *neither infinitely many nor finitely many*, etc.), but which nevertheless occur in existential contexts. A determiner (e.g. *some*) is *existential* if sentences of the form *Det-N-that-be-Pred* have the same truth conditions as sentences of the form *Det-N-that-be-Pred-exist*. For example, *some* is existential because the following pair of sentences has the same truth conditions:

- (88) a. Some student is a vegetarian.
- b. Some student who is a vegetarian exists.

A strong determiner such as *every*, on the other hand, is not existential because (89) b. is always true, while (89) a. can be false:

- (89) a. Every student is a vegetarian.
- b. Every student who is a vegetarian exists.

Keenan apparently takes existentiality to be a basic property of individual determiners. If existentiality were indeed an inherent property of weak determiners, that is to say, if the property of existentiality could be shown to be an intrinsic part of the lexical content of

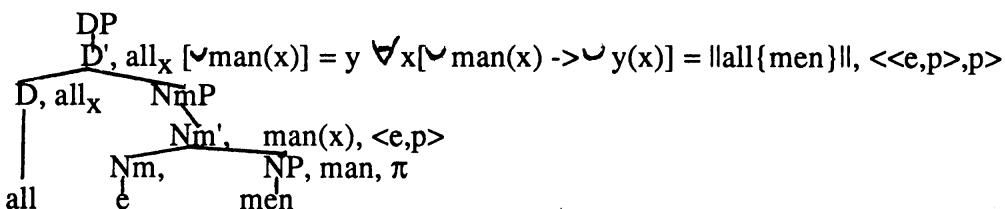
quantifiers such as *many*, *few*, and the cardinal numbers, then we could justifiably conclude that the explanation for the DR is purely semantic. This, however, is not the case, as is shown by another observation due originally to Milsark (1974). Milsark noted that NPs with weak determiners in subject position are ambiguous between a quantificational reading and a cardinal reading. Thus the sentence:

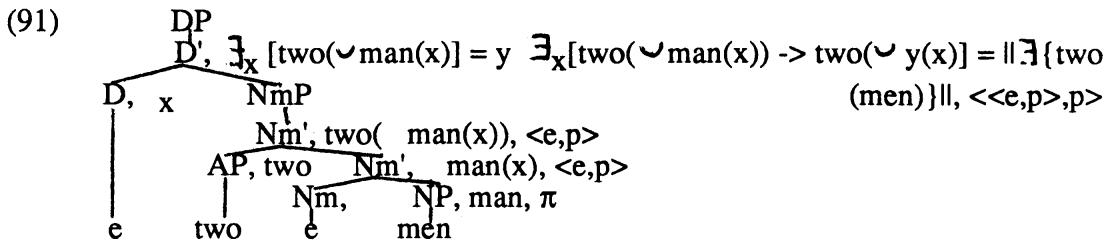
(90) Many men are in the garden.

can either mean: (i) 'of the existing men, a large proportion are in the garden', or (ii) 'there are many men in the garden'. The latter interpretation is identical to that of the existential sentence (87) a. The former is quantificational, similar to (87) c., and in this interpretation *many* is not existential. This shows that the property of existentiality is not somehow intrinsic to the concept of "many-ness". Rather, it appears to be a semantic property that some determiners (the weak ones) can optionally acquire in the right context, but which other determiners (the strong ones) cannot. There are, then, two questions that have to be answered: (a) how does the property of existentiality arise?; (b) why can some determiners, but not others, acquire it?

According to the theory proposed here, weak determiners are categorized as adjectives, while strong determiners belong to the functional category D. Hence all we need in order to answer (b) is to suppose that some determiners belong either to the category A or to the category D, while others only belong to the category D. I return to this point shortly (There could also be determiners that only belong to the category A; a good candidate might be the indefinite determiner *a*.) To answer (a), we have to show that the property of existentiality arises somehow from structures containing adjectival quantifiers and not from structures containing D quantifiers. I shall now try to show that the property of existentiality, and hence the DR, can be derived from assumptions (1')-(5') (cf. p. 1), repeated here for convenience: (1') NPs denote properties and are therefore assigned the type π in If; (2') the semantic function of Nm^0 (like Pr^0) is to turn properties into propositional functions, and hence it is translated as " \cup ", the predication operator; (3') X'-adjuncts are uniformly translated as modifiers, from which it follows that weak determiners do not change the type of the expressions they modify; (4') the members of D, in contrast, following the theory of generalized quantifiers (Montague (1970), Barwise and Cooper (1981)), map properties onto sets of properties, thereby changing the type of the NmP complements they select; (5') if there is no lexical determiner in D, then it is obligatorily interpreted as the existential quantifier \exists , as a default value. Simply stated, the idea is that every nominal (that is not a predicate nominal, of course) has to become a generalized quantifier. If no overt quantifier is available in D, then the propositional function created by NmP is turned into the existential generalized quantifier as a default value. The nominals *all men* and *two men* would thus be derived as follows:

(90)





In support of this analysis, note first that the fact that weak, but not strong, determiners have the property of existentiality (from which the properties of intersectivity and symmetry follow (Barwise and Cooper (1981), Keenan (1988))) is derived from assumptions (3') and (5'). Weak determiners are, by hypothesis, syntactically Nm'-adjuncts. Therefore by (3') they don't change the type of the propositional function they modify, but rather just specify the cardinality of the set in question. By (5'), the empty D must be interpreted as the existential quantifier in order to turn its NmP complement into a generalized quantifier. Strong determiners, in contrast, are members of D; by hypothesis, they *are* generalized quantifiers, hence in complementary distribution with the existential quantifier.

Second, the DR follows directly from (5'). By hypothesis, Nm converts a NP (of type π) into a propositional function (of type $\langle e, p \rangle$). However, since weak determiners are Nm' modifiers, they don't change the type of the expressions they modify. Therefore, in order for a NP containing only a weak determiner to be converted into a generalized quantifier, i.e. an expression that combines with a propositional function to yield a proposition, it must first be operated on by the 'default' existential quantifier, as shown above in (91). The fact that it happens to be in post-copular position in an existential sentence is actually irrelevant, for NPs with weak determiners generally have an existential interpretation regardless of what position they occur in, as the following examples with the relevant interpretations show:

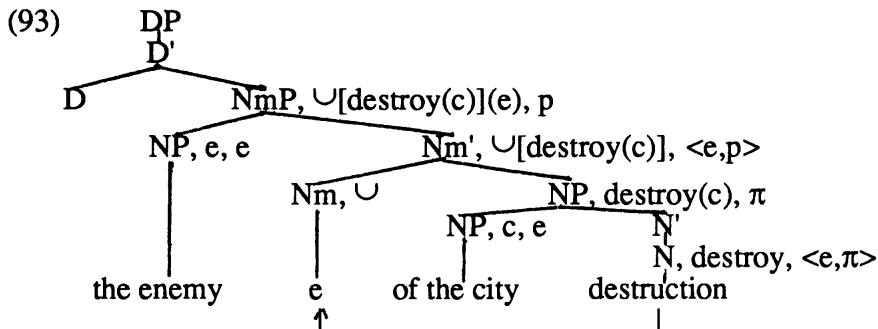
- (92) a. Two men are in the garden.
 $'\exists(Y)(Y = \{(x)|man(x) \wedge x \text{ in the garden}\} \wedge |Y| = 2'$
- b. Mary knows two men.
 $'\exists(Y)(Y = \{(x)|man(x) \wedge Mary \text{ know } x\} \wedge |Y| = 2'$

Finally, returning to Milsark's observation that certain weak quantifiers such as *many* can have either a quantificational or an existential interpretation, this can be explained by assuming simply that such quantifiers are dually categorized as either A or D. In the first case, a quantifier such as *many* will receive an existential interpretation; in the second, it will receive a quantificational interpretation.

4.2. The semantics of action nominals.

The results of the §3.3. show that action nominals are syntactically parallel in structure to sentences. If the general approach developed here is correct, we would naturally expect to find an equally close parallel between the semantics of sentences and action nominals. Let us assume therefore that action nouns are expressions of type π , $\langle e, \pi \rangle$, or $\langle e, \langle e, \pi \rangle \rangle$, depending on how many argument places they require. We have already assumed that the function of Nm, just like the function of Pr in sentences, is to map property expressions onto propositional functions. Furthermore, since head raising is obligatory in action nominals, we must assume that an action noun assigns (or checks the assignment of) a theta-role to [Spec, Nm]. Hence this position must either be occupied by a lexical NP (which must then move to [Spec, D] to receive case) or by PRO, either of which will saturate the primary subject position in [Spec, Nm], as required. Some syntactic evidence

in support of the conclusion that action nominals may have PRO subjects has already been discussed in §3.3. As far as the semantics of action nominals is concerned, the apparatus we already have will produce LF representations and type assignments for NmP virtually identical to those of PrP:



Both the syntax and the semantics of action nominals is therefore very close to that of the gerundive nominals discussed in §3.0. The only real difference between them lies in the syntactic category label of the complement of D.⁷ This of course has syntactic consequences that were discussed earlier, but does not seem to materially affect the semantics. Both appear to be propositions, whereas result nominals, like basic nouns, are not propositions at all, but rather are generalized quantifiers.

Notes

¹ See Bowers (1991) and Larson (1990) for arguments against Jackendoff's (1990) suggestion that such examples might be instances of gapping. I also show there that the needed intermediate category cannot be Agr^0 (Pollock (1989)).

² If D is non-empty, then an English-specific constraint requires that the possessive NP move into a postposed of-phrase, as in the following example:

(i) This singing songs of John's must cease.

I shall not attempt to analyze the structure of such postposed genitives in this paper, simply noting that in many languages possessives can cooccur with elements of D without having to be postposed (cf. Abney (1987), for discussion).

³ This analysis is also consistent with the claim of Chomsky (1971) that gerundives are verbs whereas derived nominals are nouns.

⁴ See Tang (1990) for detailed arguments in support of this analysis and for many other arguments from Chinese in support of the proposed analysis of clause structure and nominal structure.

⁵ I assume without argument that an agentive *by*-phrase is an optional, base-generated PP adjunct, as it is in sentences.

⁶ It is interesting to note in this connection that in Chinese (see Tang (1990)) all

arguments of nouns are contained in phrases with the general modification marker *-de* that is used for adjective modifiers, relative clauses and so forth, suggesting once again that basic nouns do not take arguments *per se*, though they can assign theta-roles indirectly to NPs in non-argument positions.

⁷ Action nominals are also similar to gerundives in that they may occur with demonstratives but not with strong quantifiers:

- (i) a. This/*every/*each destruction of the city bothers everyone.
- b. That/*most/*all publication(s) of the article precipitated a crisis.

It seems likely that there is some difference yet to be understood between demonstratives and strong quantifiers.

Bibliography

- Abney, S. (1987) *The English Noun Phrase in its Sentential Aspect*, Doctoral dissertation, MIT, Cambridge, Massachusetts.
- Aczel, P. (1980) "Frege Structures and the Notions of Proposition, Truth and Set," in J. Barwise, J. Keisler and K. Kunen, eds., *The Kleene Symposium*, North Holland, Amsterdam.
- Bach, E. (1979) "Control in Montague Grammar," *Linguistic Inquiry* 10, 515-531.
- Bailyn, J. and E. Rubin (1990) "The Unification of Instrumental Case Assignment in Russian," paper read at WECOL, El Paso, Texas, October 29, 1990.
- Barss, A. and H. Lasnik (1986) "A Note on Anaphora and Double Objects," *Linguistic Inquiry* 17, 347-354.
- Barwise, J. and R. Cooper (1981) "Generalized Quantifiers and Natural Language," *Linguistics and Philosophy* 4: 159-220.
- Bealer, G. (1982) *Quality and Concept*, Clarendon Press, Oxford.
- Bowers, J. (1975) "Adjectives and Adverbs in English," *Foundations of Language* 13: 529-562.
- Bowers, J. (1983) "Conditions on Logical Form," *Linguistic Analysis* 11, 27-101.
- Bowers, J. (1987) "Extended X-bar Theory, the ECP and the Left Branch Condition," *Proceedings of the West Coast Conference on Formal Linguistics*, Vol. 6, The Stanford Linguistics Association.
- Bowers, J. (1988) "A Structural Theory of Predication," unpublished ms., Cornell University, Ithaca, N.Y.
- Bowers, J. (1989) "Predication in Extended X-Bar Theory," paper presented at the conference "Perspectives on Phrase-Structure," University of Arizona, Tucson, Arizona, July 5-6, 1989.
- Bowers (1991) "The Syntax of Predication," ms., Cornell University, Ithaca, N.Y.
- Chierchia, G. (1984) *Topics in the Syntax of Infinitives and Gerunds*, Doctoral dissertation, University of Massachusetts, Amherst.
- Chierchia, G. (1985) "Formal Semantics and the Grammar of Predication," *Linguistic Inquiry* 16, 417-443.
- Chierchia, G. (1989) "A Semantics for Unaccusatives and its Syntactic Consequences," unpublished ms., Cornell University, Ithaca, N.Y.
- Chierchia, G. and R. Turner (1988) "Semantics and Property Theory," *Linguistics and Philosophy* 11, 261-302.
- Chomsky, N. (1955)/75) *The Logical Structure of Linguistic Theory*, University of Chicago Press, Chicago, Illinois.

- Chomsky, N. (1970) "Remarks on Nominalization," in R. Jacobs and P. Rosenbaum, eds., *Readings in English Transformational Grammar*, Waltham, Mass.: Ginn.
- Chomsky, N. (1981) *Lectures on Government and Binding*, Foris, Dordrecht.
- Chomsky, N. (1986) *Knowledge of Language: Its Nature, Origin, and Use*, Praeger, New York.
- Dowty, D. (1982) "Grammatical Relations and Montague Grammar," in P. Jacobson and G. K. Pullum, eds., *The Nature of Syntactic Representation*, Reidel, Dordrecht.
- Emonds, J. (1978) "The Verbal Complex V'-V in French," *Linguistic Inquiry* 9, 151-175.
- Fukui, N. (1986) *A Theory of Category Projection and its Applications*, Doctoral dissertation, MIT, Cambridge, Massachusetts.
- Grimshaw, J. (1990) *Argument Structure*, MIT Press, Cambridge, Massachusetts.
- Jackendoff, R. (1977) *X' Syntax: A Study of Phrase Structure*, *Linguistic Inquiry Monograph* 2, MIT Press, Cambridge, Massachusetts.
- Jackendoff, R. (1990) "On Larson's Treatment of the Double Object Construction," *Linguistic Inquiry* 21, 427-456.
- Jacobson, P. (1983) "Grammatical Relations," paper presented at the 1983 Winter meeting of the Linguistics Society of America, Minneapolis, Minnesota.
- Jacobson, P. (1987) "Phrase Structure, Grammatical Relations and Discontinuous Constituents," in G. Huck and A. Ojeda, eds., *Syntax and Semantics 20: Discontinuous Constituency*, Academic Press, New York.
- Jubien, M. (1985) "First-order Property Theory," ms., University of Massachusetts, Amherst.
- Kayne, R. (1984) *Connectedness and Binary Branching*, Foris, Dordrecht.
- Keenan, E. (1987) "A Semantic Definition of 'Indefinite NP,'" in *The Representation of (In)definiteness*, E.J. Reuland and Alice G.B. ter Meulen, eds., MIT Press, Cambridge, Mass.
- Koopman, H. and D. Sportiche (1985) "Theta Theory and Extraction," in *GLOW Newsletter* 14, 57-58.
- Koopman, H. and D. Sportiche (1987) "Subjects," unpublished ms., University of California, Los Angeles, California.
- Kuroda, S.-Y. (1986) "Whether You Agree or Not: Rough Ideas about the Comparative Syntax of English and Japanese," ms., University of California, San Diego.
- Lamontagne, G. and L. Travis (1987) "The Syntax of Adjacency," *Proceedings of the West Coast Conference on Formal Linguistics*, Vol. 6, The Stanford Linguistics Association.
- Larson, R. (1988) "On the Double Object Construction," *Linguistic Inquiry* 19, 335-391.
- Maling, J. (1976) "Notes on Quantifier Postposing," *Linguistic Inquiry* 7, 708-718.
- Mallen, E. (1989) *The Internal Structure of Determiner Phrases*, Doctoral dissertation, Cornell University, Ithaca, N.Y.
- Milsark, G. (1974) *Existential Sentences in English*, Doctoral dissertation, MIT.
- Montague, R. (1970) "Universal Grammar," *Theoria* 36, 373-398.
- Pollock, J.-Y. (1989) "Verb Movement, Universal Grammar, and the Structure of IP," *Linguistic Inquiry* 20, 365-424.
- Postal, P. and G. Pullum (1988) "Expletive Noun Phrases in Subcategorized Positions," *Linguistic Inquiry* 19, 635-670.
- Radford, A. (1988) *Transformational Grammar*, Cambridge University Press.
- Ritter, E. (1989) "Two Functional Categories in Noun Phrases: Evidence from Modern Hebrew," paper read at the conference "Perspective on Phrase Structure," July 5-6, Tucson, Arizona.
- Roeper, S. (1987) "Implicit Arguments and the Head-Complement Relation," *Linguistic Inquiry* 18, 267-310.
- Rothstein, S. (1983) *The Syntactic Form of Predication*, Doctoral dissertation, MIT.

- Sportiche, D. (1988) "A Theory of Floating Quantifiers and Its Corollaries for Constituent Structure," *Linguistic Inquiry* 19, 425-449.
- Stowell, T. (1981) *Origins of Phrase Structure*, Doctoral dissertation, MIT, Cambridge, Massachusetts.
- Tang, C.-C. Jane (1990) *Chinese Phrase Structure and the Extended X'-Theory*, Doctoral dissertation, Cornell University, Ithaca, N.Y.
- Travis, L. (1988) "The Syntax of Adverbs," paper presented at NELS 19, Ithaca, N.Y.
- Williams, E. (1975) "Small Clauses in English," in J. Kimball, ed., *Syntax and Semantics*, vol. 4, Academic Press.
- Williams, E. (1980) "Predication," *Linguistic Inquiry* 11, 203-238.
- Williams, E. (1983) "Against Small Clauses," *Linguistic Inquiry* 14, 203-238.
- Williams, E. (1985) "PRO in NP," *Natural Language and Linguistic Theory* 3, 277-295.

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Bare sentences*

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1. The meaning of bare sentences

A bare sentence is a sentence with no overt (morphological) tense, e.g. (1) from Haitian.

- (1) Msye renmen Titid. 'He likes Titid'
3sg like Titid

A standard assumption in the literature (e.g. Enç 1981: 103f.; Comrie 1985: 50-52; Hornstein 1990: 216, *fn. 25*) is that in the absence of tense morphemes, the temporal reference of a sentence like (1) is determined only by context (e.g. via covert tense operators) or by an overt temporal adverb. This view cannot be maintained, however. In 'tenseless languages' like Fòn-Gbè, Haitian, Igbo and Vātà, a bare sentence is not temporally ambiguous; instead, its temporal reference is determined by inherent aspectual properties of the predicate, specifically by the eventive/stative distinction.

I adopt the hypothesis that the interpretation of a bare sentence is computed from local syntactic relations: the interaction of inflectional (Infl), verbal (V), and nominal (D/N) projections. A general consequence of this approach is that there is no need to posit tense operators to derive the interpretation of bare sentences.

The rest of section 1 presents a range of data (mostly from Haitian) showing how the eventive/stative distinction affects the interpretation of bare sentences. Section 2 observes that the eventive/stative split is relevant for a number of other syntactic phenomena of Haitian. An account for the source of temporal reference in bare sentences is given in section 3; sections 4 - 5 draw some consequences of the analysis for Haitian intransitive verbs and for the preverbal element *ap*. Section 6 closes with speculations on the Davidsonian event argument, quantificational force and 'present tense'.

1.1 Bare sentences in Haitian

In Haitian bare sentences, Damoiseau 1982 observes a systematic difference between eventive and stative predicates. As illustrated in (2), a bare eventive predicate (e.g. *vann* 'sell') is generic with a bare NP object, and past with a specific NP object. As shown in (3), a bare stative predicate (e.g. *renmen* 'like') is consistently non-past, regardless of the specificity of the object.

*Thanks to A. Avolonto, M. Bamba, H. Borer, H. B. C. Capo, F. Charlot, E. Cowper, E. Doron, J. Fu, F. R. Higgins, U. İhl̄on̄, F. Landman, V. Manfredi, Q. Oyeláran, B. Partee, P. Portner, T. Rapoport, C. Roberts, B. Shaer, M. Speas and M. Tremblay. This research was supported in part by NSF Grant BNS 8719999 to E. Bach, A. Kratzer and B. Partee, principal investigators.

(2)a.	Pyè vann bèf. Pyè sell cattle	'Pyè sells cattle' ¹
b.	Pyè vann bèf yo. Pyè sell cattle Det	'Pyè sold the cattle'
(3)a.	Sisi renmen chat. Sisi like cat	'Sisi likes cats'
b.	Sisi renmen chat mwen. Sisi like cat 1sg	'Sisi likes my cat'

In bare sentences, prepositional (4), adjectival (5), and nominal (6) predicates have the same temporal reference as do stative verbs: non-past.²

(4)a.	Timoun yo nan lakou a. child Det Loc yard Det	'The children are in the yard' (Damoiseau 1982: 16)
b.	Vèdye ak Sisi. Vèdye with Sisi	'Vèdye is with Sisi'
(5)a.	Vèdye fò. Vèdye smart	'Vèdye is smart'
b.	Pyè bouke. Pyè tired	'Pyè is tired'
(6)a.	Pyè doktè. Pyè doctor	'Pyè is a doctor' (Damoiseau 1982: 13)
b.	Sisi bòs ebenis. Sisi master carpentry	'Sisi is a carpenter'

In the Africanist literature, the sensitivity of temporal interpretation to the eventive/stative distinction has been dubbed the *factative construction*:

The construction rather refers simply to the most natural or obvious *fact* about the particular verb used. (Welmers & Welmers 1968: 76)

The idea behind the term *factative* is that the temporal reference of a bare sentence is determined by lexical properties of the predicate. In some sense, it is a "natural or obvious fact" about events that their temporal reference is past, while it is a "natural or obvious fact" about states that their temporal reference is non-past.

1.2 Bare sentences in other languages

The *factative* effect has been reported in other languages, e.g. by Thomas (1869: 54ff.) for "Trinidad French Creole", cf. (7), and by Avolonto (1991) for Fòn-Gbè, cf. (8).

¹Bernabé cites a Guadeloupéen/Martiniquais example where a bare noun complement of an eventive verb is interpreted existentially and the predicate is interpreted as past:

(i) Pyè vann bef.
Pyè sell cattle
'Pyè sold some cattle'
(Bernabé 1987: 191)

²(Here I set aside the question of whether Haitian includes the category Adjective.) Parallel facts are noted by Thomas (1869) for "Trinidad French Creole":

When the subject of a proposition is followed by a simple attributive, by an adverb of place — in short, by any word denoting its *quality*, *situation*, or *posture* — no substantive verb is employed... as a connective, if present time is intended. (Thomas 1869: 76)

- (7)a. Moèn manger. 'I ate' OR 'I have eaten'
 1sg eat
- b. Moèn aimer. 'I love'
 1sg love
- (8)a. Sìká qà wó. 'Sika prepared the paste'
 Sika prepare paste (Avolonto 1991, ex. 4)
- b. Lili tún Kòkú. 'Lili knows Koku'
 Lili know Koku (Avolonto 1991, ex. 9)

The *factive* verbs in (7) - (8) are completely bare.³ The same effect occurs if tense is deleted for stylistic reasons: in the "Abbreviated English" used in newspaper headlines, Stowell (1991) observes that bare eventive verbs such as *beat* have only a past reading, while bare stative verbs such as *love* are interpreted as non-past:

- (9)a. MAN BEATS DONKEY
 b. MAO SECRETLY LOVES RED GUARD

In other languages, however, the *factive* is morphologically marked. In Igbo, the *factive* verb bears a toneless -rV suffix, consisting of [r] plus a copy of the rightmost vowel of the verb stem. An eventive verb plus -rV denotes past events (10a); a stative verb plus -rV denotes a present state (10b).⁴

- (10)a. Ó rí - rí rí à. 'S/he ate this food'
 3sg eat-rV food this (Éménanjo 1985: 121; Òweré dialect)
- b. Ó vù - ru ívù. 'S/he is fat'
 3sg be.fat-rV fatness (Éménanjo 1985: 121; Òweré dialect)

Similarly in Vātā (Kru), when combined with a morpheme consisting of a low tone [`], an eventive verb has a past reading (11a), and a stative verb is non-past (11b).

- (11)a. N lì saká. 'I ate rice'
 1sg [eat-`] rice (Koopman 1984: 28)
- b. N gblì nā... 'I know that...'
 1sg [know-`] Comp (Koopman 1984: 28)

Comparable facts are observed in other Kru languages (Marchese 1979: 132ff.).

³Edit Doron (p.c.) points out that nominal sentences in Modern Standard Arabic and Modern Hebrew have no overt marking for tense, and are interpreted as non-past, showing a *factive-type* effect; cf. Fassi-Fehri (1982), Doron (1983), Rapoport (1987).

⁴Some authors (Green & Igwè 1963: 54ff, Winston 1973:143ff, Nwachukwu 1976) posit two homophonous forms of the -rV suffix, respectively [-past] and [+past], in order to account for doubly-suffixed past tense stative verb forms such as that in (i):

(i) Ó mà - (r)a - ra yá. 'S/he used to know it'
 3sg know-rV-rV 3sg (Ézikeojìakú 1979: 115)

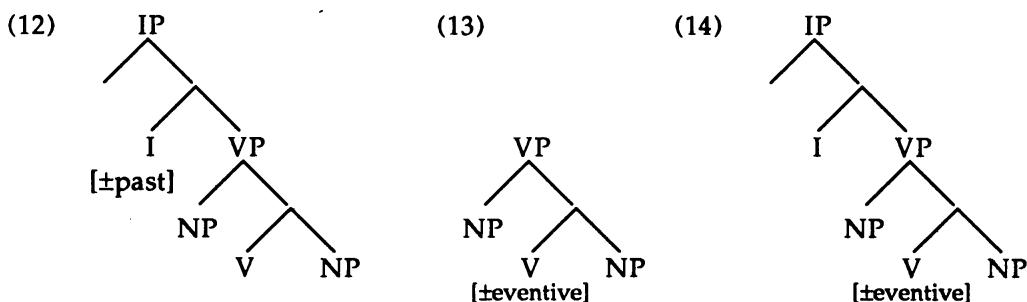
However, if these two -rV suffixes were truly independent, one would expect to find eventive verbs bearing the [-past] -rV, and that combination is impossible. Moreover, the [+past] -rV is never directly affixed to a stative verb, unless that verb is one of the few which fails to take the [-past] -rV, e.g. *dí* 'descriptive copula', *jí* 'hold', *nò* 'locative copula', *wú* 'equational copula', cf. Ùwaláàka (1988: 52-54).

1.3 The Infl of bare sentences

If bare sentences lack tense, at least three possibilities arise regarding the syntactic status of Infl.⁵ First, bare sentences might have a covert tense operator with features like [\pm past], as in (12). But this view cannot account for the sensitivity of bare sentences to the eventive/stative distinction, whereby eventive predicates are associated with [+past], while stative predicates are associated with [-past].

Alternatively, bare sentences might have no Infl projection whatsoever. The representation in (13), which treats bare sentences as matrix small clauses (Rapoport 1987), predicts that temporal reference could be determined by inherent properties of the predicate. However, on the assumption that overt inflectional material is evidence for a functional head, a small clause analysis does not extend to languages such as Igbo and Vātā, where the *factitive* construction is overtly marked.

A third possibility is that bare sentences have an Infl projection with no inherent features, as in (14). This claims that the eventive/stative distinction is relevant for the interpretation of bare sentences, and that there is a syntactic Infl position which lacks featural content. Evidence for these claims is given in the next two sections.



2. The eventive/stative split

In addition to bare sentences, the eventive/stative split shows up in (at least) two other areas of Haitian grammar: in the interpretation of the preverbal particle *ap*, and with transitivity alternations. I consider each of these in turn.

2.1 *Ap*: progressive vs. future

With eventive predicates *ap* marks the progressive (15a); with stative predicates it marks the future (16).⁶

⁵Replacing IP with a different functional projection such as T(ense) P(hrase), or eliminating VP-internal subjects, does not alter the range of possibilities in (12) – (14).

⁶Similar facts are reported by Thomas (1869: 54) for Trinidad French Creole, where progressive *ca* combines only with eventive verbs:

- | | |
|---------------------------------------|---------------|
| (i) Moèn ca manger.
1sg Prog eat | 'I am eating' |
| (ii) *Moèn ca aimer.
1sg Prog love | |

- (15)a. Pyè ap vann bëf. 'Pyè is selling cattle'
 Pyè Prog sell cattle

- b. Pyè ap vann bëf yo. 'Pyè is selling the cattle'
 Pyè Prog sell cattle Det

- (16) Msye ap renmen Titid. 'He will like Titid'
 3sg Fut like Titid

As before, prepositional (17), adjectival (18), and nominal (19) predicates pattern with stative verbs: *ap* marks future.

- (17)a. Timoun yo ap nan lakou a. 'The children will be the yard'
 child Det Fut Loc yard Det

- b. Vèdye ap ak Sisi. 'Vèdye will be with Sisi'
 Vèdye Fut with Sisi

- (18)a. Vèdye ap fò (si li vwayaje anpil). 'Vèdye will be smart (if he travels a lot)'
 Vèdye Fut smart if he travel much

- b. Sisi ap bouke (si l travay di). 'Sisi will be tired (if she works hard)'
 Sisi Fut tired if 3sg work hard

- (19)a. Pyè ap doktè *(lòt ane). 'Pyè will be a doctor next year'
 Pyè Fut doctor next year

- b. Sisi ap bòs ebenis *(lòt ane). 'Sisi will be a carpenter next year'⁷
 Sisi Fut master carpentry next year

The standard analysis of *ap* posits accidental homophony between *ap₁* 'progressive' and *ap₂* 'future' (e.g. Magloire-Holly 1982, Spears 1990). However, homophony fails to explain why 'progressive' *ap* occurs just with eventive verbs, and 'future' *ap* just with stative predicates. Recall that the same problem arises in languages where the *factive* is morphologically marked, e.g. Igbo and Vâtà.

Alternatively, there is a single *ap* whose interpretation is determined by whether it combines with a state or an event.

2.2 Transitivity alternations

The eventive/stative split interacts with transitivity, as in Haitian 'unaccusative shift' or 'middle formation' (cf. Massam 1987). The external argument of a transitive verb can be suppressed, with the internal argument appearing in subject position. Although this alternation is not morphologically marked, it induces a change in temporal reference, as shown in (20) - (21). A transitive verb is interpreted as a past event; its intransitive counterpart is interpreted as a non-past state.

- (20)a. Ti gason an mare bourik la. 'The boy tied the mule'
 dim boy Det tie mule Det (Damoiseau 1982: 28)
- b. Bourik la mare. 'The mule is tied'
 mule Det tie

⁷With nominal predicates such as *bòs ebenis*, *ap* must co-occur with a temporal adverb like *lòt ane* 'other year'. I don't know why this extra requirement holds.

- | | | |
|--------|---|-----------------------------|
| (21)a. | Timoun nan kraze vè a.
child Det break glass Det | 'The child broke the glass' |
| b. | Vè a kraze.
glass Det break | 'The glass is broken' |
- Transitivity also interacts with *ap*: with a transitive (eventive) verb *ap* marks progressive, but with the intransitive counterpart *ap* marks future, cf. (22) - (23).
- | | | |
|--------|---|---|
| (22)a. | Ti gason an ap mare bourik la.
dim boy Det Prog tie mule Det | 'The boy is tying the mule' |
| b. | Bourik la ap mare.
mule Det Fut tie | 'The mule will be tied'
(Damoiseau 1982: 29) |
- | | | |
|--------|---|-----------------------------------|
| (23)a. | Timoun nan ap kraze vè a.
child Det Prog break glass Det | 'The child is breaking the glass' |
| b. | Vè a ap kraze.
glass Det Fut break | 'The glass will break' |

3. The source of temporal reference in bare sentences

These Haitian data pose questions as to the source of temporal reference in bare sentences. Why does an eventive verb get a generic reading with a bare noun complement, but a past reading with a specific noun? Why is a stative predicate interpreted as non-past? Why is *ap* progressive with eventive verbs, but future with stative verbs? How do transitivity alternations interact with temporal reference? This section sketches an analysis of the eventive/stative split and its consequences for transitivity. Section 4 proposes an account of *ap*.

3.1 Eventive/stative vs. stage/individual-level

I have described some temporal interpretive contrasts among bare sentences in terms of the distinction between eventive and stative predicates. Another potential source of these contrasts is the distinction between "stage-level" and "individual-level" predicates, which Carlson (1977) shows to be relevant for the interpretation of bare plurals. Loosely, an individual-level predicate corresponds to a permanent property, while a stage-level predicate corresponds to a transitory property:

A stage is conceived of as being, roughly, a spatially and temporally bound manifestation of something. [...] An individual, then, is (at least) that whatever-it-is that ties a series of stages together to make them stages of the same thing.
(Carlson 1977: 115)

With an individual-level predicate, bare plural subjects are generically quantified (24a), but with stage-level predicates they are existentially quantified (24b).

- | | | |
|--------|---|---|
| (24)a. | Cats like fish.
Cats are for catching mice.
Cats are fast. | $\text{Gen}_x \text{ cat}(x) \& \text{like-fish}(x)$
$\text{Gen}_x \text{ cat}(x) \& \text{for-catching-mice}(x)$
$\text{Gen}_x \text{ cat}(x) \& \text{fast}(x)$ |
| b. | Cats tip over the garbage.
Cats are in the yard.
Cats are hungry. | $\exists_x \text{ cat}(x) \& \text{tip-over-the-garbage}(x)$
$\exists_x \text{ cat}(x) \& \text{in-the-yard}(x)$
$\exists_x \text{ cat}(x) \& \text{hungry}(x)$ |

A cross-classification of predicates according to the individual/stage-level and eventive/stative split is given in (25). Evidently, the distinction relevant for bare sentences, as well as for *ap*, is the eventive/stative split.

(25)	<i>INDIVIDUAL-LEVEL</i>	<i>STAGE-LEVEL</i>		
	know, like have blue eyes for fast, tall	in with	hungry tired	tie, cover, hit buy, sell die, fall, run dance, laugh, sing
				<i>STATE</i>
bare sentences:				<i>PAST/GENERIC</i>
<i>ap</i> :				<i>FUTURE</i>
				<i>PROGRESSIVE</i>

3.2 Deriving the *factive* effect

Davidson (1967) proposes that eventive predicates have an argument which stative predicates lack. The event argument need not be directly represented in syntax, to have syntactic and semantic effects. For example, in Haitian bare sentences, noneventive (i.e. stative) predicates are non-past, while eventive verbs are past with a specific noun and generic with a bare noun. The relevant examples are repeated below:

- | | |
|--|-----------------------|
| (1) Msye renmen Titid.
3sg like Titid | 'He likes Titid' |
| (2)a. Pyè vann bèf.
Pyè sell cattle | 'Pyè sells cattle' |
| b. Pyè vann bèf yo.
Pyè sell cattle Det | 'Pyè sold the cattle' |

I propose that the *factive* effect comes from the interaction of independent properties of the predicate, of Infl, and of the nominal projection. For the predicate, I adopt Verkuyl's (1989) characterization: an event is bounded (i.e. has a beginning, a middle, and an end); a state is unbounded. Schematically, a state corresponds to an unbounded region in time (26a), while an event corresponds to a bounded region (26b).

- (26)a. *state*: ...-----
b. *event*: e

Suppose that Infl obeys both syntactic and semantic well-formedness conditions. With respect to syntax, Infl must be lexicalized: in the absence of a Tense morpheme or an Auxiliary, the verb obligatorily raises to Infl (cf. Koopman 1984). Semantically, Infl must be referential or "anchored" relative to some moment: in the absence of a Tense operator, Infl is evaluated relative to the *moment of utterance*, t_0 (cf. Enç 1991). Stative predicates, which are unbounded, are non-past relative to the moment of utterance, cf. (27a). Eventive predicates, being bounded, are generic (roughly, iterative) if non-delimited (27b), and past if delimited (27c).

(27)

- a. *state*:
 b. *generic event*: ...e e e e e e...
 c. *past event*: e

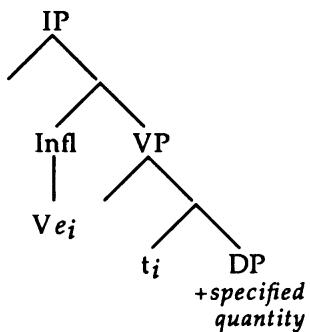
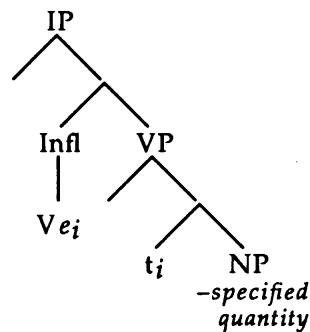
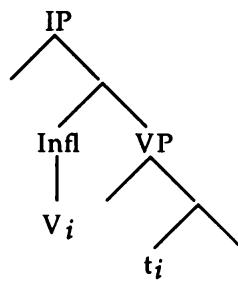
In Haitian, whether an event is delimited depends on the nominal complement: a bare noun projects NP and is [-specified quantity]; a specific noun projects a DP and is [+specified quantity] (cf. Verkuyl 1972). (This effect is absent in languages such as Igbo and Fɔn-Gbè, where bare sentences don't get a generic interpretation.) The nominal complement participates in "aspect composition" (Verkuyl 1989): if the complement of an eventive verb is [+specified quantity], then the event is terminative, or "delimited", in Tenny's (1987) terminology. If the complement is [-specified quantity], the event is non-delimited. In bare sentences, non-delimited events are generic. By definition, non-bounded predicates (= states) are not sensitive to [±specified quantity].

3.3 The event/state split revisited

With delimited events, the complement of V is [+specified quantity], cf. (28). By the lexicalization requirement, Ve raises to Infl and is evaluated relative to the moment of utterance. Relative to the moment of utterance, a delimited event is past: e.

With generic events, the complement of V is [-specified quantity], so the event is non-delimited, cf. (29). Ve raises to Infl and is evaluated relative to moment of utterance. A non-delimited event, which is nevertheless bounded (i.e. an interval), is interpreted as an ongoing repetition of events: ... e e e e e e

A stative predicate is unbounded so not sensitive to [±specified quantity], cf. (30). V raises to Infl; relative to the moment of utterance an unbounded state is non-past.

(28) *past event*(29) *generic event*(30) *non-past state*

3.3 Transitivity alternations revisited

If something along the lines of (28) - (30) is correct, then the temporal shift that correlates with transitivity alternations counts as evidence that the interpretation of bare sentences is read off of S-structure representations. Recall from above that with a transitive eventive verb a bare sentence is interpreted as past (20a), but the intransitive form of the same verb in a bare sentence is non-past (20b).

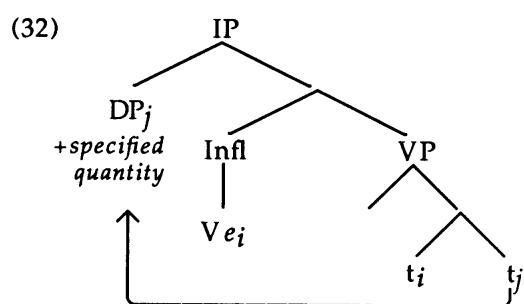
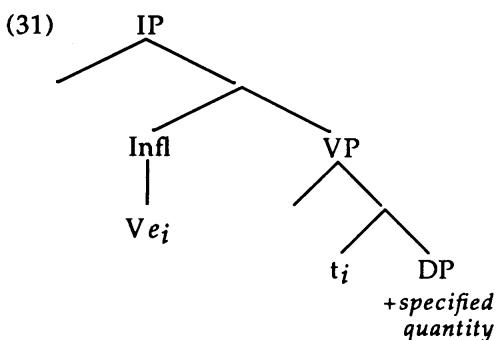
- (20)a. Ti gason an mare bourik la.
dim boy Det tie mule Det

- b. Bourik la mare.
mule Det tie

'The boy tied the mule'
(Damoiseau 1982: 28)

'The mule is tied'

As discussed above, if the complement of an eventive verb is [+specified quantity], then the event is delimited, and relative to the moment of utterance, a delimited event is past, cf. (31). With a derived intransitive, the internal argument is in subject position at S-structure, cf. (32). Even with a specific NP, derived intransitives are interpreted as non-past resultant states.



This outcome suggests that the sensitivity to [+specified quantity] is determined by S-structure configuration. If the D-structure configuration were driving the interpretation, then one would expect derived intransitives to pattern exactly like their transitive counterparts. Since they have a specific noun in complement position at D-structure, they should be interpreted as delimited events.

This point still holds even if the transitivity alternations are not derived via syntactic NP-movement, but by a lexical operation on argument structure. It can then be restated as a distinction between the lexicon and the syntax. What is relevant for the interpretation of bare sentences is the syntactic configuration and not just the lexical properties of the predicate.

4. Three classes of intransitive verbs

This analysis of bare sentences gives insight into otherwise puzzling properties of intransitive verbs, and also provides indirect evidence for a syntactic distinction between unaccusative and unergative verbs in Haitian.

In many languages, intransitive verbs split into two classes: unergative verbs like *dance* are analyzed as having a single external argument, while unaccusative verbs like *come* are analyzed as having a single internal argument. It is generally assumed that unaccusative verbs do not assign Case to their complement, which then raises to subject position so as to be Case-marked. In many languages (e.g. French, Italian, Dutch, German) the two verb classes differ according to the auxiliary they appear with: unergative verbs take the 'have' auxiliary (*avoir, avere, hebben, haben*), but unaccusative verbs take the 'be' auxiliary (*être, essere, zijn, sein*). French examples:

- (33)a. Lucie a dansé.
 Lucie have.3sg dance.participle
 b. Lucie est arrivée.
 Lucie be-3sg arrive.participle

'Lucie has danced'

'Lucie has arrived'

Haitian makes no overt morphological distinction between unergative and unaccusative verbs (Filipovich 1987), but there is still a difference in interpretation: in a bare sentence, an unergative verb is generic (34), but an unaccusative verb is past (35).

- (34)a. Sisi danse.
 Sisi dance
 b. Sisi chante.
 Sisi sing
 c. Sisi ri.
 Sisi laugh

'Sisi dances'

'Sisi sings'

'Sisi laughs'

- (35)a. Vizitè yo vini.
 visitor Det come
 b. Vèdye ale lekòl.
 Vèdye go school

'The visitors came'⁸

'Vèdye went to school'

With both unergative and unaccusative verbs, *ap* is progressive:

- (36)a. Sisi ap danse.
 Sisi Prog dance
 b. Sisi ap chante.
 Sisi Prog sing
 c. Sisi ap ri.
 Sisi Prog laugh

'Sisi is dancing'

'Sisi is singing'

'Sisi is laughing'

- (37)a. Vizitè yo ap vini.
 visitor Det Prog come
 b. Vèdye ape ale lekòl.
 Vèdye Prog go school

'The visitors are coming'

'Vèdye is going to school'

The interpretive properties of the two classes of verbs are summarized in (38):

	<i>bare sentence</i>	<i>ap</i>
(38)	<i>unergative</i>	generic
	<i>unaccusative</i>	past

A transitive verb with a specific complement is interpreted as a past event. This is an effect of delimitedness: a [+specified quantity] complement delimits the event, and a

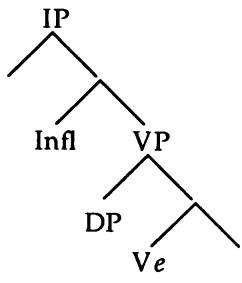
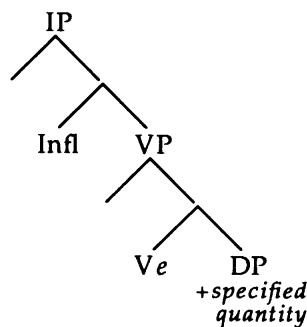
⁸Unaccusative verbs such as *vini* are interpreted as past even with bare NP subjects (which are interpreted as existentially quantified), cf. (i).

- (i) Vizitè vini.
 vistor arrive

'[Some] visitors arrived'

This past interpretation is probably related to the fact that these verbs are inherently telic, i.e. delimited (cf. Levin & Rappaport 1989: 320).

delimited event is interpreted as past relative to the moment of utterance. The difference between unergative and unaccusative is consistent with the idea that the internal argument delimits the event. With an unergative verb, the sole argument is external and so cannot delimit the event, cf. (39). As before, a non-delimited event is interpreted as a repetition of events relative to moment of utterance. With an unaccusative verb, its sole argument is internal and so can delimit the event, giving rise to a past interpretation in a bare sentence, cf. (40).

(39) *unergative: generic*(40) *unaccusative: past*

There is a third class of intransitive verbs which are ambiguous between past and non-past in a bare sentence: *kanpe* 'stand', *tonbe* 'fall', cf. (41). With just these verbs, *ap* is also ambiguous between progressive and future, cf. (42). One way of understanding these correlated ambiguities is to say that these intransitive verbs may be either eventive (volitional/ agentive) or stative (non-volitional/non-agentive).⁹

- (41)a. Sisi tonbe. 'Sisi fell' OR 'Sisi falls'
Sisi fall

- b. Sisi chita. 'Sisi sat' OR 'Sisi sits'
Sisi sit

- (42)a. Sisi ap tonbe. 'Sisi is falling' OR 'Sisi will fall'
Sisi AP fall

- b. Sisi ap chita. 'Sisi is sitting' OR 'Sisi will sit'
Sisi AP sit

Derived intransitives show the same ambiguity. The verb *kanpe* is past when transitive, cf. (43a) and (44a). The corresponding intransitive is non-past in a bare sentence (43b), and future with *ap* (43c), just if the subject is non-volitional. If the subject is volitional, then the bare intransitive is ambiguous between past and non-past (44b), and *ap* is ambiguous between progressive and future (44c).

⁹This contrast affects auxiliary selection in many languages: *be* takes telic/nonagentive predicates, *have* takes nontelic/agentive predicates (cf. Hoekstra 1984, Rosen 1984, Levin & Rappaport 1989). E.g. from Hoekstra & Mulder (1990: 8 ex. 13a):

- (i) ...dat Jan in de sloot gesprongen is '...that John jumped in(to) the ditch'
(ii) ...dat Jan in de sloot gesprongen heeft '...that John jumped (around) in the ditch'

- | | | |
|--------|--|---|
| (43)a. | Vèdye kanpe poto a.
Vèdye stand pole Det | 'Vèdye stood the [telephone] pole up' |
| b. | Poto a kanpe
pole Det stand | 'The [telephone] pole is standing' |
| c. | Poto a ap kanpe.
pole Det Fut stand | 'The [telephone] pole will be standing' |
| (44)a. | Sisi kanpe pitit la.
Sisi stand child Det | 'Sisi stood the child up' |
| b. | Pitit la kanpe.
child Det stand | 'The child stands/stood' |
| c. | Pitit la ap kanpe.
child Det AP stand | 'The child is standing/will stand up' |

Thus, bare sentences distinguish three classes of intransitives: unergative, unaccusative and a third class (ambiguously eventive/volitional vs. stative/non-volitional).

5. Single *ap*

Given this account of bare sentences, we can take another look at *ap*. With eventive verbs *ap* marks progressive (45), with stative verbs it marks future (46).

- | | | |
|------|--|-------------------------------------|
| (45) | Vèdye ap bati yon kay.
Vèdye Prog build a house | 'Vèdye is building a house' |
| (46) | Madanm nan ap gen sis pitit.
woman Det Fut have six child | 'This woman will have six children' |

5.1 Òweré Igbo

A similar link between progressive and future is found in Òweré Igbo (Éménanjø 1985). As a main verb *gá* means 'go' (47); as a verbal suffix (predictably toneless) it gives a progressive interpretation (48); preverbally it yields a future reading (49).¹⁰

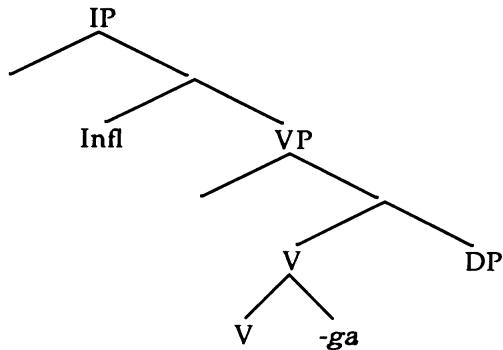
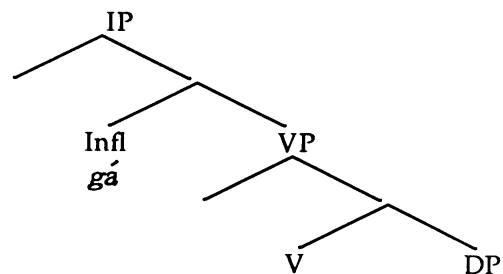
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|--------|---|--|
| (47) | Ó gá-ra Oweré.
3sg go-rV | 'S/he went to Òweré' |
| (48)a. | Ó rí - ga rí à.
3sg eat-Prog food this | 'S/he is eating this food'
(Éménanjø 1985: 122) |
| b. | Ó vù - ga ívù. | 'S/he is becoming fat'
(Éménanjø 1985: 123) |
| (49)a. | Ó gá e-rí rí à.
3sg Fut pro-eat food this | 'S/he will eat this food' |
| b. | Ó gá e-rí-ma rí à.
3sg Fut pro-eat-Dur food this | 'S/he will be eating this food' |

Whereas Haitian *ap* marks progressive only with eventive verbs, and future only with stative verbs, Igbo *gá* freely combines with both eventive and stative predicates:

	Haitian	Igbo	
	eventive verb	stative verb	eventive or stative verb
progressive	<i>ap</i>	*	- <i>ga</i>
future	*	<i>ap</i>	<i>gá</i>

¹⁰The low tone of *gá* in (47) and (49) is predictable from its position in Infl.

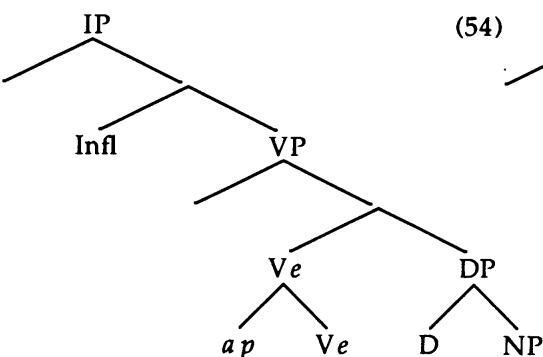
In Igbo, suppose there is a single *gá* whose meaning reflects its scope with respect to the verb. Suffix *-ga* is adjoined to V, marking progressive aspect in the scope of V as in (51). In pre-verbal position, *gá* marks future modality with scope over V as in (52).¹¹

(51) aspectual *-ga*(52) modal *gá*

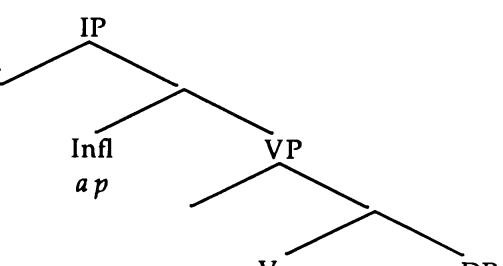
5.2 The scope of *ap*

Suppose that Haitian *ap* is similar to Igbo *gá*. If *ap* is in scope of V, *ap* marks progressive aspect (53); if V is in the scope of *ap*, *ap* marks future modality (54).

(53)



(54)

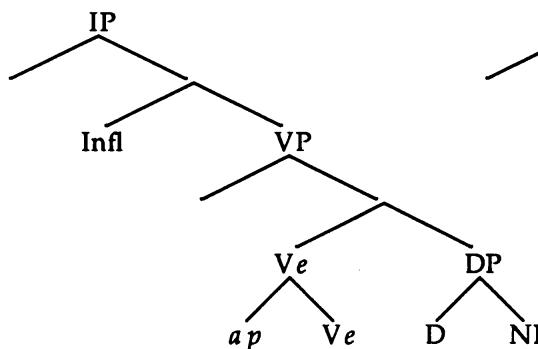
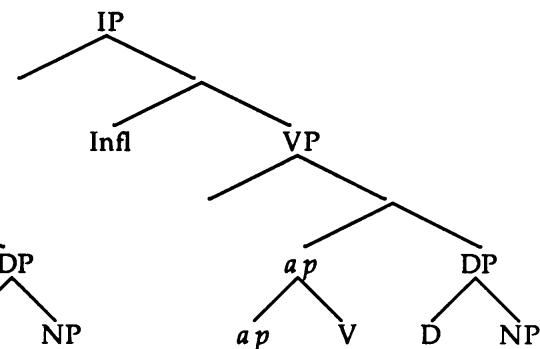


A problem with this idea is that in Haitian (53) is possible only with eventive verbs, and (54) is possible only with stative verbs.

¹¹M. Bamba (p. c.) has drawn my attention to a morpheme in Mahou (Mandekan) which denotes either progressive or future, depending on its scope. Phrase-final *ná*, with a metrically conditioned low tone, contributes the meaning of progressive aspect, cf. (i), (iii). As a suffix in Infl, *ná* adds future modality, cf. (ii), (iv).

- | | | |
|-------|--|------------------------------|
| (i) | Músà yé báá lóó ná.
Musa is rice eat Prog | 'Musa is eating rice' |
| (ii) | Músà yé-ná báá lóó.
Musa is-Fut rice eat | 'Musa will eat rice' |
| (iii) | Músà téé báá lóó ná.
Musa was rice eat Prog | 'Musa was eating rice' |
| (iv) | Músà téé-ná báá lóó.
Musa was-Fut rice eat | 'Musa would have eaten rice' |

Since *ap* only occurs pre-verbally, its attachment is evidently more restricted: either *ap* is in the scope of V (55), or V is in the scope of *ap* (56).

(55) progressive *ap*(56) future *ap*

The configuration in (55) is not possible with stative verbs in Haitian because a 'progressive stative' must be inchoative, in which case *ap vin* is used, cf. (57-58).

- (57)a. Pen an di kou yon wòch.
bread Dem hard like a rock

'The bread is hard as rock'
(Valdman 1981: 148)

- b. *Pen an ap di kou yon wòch.
bread Dem Fut hard like a rock

- c. Pen an ap vin di kou yon wòch. 'The bread'll become hard as rock'
bread Dem Fut come hard like a rock

- (58)a. Vèdye gwo.
Vèdye big

'Vèdye is big'

- b. *Vèdye ap gwo.
Vèdye Fut big

- c. Vèdye ap vin gwo.
Vèdye Fut come big

'Vèdye will become big'

As for (56), *ap* cannot mark future with eventive verbs because aspect composition requires a local relation between *Ve* and *D* (i.e. [\pm specified quantity] must be visible to *V*). This locality requirement would not be met in (56) if *V* were eventive.

In Haitian, Igbo and Mahou the same morpheme marks progressive and future. Rather than positing homophony, I propose that there is a single *ap/gá/ná/* and that the scope properties of modals and aspect (a modal has scope over *V*, *V* has scope over aspect) interact with language-particular morphological properties to provide a syntactic account of the relationship between progressive and future.

6. Consequences

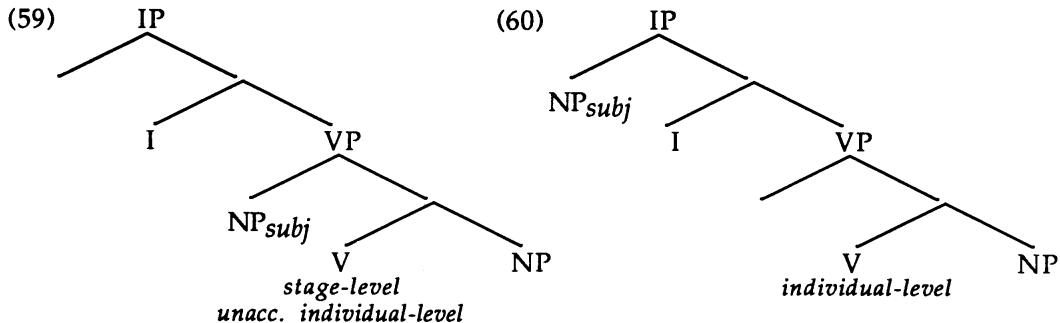
This final section considers whether the event argument is present in syntax; how tenselessness is related to quantification; and the status of 'present tense'.

6.1 Is the event argument projected?

To account for the interpretation of bare sentences, I have appealed to the distinction between eventive and stative predicates. In some recent analyses, eventive and stative

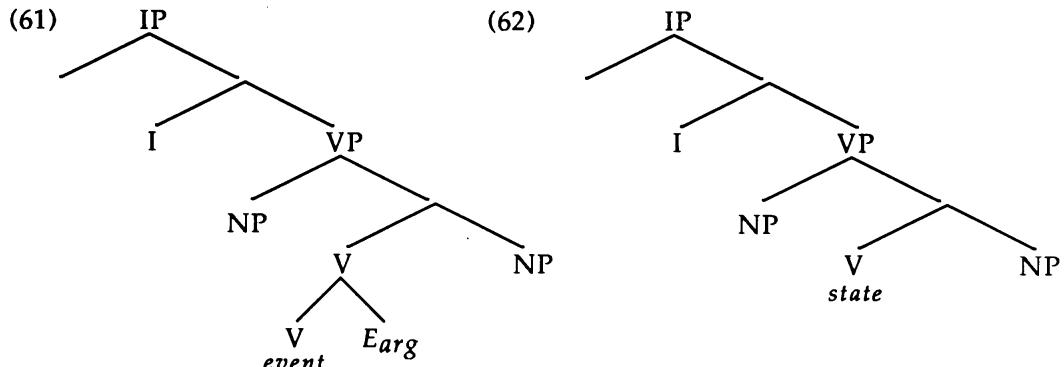
predicates are structurally distinct. Given the role of the eventive/stative distinction in determining the temporal reference of bare sentences, it is relevant to ask how bare sentences bear on two current proposals: that the event argument is projected as an external argument, or as an internal argument.

Kratzer 1989 projects the Davidsonian event argument as an implicit external argument for stage-level, but not individual-level, predicates. (Diesing 1989 implements the same idea somewhat differently.) Stage-level and unaccusative individual-level predicates have a base-generated subject within VP, as in (59). All other individual-level predicates base-generate their subject outside of VP, as in (60).



If this system is modified to refer to the event/state distinction, then eventive predicates would have the structure in (59), and stative predicates that of (60). This difference would correlate with the distribution of Haitian *ap*, progressive in (59) and future in (60). In order to account for the temporal reference of bare sentences compositionally, the representations in (59) - (60) need to be supplemented. Further, it is unclear how this system extends to the ambiguous intransitives in (41) - (44).

The other hypothesis is that the event argument projects as an implicit internal argument. Enç (1991) suggests that event predicates have a time argument which stative predicates lack. The time argument is a clitic on the verb, obligatorily bound by a Tense or Generic operator, cf. (61). Stative predicates lack a time argument, cf. (62).



If Enç's analysis is carried over to bare sentences, then eventive verbs are predicted to be generic. However, we have observed that bare sentences with eventive verbs are

generic only exceptionally; the more usual case is for them to be past. To account for the temporal force of bare sentences, both versions of the event argument hypothesis must be supplemented. This suggests that the status of the event argument as a syntactic position is independent of the properties of bare sentences.

6.2 Temporal and quantificational force

Another puzzle concerns an unexpected restriction on the quantificational force of bare noun objects. In Haitian, a bare noun complement of an eventive verb is always generic, cf. (2a) repeated here. One might expect (2a) to be ambiguous between generic and existential readings, but it isn't.

- (2)a. Pyè vann bëf. 'Pyè sells cattle'
 Pyè sell cattle [#'Pyè sold some cattle']

Haitian contrasts with Fòn-Gbè, where bare nouns with an eventive verb are interpreted either as discourse-linked or as existentially quantified, cf. (64).

- (64)a. Síká já làn. 'Sika cut the meat'
 Sika cut meat (Avolonto 1991, ex. 13a)
 b. Síká dó àtín. 'Sika planted a tree'
 Sika plant tree (Avolonto 1991, ex. 14a)

The difference between Haitian and Fòn-Gbè suggests that the temporal force of bare sentences and the quantificational force of bare nouns are not independent effects.¹²

6.3 True tenselessness?

Although I have discussed bare sentences only in languages that have the *factive* effect, there are also languages where bare sentences are indeed ambiguous. For example, Yorùbá has no morphological tense (Oyeláran 1982, 1989b), and in a bare sentence an eventive verb is temporally ambiguous between past and nonpast (63a). Stative verbs in bare sentences have an unambiguous non-past interpretation (63b).

- (63)a. Qkò ó -fò. 'The aircraft took off' OR 'The aircraft is taking off'
 vehicle Agr-fly (Oyeláran 1989a)
 b. Ayò ó -mò ó. 'Ayò knows her/him/it'
 Agr-know 3sg (Abraham 1958: 424)

Fòn-Gbè, Haitian, Igbo and Yorùbá all have bare sentences. Of these, only Yorùbá lacks the *factive* effect, and only Yorùbá has morphological agreement between the subject and the verb. Manfredi 1989 suggests that, Infl always being lexicalized in Yorùbá either by subject agreement or by an auxiliary, there is no V-to-I movement and hence no *factive* effect in that language.¹³

¹²A related issue is the interaction of quantification with case-marking. In Japanese and Korean, a topic-marked bare NP (with *-wa* in Japanese, *-n̂n* or *-în* in Korean) is generically quantified, while a nominative-marked bare NP (with *-ga* in Japanese, *-ga* or *-i* in Korean) is existentially quantified, cf. Kuno 1973, Lee 1985.

¹³The absence of V-to-I movement in Yorùbá has syntactic consequences, e.g. with respect to the licensing of verb focus and verb serialization (cf. Déchaine 1990).

The analysis of bare sentences as lacking any temporal force of their own calls for a reappraisal of tense as a syntactic category, even in languages which are widely assumed to distinguish 'past', 'present' and 'future' tenses. For example, in her discussion of English 'present tense', Enç (1991) observes that stative verbs are interpreted as non-past, but eventive verbs are interpreted generically, cf. (65):

- (65)a. Sally knows the answer.
- b. Sally sings.

On the basis of this contrast, Enç argues that English does not have 'present tense':

Suppose we assume that the present tense denotes some interval including the time of utterance (or more generally, the time of evaluation). Then we expect it to be able to bind the temporal argument of the verb and to yield a reading for this sentence which is true if Sally sings during the time of utterance. Such a reading, however does not exist for [65b].
(Enç 1991: 7)

In the absence of a tense operator, the time argument of an event verb is bound by a generic operator. (For Enç, stative verbs have no time argument, cf. previous section).

A generic interpretation for eventive verbs in the absence of tense also occurs in Chinese, which has no morphological tense. Chinese bare sentences display the same contrast as English: stative verbs are non-past, eventive verbs are generic, cf. (66).

- | | |
|------------------------------|----------------------|
| (66)a. Jīngqǐ xǐhuān mǐnbāo. | 'Jingqi likes bread' |
| Jingqi like bread | |
| b. Jīngqǐ chī píngguǒ. | 'Jingqi eats apples' |
| Jingqi eat apple | |

In Enç's analysis, a generic interpretation is assigned to eventive verbs in the *absence* of a tense operator. This predicts that if a language has a genuine present tense, eventive verbs should not receive a generic interpretation. French meets Enç's criteria for present tense: both eventive and stative verbs are interpreted as holding at the time of utterance, cf. (67). However, in addition to this, eventive verbs are ambiguous between present and generic interpretations, cf. (67a).

- | | |
|------------------------------|-------------------------------------|
| (67)a. Lucie chante. | 'Lucie sings' OR 'Lucie is singing' |
| b. Lucie connaît la réponse. | 'Lucie knows the answer' |

The ambiguity of (67a) suggests that whatever mechanism is responsible for the generic interpretation of eventive verbs, it is available independently of tense, since it is found in languages with (French) and without (English, Chinese, Haitian) present tense.

This quick survey yields the picture in (68). For all the languages discussed, bare stative predicates are interpreted as non-past, suggesting that this half of the *factual* effect holds by default. What varies cross-linguistically is the interpretation of bare eventive predicates, but this variation falls within narrow bounds: generic, past, non-past, or some combination of these.

		<i>eventive predicate</i>	<i>stative predicate</i>
(68)	Fòn-Gbè	past	non-past
	Igbo	past	non-past
	Haitian	generic ^S	non-past
	Yorùbá	past	non-past
	English	generic	past ^T
	Chinese	generic	non-past
	French	generic	non-past

notes ^Sjust with bare NP objects cf. (2a), and unergative verbs cf. (34).

^Tjust in "Abbreviated English", cf. (9a).

A close look at the occurrence of the generic interpretation reveals that it is derived compositionally. We have already seen this for Haitian. In English, there is a similar effect: an eventive verb followed by a bare plural is generic, (69a). If the noun has a definite determiner, then it expresses the so-called 'historic present', (69b).

- (69)a. Ron eats jellybeans. (...That's why he's always so happy.)
 b. Ron eats the jellybeans. (...Then he falls asleep at his desk.)

French shows the same effect: an eventive verb is ambiguous between generic and non-past if its complement is definite, (70a). With a partitive complement, the sentence has just a non-past interpretation, (70b).

- (70)a. Lucie mange le gateau. 'Lucie eats cake' OR 'Lucie is eating the cake'
 b. Lucie mange du gateau. 'Lucie is eating (some) cake'

That these differences are aspectually driven is supported by Chinese. Recall that an eventive verb is generic with a bare NP complement, cf. (66b). If the complement is [+ specified quantity], then the perfective aspectual element *le* is obligatory, (71).

- (71) Jīngqǐ chī le neì gè píngguǒ. 'Jingqi ate that apple'
 Jingqi eat Asp Dem Cl apple

If it turns out that generic interpretation always results from aspect composition, then the 'generic' column in (68) can be eliminated, leaving 'past' and 'non-past' columns.

Under the analysis proposed here, the *factual* effect arises if two conditions are met: there is no tense operator, and the verb raises to Infl (e.g. Fòn-Gbè, Haitian, Igbo). If an eventive verb is interpreted as non-past (e.g. French, Yorùbá), it must be because one of these two conditions is not met.

As discussed above, French meets the criteria for present tense, and so fails to meet the first criterion for the *factual*. As for Yorùbá, since it does not have morphological tense, it satisfies the first condition. But the second condition is not met: the verb doesn't raise to Infl in Yorùbá, as Infl in that language is always lexicalized by an subject agreement or an auxiliary. Hence there is no *factual* effect and eventive verbs are ambiguous between past and non-past.

References

- Avolonto, A. 1991 *Ná 'futur', kó révolu', nò 'habituel et la flexion verbal en fòn-gbè*, ms., Université du Québec à Montréal.
- Bernabé, J. 1987 *Grammaire créole: fondas kréyol-la*. Paris: Editions L'Harmattan.
- Carlson, G. N. 1977 *Reference to kinds in English*. UMass, Amherst, dissertation.
- Comrie, B. 1985 *Tense*. Cambridge University Press.
- Damoiseau, R. 1982 *Etudes de syntaxe comparée*. Port-au-Prince: Université d'Etat d'Haïti.
- Davidson, D. 1967 The logical form of action sentences, in N. Rescher (ed.) *The Logic of Decision and Action*, pp. 81-95. University of Pittsburgh Press.
- Déchaine, R.-M. 1990 The syntactic and semantic headedness of serial verb constructions, paper presented at GLOW workshop, S. O. A. S, 9 April.
- Diesing, M. 1989 Bare plural subjects, Inflection, and the mapping to LF, ms., University of Massachusetts, Amherst.
- Doron, E. 1983 *Verbless predicates in Hebrew*, University of Texas, Austin dissertation.
- Éménanjo, E. 'N. 1985 *Auxiliaries in Igbo Syntax: A Comparative Study*. Bloomington: I. U. L. C.
- Enç, M. 1981 *Tense without scope: an analysis of nouns as indexicals*, University of Wisconsin, Madison, dissertation.
- 1986 Towards a referential analysis of temporal expressions, *Linguistics and Philosophy* 9: 405-26.
- 1987 Anchoring conditions for tense, *Linguistic Inquiry* 18: 633-57.
- 1991 On the absence of the present tense morpheme in English, ms., University of Wisconsin, Madison.
- Ézikeoñjaku, P. A. 1979 Tense or aspect in Igbo: a preliminary study, *Kíabarà* (Port Harcourt) 2.2: 113-26.
- Fassi-Fehri, A. 1982 *Linguistique arabe: forme et interprétation*. Rabat: Publications de la Faculté des Lettres et Sciences Humaines.
- Filipovich, S. 1987 *La morphologie de l'Haïtien*. M. A. thesis, Université du Québec à Montréal.
- Green, M. M. & G. E. Igwè 1963 *A Descriptive Grammar of Igbo*. Berlin: Akademie.
- Hoekstra, T. 1984 *Transitivity*. Dordrecht: Foris.
- Hoekstra, T. & R. Mulder 1990 Unergatives as copular verbs; locational and existential predication, *The Linguistic Review* 7: 1-79.
- Hornstein, N. 1990 *As Time Goes By; Tense and Universal Grammar*. Cambridge, Mass.: M. I. T. Press.
- Koopman, H. 1984 *The Syntax of Verbs: From Verb Movement Rules in the Kru Languages to Universal Grammar*. Dordrecht: Foris.
- Kratzer, A. 1989 Stage-level and individual-level predicates, ms., UMass, Amherst.
- Kuno, S. 1973 *The Structure of the Japanese Language*. Cambridge: M. I. T. Press.
- Lee, Y.-L. 1985 Quantificational meaning of bare NPs in Korean and Japanese, in I.-K. Lee (ed.) *Seoul Papers in Formal Grammar Theory*. Seoul: Hanshin.
- Levin, B. & M. Rappaport 1989 An approach to unaccusative mismatches, *NELS* 19: 314-29.
- Magloire-Holly, H. 1982 Les modaux: auxiliaires ou verbes?, in C. Lefebvre *et al.* (eds.) *Syntaxe de l'haïtien*, pp. 92-121. Ann Arbor, Michigan: Karoma.

- Manfredi, V. 1989 The relation between aspect and V-movement in Kwa, paper presented at the 4th Niger-Congo Syntax and Semantics Workshop, Universiteit van Tilburg, 2 June.
- Massam, D. 1987 Predicate argument structure and transitivity alternations in Haitian Creole, *Projet de recherche Haïti-Fon: études syntaxique, morphologique et phonologiques*, Université du Québec à Montréal, pp. 379-409.
- Marchese, L. 1979 *Tense/aspect and the development of auxiliaries in the Kru language family*, U. C. L. A. dissertation.
- Nwachukwu, P. A. 1976 Stativity, ergativity and the -rV suffixes in Igbo, *African languages/Langues africaines* 2: 119-43.
- Oyeláran, O. 1982 The category AUX in Yorùbá phrase structure, paper presented at the 15th West African Languages Congress, University of Port Harcourt.
- 1989a Aspects of the Ọwóró verb system, paper presented at the 4th Niger-Congo Syntax and Semantics Workshop, Universiteit van Tilburg, 3 June.
- 1989b Morphological and syntactic constraints on verbal auxiliaries in Yorùbá, paper presented at the 4th Niger-Congo Syntax and Semantics Workshop, Universiteit van Tilburg, 2 June.
- Rapoport, T. 1987 *Copular, nominal, and small clauses*, M. I. T. dissertation.
- Rosen, C. G. 1984 The interface between semantic roles and initial grammatical relations, in D. M. Perlmutter & C. Rosen (eds.), *Studies in Relational Grammar* 2: 38-77. University of Chicago Press.
- Spears, A. K. 1990 Tense, mood, and aspect in the Haitian Creole preverbal marker system, in J. V. Singler (ed.) *Pidgin and Creole Tense-Mood-Aspect Systems*, pp. 121-42. Amsterdam: Benjamins.
- Stowell, T. 1991 Empty heads in Abbreviated English, paper presented at GLOW 1991, Leiden.
- Sylvain, S. 1936/1979 *Le créole haïtien: morphologie et syntaxe*. Geneva: Slatkine.
- Tenny, C. 1987 *Grammaticalizing aspect and affectedness*, M. I. T. dissertation.
- Thomas, J. J. 1869/1969 *The Theory and Practice of Creole Grammar*. London/Port of Spain: New Beacon.
- Uwalaaka, A. A. 1988 *The Igbo Verb: a Semantico-Syntactic Analysis*. Beiträge zur Afrikanistik (Wien) Band 35, Nr. 48.
- Valdman, A. 1981 *Haitian Creole-English-French Dictionary*. Bloomington: Indiana University.
- Verkuyl, H. J. 1972 *On the Compositional Nature of the Aspects*. Dordrecht: Reidel.
- 1989 Aspectual classes and aspectual composition, *Linguistics and Philosophy* 12: 39-94.
- Welmers, B. F. & Wm. E. Welmers 1968 *Igbo: A Learner's Manual*. Los Angeles: U. C. L. A.
- Winston, F.D.D. 1973 Polarity, mood and aspect in Ọhúhun Igbo verbs, *African Language Studies* 14: 119-81.

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Point of View as a Factor of Content

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The departure point for this study is the distinction between character and content, which was introduced by David Kaplan from considerations of indexicals. The character of a sentence relativizes its meaning to the utterance, by fixing the designation of all context dependent elements such as tense and personal pronouns like I. What the sentence says then, relative to a fixed designation of the indexicals, is the content of the sentence.

In the present work, I will motivate a further factorization of content into point of view and attitude, again from considerations of indexicals. Evidence for this factorization is based on the analysis of the literary style known as Free Indirect Discourse (FID), the style pervasive in stream-of-consciousness novels. My claim will be that just as it is possible to do with the cover term meaning as long as one looks only at eternal sentences, it is possible to do with the cover term content as long as one deals only with relatively simple styles such as direct speech and subordinate indirect speech. But once one is confronted with more sophisticated literary styles such as FID, a further distinction is required.

I first present a characterization of Free Indirect Discourse (FID) as it appears in the Poetics literature. FID, one finds out in Dorrit Cohn's book Transparent Minds, "...may be most succinctly defined as the technique for rendering a character's thought in his own idiom while maintaining the third-person reference and the basic tense of narration" (Cohn 1978, p.100). Another description of FID found in Pascal's book, The Dual Voice, says "that the narrator, though preserving the authorial mode throughout and evading the 'dramatic' form of speech or dialogue, yet places himself, when reporting the words or thoughts of a character, directly into the experiential field of the character, and adopts the latter's perspective in regard to both time and place." (Pascal 1977, p.9)

The illustration in (1) is from Virginia Woolf's To the Lighthouse, and consists of two fragments of a passage where Lily Briscoe is settling to work on a painting she had wanted to do ten years before:

(1) "She fetched herself a chair. She pitched her easel with her precise old-maidish movements on the edge of the lawn, not too close to Mr. Carmichael, but close enough for his protection. Yes, it must have been precisely here that she had stood ten years ago. There was the wall; the hedge; the tree. The question was of some relation between those masses. She had borne it in her mind all these years. It seemed as if the solution had come to her: she knew now what she wanted to do.

But with Mr. Ramsay bearing down on her, she could do nothing. Every time he approached - he was walking up and down the terrace - ruin approached, chaos approached. She could not paint....

...She rejected one brush; she chose another. When would those children come? When would they all be off? she fidgeted. That man, she thought, her anger rising in her, never gave; that man took. She, on the other hand, would be forced to give. Mrs. Ramsay had given. Giving, giving, giving, she had died - and had left all this. Really, she was angry with Mrs. Ramsay. With the brush slightly trembling in her fingers she looked at the hedge, the step, the wall." (p.168, 170)

The reader of this passage can get a fairly good idea of which sentences are written from the perspective of the narrator, and which sentences constitute, to a greater or lesser extent, a direct representation of Lily Briscoe's consciousness. These latter sentences are written in the style of Free Indirect Discourse. This style was first identified by Charles Bally in 1912, and was named by him 'style indirect libre'. It had evolved in the 19th century, and it is interesting to note that it developed independently in different languages.

There are different signs of FID in the Woolf passage. One stylistic sign is the choice of words. The expressions those children, they all, that man, reflect Lily Briscoe's inner way of referring to those people at that moment, and betray her irritation towards them, not the narrator's. The metaphors ruin approached, chaos approached, are Lily's, and so is the repetition: giving, giving, giving. Another stylistic sign is the use of exclamations, such as yes, which normally appear in direct speech, not in narrative.

What characterizes FID sentences syntactically is that they are never embedded, but sometimes cooccur with parentheticals, such as she thought. Though these sentences are not embedded, they make use of "shifted tenses", typical of embedded clauses, such as past perfect and "future in the past": "Mrs. Ramsay had given" and "She would be forced to give."

Semantically, it is a very salient characteristic of FID that deictic expressions are anchored to the subject of consciousness (that is the character whose point of view it is), not to the narrator: "speech-act" adverbs such as really, locative deictics such as here, there, verbs with deictic elements such as approach, demonstratives such as these, those, temporal deictics such as now, ten years ago.

On the other hand, tense is anchored to the narrator. Hence the surprising effect of present and future time deictics cooccurring with the past tense. An example from the above passage is she knew now; in (2) you can find a striking example quoted in Ann Banfield's 1982 book Unspeakable Sentences, from D.H. Lawrence:

- (2) 'Tomorrow was Monday, Monday, the beginning of another school week!' (Lawrence, Women in Love, p. 185).

More examples can be found in the 83 paper by Kamp and Rohrer, "Tense in Text". In FID then, temporal deictics are anchored to the character while tense is anchored to the narrator. In this, it differs from subordinate clauses, where both tense and deictics are normally anchored to the speaker. Thus, the truth of the embedded clause in (3)

- (3) Gudrun said on Sunday that tomorrow was Monday
does not follow from the matrix clause, but depends on the time of utterance.

Ann Banfield in her book notices another formal characteristic of FID. Third person pronouns which are linked to the subject of consciousness are logophoric in the sense of Sells 1987. They can be reflexivized under the same conditions which normally hold only for first and second person pronouns, i.e without an overt antecedent, as (4), from Mrs Dalloway shows:

- (4) That was one of the bonds between Sally and himself.
(Woolf, Mrs Dalloway, p. 84)" (from Banfield 1982,
p.91)

Another descriptive point worth mentioning is that in French, the passé simple doesn't occur in the style indirect libre, only the imparfait. In fact, this used to be considered the most salient characteristic of this style in French. The example in (5) is quoted in Banfield:

- (5) 'Emma mit un chale sur ses épaules, ouvrit la fenetre et s'accouda. La nuit était noire. Quelques gouttes de pluie tombaient...' (Flaubert, Madame Bovary, p. 374.) [Emma put a shawl round her shoulders, opened the window and leaned on her elbows. The night was black. A few drops of rain were falling.]

Moshe Ron has pointed out to me an additional semantic characteristic of FID. The narrator may use, to refer to an individual, definite descriptions that the subject of consciousness believes to pick out that individual, even though the narrator knows they don't. What I think this points out to is that in general, referential use of definite descriptions is connected to the speaker, while attributive use is connected to the subject of consciousness. So if the speaker is distinct from the subject of consciousness, both uses can be detected at once. Consider a specific example: in The Marriage of Figaro, there is a scene where Figaro sees Countess Almaviva, wearing his wife's clothes, approaching Count Almaviva in the dark. Then the FID portion of the text in (6) is a description of what Figaro sees, even though the mistaken description his wife is used:

- (6) 'Figaro froze in place. He couldn't believe his eyes. His wife had swooned into the Count's arms and was now kissing him passionately.'

This example shows that FID perception reports are very different from the two kinds of perception reports that were discussed by Barwise, like those in (7):

- (7a) Figaro saw his wife swoon into the Count's arms.
 b Figaro saw that his wife had swooned into the Count's arms.

As was discussed in Situations and Attitudes for example, the embedded sentence in naked infinitive reports such as (7a) describes the situation seen without the mediation of the seer's consciousness. "See that" reports, like (7b), take one step into the seer's consciousness: they report the existence of an attitude of the subject's, but they deliver it anchored by the speaker. So in both these case the narrator is the one responsible for the reference of the description his wife. FID

perception reports such as in (6) take one further step into the subject's consciousness: they deliver the attitude itself. The benefit is substantial: FID perception reports describe both the subject's consciousness and reality, all at once. This point is similar to the observation of Dorrit Cohn when she says that sentences of Free Indirect Discourse "can reflect sites and happenings even as they show a character reflecting on these sites and happenings." (Cohn 1978, 132)

The representation of FID in Situation Semantics

I now turn to an analysis of FID, which I formulate in the framework of Situation Semantics, in order to take advantage of this theory's articulated account of contextual factors. Also, since I want to talk about situations, I will be making the simplificatory assumption that the narratives in question describe reality; for FID, it makes no difference if the narrative is fiction or not.

Sentence meaning is represented in Situations and Attitudes as the three-place relation shown in (8):

(8) $d, c[[\phi]]e$ where $d := \text{at } l(d)$: saying, $a(d), \phi$

between d, c, and e. d is a discourse situation (where a(d) is the speaker and l(d) is the discourse location), e is the described situation, and c, the connections, is a partial function from referring expressions in ϕ to e.

Consider an example where ϕ is as in (9a):

(9)a He was in love with her.

and where d is fixed, and c is fixed as in (9b),

(9)b $c(\underline{\text{he}}) = \text{Jerry}, c(\underline{\text{her}}) = \text{Jill}, c(\text{tns}) = 1$

that is the function c applies to the pronouns and to the tense to yield the individuals Jerry and Jill and the location l respectively. Then all the situations described by this sentence will contain e in (9c):

(9)c $e := \text{at } 1: \text{be-in-love-with, Jerry, Jill}$

But the sentence in (9a) could, in addition to being a description of e, be a representation of different people's thoughts; maybe Jerry's, or Jill's, or maybe just the speaker's. Even though the sentence describes the same situations whoever the thinker is, it certainly describes totally different states of mind: that of the lover is different from that of the beloved, and both are different from that of a third party. These different states of mind is exactly what needs to be taken into account to explain FID. It would therefore be better to build them into the meaning relation, by letting it be defined not on the described situation itself but on different states of mind, which I will call "attitudes", which are situation-types with the indeterminates, or roles, "I" and "here", which represent the subject of consciousness and her location. The different attitudes will yield the same situation relative to their contexts. A context is a situation which I will call "point of view", where the indeterminates "I" and "here" are anchored.

If, for example, ϕ in (9a) describes the speaker's state of mind, it could be simply represented by e itself. The context can be trivially d. But if ϕ represents Jill's state of mind, the fact that the sentence is about herself, de se if you want, this fact is linguistically significant, as FID shows. Still, ϕ could correspond to different attitudes of Jill's. It could represent what Jill has in common with other people who are conscious of being loved, as in (10a), or with people conscious of being loved by Jerry (as in (10b)), or with people conscious of being loved by someone they think of as being called "Jerry", as in (10c), or many others. (E in (10) is the attitude, and indeterminates are signalled by preceding dots.)

- (10)a E:= at .h: be-in-love-with, .x, .i
- b E:= at .h: be-in-love-with, Jerry, .i
- c E:= at .h: be-in-love-with, .x, .i
 refer-to, "Jerry", .x

In (11), an example is given of a point of view p . A point of view always assign to "I" the role of being the subject of consciousness, that is the individual who has the attitude E at the location which anchors "here". Such a situation is called a "represented attitude" by Barwise and Perry in Situations and Attitudes. In (11) the subject of consciousness is Jill, at location l:

- (11) p:= at l: has-attitude, Jill, E
 of, .x, Jerry

The remaining indeterminates in E , other than $.i$ and $.h$, will be anchored according to what is called the setting of p , which are equations like the second line of (11), which says that the indeterminate $.x$ in (10) is anchored to Jerry.

The different attitudes E in (10) are all anchored to the same situation by the point of view p in (11). Conversely, (12) shows that it is possible for an attitude E to be anchored to the same situation by two different points of view p_1 and p_2 :

(12)a Was he in love with her? Jill and Jerry both wondered.

These two characters are having the same thought, each from their own point of view:

(12)b $E := \text{at } .h : \text{be-in-love-with}, .i', .i; ?$

$p_1 := \text{at } l : \text{wonder, Jill}, E \quad p_2 := \text{at } l : \text{wonder, Jerry}, E$
 $\text{of, } .i', \text{ Jerry} \qquad \qquad \qquad \text{of, } .i, \text{ Jill}$

"Real life" examples from actual novels are shown in a paper by Ron 1981, from The Portrait of a Lady and others.

In order to account for FID, I therefore propose to relativize meaning not only to the discourse but also to the point of view, which represents the focus of consciousness. The meaning relation I propose is shown in (13),

(13) $d, c[[\Phi]]E, p$
iff
 $Ae(\underline{Ep[f]} \subseteq e \rightarrow d, c[[\Phi]]e)$

a four-place relation between d , c , E and p . E is a situation-type with two indeterminates $.i$ and $.h$, p is a represented attitude which is a context for E (that is, a situation where the roles $.i$ ("I") and $.h$ ("here") are uniquely defined). The setting of p contains equations which define an anchor f for each additional indeterminate $.x$ in E .

(13) says in effect that for every situation e which includes the result of anchoring the situation-type E with p and f , e is an interpretation of Φ according to the old three place meaning relation.

This puts us in the position to propose the explication in (14) for what it means to say that a sentence Φ is a sentence of FID:

- (14) ϕ is interpreted as FID iff it is interpreted such that
 $p \neq d$.

In everyday discourse, typically, $p = d$, that is, in everyday discourse the speaker is also the subject of consciousness.

When we now look afresh at deixis, taking into account this more sensitive meaning relation, we see that the meaning of some deictic elements depends on the discourse, but that the meaning of others depends on the point of view. First and second person pronouns, for example, are discourse-situation sensitive but point-of-view insensitive, as in (15):

- (15) $d, c[[I]]a, E, p$ iff $a = a(d)$

According to (15), the interpretation of the pronoun I given d, c, E, and p is that individual a which is $a(d)$, the speaker. Note that the interpretation of the pronoun "I" does not have to coincide with the subject of consciousness. The sentence in (16),

- (16) I should have realized that something had happened to her.

which I found quoted in the same paper by Ron, is from Henry Miller's Sexus, which is a first-person narrative. (16) appears there as part of an FID passage written from the point of view of Mara, who is the referent of the third person pronoun her. Henry has just complained to Mara after she had stood him up, and he writes: 'She seemed surprised that I should get so upset over so trivial a thing. What had kept her? Oh, it was nothing at all. She had been out late, a rather wild party.... Yes, there had been a lot to drink and somebody had asked her to do the splits and she had tried.... well, and she had hurt herself a bit. That was all. I should have realized that something had happened to her. She wasn't the sort who made dates and broke them - just like that.' (Miller, Sexus, Grove, p.69-70) So it is clear that the first person pronoun can refer to the speaker without referring to the subject of consciousness.

Demonstratives, unlike first and second person pronouns, are point-of-view sensitive but discourse-situation insensitive, as shown in (17):

- (17) if $d, c[[this]]b, E, p$
 in p : at $l(p)$: attending-to, $a(p)$, b

(17) says that the interpretation of this is an individual b that the subject of consciousness a(p) is attending to in the point of view situation. We saw an example above, where Virginia Woolf uses words such as this tree for something that Lily Briscoe is attending to. The denotation of this is therefore a function of the point-of-view, not of the discourse.

Third person pronouns are sensitive to both discourse and point of view, as can be seen in (18):

- (18) d,c[[she]]b,E,p
 if
 (1) b ≠ a(d) and b ≠ a(p)
 in which case attribution of feminine gender is part of p
 or
 (2) b ≠ a(d) and b = a(p),
 in which case attribution of feminine gender is part of d

According to (18), if she refers to the individual b, then b must always be distinct from the speaker, and could also be distinct from the subject of consciousness, as in (18.1), in which case the attribution of feminine gender is part of the point of view, but b could be equal to the subject of consciousness, as in (18.2), in which case gender attribution is part of d.

The difference in where gender is attributed is quite crucial. In case (1) of (18), the narrator can refer with the pronoun she to a masculine character, if the subject of consciousness thinks it's a woman. Examples like this are quoted by Ron from Balzac's Sarrasine, and I also found such a case in a Hebrew novel called Molcho, by Yehoshua.

On the other hand, if she is connected to the subject of consciousness, gender information cannot be attributed to her. Consider the difference in information between the direct discourse in (19a) and the FID in (19b):

- (19)a Robin thought: "I am tired."
 b She was tired, thought Robin.

(a) does not contain the information whether Robin is female. The name Robin is unisex, and the first person pronoun is not marked for gender. But a third person pronoun is, therefore (b) is more informative than (a). This extra information cannot be attributed to Robin herself, because what she actually thought was: "I am tired," which does not imply that she is female. Gender information in this case clearly emanates from d, the

discourse situation, which is the situation of the narrator.

This last point, by the way, I believe settles a debate in the poetics literature about whether in FID, consciousness is represented unmediated by the narrator, (as Banfield for example believes), or whether the voice of the narrator blends in with that of the subject of consciousness. The latter view is called "the dual voice" position. The present work, considered in the perspective of this debate, actually gives an explicit formulation of the dual voice position: the narrator's voice "emanates" from d , and the character's voice from p .

We now move on to temporal deictics. These behave like demonstratives and not like first and second person pronouns, as seen in (20) and (21):

- | | | |
|------|----------------------------|---|
| (20) | $d, c[[now]]l, E, p$ | iff $l \circ l(p)$
(read: l overlaps $l(p)$) |
| (21) | $d, c[[yesterday]]l, E, p$ | iff $l = \text{day preceding the day containing } l(p)$. |

Temporal deictics are not dependent upon the discourse situation but only upon the point-of-view.

Tense, on the other hand, like third person pronouns, depends both on the discourse situation and the point of view. This speaks in favour of a Reichenbach-type treatment of tense, whereby tense is a relation between $l(d)$ (discourse time), l (event time) and $l(p)$ (point of reference). The point of reference can be any event, but in cases of FID it coincides with the point-of-view.

- | | | |
|------|-----------------------------------|--|
| (22) | $d[[\text{present (prog.)}]]l, p$ | iff $l \circ l(p)$ and $l(p) \circ l(d)$ |
| | $d[[\text{imparfait}]]l, p$ | iff $l \circ l(p)$ and $l(p) \alpha l(d)$ |
| | $d[[\text{passé simple}]]l, p$ | iff $l \alpha l(p)$ and $l(p) \circ l(d)$ |
| | $d[[\text{past perfect}]]l, p$ | iff $l \alpha l(p)$ and $l(p) \alpha l(d)$ |
| | $d[[\text{will}]]l, p$ | iff $l(p) \alpha l$ and $l(p) \circ l(d)$ |
| | $d[[\text{would}]]l, p$ | iff $l(p) \alpha l$ and $l(p) \alpha l(d)$ |

(The past tense in English is defined as the disjunction of passé simple and imparfait.)

Of the six tenses in (22), three are "simple", those where the point of reference overlaps the discourse time: present progressive, passé simple and the future. Simple tenses are not appropriate for FID, since FID always involves a point of reference, the point of view, different from the discourse

situation. The tenses found in FID are therefore the "complex" tenses, *imparfait*, *past perfect* and would. (as we've seen in the passages above)

The discrepancy between tense and temporal deixis in FID is therefore explained by the discourse-sensitivity of tense versus the discourse insensitivity of temporal deictics. Two examples of this discrepancy follow in (23) and (24):

(23)a He would return tomorrow.

In (23), the situation described is past in relation to the discourse, but future in relation to the point of view; the complex tense would is therefore used. Tomorrow is a relation independent of the discourse situation, it denotes the temporal relation between the described situation and the point of view. It is part of E, since it is part of the way the subject is thinking about the described situation:

(23)b d,c[[he would return tomorrow]]E,p
 if
 p:= at l: has-attitude, a, E
 of, .l, l'
 E:= at .l: return, .i
 tomorrow, .l

where

d[[would]]l',l

(24)a Tomorrow was Monday.

In (24), the past tense denotes the *imparfait*: the described situation is past in relation to the discourse but cotemporal with the point of view. The situation described is such that the day following it is a Monday:

(24)b d,c[[tomorrow was Monday]]E,p
 if
 p:= at l: has-attitude, a, E
 of, .l, l'
 of, .t, l'
 E:= at .h: tomorrow, .l
 be-Monday, .t
 same, .t, .l

where

d[[imparfait]]l,l

Lastly, we turn to the duality in the use of definite descriptions in Free Indirect Discourse. For that purpose, we return to the hypothetical example from "The Marriage of Figaro". Let ϕ be the sentence 'His wife was kissing the Count', as in (25). This sentence indeed describes the scene that Figaro sees, since the narrator is using the definite description his wife referentially, by connecting it to Countess Almaviva. The given E, p, d, and c in (25) therefore make the sentence describe the scene that Figaro relates to visually.

- (25) d,c [[His wife was kissing the Count]] E,p
 iff E:= at .h: kiss, .x, Count Almaviva
 p:= at l: see, Figaro, E
 of, .x, Countess Almaviva

where c(his wife) = Countess Almaviva
 c(the Count) = Count Almaviva

But this same E in (26) interacts with other beliefs of Figaro, such as E' in (26):

- (26) E':= at .h: wife-of, .z, .i
 same, .z, .x
 p':= at l: believe, Figaro, E'
 of, .x, Countess Almaviva
 of, .z, Susana

E' expresses the fact that Figaro applies his concept of his wife to the person that he sees kissing the Count. Notice that E + E' is internally coherent, and expresses Figaro's belief that he is watching his wife kiss Count Almaviva. This is how the sentence ϕ contains information on Figaro's state of mind despite the fact that ϕ does not describe any real situation which anchors E + E'. E + E' is actually impossible to anchor consistently, as it identifies two different people, Susana and Countess Almaviva, as one.

Conclusion

This paper investigates a phenomenon of the semantics of natural language which can be understood through the study of Poetics. Semanticists usually find their data, for reasons of simplicity, in every day discourse or in stylistically simple written narrative. In such styles, it happens that the point of view coincides with the utterance, which has prevented semanticists from recognizing the distinction. But, as known to scholars in Poetics, natural language supports more sophisticated styles just as easily. FID is interpreted by educated speakers without any special training. The study of deixis in FID reveals the oversimplification in existing semantic theories which is due to the identification of the point of view with the utterance.

Once we recognize that content must be factored into point of view and attitude, we must give up the simple picture according to which once the discourse situation is fixed, this already determines what is being said. What is said does not depend only on the discourse situation, but on the point of view as well. Moreover, as the reader may have guessed all along, this too is not enough. The attitude itself can in principle again be factored into point of view and another attitude, and so on. Examples of recursive FID are not so difficult to come by, and some were shown to me by Moshe Ron. In Henry James' The Portrait of a Lady, for one, examples abound, such as the excerpt in (27) from Isabel's meditations:

- (27) 'It was in all this she had found her occasion. She would launch his boat for him; she would be his providence; it would be a good thing to love him. And she had loved him...' (Henry James, The Portrait of a Lady, Penguin Modern Classics, p. 427)

or to go back to Lily Briscoe, in a passage pointed out to me by Anita Mittwoch:

- (28) 'Letting herself be helped by him, Mrs Ramsay had thought (Lily supposed) the time has come now, she would say it now. Yes, she would marry him. And she stepped slowly, quietly on shore. Probably she said one word only, letting her hand rest still in his... Time after time the same thrill had passed between them - obviously it had, Lily thought.' (Virginia Woolf, To the Lighthouse, Penguin Modern Classics, p. 225)

To conclude, determining what is being said is a recursive process, in principle unbounded.

Bibliography

- Banfield, A.: 1982, Unspeakable Sentences, Boston: Routledge & Kegan Paul.
- Barwise, J. and J. Perry: 1983, Situations and Attitudes, Cambridge, MA: MIT Press.
- Cohn, D.: 1978, Transparent Minds, Princeton, NJ: Princeton University Press.
- Doron, E.: 1990, 'Point of View,' CSLI Report No. CSLI-90-143.
- Hamburger, K., trans. M. Rose: 1973, The Logic of Literature, Bloomington: Indiana University Press.
- Kamp, H. and C. Rohrer: 1983, 'Tense in Texts,' in R. Bauerli, C. Schwarze and A. von Stechow (eds.) Meaning, Use, and Interpretation in Language, Walter de Gruyter, Berlin.
- Pascal, R.: 1977, The Dual Voice, Manchester: Manchester University Press.
- Ron, M.: 1981, 'Free Indirect Discourse, mimetic language games and the subject of fiction', Poetics Today 2, 17-40.
- Sells, P.: 1987, 'Aspects of Logophoricity', Linguistic Inquiry 18, 445-79.

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Dynamic Interpretation and Hoare Deduction

Extended Abstract

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1 Introduction

This paper presents a dynamic assignment language (called *DAL*) with η and ι assignments and generalized quantifiers, in the style of dynamic predicate logic [8]. The constructs for η and ι assignments allow us a straightforward analysis of indefinite and definite descriptions in natural language. The addition of quantifiers permit us to treat a wide variety of ‘donkey’ sentences.

Given a translation π of a natural language sentence S that maps pronouns to dynamically bound variables (see [2], [8]), we use ideas from Hoare’s logic to calculate the static meaning of S as the weakest precondition for which program π can succeed. Here are some simple examples we claim we can treat correctly.

- (1) *If a girl has a boyfriend, she teases him.*
- (2) *Every girl who has a boyfriend teases him.*
- (3) *Most girls who have a boyfriend tease him.*

Our account gives (2) and (3) two possible readings, (these coincide with so-called *weak* and *strong* readings known from the literature for such examples). The strong reading of (2) is equivalent to the reading we get for (1). Our treatment of (3) does not suffer from the so-called *proportion problem* (see [10]). We can handle non-conservative quantifiers, provided they do not have internal dynamic effects. We cannot at present handle (4), because of the presence of the donkey anaphor in a non-conservative quantifier context.

- (4) *Only girls who do tease a boyfriend lose him.*

Our proposal for the treatment of quantifiers can be viewed as a compositional reformulation (and quite possibly a correction) of previous proposals for the definition of dynamic generalized quantifiers (see e.g. [13]).

After the introduction of the language and a discussion of its semantics, we present a proof system for it in terms of Hoare's logic. In the full paper ([6]) it is proved that this deduction system is sound and complete with respect to the dynamic semantics.

2 Dynamic Assignment Language: Syntax

We first define the set of programs of *DAL* and the set av of *assignment variables* of a *DAL* program. For simplicity's sake we take the terms of *DAL* to be a set of individual variables V (one might want to add constants and deictic parameters to this, but we will not do so here).

Given a set of terms and a set of relation symbols, the set of *DAL* programs is the smallest set such that the following hold.

1. \perp is a program.
2. If t_1, t_2 are terms, then $t_1 = t_2$ is a program.
3. If R is an n -place relation symbol and t_1, \dots, t_n are terms, then $R(t_1 \dots t_n)$ is a program.
4. If π_1 and π_2 are programs then $(\pi_1; \pi_2)$ is a program.
5. If π_1 and π_2 are programs then $(\pi_1 \Rightarrow \pi_2)$ is a program.
6. If π is a program, then $\neg\pi$ is a program.
7. If π is a program and x is a variable, then $\eta x : \pi$ is a program.
8. If π is a program and x is a variable, then $\iota x : \pi$ is a program.
9. If π_1 and π_2 are programs and Q is a quantifier symbol, then $Q^w x(\pi_1, \pi_2)$ and $Q^s x(\pi_1, \pi_2)$ are programs.

The operator ; is used for program composition. \Rightarrow denotes dynamic implication between programs. ηx is used for indefinite assignment, while ιx denotes definite assignment. The quantifier symbols Q are supposed to denote binary generalized quantifiers. Q^w and Q^s distinguish between the weak and strong readings of these. The discussion of the semantic clauses below will make the difference clear.

We will follow the usual predicate logical convention of omitting outermost parentheses for readability. Also, it will become evident from the semantic clause for sequential composition that the ; operator is associative. Therefore, we will often take the liberty to write $\pi_1; \pi_2; \pi_3$ instead of $(\pi_1; \pi_2); \pi_3$ or $\pi_1; (\pi_2; \pi_3)$. Also, we use T as an abbreviation for $\neg\perp$.

Here are the *DAL* translations of (1), (2) (strong reading), and (3) (weak reading).

- (5) $(\eta x : girl x; \eta y : boyfriend y; has(x, y)) \Rightarrow tease(x, y).$
- (6) $Q_{\forall}^s x(girl x; \eta y : boyfriend y; has(x, y), tease(x, y)).$
- (7) $Q_M^w x(girl x; \eta y : boyfriend y; has(x, y), tease(x, y)).$

In these translations, $\eta v : \pi$ is a command to assign to variable v an object d for which *DAL* program π succeeds; \Rightarrow denotes dynamic implication, Q_{\forall}^s is the generalized universal quantifier (in its strong reading), and Q_M^w is the generalized quantifier *most* (in its weak reading).

3 Informal Semantics

This section is devoted to an informal account of the semantics of atomic test predicates, implication, negation and union of *DAL* programs, and η and ι assignment. Section 4 will give the formal semantics. The semantics of quantifiers will be presented in section 5.

The semantic objects of our prime interest are *states*, functions from the set of *DAL* variables to individuals in a model. Semantically, *DAL* programs act as state transformers: a *DAL* program takes an input state and either indicates success by producing an output state or it indicates failure by not producing anything at all. Equivalently, we can view the meaning of a program as a function mapping any input state to the set of all possible outputs the program can produce for that input. A program which is a test will on input A either produce output set $\{A\}$ (in case the test succeeds) or output set \emptyset (in case the test fails). Programs which may produce non-singleton sets are non-deterministic; for some inputs there is more than one possible output state. Examples of non-deterministic programs are η assignment programs; the program $\eta x : \pi$ has, on input A , the set of all states which may differ from A in the fact that they have another x value, namely some value that satisfies π .

The program \perp expresses a test which always fails; it is meant to express the same as **if true then fail else skip fl**. In other words: for every input state A , \perp will produce output state \emptyset . As was mentioned above, we use \top as an abbreviation for $\neg\perp$. The program \top is a test which always succeeds; in other words, it is meant to express the same as the ALGOL style statement **if true then skip else fail fl**. In other words, for every input state A , \top will produce output set $\{A\}$. Atomic predicates like $t_1 = t_2$ or $R(t_1 \dots t_n)$ are meant to express tests which may fail; in ALGOL style notation: **if $R(t_1 \dots t_n)$ then skip else fail fl**. Again in terms of input output behaviour: If $R(t_1 \dots t_n)$ evaluates to true in state A , the predicate will have output set $\{A\}$, otherwise the output set will be \emptyset .

Programs of the form $(\pi_1 \Rightarrow \pi_2)$ are intended to treat the interplay of natural language implication and descriptions, as in the translation of example (1)

which was given above as (5). To get the semantics right, one has to assume that (5) is true if and only if every output state for the antecedent $\eta x : \text{girl } x; \eta y : \text{boyfriend } y; \text{has}(x, y)$ will be an appropriate input state for the consequent $\text{tease}(x, y)$ (see [2] or [8]).

Negation should allow one to treat examples like the following, where the negation has scope over an indefinite (for convenience we use indices to force the translation to corresponding variables).

- (8) *The manager¹ does not use a PC².*

This example can be translated into *DAL* as follows:

- (9) $\iota v_1 : (\text{manager } v_1); \neg(\eta v_2 : \text{pc } v_2; \text{use}(v_1, v_2)).$

To get the semantics right, a negated program should act as a test: $\neg\pi$ should accept (without change) all variable states which cannot serve as input for π , and reject all others. In fact, it will turn out that $\neg\pi$ is definable in terms of \Rightarrow and \perp , as $\pi \Rightarrow \perp$.

Definite descriptions can act as anaphors and antecedents at the same time. Discourse (10) provides an example.

- (10) *A customer¹ entered. The woman₁² sat down. She₂ smiled.*

The indices indicate that *the woman* has *a customer* as its antecedent, while at the same time acting itself as antecedent for *she* in the next sentence (and constraining the gender of the pronoun). A *DAL* translation of (10) is given in (11).

- (11) $\eta v_1 : \text{customer } v_1; \text{enter } v_1; \iota v_2 : (v_2 = v_1; \text{woman } v_2);$
 sit-down $v_2; \text{smile } v_2.$

The ι assignment in (11) is dependent on the η assignment to variable v_1 . With reference to a particular assignment for v_1 , the description is unique. Note that the ι assignment to v_2 does indirectly act as a test on the previous η assignment to v_1 : this test will weed out η assignments that are inappropriate in the light of the subsequent discourse.

Definite descriptions can also be dependent on each other. Consider the string of characters in (12).

- (12) *a \hat{A} $\hat{\wedge}$ b C.*

Suppose just for an instant that (12) is a state of affairs one is talking about. The state of affairs involves characters and hat symbols (*hats* for short). With reference to (12), it does make sense to talk about *the character with the hat*, although (12) neither has a unique character nor a unique hat. We can, for instance, truthfully assert (13) about (12).

- (13) *The character with the hat is a capital.*

The translation into *DAL* is straightforward:

$$(14) \quad \iota v_1 : (\text{character } v_1; \iota v_2 : (\text{hat } v_2; \text{with}(v_1, v_2))); \text{capital } v_1.$$

Intuitively, the first ι assignment ‘tries out’ individual characters C until it finds the unique C with the property that a unique hat H for C can be found.

4 Semantics: Formal Definitions

The semantics of *DAL* programs is given in terms of input-output behaviour. Given a model \mathcal{M} to interpret the basic vocabulary of a program π , the interpretation of program π , notation $[\![\pi]\!]$, is a function from variable states A for the language—mappings of (subsets of) the set of variables of the language to the domain of the model—to sets of variable states (the possible output states for variable state A). If for a given input state A , $[\![\pi]\!](A) \neq \emptyset$, then π succeeds on A , otherwise π fails on A .

Assume a model $\mathcal{M} = \langle U, I \rangle$, with U a universe of individuals and I an interpretation function for the first order relation symbols of the language. We consider the set S of all functions $A : V \rightarrow U$. This is the set of *states* for \mathcal{M} .

A state A for $\mathcal{M} = \langle U, I \rangle$ determines a valuation V_A for the terms of the language as follows: if $t \in V$ then $V_A(t) = A(t)$ (as we take all our terms to be variables, this is all there is to the definition of V_A). If A is a state for \mathcal{M} , x a variable and d an element of the universe or \mathcal{M} , then $A[x := d]$ is the state for \mathcal{M} which is just like A except for the possible difference that x is mapped to d .

We define a function $[\![\pi]\!]_{\mathcal{M}} : S \rightarrow \wp S$ by recursion. A, B, C are used as metavariables over states. The function $[\![\pi]\!]_{\mathcal{M}}$ depends on the model \mathcal{M} , but for convenience we will often write $[\![\pi]\!]$ rather than $[\![\pi]\!]_{\mathcal{M}}$. The function should be read as: on input state A , π may produce any of the outputs in output state set $[\![\pi]\!](A)$.

1. $[\![\perp]\!](A) = \emptyset$.
2. $[\![R(t_1 \dots t_n)]\!](A) = \begin{cases} \{A\} & \text{if } \langle V_A(t_1), \dots, V_A(t_n) \rangle \in I(R) \\ \emptyset & \text{otherwise.} \end{cases}$
3. $[\![t_1 = t_2]\!](A) = \begin{cases} \{A\} & \text{if } V_A(t_1) = V_A(t_2) \\ \emptyset & \text{otherwise.} \end{cases}$
4. $[\!(\pi_1; \pi_2)\!](A) = \bigcup \{[\![\pi_2]\!](B) \mid B \in [\![\pi_1]\!](A)\}.$
5. $[\!(\pi_1 \Rightarrow \pi_2)\!](A) = \begin{cases} \{A\} & \text{if for all } B \in [\![\pi_1]\!](A) \text{ it holds that } [\![\pi_2]\!](B) \neq \emptyset \\ \emptyset & \text{otherwise.} \end{cases}$
6. $[\![\neg\pi]\!](A) = \begin{cases} \{A\} & \text{if } [\![\pi]\!](A) = \emptyset \\ \emptyset & \text{otherwise.} \end{cases}$
7. $[\![\eta x : \pi]\!](A) = \bigcup \{[\![\pi]\!](A[x := d]) \mid d \in U\}.$

$$8. \llbracket \iota x : \pi \rrbracket(A) = \begin{cases} \llbracket \pi \rrbracket(A[x := d]) \text{ for the unique } d \in U \\ \text{for which } \llbracket \pi \rrbracket(A[x := d]) \neq \emptyset \\ \emptyset \end{cases} \quad \begin{array}{l} \text{if such a } d \text{ exists} \\ \text{otherwise.} \end{array}$$

9. The rules for the quantifiers will be given in the next section.

Truth is defined in terms of input-output behaviour: π is true relative to model \mathcal{M} if there are states A, B for \mathcal{M} such that $B \in \llbracket \pi \rrbracket_{\mathcal{M}}(A)$. Two programs π_1, π_2 are equivalent if for every model \mathcal{M} and every state A for \mathcal{M} , $\llbracket \pi_1 \rrbracket_{\mathcal{M}}(A) = \llbracket \pi_2 \rrbracket_{\mathcal{M}}(A)$.

Dynamic consequence is defined as follows: $\pi_1 \models \pi_2$ if for every model \mathcal{M} and for all states A, B for \mathcal{M} : if $B \in \llbracket \pi_1 \rrbracket_{\mathcal{M}}(A)$ then there is a state C with $C \in \llbracket \pi_2 \rrbracket_{\mathcal{M}}(B)$.

The statement $\eta x : \pi$ performs a non-deterministic action, for it sanctions any assignment to x of an individual satisfying π . The statement acts as a test at the same time: in case there are no individuals satisfying π the set of output states for any given input state will be empty. In fact, the meaning of $\eta x : \pi$ can be thought of as a random assignment followed by a test, for $\eta x : \pi$ is equivalent to $\eta x : \top ; \pi$, or in more standard notation, $x := ? ; \pi$. It follows immediately from this explanation plus the dynamic meaning of sequential composition that $\eta x : (\pi_1 ; \pi_2)$ is equivalent with $\eta x : (\pi_1 ; \pi_2)$.

The interpretation conditions for ι assignment make clear how the uniqueness condition is handled dynamically. The statement $\iota x : \pi$ consists of a test followed by a deterministic action in case the test succeeds: first it is checked whether there is a unique π ; if so, this individual is assigned to x ; otherwise the program fails (in other words, the set of output states is empty). Thus we see that the two programs $\iota x : (\pi_1 ; \pi_2)$ and $\iota x : (\pi_1 ; \pi_2)$ are not equivalent. The program $\iota x : (\pi_1 ; \pi_2)$ succeeds if there is a unique object d satisfying $\pi_1 ; \pi_2$, while the requirement for $\iota x : (\pi_1 ; \pi_2)$ is stronger: there has to be a unique individual d satisfying π_1 , and d must also satisfy π_2 .

5 The Semantics of Quantification

Quantifiers are treated as binary operators on programs that form test programs. The semantic clauses given below ensure that the quantifier variable receives its values in a dynamic way. The quantifier symbol itself has its usual meaning of a relation between sets.

Let Q_1, Q_2, \dots be a list of binary quantifier symbols. Assume that the interpretation functions of the models $\mathcal{M} = \langle D, I \rangle$ are extended with suitable interpretations for these. That is to say, for every Q_i , $I(Q_i)$ is a binary quantifier relation on $\wp(D)$, i.e. a relation satisfying the constraints of *extension*, *isomorphy* and *conservativity* (see for example [16]).

A quantifier relation $I(Q)$ is *conservative* (or: lives on its first argument) if $I(Q)(A, B)$ iff $I(Q)(A, A \cap B)$. A quantifier relation satisfies *extension* if adding or deleting individuals from the part of the universe which is outside the extension of

the arguments does not affect the relation, i.e., if the relation satisfies $I(Q)_E(A, B)$ iff $I(Q)_{E'}(A, B)$, for all E, E' with $E, E' \supseteq A \cup B$.

The semantic clauses for quantifier programs, in their weak and strong readings, respectively, now run as follows:

Weak readings of quantifiers

$$\llbracket Q^w x(\pi_1, \pi_2) \rrbracket(A) = \begin{cases} \{A\} & \text{if } \langle \{d \in U \mid \llbracket \pi_1 \rrbracket(A[x := d]) \neq \emptyset\}, \\ & \quad \{d \in U \mid \llbracket \pi_1; \pi_2 \rrbracket(A[x := d]) \neq \emptyset\} \rangle \\ & \quad \in I(Q) \\ \emptyset & \text{otherwise.} \end{cases}$$

Strong readings of quantifiers

$$\llbracket Q^s x(\pi_1, \pi_2) \rrbracket(A) = \begin{cases} \{A\} & \text{if } \langle \{d \in U \mid \llbracket \pi_1 \rrbracket(A[x := d]) \neq \emptyset\}, \\ & \quad \{d \in U \mid \llbracket \pi_1 \Rightarrow \pi_2 \rrbracket(A[x := d]) \neq \emptyset\} \rangle \\ & \quad \in I(Q) \\ \emptyset & \text{otherwise.} \end{cases}$$

The first of these semantic clauses ensures that example program (7) will succeed in all models where the majority of girls with boyfriends are girls who tease at least one of their boyfriends. The second semantic clause takes care of the strong reading of this example. In this reading, the program will succeed in all models where the majority of girls with boyfriends are girls who tease *all* their boyfriends.

Note that quantifier programs behave as tests: in case the test succeeds the set of output states has the input state as its only member. Externally, quantifier programs, as defined here, do not change assignments. This means that external dynamic effects of quantification are not yet taken into account in this proposal. In fact, they are beyond the scope of this paper.

To see how the semantics of quantification works in the simplest possible case, let us walk through example program (15).

$$(15) \quad Q^w x(Sx, Tx).$$

According to the semantic clause, on input state A this program gives $\{A\}$ iff the sets (16) and (17) are in the relation $I(Q)$.

$$(16) \quad \{d \in U \mid \llbracket Sx \rrbracket(A[x := d]) \neq \emptyset\}.$$

$$(17) \quad \{d \in U \mid \llbracket Sx; Tx \rrbracket(A[x := d]) \neq \emptyset\}.$$

According to the semantic clause for atomic tests and the definition of the valuation function for terms, the set (16) can be rewritten as (18).

$$(18) \quad \{d \in U \mid d \in I(S)\}.$$

In the same way, and using the semantic clause for ; , the set (17) can be rewritten as (19).

$$(19) \quad \{d \in U \mid x \in I(S) \text{ and } x \in I(T)\}.$$

Because the Q is assumed to denote a conservative quantifier with first argument as given by (18), (19) can be replaced by (20).

$$(20) \quad \{d \in U \mid x \in I(T)\}.$$

Thus we find that (15) is true iff the sets given in (18) and (20) are in the relation denoted by the quantifier. This is the expected result.

Nothing out of the ordinary yet. In fact, it is easy to show that as long as the antecedent program π_1 does not have an external dynamic effect, there is nothing to choose between the weak and the strong readings of a quantifier.

Proposition 1 *If Q is a quantifier satisfying extension and conservativity and π_1 is a test, then the programs $Q^w x(\pi_1, \pi_2)$ and $Q^s x(\pi_1, \pi_2)$ are equivalent.*

Proof: Omitted. ■

It is not difficult to show (in fact, it follows immediately from the proof of proposition 1, which is given in the full paper) that the strong readings of quantifiers do not depend on their conservativity at all. Thus, we will get the right results for non-conservative quantifiers provided they satisfy *extension* and provided their first argument is a test. It turns out that we can handle examples like *Only men are chauvinists*, because in this case the first argument is a test and *only* does satisfy extension. The recipe is simply to rely on the strong reading of the quantifier *only*.

The internal dynamic effect of a quantifier comes into play when its first argument is not a test. Typically, this is the case if the first argument contains a definite or indefinite which is not screened off by a test. The traditional ‘donkey’ examples such as (2), repeated here as (21), are cases in point (see [7]).

$$(21) \quad \text{Every girl}^1 \text{ who has a boyfriend}^2 \text{ teases him}_2.$$

The DAL translation for the strong reading of example (21) is repeated here as (22).

$$(22) \quad Q^s_{\forall} v_1 (Gv_1; \eta v_2 : Bv_2; Hv_1v_2, T v_1v_2).$$

Here Q^s_{\forall} denotes the generalized universal quantifier, i.e. the relation of inclusion, in its strong reading. Establishing the meaning of examples like (21) by direct reasoning about the operational semantics is awkward, so we will guide the reader through the thicket once more.

According to the semantic clause for quantifier programs, on input state A this program gives $\{A\}$ iff the sets (23) and (24) are in the inclusion relation.

$$(23) \quad \{d \in U \mid [(Gv_1; \eta v_2 : Bv_2; Hv_1v_2)](A[v_1 := d]) \neq \emptyset\}.$$

$$(24) \quad \{d \in U \mid [(Gv_1; \eta v_2 : Bv_2; Hv_1v_2) \Rightarrow T v_1v_2](A[v_1 := d]) \neq \emptyset\}.$$

First we reduce (23). Applying the semantic clauses for ; and η assignment and for atomic tests makes clear that (23) describes the same set as (25).

$$(25) \quad \{d \in U \mid \text{there is a } d' \in U \text{ such that } d \in I(G), d' \in I(B), \\ \langle d, d' \rangle \in I(H)\}.$$

Similarly, application of the semantic clauses for ;, for η assignment, for \Rightarrow and for atomic tests makes clear that (24) describes the same set as (26).

$$(26) \quad \{d \in U \mid \text{for all } d' \in U \text{ such that } d \in I(G), d' \in I(B), \langle d, d' \rangle \in I(H), \\ \text{it holds that } \langle d, d' \rangle \in I(T)\}.$$

Paraphrasing this, we see that the semantic clause for quantified programs entails that translation (22) of (21) is true iff the set of girls who have a boyfriend is included in the set of girls who tease all their boyfriends. Thus we see that the strong reading for (2) is equivalent to the reading we got for (1).

We invite the reader to look more closely at these examples to check our claim that the weak readings do depend on conservativity plus extension while the strong readings depend only on extension.

Our story about the dynamics of quantification does not work for the quantifier relation interpreting *only*, in those cases where there is an internal dynamic effect. *Only P Q* is true iff the set of non-Ps is included in the set of non-Qs, or equivalently, iff the set of Qs is included in the set of Ps. Because *only* is not conservative, (27) does not mean the same as (28).

$$(27) \quad \textit{Only girls}^1 \textit{ who tease a boyfriend}^2 \textit{ lose him}_2.$$

$$(28) \quad \textit{Only girls}^1 \textit{ who tease a boyfriend}^2 \textit{ tease a boyfriend and lose him}_2.$$

Neither does it mean the same as (29), although this paraphrase comes a bit closer.

$$(29) \quad \textit{Only girls}^1 \textit{ who tease a boyfriend}^2 \textit{ lose all the boyfriends that they}_1 \textit{ tease.}$$

Rather, (27) means something like (30).

$$(30) \quad \textit{Only girls}^1 \textit{ who tease a boyfriend}^2 \textit{ lose their boyfriend}_2.$$

This suggests that in this case the pronoun is a pronoun of laziness rather than a genuine donkey pronoun. But pronouns in the context of non-conservative quantifiers pose difficult problems, as is also borne out by the following example.

$$(31) \quad \textit{Only girls}^1 \textit{ who have a boyfriend}^2 \textit{ bring him}_2 \textit{ to the party.}$$

On its most salient reading, (31) is true as a matter of course, because it can be paraphrased as (32).

$$(32) \quad \textit{No girls}^1 \textit{ who don't have a boyfriend}^2 \textit{ will bring him}_2 \textit{ to the party.}$$

Interestingly, the paraphrase (32) poses a difficulty for our framework too. The problem is that the variable for *a boyfriend*² is screened off by the negation operator, so that it is not available anymore at the level where *him₂* looks for an antecedent. To deal with (32) one would again need externally dynamic negation. We leave the problem of non-conservative quantifiers that are internally dynamic with the remark that it merits further investigation.

Example (3), repeated here as (33), gives rise to the so-called *proportion problem* in traditional discourse representation theory (see [12] for the basics of discourse representation theory, [13] for an up-to-date formulation, and [10] for details on the proportion problem).

- (33) *Most girls¹ who have a boyfriend² tease him₂.*

The proportion problem may arise in connection with (33) in case there are girls who are naughty enough to have a large number of boyfriends and to tease them all. Accounts which give rise to the proportion problem would handle (33) as a case of quantification over girl-boyfriend pairs. To see how the present proposal fares, consider the translation of (33) in *DAL*, under its weak reading, repeated here as (34).

- (34) $Q_M^w v_1((\text{girl } v_1; \eta v_2 : \text{boyfriend } v_2; \text{have } (v_1, v_2)), \text{tease } (v_1, v_2)).$

This is true in state *A* if there are states *B, C* such that the sets given in (35) and (36) are in the Q_M -relation.

$$(35) \quad \{d \in U \mid B \in [\text{girl } v_1; \eta v_2 : \text{boyfr } v_2; \text{have } (v_1, v_2)](A[v_1 := d])\}$$

$$(36) \quad \{d \in U \mid B \in [\text{girl } v_1; \eta v_2 : \text{boyfr } v_2; \text{have } (v_1, v_2); \\ \text{tease } (v_1, v_2)](A[v_1 := d])\}$$

The set given by (35) is the set of all girls who have a boyfriend, while the set given by (36) is the set of all girls who have a boyfriend and tease him. The quantification is over girls, as it should be, and not over girl-boyfriend pairs, as in the accounts which give rise to the proportion problem. In other words, this spells out a reading that does not suffer from the proportion problem. This is not the only possible reading; the strong reading can be had by replacing Q_M^w in the translation by Q_M^s and applying the semantic clause for strong readings of quantifiers.

To show that the treatment of quantification proposed here is different from the treatment proposed in [8], it is enough to show that the approach advocated there suffers from the proportion problem. One of the examples discussed in [8] (p.81) is, essentially, (37), in the reading which can be paraphrased as (38).

- (37) *If a girl¹ has a boyfriend² she usually teases him₂.*

- (38) *In most cases in which a girl¹ has a boyfriend² she teases him₂.*

To treat this example, Groenendijk and Stokhof reconstruct Lewis' adverb of quantification approach in dynamic predicate logic, by reading the quantifier as a relation

between sets of states. Dynamic implication, \Rightarrow , would then correspond to \rightarrow_v , to be interpreted as: for *all* output states A of the antecedent, applying the consequent to A will produce an output. Similarly, the examples with *usually* or *in most cases* are analyzed with \rightarrow_M , to be interpreted as: for *most* output states A of the antecedent, applying the consequent to A will produce an output. To see that this account does give rise to the proportion problem, observe that output states of the antecedent *a girl has a boyfriend* where Mary has John as a boyfriend and where the same Mary has Fred as a boyfriend will have to count as different states. The example sentences may have a reading where these should indeed count as different, but the point is that quantification over states makes it impossible to express readings where they should count as the same, as in the reading of (37) which is equivalent to the most salient reading of (33). For such cases, quantification over states does simply lead to incorrect results.

Our approach differs from the approach in [8] precisely in that quantification is always over individuals and never over states. Our reconstruction of (38) would be as follows. Because the quantification is over cases or occasions, we have to add an occasion parameter to the predicates used for translating verb phrases, so $have(x, y, o)$ and $tease(x, y, o)$ for x has y at occasion o and x teases y at occasion o , respectively. The *DAL* translation of (38) now becomes:

$$(39) \quad Q_M^w o_1(\eta v_1(girl\ v_1; \eta v_2 : boyfriend\ v_2; have\ (v_1, v_2, o_1)), tease\ (v_1, v_2, o_1)).$$

To make this true, on our account, the set of occasions at which a girl has a boyfriend and the set of occasions at which a girl has a boyfriend which she teases must be in the Q_M -relation.

Of course, on our account there is still a fair amount of latitude as to how (37), (38) and (40) are interpreted.

$$(40) \quad If\ a\ girl\ has\ several\ boyfriends,\ she\ usually\ teases\ them.$$

But the latitude resides where it belongs, for a margin of uncertainty remains as long as it is unclear what counts as an *occasion*, and it disappears as soon as this is resolved. As soon as we have a model where occasions are fully individuated, our quantificational analysis gives the right meanings. The discussion summarised in [10] of the meanings of ‘donkey’ examples with *usually* should therefore in our view be re-interpreted as a discussion of factors that might be involved in the individuation of occasions.

6 A Calculus for Dynamic Interpretation

Discussions about the correctness or incorrectness of proposals for dynamic interpretation of language have been hampered in the past by the difficulty of seeing through the ramifications of the dynamic semantic clauses in non-trivial cases. (Incidentally,

this is why we cannot be sure if our proposal is a correction of the proposal for dynamic treatment of generalized quantifiers in [13].) To remedy this, we supplement the dynamic semantics of our representation language with a calculus in the style of Hoare (see [1] for an overview of this approach). The axioms and proof rules we propose form a deduction system allowing us to prove statements about *DAL* programs.

Our deductive system for dynamic logic is a hybrid calculus, with statements characterizing variable states, plus two kinds of correctness statements, which we call *universal* and *existential* correctness statements. Thus, the system has three kinds of statements: (i) formulae of a language of first order predicate logic with the same sets of variables and predicate letters as the *DAL* language under consideration, and extended with the same set of generalized quantifiers (call this language *L*), (ii) triples of the form $\{\varphi\} \pi \{\psi\}$, where φ, ψ are *L*-formulae, and π is a *DAL*-program, and (iii) triples of the form $\langle\varphi\rangle \pi \langle\psi\rangle$, where again φ, ψ are *L*-formulae, and π is a *DAL*-program.

The statements of the form φ are used for making assertions about variable states *A* for *L* with respect to models \mathcal{M} for *L*. Because the *DAL* language and the assertion language *L* have the same set of variables, variable states for the *DAL* language are variable states for *L*. The relation $\mathcal{M} \models \varphi[A]$, for state *A* verifies φ in \mathcal{M} , is defined in the standard way.

The statements of the form $\{\varphi\} \pi \{\psi\}$ are *universal* correctness statements. In the terminology of Hoare's logic, they express partial correctness. The statement $\{\varphi\} \pi \{\psi\}$ expresses that all variable states *A* (for an arbitrary model \mathcal{M}) such that $\mathcal{M} \models \varphi[A]$ have the property that if some variable state *B* is an output state of π for input state *A*, then $\mathcal{M} \models \psi[B]$.

The statements of the form $\langle\varphi\rangle \pi \langle\psi\rangle$ are *existential* correctness statements. In terms of Hoare's logic, they represent the bits one has to add to partial correctness statements to ensure total correctness. The statement $\langle\varphi\rangle \pi \langle\psi\rangle$ expresses that for all input variable states *A* (for an arbitrary model \mathcal{M}) such that $\mathcal{M} \models \varphi[A]$ there is some variable state *B* satisfying $\mathcal{M} \models \psi[B]$ in the set of output states of π .

Because our intuitions about static meaning seem to be much better developed than our intuitions about dynamic meaning, we can, for a large class of natural language sentences, check whether the intuitive meaning of a sentence *S* corresponds to the meaning of its *DAL* translation π in the following precise sense. Does the intuitive meaning of *S* precisely describe the set of states for which π terminates successfully? In terms of Hoare's logic, we can describe this set of states by the weakest existential precondition of π with respect to \top . What we are looking for is the weakest φ for which the statement $\langle\varphi\rangle \pi \langle\top\rangle$ is still true. The φ we are looking for has to satisfy the additional condition that it does not contain free occurrences of the assignment variables of π (the variables for which π may have changed the values between input and output state; the full paper makes this precise); φ gives the *static meaning* of the program π .

Our calculus allows us to find weakest preconditions, as follows. Start with the conclusion $\langle ? \rangle \pi \langle \top \rangle$, and apply the rules of the calculus to work backwards, thus decomposing π . This will eventually produce a formula φ to fill the $?$ slot. In the full paper we prove that φ does indeed express the weakest precondition for existential correctness of π relative to \top .

It may seem that our intention to use the calculus to get from dynamic to static meaning will allow us to get by with just existential correctness statements. To see that this is not so, note that such statements do not allow us to express failure of a program for a given sets of input states. The statement $\langle \varphi \rangle \pi \langle \perp \rangle$ does *not* express failure of π on input states satisfying φ . Rather, it expresses the fact that for all inputs satisfying φ the program π is guaranteed to produce an output satisfying \perp , a statement which is absurd for all non-contradictory φ . Failure of a *DAL* program π on the set of inputs specified by φ , is readily expressed in terms of universal correctness, namely by $\{ \varphi \} \pi \{ \perp \}$.

It is clear that in order to treat negation of programs and dynamic implication between programs, both universal and existential correctness statements are needed in the calculus. Here are the axioms and rules of the deduction system for *DAL*.

Test Axioms

- $\{ \top \} \perp \{ \perp \}.$
- $\langle \perp \rangle \perp \langle \perp \rangle.$
- $\{ R(t_1 \cdots t_n) \rightarrow \varphi \} R(t_1 \cdots t_n) \{ \varphi \}.$
- $\langle R(t_1 \cdots t_n) \wedge \varphi \rangle R(t_1 \cdots t_n) \langle \varphi \rangle.$
- $\{ t_1 = t_2 \rightarrow \varphi \} t_1 = t_2 \{ \varphi \}.$
- $\langle t_1 = t_2 \wedge \varphi \rangle t_1 = t_2 \langle \varphi \rangle.$

For purposes of reasoning with the system one needs an oracle rule for the class \mathcal{K} of models that one is interested in (for natural language applications such a class will generally be given by specifying a set of meaning postulates that all members of \mathcal{K} should satisfy).

\mathcal{K} Oracle Rule

Every assertion valid in \mathcal{K} is an axiom.

The well-known consequence rule holds for universal and existential correctness.

Consequence Rules

$$\frac{\varphi \rightarrow \psi \quad \{ \psi \} \pi \{ \chi \} \quad \chi \rightarrow \xi}{\{ \varphi \} \pi \{ \xi \}} \qquad \frac{\varphi \rightarrow \psi \quad \langle \psi \rangle \pi \langle \chi \rangle \quad \chi \rightarrow \xi}{\langle \varphi \rangle \pi \langle \xi \rangle}.$$

Next, one needs to provide rules for complex programs.

Rules of Composition

$$\frac{\{ \varphi \} \pi_1 \{ \psi \} \quad \{ \psi \} \pi_2 \{ \chi \}}{\{ \varphi \} (\pi_1; \pi_2) \{ \chi \}}. \qquad \frac{\langle \varphi \rangle \pi_1 \langle \psi \rangle \quad \langle \psi \rangle \pi_2 \langle \chi \rangle}{\langle \varphi \rangle (\pi_1; \pi_2) \langle \chi \rangle}.$$

Rules of Negation

$$\frac{\{\varphi\} \pi \{\perp\}}{\langle \varphi \wedge \psi \rangle \neg \pi \langle \psi \rangle}.$$

$$\frac{\langle \varphi \rangle \pi \langle \top \rangle}{\{\varphi \vee \psi\} \neg \pi \{\psi\}}.$$

Rules of Implication

$$\frac{\{\varphi\} \pi_1 \{\psi\} \quad \langle \psi \rangle \pi_2 \langle \top \rangle}{\langle \varphi \wedge \chi \rangle (\pi_1 \Rightarrow \pi_2) \langle \chi \rangle}.$$

$$\frac{\langle \varphi \rangle \pi_1 \langle \psi \rangle \quad \{\psi\} \pi_2 \{\perp\}}{\{\varphi \vee \chi\} (\pi_1 \Rightarrow \pi_2) \{\chi\}}.$$

Rules of η Assignment

$$\frac{\{\varphi\} \pi \{\psi\}}{\{\forall x \varphi\} \eta x : \pi \{\psi\}}.$$

$$\frac{\langle \varphi \rangle \pi \langle \psi \rangle}{\langle \exists x \varphi \rangle \eta x : \pi \langle \psi \rangle}.$$

In the rules of ι assignment it is convenient to use $\exists!x\varphi$ as an abbreviation for $\exists x \forall y ([y/x]\varphi \leftrightarrow y = x)$, where y is a variable which is free for x in φ .

Rules of ι Assignment

$$\frac{\langle \varphi \rangle \pi \langle \psi \rangle \quad \{\neg\varphi\} \pi \{\perp\}}{\langle \exists!x \varphi \rangle \iota x : \pi \langle \psi \rangle}.$$

$$\frac{\langle \varphi \rangle \pi \langle \top \rangle \quad \{\neg\varphi\} \pi \{\perp\} \quad \{\psi\} \pi \{\chi\}}{\{\forall x (\forall y ([y/x]\varphi \leftrightarrow y = x) \rightarrow \psi)\} \iota x : \pi \{\chi\}}.$$

Note that in the static description logic the η and ι operators from the dynamic assignment logic are contextually eliminated.

Rules of Quantification: Weak Readings

$$\frac{\langle \varphi \rangle \pi_1 \langle \top \rangle \quad \{\neg\varphi\} \pi_1 \{\perp\} \quad \langle \psi \rangle \pi_1; \pi_2 \langle \top \rangle \quad \{\neg\psi\} \pi_1; \pi_2 \{\perp\}}{\langle Qx(\varphi, \psi) \wedge \chi \rangle Q^w x(\pi_1, \pi_2) \langle \chi \rangle}.$$

$$\frac{\{\neg\varphi\} \pi_1 \{\perp\} \quad \langle \varphi \rangle \pi_1 \langle \top \rangle \quad \{\neg\psi\} \pi_1; \pi_2 \{\perp\} \quad \langle \psi \rangle \pi_1; \pi_2 \langle \top \rangle}{\langle Qx(\varphi, \psi) \rightarrow \chi \rangle Q^w x(\pi_1, \pi_2) \{\chi\}}.$$

Rules of Quantification: Strong Readings

$$\frac{\langle \varphi \rangle \pi_1 \langle \top \rangle \quad \{\neg\varphi\} \pi_1 \{\perp\} \quad \langle \psi \rangle \pi_1 \Rightarrow \pi_2 \langle \top \rangle \quad \{\neg\psi\} \pi_1 \Rightarrow \pi_2 \{\perp\}}{\langle Qx(\varphi, \psi) \wedge \chi \rangle Q^s x(\pi_1, \pi_2) \langle \chi \rangle}.$$

$$\frac{\{\neg\varphi\} \pi_1 \{\perp\} \quad \langle \varphi \rangle \pi_1 \langle \top \rangle \quad \{\neg\psi\} \pi_1 \Rightarrow \pi_2 \{\perp\} \quad \langle \psi \rangle \pi_1 \Rightarrow \pi_2 \langle \top \rangle}{\langle Qx(\varphi, \psi) \rightarrow \chi \rangle Q^s x(\pi_1, \pi_2) \{\chi\}}.$$

If we know Q to be \downarrow MON, \uparrow MON, MON \downarrow or MON \uparrow , then in the rules of quantification the first, second, third or fourth premiss, respectively, can be omitted.

7 Soundness of the Calculus

The above axioms and rules engender a notion of \mathcal{K} -derivation, as follows. A \mathcal{K} -derivation is a finite sequence of correctness formulae F_1, \dots, F_n such that for every

i , $1 \leq i \leq n$, F_i is a test axiom or a an axiom according to the \mathcal{K} oracle rule, or F_i is the conclusion of an instance of one of the inference rules while the premisses of that rule occur among F_1, \dots, F_{i-1} . A \mathcal{K} -derivation F_1, \dots, F_n is said to be a \mathcal{K} -derivation of F_n . F is called \mathcal{K} -derivable in the proof system if there is a \mathcal{K} -derivation of F . Notation: $\mathcal{K} \vdash F$. In the next section, the soundness of this proof system relative to \mathcal{K} will be proved.

An inference from premisses F_1, \dots, F_n to conclusion F is called \mathcal{K} -valid if \mathcal{K} validity of the premisses implies \mathcal{K} validity of the conclusion. We will now show that the proof system given in the previous section is correct relative to \mathcal{K} , i.e. for every correctness statement F :

$$\mathcal{K} \vdash F \text{ implies } \mathcal{K} \models F.$$

To prove this, we first show that the axioms are \mathcal{K} -valid, and next that the inference rules preserve \mathcal{K} -validity. The soundness result then follows by induction on the length of derivations.

Theorem 2 (Soundness) *If $\mathcal{K} \vdash F$ then $\mathcal{K} \models F$.*

Proof: Omitted. ■

8 Completeness of the Calculus

Suppose we establish $\mathcal{K} \vdash \langle \varphi \rangle \pi_1 \Rightarrow \pi_2 \langle \varphi \rangle$ for some φ with $\mathcal{K} \models \varphi$. Then it follows by the soundness of the calculus that $\mathcal{K} \models \langle \varphi \rangle \pi_1 \Rightarrow \pi_2 \langle \varphi \rangle$, and by the \mathcal{K} validity of φ that $\mathcal{M} \models \pi_1[A]$ implies $\mathcal{M} \models \pi_2[A]$, for all $\mathcal{M} \in \mathcal{K}$ and all states A for \mathcal{M} defined for φ . In other words, the proof system can be considered as an axiomatisation of the notion of dynamic consequence, relative to classes of models \mathcal{K} . To see that the proof system is powerful enough we also have to establish its completeness relative to \mathcal{K} . For this we need the concepts of the weakest universal precondition and the weakest existential precondition of a *DAL* program and a formula of the assertion language.

The weakest universal precondition of a *DAL* program π and an *L* formula ψ is the *L* formula φ for which the following holds: $\mathcal{M} \models \varphi[A]$ iff for all $B \in [\pi]_{\mathcal{M}}(A)$, it holds that $\mathcal{M} \models \psi[B]$ (for arbitrary \mathcal{M}). The weakest existential precondition of a *DAL* program π and an *L* formula ψ is the *L* formula φ for which the following holds: $\mathcal{M} \models \varphi[A]$ iff there is a $B \in [\pi]_{\mathcal{M}}(A)$ with $\mathcal{M} \models \psi[B]$ (for arbitrary \mathcal{M}).

Note that it follows immediately from these definitions that the weakest universal precondition of a program π and an *L* formula ψ equals the negation of the weakest existential precondition of π and $\neg\psi$. This is because for all $B \in [\pi]_{\mathcal{M}}(A)$ it holds that $\mathcal{M} \models \psi[B]$ is equivalent to: there is no $B \in [\pi]_{\mathcal{M}}(A)$ for which $\mathcal{M} \models \neg\psi[B]$. This equivalence means that either of the two notions would suffice for what follows. For practical purposes, however, it is convenient to use both weakest universal and weakest existential preconditions, so we will define functions for both.

It is not obvious at first sight that the weakest universal and existential precondition of a *DAL* program and an *L* formula always exist (as formulas of *L*), so we have to show that this is indeed the case. In the full paper, we inductively define functions $\text{wup}(\pi, \psi)$ and $\text{wep}(\pi, \psi)$ of which we then show that they express the weakest universal precondition, respectively the weakest existential precondition of π and ψ . The proof of this uses a case by case check; the cases of atomic programs are checked directly, and induction is used to check the cases of complex programs. Thus we arrive at the following lemma.

Lemma 3 (wep/wup adequacy) *For all $\mathcal{M} \in \mathcal{K}$, all states A for \mathcal{M} , all $\psi \in L$, and all $\pi \in DAL$:*

$\mathcal{M} \models \text{wup}(\pi, \psi)[A]$ iff it holds for all $B \in [\pi]_{\mathcal{M}}(A)$ that $\mathcal{M} \models \psi[B]$.

$\mathcal{M} \models \text{wep}(\pi, \psi)[A]$ iff there is a $B \in [\pi]_{\mathcal{M}}(A)$ with $\mathcal{M} \models \psi[B]$.

Proof: Omitted. ■

Next, in the full paper, we prove the following result.

Lemma 4 (wep/wup derivability) *For all $\pi \in DAL$ and for all $\psi \in L$,*

$\mathcal{K} \vdash \langle \text{wep}(\pi, \psi) \rangle \pi \langle \psi \rangle$ and $\mathcal{K} \vdash \{\text{wup}(\pi, \psi)\} \pi \{\psi\}$.

Proof: Omitted. ■

The rest of the proof of the completeness result is now very easy. We want to show that $\mathcal{K} \models F$ implies $\mathcal{K} \vdash F$. In case F equals φ for some $\varphi \in L$, $\mathcal{K} \models \varphi$ implies $\mathcal{K} \vdash \varphi$ by the \mathcal{K} oracle rule. For the case where F equals $\langle \varphi \rangle \pi \langle \psi \rangle$ the reasoning is as follows. Assume (41).

$$(41) \quad \mathcal{K} \models \langle \varphi \rangle \pi \langle \psi \rangle.$$

By the **wep** adequacy lemma it follows from (41) that (42).

$$(42) \quad \mathcal{K} \models \varphi \rightarrow \text{wep}(\pi, \psi).$$

From this, by the \mathcal{K} oracle rule, (43).

$$(43) \quad \mathcal{K} \vdash \varphi \rightarrow \text{wep}(\pi, \psi).$$

From the **wep/wup** derivability lemma we have (44).

$$(44) \quad \mathcal{K} \vdash \langle \text{wep}(\pi, \psi) \rangle \pi \langle \psi \rangle.$$

From (43) and (44) by an application of the existential consequence rule, (45).

$$(45) \quad \mathcal{K} \vdash \langle \varphi \rangle \pi \langle \psi \rangle.$$

By similar reasoning we derive from (46) that (47).

$$(46) \quad \mathcal{K} \models \{\varphi\} \pi \{\psi\}.$$

$$(47) \quad \mathcal{K} \vdash \{\varphi\} \pi \{\psi\}.$$

This completes the proof of the final result:

Theorem 5 (Completeness) *If $\mathcal{K} \models F$ then $\mathcal{K} \vdash F$.*

9 Use of the Calculus

The calculus allows us to derive the static meanings of *DAL* programs. As an example, we calculate the static meaning of the conditional donkey example in (5). We want to find the weakest precondition φ such that (48).

$$(48) \quad \langle \varphi \rangle (\eta x : Gx; \eta y : By; Hxy) \Rightarrow Txy \langle \top \rangle.$$

According to the rule for implication, we are done if we can find the weakest ψ such that $\langle \psi \rangle Txy \langle \top \rangle$ and then calculate the weakest φ such that (49).

$$(49) \quad \{\varphi\} \eta x : Gx; \eta y : By; Hxy \{\psi\}.$$

It follows from one of the test axioms plus the existential consequence rule that ψ equals Txy . Thus, we are done if we can find the weakest φ such that (50).

$$(50) \quad \{\varphi\} \eta x : Gx; \eta y : By; Hxy \{Txy\}.$$

Two applications of the universal rule for composition and two applications of the universal rule for η assignment give the end result.

$$(51) \quad \{\forall x(Gx \rightarrow \forall y(By \rightarrow (Hxy \rightarrow Txy)))\} \eta x : Gx; \eta y : By; Hxy \{Txy\}.$$

As we have not used the consequence rules for presupposition strengthening, we have indeed calculated the weakest precondition. From the fact that the procedure calculates the weakest precondition under which (5) can succeed it follows that $\forall x(Gx \rightarrow \forall y(By \rightarrow (Hxy \rightarrow Txy)))$ is the static meaning of this program.

Next, we derive the static meaning of (3) (under its weak reading), the translation of which is repeated again for convenience.

$$(52) \quad Q_M^w v_1(Gv_1; \eta v_2 : Bv_2; Hv_1v_2, Tv_1v_2).$$

We want to find the weakest precondition φ for which (53).

$$(53) \quad \langle \varphi \rangle Q_M^w v_1(Gv_1; \eta v_2 : Bv_2; Hv_1v_2, Tv_1v_2) \langle \top \rangle.$$

In view of the first quantifier rule, we know that φ equals $Q_M^w v_1(\psi, \chi)$, where ψ and χ are given by (54), (55), (56), and (57).

$$(54) \quad \langle \psi \rangle Gv_1; \eta v_2 : Bv_2; Hv_1v_2 \langle \top \rangle.$$

$$(55) \quad \{\neg \psi\} Gv_1; \eta v_2 : Bv_2; Hv_1v_2 \{\perp\}.$$

$$(56) \quad \langle \chi \rangle Gv_1; \eta v_2 : Bv_2; Hv_1v_2; Tv_1v_2 \langle \top \rangle$$

$$(57) \quad \{\neg \chi\} Gv_1; \eta v_2 : Bv_2; Hv_1v_2; Tv_1v_2 \{\perp\}.$$

Note that (55) and (57) are only there to guarantee that ψ and χ are *weakest* existential preconditions of the given programs with respect to \top . The quantifier

rule says that the rule in this case would still hold if we omit (57) (by virtue of the fact that Q_M is MON^\uparrow), but of course then there is no guarantee anymore that $Q_M v_1(\psi, \chi)$ expresses the *weakest* existential precondition of (52) with respect to \top . However, if we take care not to use the consequence rules we calculate weakest preconditions anyway, so then we can omit (55) and (57) and still arrive at the weakest existential precondition of (52) with respect to \top .

Application of the rules for η assignment and composition give the following value for ψ :

$$(58) \quad Gv_1 \wedge \exists v_2(Bv_2 \wedge Hv_1v_2).$$

$$(59) \quad Gv_1 \wedge \exists v_2(Bv_2 \wedge Hv_1v_2 \wedge T v_1v_2).$$

Thus, we arrive at the following static meaning for (52):

$$(60) \quad Q_M v_1(Gv_1 \wedge \exists v_2(Bv_2 \wedge Hv_1v_2), Gv_1 \wedge \exists v_2(Bv_2 \wedge Hv_1v_2 \wedge T v_1v_2)).$$

One final remark on the fact that our calculus is geared to finding preconditions, given a program and an output condition. We hope to have demonstrated the usefulness of this in the above examples. However, one might also be interested in calculating postconditions (which of course is possible with the calculus). It is straightforward to check the following. For a program π which is a test, calculating the weakest existential precondition of π with respect to \top is equivalent to calculating the strongest universal postcondition of π with respect to \top . For programs which are not tests, this equivalence breaks down, but in such cases there is a different reason for being interested in postconditions. The strongest universal postcondition with respect to \top of a program π which is not a test will have free occurrences of precisely those variables that are available for external dynamic binding in programs π' following π .

10 Conclusion

In this paper we have demonstrated the potential of the use of tools from programming language semantics for the semantics of natural language. While η and ι assignment can in principle be decomposed in random assignment with subsequent testing, we have two reasons for preferring the treatment we gave. In the first place, extending the treatment of definite descriptions with an account of their presuppositions (which is an obvious next move in the framework we have presented) would make a decomposition of ι assignment impossible or at least very impractical. Secondly, and more importantly, ι and η assignments are to be preferred over a decomposition in terms of random assignment plus subsequent testing because the introduction of an individual by a definite or an indefinite noun phrase gets an exact counterpart in the dynamic translation language. In other words, the real merit of ι and η assignments is that they allow faithfulness to linguistic form.

Instead of the universal and existential Hoare-style correctness statements that we employed we might have used the toolkit of dynamic logic (cf. [9]). Replacing $\{\varphi\} \pi \{\psi\}$ by $\varphi \rightarrow [\pi]\psi$ and $\langle\varphi\rangle \pi \langle\psi\rangle$ by $\varphi \rightarrow \langle\pi\rangle\psi$ is all there is to such a change. Still, we prefer our notation, for several reasons. In the first place, it is less cluttered than the dynamic logic notation. Next, the full expressive power of dynamic logic is not needed for our purposes, so it seems wiser to choose a tool that fits the requirements more precisely. Finally, the static $\{\varphi\}$ and $\langle\varphi\rangle$ statements can be used as comments to annotate *DAL* programs, thus providing proof outlines for deriving the static meanings of programs.

Acknowledgement

This paper has benefitted from helpful comments by Krzysztof Apt, Reinhard Muskens, Martin Stokhof, Johan van Benthem and Albert Visser.

References

- [1] K.R. Apt, ‘Ten Years of Hoare’s Logic: A Survey—Part I’, *ACM Transactions on Programming Languages and Systems*, Vol. 3, No. 4, October 1981, 431–483.
- [2] J. Barwise, ‘Noun Phrases, Generalized Quantifiers and Anaphora’, in P. Gärdenfors (ed.), *Generalized Quantifiers / Linguistic and Logical Approaches*, 1–29, Reidel, Dordrecht, 1987.
- [3] J. van Benthem, ‘General Dynamics’, ITLI report, Amsterdam, 1990 (to appear in *Theoretical Linguistics*).
- [4] Gennaro Chierchia, ‘Anaphora and Dynamic Logic’, in M. Stokhof, J. Groenendijk & D. Beaver (eds.), *Quantification and Anaphora I*, Edinburgh 1991 (DYANA deliverable R2.2.A), 37–78.
- [5] G. Evans, ‘Pronouns’, in: *Linguistic Inquiry*, 11, 337–362.
- [6] J. van Eijck & F.J. de Vries, ‘Dynamic Interpretation and Hoare Deduction’, CWI Technical Report CS-R9115, Amsterdam 1991 (submitted for publication to the *Journal of Logic, Language and Information*).
- [7] P.T. Geach, *Reference and Generality / An Examination of Some Medieval and Modern Theories*, Cornell University Press, Ithaca & London, 1962 (Third revised edition: 1980).
- [8] J. Groenendijk & M. Stokhof, ‘Dynamic Predicate Logic’, *Linguistics and Philosophy*, 14, 1991, 39–100.

- [9] D. Harel, 'Dynamic Logic', in D. Gabbay & F. Guentner, *Handbook of Philosophical Logic, Vol. II*, Reidel, Dordrecht, 1984, 497–604.
- [10] I. Heim, 'E-Type Pronouns and Donkey Anaphora', *Linguistics and Philosophy*, 13, 1990, 137–177.
- [11] C.A.R. Hoare, 'An Axiomatic Basis for Computer Programming', *Communications of the ACM*, Vol. 12, no. 10, 1969, 567–580, 583.
- [12] H. Kamp, 'A Theory of Truth and Semantic Representation', in Groenendijk e.a. (eds.), *Formal Methods in the Study of Language*, Mathematisch Centrum, Amsterdam, 1981.
- [13] H. Kamp & U. Reyle, *From Discourse to Logic*, Manuscript, Institute for Computational Linguistics, University of Stuttgart, 1990.
- [14] C. Roberts, 'Modal Subordination and Pronominal Anaphora in Discourse', *Linguistics and Philosophy*, 12, 1989, 683–721.
- [15] B. Russell, 'On Denoting', *Mind*, 14, 1905, 479–493.
- [16] D. Westerståhl, 'Quantifiers in Formal and Natural Languages', in Gabbay & Guentner (eds.), *Handbook of Philosophical Logic*, Vol. IV, Reidel, Dordrecht, 1989, 1–131.

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Exceptional Constructions*

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Introduction

Universally quantified statements exert an enormous attraction on language users. Their emotional force unfortunately clashes with the rather strict requirements on their truth. Small wonder then that there is a class of expressions used to reduce their force. These expressions typically diminish the domain quantified over. The exceptional constructions studied in this paper are prime examples. I will concentrate on the two types illustrated in (1), the highly grammaticalized English *but*-phrase in (1a), and the 'free exceptional' with *except for* in (1b).

- (1) a. Every student but John attended the meeting.
 b. Except for John, every student attended the meeting.

This paper has two concerns, a narrowly descriptive one and a broader and potentially more interesting theoretical one. Although exceptional constructions and some of their core properties have been known since the times of the medieval semanticists, their proper analysis in a formal theory has proven very elusive.¹ The analysis proposed in this paper will hopefully at least be more adequate than earlier attempts.

*Some of the material in this paper was presented at the Conference on Cross-Linguistic Quantification at the LSA Summer Institute in Tucson, Arizona, July 22, 1989, at WCCFL X in Tempe, Arizona, March 1991, and at "Semantics and Linguistic Theory I", Cornell University, Ithaca, New York, April 1991. For comments and suggestions, I would like to thank especially Angelika Kratzer, Barbara Partee, Roger Higgins, Hotze Rullmann, Ginny Brennan, Paul Portner, Ed Keenan, Joe Moore, and Sue Tunstall. Research on this paper has been partially supported by the National Science Foundation under Grant No. BNS 87-19999 (Principal Investigators: Emmon Bach, Angelika Kratzer, and Barbara Partee). No one but myself should be blamed for the remaining mistakes and errors.

¹Modern references include: Keenan & Stavi (1986), Hoeksema (1987, 1990), Landman & Moerdijk (1979), Reinhart (1989).

The broader concern of this paper, however, has to do with the notion of degrees of grammaticalization and whether it can be captured in a compositional theory of the interaction between syntax and semantics. If the difference between the lexical items *but* and *except for* is only reconstructable by associating different kinds of lexical stipulations with them, this would be a disappointing result. A reduction to more general principles, on the other hand, would be a success. I will show that assuming something like Chierchia's three-layers hypothesis (1984), it can be derived that the free type of exceptive is less strong than the NP-internal type.

In Section 1 of this paper, I propose a semantic analysis of English *but*-phrases as in (2).

- (2) a. Every student but John attended the meeting.
- b. No student but John attended the meeting.

There is a problem of compositionality here: we would like to be able to give *but* a unified meaning that is applicable to both the positive determiner *every* and the negative one *no*. I show that it is indeed possible to give such a unified semantics, which turns out to have the added advantage of automatically explaining the co-occurrence restrictions of *but*-phrases. An interesting side-effect of the solution is that a previously unknown formal property is singled out that *every* and *no* share to the exclusion of all other basic determiners.

In Section 2, ways of connecting the semantics to the syntax are considered. The semantics of Section 1 puts certain constraints on possible syntactic analyses. I will argue for an NP-internal syntax of *but*-phrases and discuss two possible constituencies which merely correspond to different 'curryings' of the semantics.

Section 3 then is devoted to the analysis of free exceptives, especially those formed with *except for* as in (3).

- (3) Except for the usual dissenters, most members didn't object.

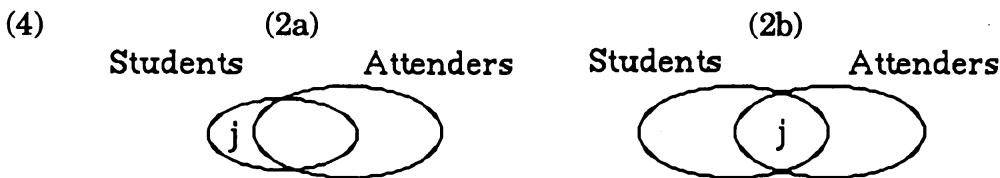
There are at least two intriguing problems raised by this type of exceptive. How are free roaming exceptives associated with their target quantifier? I will side with Reinhart (1989) who argues that quantifier raising (QR) brings about the rendez-vous of free exceptive and target quantifier. The compositionality problem remains: how do exceptive and target combine after the association is established? I will suggest that the adjunct exceptive gets inside the target by binding a context set variable. The lower degree of grammaticalization of free exceptives will be traced back to restrictions on the possible logical type of such free variables.

1. A Semantics for 'But'-Phrases

1.1 What Do 'But'-Phrases Mean?

Considering the paradigm sentences with *but* in (2), repeated here, their truth-conditions are intuitively rather obvious. In (2a), John is the only student who did not attend the meeting. In (2b), John is the only student who did attend the meeting. The sentences, if true, correspond to the diagrams in (4).

- (2) a. Every student but John attended the meeting.
 b. No student but John attended the meeting.



In trying to derive the truth-conditions of *but*-sentences compositionally, we would like the determiners *every* and *no* to have their usual denotation creating the generalized quantifiers given in (5).²

- (5) $\llbracket \text{every} \rrbracket(\llbracket \text{student} \rrbracket) = \{P \subseteq E \mid \bar{P} \cap \llbracket \text{student} \rrbracket = \emptyset\}$
 $\llbracket \text{no} \rrbracket(\llbracket \text{student} \rrbracket) = \{P \subseteq E \mid P \cap \llbracket \text{student} \rrbracket = \emptyset\}$

We need to find a denotation $\llbracket \text{but} \rrbracket$ that together with the determiner meanings in (5) derives the meanings given in (6) for the whole NP.³

- (6) $\llbracket \text{every student but John} \rrbracket = \{P \subseteq E \mid \bar{P} \cap \llbracket \text{student} \rrbracket = \{\llbracket \text{John} \rrbracket\}\}$
 $\llbracket \text{no student but John} \rrbracket = \{P \subseteq E \mid P \cap \llbracket \text{student} \rrbracket = \{\llbracket \text{John} \rrbracket\}\}$

²The principal references on generalized quantifiers are Barwise & Cooper (1981) and Keenan & Stavi (1986). Throughout this paper, I will employ the notational framework of Barwise & Cooper instead of Keenan's Boolean semantics or the lambda-expressions of Montague semantics. Everything here should be straightforwardly translatable into the other frameworks. $\llbracket \text{every} \rrbracket$ is defined in (5) in a way different from but equivalent to the standard formulation ($\llbracket \text{student} \rrbracket \subseteq P$); the definition given here has the advantage of making the fundamental similarity between *every* and *no* more obvious.

³The meanings in (6) are exactly those given by Keenan & Stavi (1986) in their brief mention of exceptives. They do not however attempt a compositional derivation, which is my main concern here.

The meanings in (6) are the result we want because they are equivalent to the intuitive meaning given for (1) above. What does $\llbracket \text{but} \rrbracket$ have to be for us to get the results in (6)? We especially want to have a unified meaning for *but* that can combine with both *every* and *no* without sneaking in a disjunctive stipulation. In the following sections, I will go through three successively stronger analyses that ultimately culminate in such an adequate semantics for *but*.

1.2 'But' as a Minus Sign: Domain Subtraction

The intuition which I will found my treatment of exceptives on is that they subtract entities from the domain of a quantifier. In a first approximation then, we could treat *but* as creating a noun modifier with a semantics as in (7). Some discussion of such an analysis can be found in Hoeksema (1987).

$$(7) \quad \llbracket \text{students but John} \rrbracket = \llbracket \text{students} \rrbracket - \{\llbracket \text{John} \rrbracket\}$$

Our test sentence (2a) would then be true iff everyone who is a student but who isn't John attended the meeting. While I do think that domain subtraction as in (7) is the central part of the meaning of exceptive, as a semantics for *but* it fails on two grounds.

First, it fails to capture the co-occurrence restrictions of *but*-phrases. If *but* is a mere minus sign then the resulting set will be just like any other set without any distinguishing properties. The set of students minus John is a maximally dull set as far as set theory is concerned. There would then be no reason why *some* or *most* should not combine with it to form a well-formed noun phrase. But, **some students but John* and **most students but John* are clearly ill-formed.

Secondly, analyzing *but* as a minus sign allows some inferences to go through that are plainly illicit. The reason for this is that the universal determiners *every* and *no* are left downward monotone on their first argument as defined in (8).

$$(8) \quad \textit{Left Downward Monotonicity} (\downarrow\text{mon})^4$$

$$P \in D(A) \text{ and } B \subseteq A \Rightarrow P \in D(B).$$

This property of universal determiners is what makes the inferences in (9) valid.

$$(9) \quad \begin{aligned} & \text{Every human being is mortal.} \\ & \Rightarrow \text{Every male human being is mortal.} \end{aligned}$$

⁴Barwise & Cooper (1981) use the term 'anti-persistent'.

No human being is mortal.
 \Rightarrow No male human being is mortal.

If we put the left downward monotonicity of the universal determiners together with the view that *but* is a mere minus sign we now predict the inferences in (10) to be valid without further assumptions. The reason is that the set of students minus John and Jill is of course a subset of the set of students just minus John. Hence we should be able to infer down from the latter to the former.

- (10) Every student but John attended the meeting.
 $? \Rightarrow ?$ Every student but John and Jill attended the meeting.

No student but John attended the meeting.
 $? \Rightarrow ?$ No student but John and Jill attended the meeting.

But the inferences in (10) are blatantly incorrect. The conclusions imply that Jill is a student who did or did not attend the meeting. But that is something which we cannot validly infer from the premise. A satisfactory treatment of *but* then has to make sure that the downward monotonicity of the universal determiners is blocked in some way to prevent the inferences in (10) from falsely going through.

These problems notwithstanding, I would like to maintain the initial intuition as far as possible. I will assume that the central part of the meaning of *but* is indeed set subtraction. The strategy I pursue will be to add enough further conditions to the right hand side of the implication arrow in (11) to make it an equivalence.⁵

- (11) $D A [[but]] C P = \text{True} \Rightarrow P \in D(A-C)$

Key for (11): $D = [[\text{every}]], [[\text{no}]]$
 $A = [[\text{student}]]$
 $C = \{[[\text{John}]]\}$
 $P = [[\text{attended the meeting}]]$

At this point, I will not as yet commit myself to a particular bracketing of the noun phrase. Its internal constituency, the question of where the exceptive exactly operates, is the topic of Section 2.

⁵For the semantics developed here to work, the NP after *but* has to introduce a set that can be subtracted from the set denoted by the head noun. This is arguably a healthy consequence because it appears that only NPs that can denote sets can appear after *but*; witness the ill-formedness of **all the students but each foreigner*.

1.3 The Uniqueness Condition

We have to strengthen the conditions even further. What does it mean to be the set of exception to a quantified statement? My answer is given in (12).

- (12) The set of exceptions to a quantified sentence D (A) P is the smallest set C such that D (A-C) P is true.

The exception set C has to be the smallest set such that if it is subtracted from the quantifier domain the quantification comes out true. This can be factored out into two conditions, one of which is the domain subtraction clause we already know, and the other is essentially a condition of uniqueness. The formulation in (13) contains three equivalent ways of conceiving of the uniqueness condition.

- (13) D A [[but]] C P = True

$$\begin{aligned}
 &\Leftrightarrow P \in D(A-C) \ \& \ \forall Y (P \in D(A-Y) \Rightarrow C \subseteq Y). \\
 &\Leftrightarrow P \in D(A-C) \ \& \ \forall B (B \subseteq A \ \& \ P \in D(B) \Rightarrow C \cap B = \emptyset) \\
 &\Leftrightarrow P \in D(A-C) \ \& \ \cap \{Y \mid P \in D(A-Y)\} = C
 \end{aligned}$$

$\uparrow \qquad \qquad \qquad \uparrow$
 Domain Subtraction Uniqueness Condition

Consider again the paradigm sentence (1a) and the illustration of the state of affairs described by it, repeated here in (14). (13) then says that (1a) will be true iff everyone who is a student but who isn't John attended the meeting and it is the case that all the subsets of the students that contain only attenders do not contain John (that is a paraphrase of the second formulation of uniqueness). Note that this corresponds faithfully to the picture in (14). What the uniqueness condition boils down to then is that a *but*-phrase names the set responsible for the falsehood of the modified quantification.

- (14) Students Attenders



It should be obvious that the uniqueness condition is pragmatically natural. It ensures maximal relevance of the *but*-phrase: the exceptive not only is necessary to save the quantification, it also is the most economic way of doing that. The lexical meaning of *but* then has, I claim, internalized this pragmatically natural condition.

Given the semantics for *but* in (13), the truth-conditions for exceptive sentences can be calculated as illustrated in (15). Apart from the application of the assumed standard definitions of $\llbracket \text{every} \rrbracket$ and $\llbracket \text{no} \rrbracket$, all the steps in these derivations are justified by fairly elementary set-theoretic equivalences.⁶ The resulting truth-conditions are exactly the ones that we set out to obtain. So far then, (13) is what we wanted. The test sentences get their desired meaning: (1a) is true iff John is the only student who did not attend the meeting, (1b) is true iff he is the only student who did attend the meeting.

(15) $\llbracket \text{every} \rrbracket A \llbracket \text{but} \rrbracket C P = \text{True}$

$$\begin{aligned} &\Leftrightarrow P \in \llbracket \text{every} \rrbracket (A-C) \& \forall Y (P \in \llbracket \text{every} \rrbracket (A-Y) \Rightarrow C \subseteq Y) \\ &\Leftrightarrow (A-C) \subseteq P \& \forall Y ((A-Y) \subseteq P \Rightarrow C \subseteq Y) \\ &\Leftrightarrow \bar{P} \cap A \subseteq C \& \forall Y (\bar{P} \cap A \subseteq Y \Rightarrow C \subseteq Y) \\ &\Leftrightarrow \bar{P} \cap A \subseteq C \& C \subseteq \bar{P} \cap A \\ &\Leftrightarrow \bar{P} \cap A = C \end{aligned}$$

$\llbracket \text{no} \rrbracket A \llbracket \text{but} \rrbracket C P = \text{True}$

$$\begin{aligned} &\Leftrightarrow P \in \llbracket \text{no} \rrbracket (A-C) \& \forall Y (P \in \llbracket \text{no} \rrbracket (A-Y) \Rightarrow C \subseteq Y) \\ &\Leftrightarrow P \cap (A-C) = \emptyset \& \forall Y (P \cap (A-Y) = \emptyset \Rightarrow C \subseteq Y) \\ &\Leftrightarrow P \cap A \subseteq C \& \forall Y (P \cap A \subseteq Y \Rightarrow C \subseteq Y) \\ &\Leftrightarrow P \cap A \subseteq C \& C \subseteq P \cap A \\ &\Leftrightarrow P \cap A = C \end{aligned}$$

It is also easy to show that the unwanted inferences discussed earlier do not go through anymore. Consider the sentences in (16).

Assuming that (16a) is true, we can easily see that the semantics in (13) predicts that (16b) cannot be true at the same time. For if (16b) were true then all the sets of attending students would contain neither John nor Jill. But (16a) asserts that the set of students minus just John is a set of attenders, but it does contain Jill, in contradiction to (16b). The inference is therefore blocked.

- (16) a. Every student but John attended the meeting.
 b. Every student but John and Jill attended the meeting.

To complete the demonstration that (13) is a successful semantics for *but*, it has to be shown that the co-occurrence restrictions are suc-

⁶The set-theoretic tautologies employed are:

- (i) $X-Y \subseteq Z \Leftrightarrow X \cap \bar{Z} \subseteq Y$
- (ii) $\forall Y (X \subseteq Y \Rightarrow Z \subseteq Y) \Leftrightarrow Z \subseteq X$
- (iii) $X \subseteq Y \& Y \subseteq X \Leftrightarrow X = Y$

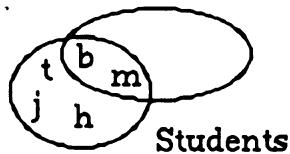
cessfully captured. The crucial observation is that among simple natural determiners the existence of a unique exception set is only guaranteed by the universal ones, e.g., *all* (and its synonyms) and *no* (and its synonyms).

One direction is fairly elementary: if you have a universal determiner and it turns out that $P \notin D(A)$, then the unique exception is easy to obtain. If D is *no*, then $P \cap A$ is the culprit, it should have been empty but wasn't; it is the unique exception we are looking for. If D is *all*, then $\bar{P} \cap A$ is the offender and the unique exception, it should have been empty.

As an example of a determiner that is not universal and does not give rise to unique exceptions let us examine *most*. Consider the situation illustrated in (18) where (17a) is false because there are three students (Tom, John, and Harry) who did not attend the meeting while only two students (Bill and Mary) attended.

- (17) a. Most students attended the meeting.
 b. *Most students but Tom and John attended the meeting.

- (18)



We could try to make the *most*-quantification true by excluding a sufficient number of non-attending students from the set we are quantifying over. So, we attempt (17b), excluding Tom and John, thus creating a situation where still only two students attended (Bill and Mary) but only one non-attender (Harry) remains. So now a majority of the students under consideration did attend the meeting. But note that since the *most*-claim is not a universal one we did not have to exclude all non-attending students. Hence we had a choice of which students to exclude. We could equally as well have excluded Tom and Harry or John and Harry. There is then obviously no unique set of students that we have to exclude. The uniqueness condition encoded in (13) brandmarks (17b) as false, since Tom and John are not the unique exception set to the quantification in (17a). Parallel thought experiments can be carried out for all determiners that even stand a chance of having exceptions (recall that the upward monotone ones are excluded by even more elementary considerations).

It has to be noticed that there are limiting cases where even a *most*-quantification has a unique exception. If there were only two students John and Harry and only one of them, Harry, attended the

meeting, we can make the statement *Most students attended the meeting* true by excepting the unique student who did not attend the meeting: John. The existence of such exotic situations is obviously not enough for *but* to be able to occur with *most*.

The analysis of the co-occurrence restrictions of *but* that I propose then is that they are a grammaticalization of the semantic fact that only universal determiners guarantee the existence of a unique exception set. In some way this will have to be built into the lexical entry for *but*. This concludes the demonstration that (13) is an adequate specification of the meaning of exceptive *but*. I have shown that (13) predicts the correct truth-conditions, that unwarranted inferences induced by the monotonicity of universal determiners are blocked, and that the co-occurrence restrictions of *but* are straightforwardly explained.

2. The Syntax of 'But'-Phrases

So far I have been careful not to commit myself to a position of how exactly the elements in a noun phrase like *every student but John* combine semantically and how this is linked to a particular syntactic structure. This section is devoted to these issues.

2.1 The NP-Internal Operator 'But'

A close look at the semantics in (13), repeated here in one of its formulations, reveals that the *but*-phrase must have access to both the determiner D and its domain A. D is applied more than once in (19) to different sets, and A is subtracted from at various points.

(19) D A [[but]] C P = True

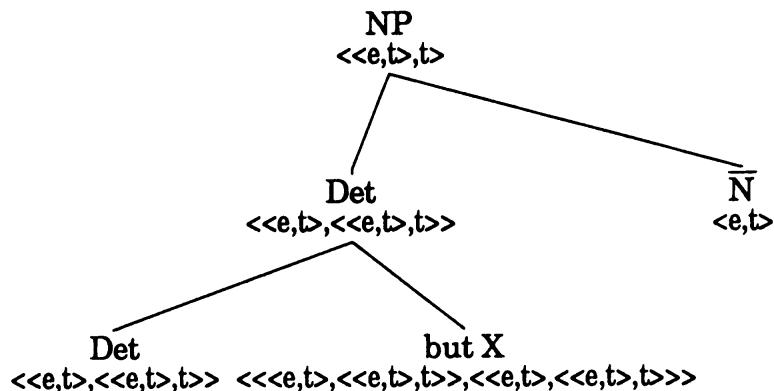
$$\Leftrightarrow P \in D(A-C) \ \& \ \forall Y (P \in D(A-Y) \Rightarrow C \subseteq Y).$$

The necessity of 'simultaneous access' then excludes two initially attractive implementations. It is first not possible to have the exceptive operate solely on the domain A, which would have made it possible to treat it as a fairly ordinary common noun modifier. It is also not possible to compute the noun-phrase denotation D(A) first and have the exceptive then take the result as its argument, which would have corresponded to an analysis of *but*-phrases as NP modifiers. The semantics in (19) forces more exotic analyses.

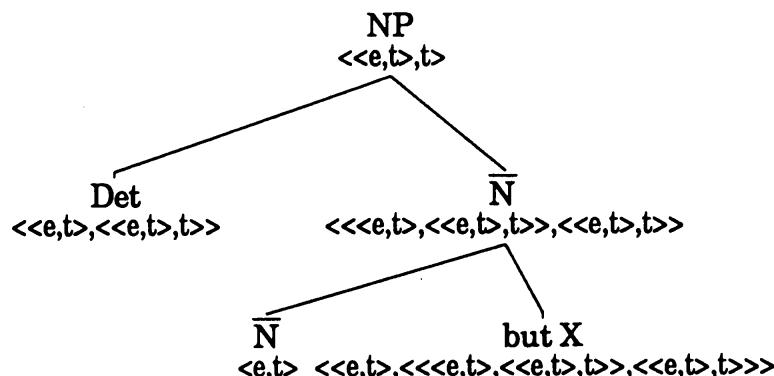
Assuming binary branching in both syntax and semantics, we have to decide whether the *but*-phrase applies first to the determiner and then to the common noun or the other way round. That is, we

have to decide between two different ‘curryings’⁷ of the function denoted by the *but*-phrase, given in (20).⁸

(20) a.



b.



The first possibility is to treat *but*-phrases as modifiers of determiners which make them be of the same type as adverbs like *almost* in *almost all* (namely, functions from determiner denotations to determiner deenotations). This is actually implicit in an earlier proposal by Keenan & Stavi (1986) who, however, do not give any compositional derivation but treat *every...but...* and *no...but...* as complex lexical items instead. Syntactically this would force us to accept either a discontinuous constituency or a local movement around the head noun.⁹ Treating *but*-phrases as modifiers of determiners may

⁷Or rather ‘schönfinkelizations’, cf. Schönfinkel (1924).

⁸Adopting the DP-hypothesis would of course mutliply the possible structures even more. At the moment I do not see any strong arguments for any particular structure.

⁹Such local wrappings are presumably independently motivated by constructions like *an easy rug to clean* or *the first person we talked to* (Ed Keenan, pc). For references on the status of discontinuity in the theory of grammar see the

provide a natural connection to constructions like *all but at most five students* where we find a complex determiner phrase built with *but* to the left of the head noun.

The second and semantically more adventurous option has the *but*-phrase combine with the common noun first to give a higher type common noun which then takes the determiner as its argument, in a reversal of the usual function-argument structure. This high type for common nouns is not usually employed in semantic analyses and we would like independent evidence for it.¹⁰

It seems to me very difficult to decide between these options and in the absence of decisive evidence I will not commit myself to one of them in particular. It may even be that the data underdetermine the choice of structure, which would mean that there are two nearly equivalent grammars for this phenomenon.

What is crucial for the main argument of this paper is that the *but*-phrase, because of the built-in uniqueness condition, has to have a rather high logical type. In Section 3.4, I will suggest that this distinguishes them from the less grammaticalized free exceptives.

3. Free Exceptives

Can the notion of degrees of grammaticalization be reconstrued in a formal theory of grammar? That will be the focus of this section, in which I turn to the analysis of free exceptives with *except for*. The next subsections will establish that free exceptives are in some sense a less grammaticalized cousin of *but*-phrases which at some point in their history presumably got ‘subducted’ from the status of an adjunct to the status of a logical operator inside the noun phrase. The main claim will be that the differences between the two types of exceptives follow from the fact that free exceptives have a lower logical type than the high one of *but*-phrases.

contributions in Huck & Ojeda (1987) and Jim Blevins’ dissertation (1990). See also Bach’s (1979, 1981) Right Wrap operation which is one of the influences on the HPSG framework.

¹⁰There is one place in the literature I am aware of where this type is discussed. Partee & Rooth (1983: 374ff) cite a manuscript by Robin Cooper where he proposes to analyze the reading of (i) where it means “most men swim and most women swim” by raising the type of the common noun phrase.

(i) Most men and women swim.

Partee & Rooth discuss some of the issues that arise from admitting such type-raising.

3.1 'Except for'

What I call free exceptives are phrases marked with *except for*, which can appear both in left- and right-peripheral positions.

- (21) a. Except for the famous detective, no one suspected the cook.
 b. No one suspected the cook, except for the famous detective.

This positional freedom makes free exceptives crucially different from *but*-phrases. I will assume without much argument that it is not possible to consider free exceptives as being related to their associate quantifier by an s-structure movement rule. This is in accord with Baltin (1985) who argues that modifiers cannot in general be extraposed to the left. Suppose then that free exceptives are base-generated as sentence adjuncts.

There are, I think, three degrees of semantic integration of the free exceptive into the sentence they modify. The loosest connection is found in cases where the exceptive is an afterthought, repair, or self-correction, illustrated by (22). It seems unlikely that these are amenable to a compositional analysis. I will leave them aside.

- (22) Everyone loved the new show and noone thought it would be cancelled so soon. Except for George, of course.

An intriguing, perhaps best termed 'appositive', use is shown in (23). If near-universal determiners like *most* or *few* are employed, this probably gives rise to an implicature that it was not possible to use a universal determiner. In other words, they implicate the existence of an exception set. The sentences in (23) seem to have as their most prominent reading one where the exceptive gives further information about the exception set. (23a) then would convey that Joan is a notable exception to the generalization that cabinet members liked the proposal. It seems obvious that this appositive reading should only arise with free exceptives. They can, so to speak, 'wait' until the implicatures of the sentence are computed.

- (23) a. Except for Joan, most cabinet members liked the proposal.
 b. Except for John, few employees openly opposed the pay cut.

The third use of free exceptives, which is most similar to *but*-phrases, is the one I want to concentrate on here. In (24) the exceptive is used 'restrictively': only after the exceptive has done its thing will the quantification come out true.

- (24) a. Except for Jim, noone really liked the soup.
 b. Except for Jane, my relatives are (all) total bores.
 c. Except for the assistant professors, most faculty members supported the dean.

The account I will argue for again gives the exceptive a semantics of Domain Subtraction. The exceptive then has to 'get inside' the NP, which I show can be achieved via binding of a context set variable. Following work by Chierchia (1984), I will propose that such a variable can only be of type $\langle e, t \rangle$. As a consequence then, free exceptives will have a logically weaker semantics than *but*-phrases and can therefore also appear with non-universal determiners as (24c) shows.

3.2 Reinhart (1989): Free Exceptives and QR

Reinhart (1989) proposes that the association between free exceptive and target quantifier is established by quantifier raising (QR). The best evidence for this comes from examples where s-structure movement is routinely ruled out whereas QR is acknowledged to be possible. One such case is demonstrated in (25).¹¹

- (25) a. *Which city; does [somebody from t_i] despise it?
 b. Somebody from every city despises it.
 c. Except for London, somebody from every city despises it.
 d. *Somebody from every city despises it but London.

It was May (1977, 1985) who presented 'inverse linking' examples like (25b) to show that QR is freer than overt *wh*-movement which cannot extract from a complex subject as in (25a). (25c) shows that a free exceptive can associate with a quantifier inside a complex subject. As a tidbit and another argument for an s-structure extraposition movement for *but*-phrases, (25d) clearly shows that the limited possi-

¹¹The discussion here is very much in the spirit of Reinhart's discussion.

However, her own example (i) fails to make the point.

(i) Jokes about everyone were told except Felix.

The biggest problem with (i) is that it sounds ungrammatical to most native speakers. Note that the underlying sentence itself, i.e. (iia), seems degraded, perhaps because extraposition of the PP as in (iib) is strongly preferred.

(ii) a. *? Jokes about everyone were told.

b. Jokes were told about everyone.

Furthermore, most of her examples have a right-peripheral exceptive formed with bare *except* (without *for*) and some of these do not sound as good as she claims.

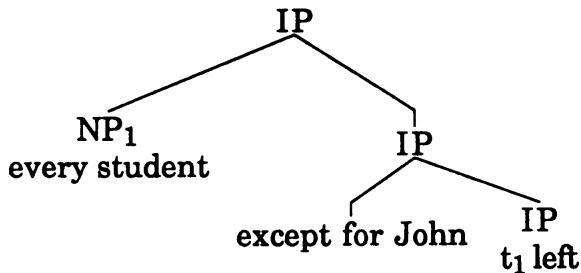
Except is perhaps more like *but* than she realizes (she actually does not discuss any differences between types of exceptives). To make sure that extraposition does not play a role, I use left-peripheral *except for*-phrases in my examples.

bility of having *but*-phrases sentence-finally is subject to much stronger constraints than free exceptives.

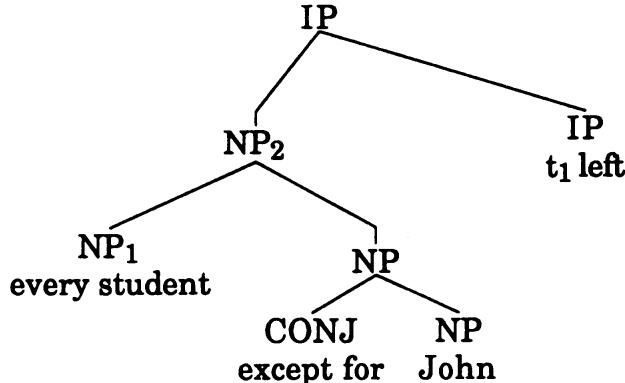
Reinhart (1989) now proposes that after QR has applied to the associate of a free exceptive, the resulting configuration is in fact sufficient to allow the semantic rules to operate successfully. Depending on certain theoretical decisions that do not have to concern us here, we can give a sentence like (26a) one of the LF representations in (26b).

- (26) a. Except for John, every student left.

b.



or



The choice between the two LFs in (26b) depends on whether in the second version the raised quantifier will be able to antecedent-govern its trace. Reinhart suggest that in an adjunction structure like this the antecedent-government definition may be fulfilled. She has to give the exceptive a very dubious structure, though, treating *except for* as a conjunction. We may then prefer the first version as less theoretically dicey.

As Reinhart herself realizes, even after the LFs in (26) have been created, it still remains unclear how they are interpreted correctly. First, the NP *every student* on its own is of course not the correct semantic binder of its trace. It seems obvious that it has to be the LF-created constituent *every student except for John* that binds the argument trace in the IP. This problem will probably take care of

itself once we have solved the second problem: how does the exceptive get to operate inside the associate quantifier although we only have an adjunction structure?

3.3 Tricks of the Relative Clause Trade

Let us suppose that we cannot touch the structural integrity of the associate quantifier, that is, that we cannot blow it up and reassemble the pieces as we need them. In some ways, this situation is reminiscent of the long standing debate about the constituency of relative clauses.¹² Here, semantic arguments favour an \bar{N} -modifier analysis, while there are other considerations that support an NP-modifier analysis. The last word about this recently rather dormant issue has presumably not been spoken. The study of exceptives can probably profit from some of the precedents set in the realm of relative clauses.

Robin Cooper in his dissertation (1975) proposed a way of interpreting correlative clauses (Hittite was his particular data source) that made them common noun modifiers semantically despite their fairly indisputable S-adjunct status. Bach and Cooper (1978)¹³ showed that this solution could also be used to reconcile an NP-level syntax of English relative clauses with an \bar{N} -semantics.¹⁴ The crucial technique is the introduction of a free variable at the \bar{N} -level which can then later be filled in by the relative clause. In informal notation, the NP with relative clause in (27a) will be interpreted as in (27b).

- (27) a. [[every man] who loves Mary]
- b. $\lambda R [[\text{every}] ([\text{man}] \cap R)] ([\text{loves Mary}])$
- $\Leftrightarrow [\text{every}] ([\text{man}] \cap [\text{loves Mary}])$

Non-trivial questions about the restrictiveness of the resulting framework arise then.¹⁵ What is the status of the NP-internal free variable posited here? One way of conceiving of the status of such free variables is that they are something like miraculously base-generated traces of base-generated adjuncts; base-generation would have to be less constrained than actual movement traces. For Hindi correlative clauses, Srivastav (1990) presents an alternative where what the correlative clause binds in its associate is not a free

¹²A partial list of references should include at least: Stockwell, Schachter & Partee (1973: Chapter 7 on 'Relativization') and their list of earlier references, Partee (1973, 1975), Chomsky (1975), McCawley (1981). Further references will be mentioned below.

¹³This article is an elaboration of Appendix A of Cooper's dissertation.

¹⁴An application to German relative clauses is given in von Stechow (1979).

¹⁵Some discussion can be found in Janssen (1983) and Partee (1984).

variable *ex nihilo* but is in fact created by the demonstrative determiner of the NP.¹⁶ I favor a third possibility which was actually briefly put forward by Cooper himself (1975: 258f). When the free variable inside the noun phrase is not bound off by a relative clause, he suggests, it may represent the contextual restriction of the NP-interpretation to a specific restricted set of entities.¹⁷ The need for such restrictions has been discussed in some recent work on generalized quantifiers (Westerståhl 1985, Johnsen 1987) and can be traced all the way back to early contributions to logical theory by Wallis, Boole, and de Morgan.

3.4 Binding R

I would now like to urge that the analysis of free exceptives should be the one informally represented in (28).

- (28) a. [IP [every student]; [IP [except for John] [IP t; left]]]
 b. $\lambda R ([\text{every}] ([\text{student}] \cap R) [\text{except for John}]) ([\text{left}])$
 $\Leftrightarrow [\text{every}] ([\text{man}] \cap \overline{\{j\}}) [\text{left}]$
 $\Leftrightarrow [\text{man}] - \{j\} \subseteq [\text{left}]$.

A free variable R of type $\langle e, t \rangle$ is introduced into the translation which is conjoined with the denotation of the common noun. The associate quantifier adjoins to the same IP that the free exceptive is a base-generated adjunct of. Following Reinhart's idea the two phrases can then be interpreted as if they were sisters. The free exceptive gets quantified into the free variable R inside the quantifier. The semantic effect is that of set subtraction.

Three obvious problems should immediately be addressed: (i) Why is this approach not also adequate for *but*-phrases? (ii) Does this approach explain why the co-occurrence restrictions of free exceptives are less rigid than those of *but*-phrases? and (iii) Why do sentences with universal determiners and free exceptives seem to have the same meaning as the corresponding sentences with *but* if all free exceptives do is set subtraction?

The important ingredient in answering all these questions is a restriction on the logical type of the context set variable. The particu-

¹⁶I hope to be able to discuss Srivastav's analysis and a possible different treatment some other time.

¹⁷Cooper refers to a similar suggestion made by Vendler (1967) who used an unexpressed relative clause to introduce the implicit restrictions on definites. Another early reference is Hausser's dissertation (1974).

lar formulation I adopt comes from work by Gennaro Chierchia.¹⁸ In his dissertation (1984: 74-90) he has some thoughts about the status of the hierarchy of logical types. There are, Chierchia says, basically three levels of natural language meanings: entities, properties, and functors. The third layer, the level of functors, is the exotic one. He proposes that there can be no variables of a functor type as formulated in (29).¹⁹

(29) The “No Functor Anaphora Constraint” (Chierchia 1984)

Functors do not enter anaphoric processes in natural languages.

Among the consequences of this constraint are the absence of *wh*-questions for determiners, non-predicative adverbs like *almost*, and other previously mysterious properties of natural language. For our context set variable the constraint will ensure that it can only be a set variable of type $\langle e, t \rangle$. Remember that the uniqueness condition grammaticalized in the lexical meaning of *but* forced us in Section 2 to give the *but*-phrase a functor type rather higher than $\langle e, t \rangle$. The consequence of adopting (29) then is that an exceptive can only have the uniqueness condition as part of its lexical meaning if it is base-generated in an NP-internal position. Free exceptives which get inside via binding of a variable cannot have the uniqueness condition as part of their lexical meaning. Since it was the uniqueness condition that explained the strict co-occurrence restrictions of *but*-phrases, it is no surprise that free exceptives have looser restrictions and can indeed occur with non-universal determiners.

The weakness of the lexical meaning of free exceptives does not preclude that there are pragmatic strengthenings of that meaning. With universal determiners, the maximally relevant reading will

¹⁸Chierchia's ideas are inspired by Jespersen's hierarchy of primaries, secondaries, and tertiaries (1924: Chapter VII). I am very grateful to Paul Portner for reminding me of Chierchia's discussion.

¹⁹The use of a free variable to stand in for the choice between a number of sentential connective meanings (*because*, *in spite of*, ...) by Stump (1981, 1985) in his treatment of the interpretation of free absolutes and adjuncts might be a counterexample. I suspect though that his use of a free variable is rather different from the one discussed in this paper. His variable is not subject to *wh*-movement, anaphora, or binding. Still, this whole area needs a lot of further attention. For some comments on Stump's analysis see Partee (1984). Angelika Kratzer (pc) points out two further potential problems: *only* seems to be able to associate with focussed determiners or focussed bound variable pronouns, and functional questions (cf. Elisabeth Engdahl's work) seem to *wh*-move functors. At this point, I have no thoughts on these.

still be the one where the exception stated is the unique smallest one. The perceived equivalence of universal statements modified by *but*-phrases or free exceptives then merely conceals the different way these readings come about.

Conclusion

The differences between the highly grammaticalized *but*-phrases on the one hand and the somewhat looser free exceptives are then reconstructed as follows in my account.

Free exceptives are sentence adjuncts. Under their restrictive reading, they bind the context set variable in their intended target, which has been quantifier-raised to a position that makes it a sister of the exceptive. Since this is an anaphoric process, the type of the operation these exceptives denote can not be higher than $\langle e, t \rangle$. Domain Subtraction is then all they can lexically mean. Depending on the quantificational force of the target, the meaning may be pragmatically strengthened to implicate uniqueness or minimality of the exception.

But-phrases are NP-internal operators. As such they are not subject to the constraint in (29). They incorporate the uniqueness condition into their lexical meaning, hence they are ungrammatical with non-universal associates. It is rather pleasant to speculate that *but*-phrases at some point may have been free exceptives just like *except for*-phrases are today. The process of grammaticalization then would have sucked them down into the noun phrase (a generally active process in the history of languages that Roger Higgins has termed ‘subduction’). Concomitantly to becoming an NP-internal operator, it could have acquired a stronger meaning incorporating the uniqueness condition. At this point, this is mere speculation, although I strongly suspect that something like this has to be what happened.

Let me conclude by saying that even if the specific decisions made in this paper turn out to be mistaken, the following four points might survive. (i) The study of exceptives and in general domain restrictors on quantifiers can serve as a probe into quantificational structures. (ii) Careful investigation of the techniques available to describe operators “from the outside” is still needed. (iii) Constraints such as the “No Functor Anaphora Constraint” of Chierchia deserve further attention. (iv) A formal reconstruction of the notion of grammaticalization may not be impossible.

References

- Abney, Steven Paul: 1987, *The English Noun Phrase in its Sentential Aspect*, Ph.D. Dissertation, MIT, Cambridge.
- Bach, Emmon: 1979, 'Control in Montague Grammar', *Linguistic Inquiry* 10, 515-531.
- : 1981, 'Discontinuous Constituents in Generalized Categorial Grammars', *NELS* 11.
- and Robin Cooper: 1978, 'The NP-S Analysis of Relative Clauses and Compositional Semantics', *Linguistics and Philosophy* 2, 145-150.
- Baltin, Mark: 1985, *Toward a Theory of Movement Rules*, Garland, New York.
- Barwise, John and Robin H. Cooper: 1981, 'Generalized Quantifiers and Natural Language', *Linguistics and Philosophy* 4, 159-219.
- van Benthem, Johan: 1984, 'Questions about Quantifiers', *Journal of Symbolic Logic* 49, 443-466.
- Blevins, James P.: 1990, *Syntactic Complexity: Evidence for Discontinuity and Multidomination*, Ph.D. Dissertation, GLSA, University of Massachusetts at Amherst.
- Chierchia, Gennaro: 1984, *Topics in the Syntax and Semantics of Infinitives and Gerunds*, Ph.D. Dissertation, GLSA, University of Massachusetts at Amherst.
- Chomsky, Noam: 1975, 'Questions of Form and Interpretation', *Linguistic Analysis* 1, ???-??? [reprinted in Noam Chomsky, 1977, *Essays on Form and Interpretation*, North-Holland, Amsterdam, pp. 25-59].
- Cooper, Robin H.: 1975, *Montague's Semantic Theory and Transformational Syntax*, Ph.D. Dissertation, GLSA, University of Massachusetts at Amherst.
- Emonds, Joseph E.: 1985, *A Unified Theory of Syntactic Categories*, Foris, Dordrecht.
- Hausser, Roland: 1974, *Quantification in an Extended Montague Grammar*, Ph.D. Dissertation, University of Texas, Austin.
- Hoeksema, Jack: 1987, 'The Logic of Exception'. in A. Miller and J. Powers (eds), *Proceedings of the Fourth Eastern States Conference on Linguistics (ESCOL 4)*, Ohio State University, Columbus, OH, pp. 100-113.
- : 1990, 'Exploring Exception Phrases', in Martin Stokhof and Leen Torenvliet (eds.), *Proceedings of the Seventh Amsterdam Colloquium*.

- Huck, Geoffrey J. and Almerindo E. Ojeda (eds.): 1987,
Discontinuous Constituency (Syntax and Semantics, Vol. 20),
 Academic Press, Orlando.
- Janssen, Theo M.V.: 1983, *Foundations and Applications of Montague Grammar*, Mathematisch Centrum, Amsterdam.
- Jespersen, Otto: 1924, *The Philosophy of Grammar*, Allen & Unwin, London.
- Johnsen, Lars G.: 1987, 'There-Sentences and Generalized Quantifiers', in Peter Gärdenfors (ed.), *Generalized Quantifiers: Linguistic and Logical Approaches*, Reidel, Dordrecht, pp. 93-107.
- Kadmon, Nirit and Fred Landman: 1990, 'Polarity Sensitive *any* and Free Choice *any*', in Martin Stokhof and Leen Torenvliet (eds.), *Proceedings of the Seventh Amsterdam Colloquium*.
- Keenan, Edward L.: 1987, 'Multiply-Headed Noun Phrases', *Linguistic Inquiry* 18, 481-490.
- and J. Stavi: 1986, 'A Semantic Characterization of Natural Language Determiners', *Linguistics and Philosophy* 9, 253-326.
- Landman, Fred and Ieke Moerdijk: 1979, 'Behalve als voorzetsel', *Spektator: Tijdschrift voor Nederlandstiek* 9, 335-347.
- May, Robert: 1977, *The Grammar of Quantification*, Ph.D. Dissertation, MIT, Cambridge, (distributed by the Indiana University Linguistics Club, Bloomington).
- : 1985, *Logical Form: Its Structure and Derivation*, MIT Press, Cambridge.
- McCawley, James D.: 1981, 'The Syntax and Semantics of English Relative Clauses', *Lingua* 53, 99-149.
- : 1989, 'Individuation in and of Syntactic Structures', in Mark R. Baltin and Anthony S. Kroch (eds.), *Alternative Conceptions of Phrase Structure*, University of Chicago Press, Chicago, pp. 117-138.
- Partee, Barbara H.: 1973, 'Some Transformational Extensions of Montague Grammar', *Journal of Philosophical Logic* 2, 509-534 [reprinted in Barbara Partee (ed.), 1976, *Montague Grammar*, Academic Press, New York, pp. 51-76].
- : 1975, 'Montague Grammar and Transformational Grammar', *Linguistic Inquiry* 6, 203-300.
- : 1984, 'Compositionality', in Fred Landman and Frank Veltman (eds.), *Varieties of Formal Semantics*, Foris, Dordrecht, pp. 283-311.
- : 1988, 'Many Quantifiers', *Proceedings of ESCOL 1988*.
- : 1989, 'Binding Implicit Variables in Quantified Contexts', *Chicago Linguistics Society* 25.
- and Mats Rooth: 1983, 'Generalized Conjunction and Type Ambiguity', in Rainer Bäuerle, Christoph Schwarze, and

- Arnim von Stechow (eds.), *Meaning, Use, and Interpretation of Language*, de Gruyter, Berlin, pp. 361-383.
- Reinhart, Tanya: 1989, 'Non-quantificational LF', to appear in A. Kasher (ed.), *The Chomskyan Turn*, Blackwell.
- Rochemont, Michael S. and Peter W. Culicover: 1990, *English Focus Constructions and the Theory of Grammar*, Cambridge University Press, Cambridge [Cambridge Studies in Linguistics; 52].
- Rooth, Mats Edward: 1985, *Association with Focus*, Ph.D. Dissertation, GLSA, University of Massachusetts at Amherst.
- Schönfinkel, M.: 1924, 'Über die Bausteine der mathematischen Logik', *Mathematische Annalen* 92, 305-316.
- Srivastav, Veneeta: 1991, 'The Syntax and Semantics of Correlatives', ms, to appear in *Natural Language and Linguistic Theory*.
- von Stechow, Arnim: 1979, 'Visiting German Relatives', in Rainer Bäuerle, Urs Egli, and Arnim von Stechow (eds.), *Semantics from Different Points of View*, Springer, Berlin, pp. 226-265.
- Stockwell, Robert P., Paul Schachter, and Barbara Hall Partee: 1973, *The Major Syntactic Structures of English*, Holt, Rinehart, and Winston, New York.
- Stump, Gregory T.: 1981, *The Formal Semantics and Pragmatics of Free Adjuncts and Absolutes in English*, Ph.D. Dissertation, Ohio State University.
- : 1985, *The Semantic Variability of Absolute Constructions*, Reidel, Dordrecht.
- Vendler, Zeno: 1967, *Linguistics in Philosophy*, Ithaca, Cornell University Press.
- Wells, R.: 1947, 'Immediate Constituents', *Language* 23, 81-117.
- Westerståhl, Dag: 1985, 'Determiners and Context Sets', in Johan van Benthem and Alice ter Meulen (eds.), *Generalized Quantifiers in Natural Language*, Foris, Dordrecht, pp. 45-71.

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Aspect and Adverbials

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The aim of this article is to introduce a treatment of the prepositions heading temporal adverbials as binary operators which select for certain aspectual properties of their arguments and order these arguments temporally. I extend the Dowty [1986]/Taylor [1977] characterization of the aspectual classes to include certain basic properties of events and argue that a treatment of the selectional properties of temporal adverbials based on such a framework avoids certain incorrect predictions. I motivate this treatment with an analysis of **until** and suggest a treatment of the interaction of negation with adverbials. Finally I discuss how this treatment can be extended to other prepositions, such as **for** and **in**.

Karttunen [1974] (following Lakoff [1969], Lindholm [1969], Horn [1971; 1972], and others) proposes that **until** is ambiguous between a durative **until** and a punctual, negative-polarity item. Consider the following sentences from Karttunen [1974]¹:

- (1) The princess slept until the prince kissed her.
- (2) #The princess woke up until the prince kissed her.

In (1), [**The princess slept**] describes an eventuality² with a certain duration, and combines amicably with the **until** phrase. In (2), [**The princess woke up**] describes a punctual eventuality, and the combination is infelicitous. These examples are characteristic of durative **until**. When (2) is negated, however, as in (3), Karttunen argues that the acceptability of the resulting sentence is due to the presence of punctual, negative-polarity **until**.

- (3) The princess didn't wake up until the prince kissed her.

Mittwoch [1977] (following Klima [1964], Fillmore [1968], Smith [1970], Heinämäki [1974], Seuren [1974], and others) disagrees, and instead argues that **until** is unambiguously durative. Crucially, this treatment analyzes negated eventualities as duratives.

Both treatments, however, fail to adequately characterize durativity. Accomplishments such as [eat a sandwich] have duration, but are nevertheless infelicitous with until adverbials, as in (4):

- (4) #Joe ate a sandwich until noon.

Also, if until selects for a punctual item when in a negative environment, as Karttunen claims, then a durative item is predicted to be incompatible with until in such an environment. The acceptability of the durative [Joe sleeps] in (5) shows this prediction to be incorrect.

- (5) Joe didn't sleep until midnight.

Karttunen might avoid this problem by saying that the matrix verb phrase describes an inchoative (and therefore punctual) eventuality in such cases. Sentence (5), for example, it would be understood that Joe begins to sleep at midnight, interpreting [Joe sleeps] as an inchoative achievement.

There is another problem, however. Karttunen points out that when a sentence with an until adverbial is negated there is a shift in what he calls the "focus" of the sentence. In positive sentences such as (6), the event described by the matrix sentence occurs before the time indicated by the until phrase, but in negated sentences such as (7) the event occurs at or after that time. As evidence of this shift, Karttunen contrasts the acceptability of (6) and (7) with the phrase [at the earliest]:

- (6) She slept until noon #[at the earliest].
 (7) She didn't wake up until noon [at the earliest].

Mittwoch suggests that the shift may be due to implicature, but both Karttunen and Mittwoch agree that these data are puzzling.

In the following pages I will describe a characterization of the aspectual classes and of the selectional properties of temporal adverbials which avoids the above incorrect predictions. After motivating this treatment for positive sentences I'll propose a treatment of the interaction of negation with temporal adverbials to explain this "shift of focus".

Background

The categorization of verbs shown below can be traced as far back as Aristotle, and has since been examined by Ryle [1949], Kenny [1963], Taylor [1977] and Dowty [1979; 1986], among others.

Statives	Activities	Accomplishments	Achievements
know	run	draw a circle	recognize
love	write	build a house	reach the top
be hungry	sleep	eat a sandwich	wake up

Vendler [1967] and Dowty [1979] give a series of tests to determine the category of a specific verb, including tests for the acceptability of a verb with certain temporal adverbials such as **for** and **in**.

Dowty's [1986] definitions of the aspectual classes, originally from Taylor [1977], are repeated below.

- A sentence ϕ is **stative** iff it follows from the truth of ϕ at an interval I that ϕ is true at all subintervals of I . (e.g., if John was asleep from 1:00 until 2:00 PM, then he was asleep at all subintervals of this interval: *be asleep* is a stative).
- A sentence ϕ is an **activity** (or *energeia*) iff it follows from the truth of ϕ at an interval I that ϕ is true of all subintervals of I down to a certain limit in size (e.g. if John walked from 1:00 until 2:00 PM, then most subintervals of this time are times at which John walked; *walk* is an activity.)
- A sentence ϕ is an **accomplishment/achievement** (or *kinesis*) iff it follows from the truth of ϕ at an interval I that ϕ is false at all subintervals of I . (e.g. if John built a house in exactly the interval from September 1 until June 1, then it is false that he built a house in any subinterval of this interval: *build a house* is an accomplishment/achievement.)

Treatments of the selectional properties of temporal adverbials often rely on definitions based on an interval semantics, such as these. I claim that when discussing the interaction of adverbials with aspect it is necessary to refer not only to the interval over which the event occurs, but also to other properties of the event, such as whether it culminates. I'll now construct a description of the aspectual classes which incorporates certain basic properties of events into the Dowty [1986]/ Taylor [1977] aspectual classes.

Termination Points

Certain past tense sentences entail that the eventuality they describe has ended. Aspect is an indicator of the existence of this entailment: Accomplishment and achievement sentences, as in (8), have this entailment, and activity and stative sentences, as in (9), do not.

- (8) Joe [ate his sandwich] this morning.
Joe [recognized Bill] this morning.
- (9) Joe [jogged] this morning.
Irene [was happy] this morning.

I will say, following Kamp and Rohrer [1990], that accomplishments and achievements have **well-defined** termination points. Conversely, activities and statives have **poorly-defined** termination points.

We can test for the presence of a well-defined termination point by combining a statement which implies that a certain eventuality has terminated with a statement that cancels that implicature. The result is contradictory only when the eventuality has a well-defined termination point:

- (10) **Activity:** Did Joe [jog] this morning? Yes, and he's still jogging.
(\Rightarrow poorly-defined termination)
- (11) **Accomplishment:** Did Joe [eat his sandwich] this morning? #Yes,
and he's still eating his sandwich. (\Rightarrow well-defined termination)

I propose that Dowty's framework be complemented by the following:

- (12)
 - If a sentence is an activity or a stative then it is true over an interval with a poorly-defined termination point.
 - If a sentence is an accomplishment/achievement then it is true over an interval (or "preparatory period") with a well-defined termination point.

For example, if an accomplishment sentence P is true over an interval P_t , then P_t is an interval with a well-defined termination point and P is false at all subintervals of P_t .

Temporal prepositions order their arguments

Consider the sentences [**Joe ate oysters**] and [**George brought out the sushi**]. Because these sentences represent eventualities with no intrinsic interdependency, they can occur in either order, or they can co-occur.

Consider their ordering in the following sentences:

- (13) [Joe ate oysters] before [George brought out the sushi].
- (14) [Joe ate oysters] until [George brought out the sushi].
- (15) [Joe ate oysters] after [George brought out the sushi].
- (16) [Joe ate oysters] while [George brought out the sushi].

As the preposition varies, the order of the events vary. With such intuitions, the prepositions which head temporal adverbials can be divided, roughly, into the following classes:

- Class I. Prepositions which place **A** prior to **B**: **before**, **until**
- Class II. Prepositions which place **B** prior to **A**: **after**
- Class III. Prepositions which place **A** concurrently with **B**: **while**, **at**, **during**, **for**

This tentative classification predicts that a sentence containing a temporal adverbial will be nonsensical if world knowledge or context forces it to take on an ordering of events contrary to that specified by the preposition heading that adverbial. Specifically, if P_i is a preposition of class i , and A_e and B_e are the eventualities represented by phrases **A** and **B**, respectively, such that A_e must occur after B_e , then sentences of the form $[A P_I B]$ and $[B P_{II} A]$ are predicted to be nonsensical. These predictions are upheld in the following examples:

- (17) #**[Joe got into the car] before_I [he opened the car door].**
- (18) #**[The bucket overflowed] until_I [Joe poured water into it].**
- (19) #**[Joe opened the car door] after_{II} [he got into the car].**

Also, if **A** cannot co-occur with **B**, then sentences of the form $[A P_{III} B]$ are predicted to be nonsensical, as in (20):

- (20) #**[Joe called the plumber] while_{III} [the phone was dead].**

The prepositions **at**, **during**, and **for** subcategorize for an NP complement rather than a sentential complement. In a sentence such as **[Joe was home at 2PM]**, the classification of the preposition **at** requires that the stative described by the phrase **[Joe was home]** must temporally coincide with 2PM. Any contradiction of this coincidence is predicted be nonsensical, as below:

- (21) **[Joe was home] at [2PM]. #...He was at school all afternoon.**
- (22) **[Joe was home] during [Irene's hockey practice this morning]. #...He arrived home at noon.**
- (23) **[Joe was home] for [the dinner hour]. #...He arrived at home at midnight.**

I'll conclude that in sentences of the form $[A P; B]$, the preposition P determines the temporal order of the eventualities A_e and B_e .

If there are three ways to order eventualities, then a language only needs three prepositions for this purpose. Our classification of English prepositions lists seven of them, however, and there are many more. By way of explanation of this overabundance, consider the following sentences:

- (24) Joe ate his sandwich [before noon] / #[until noon].
- (25) Irene recognized Bill [at noon] / #[during noon].
- (26) Irene read the paper #[at her lunch hour] / [during her lunch hour].

These sentences are acceptable with one preposition of a class but not with another, suggesting the existence of a subtle difference in usage or meaning of the prepositions within a class³. Before discussing in detail the selectional properties of *until* and its manner of relating intervals, I will introduce the following terminology:

In the DRT treatment of tense, a sentence **introduces** an event into the discourse (Hinrichs [1981], Partee [1984]). I will say that a sentence (or temporal phrase) A introduces into the discourse an event A_e , and that that event is true over the interval A_t as per the description of the aspectual classes given in (12). A_t corresponds to the notion of *event time* in Reichenbach's [1947] temporal analysis.

I can now refine my statement of the above conclusion as follows: In a sentence of the form $[A P; B]$, the phrases A and B introduce the events A_e and B_e , respectively, into the discourse, and P ; orders A_t and B_t , which are intervals defined as in (12). Consider the following example:

- (27) [Joe got into the car] after [he opened the car door].

The A argument of **after**, [**Joe got into the car**], introduces an accomplishment A_e which occurs on the interval A_t , an interval with a well-defined termination point. The B argument, [**he opened the car door**], introduces a B_e which occurs on the interval B_t , also an interval with a well-defined termination point. The preposition **after** then orders A_t and B_t (and therefore A_e and B_e) temporally.

Until

We are now prepared to explore in detail the selectional properties of *until* and the manner in which it orders eventualities.

Eventualities which are true over an interval with a poorly-defined termination point are felicitous with *until* adverbials:

- (28) **Activity:** [Joe swam] until noon.
- (29) **Stative:** [Joe was hungry] until noon.

Eventualities which are true over an interval with a well-defined termination point are infelicitous with **until** adverbials:

- (30) **Accomplishment:** #[Joe ate a sandwich] until noon.
- (31) **Achievement:** #[Joe recognized] Irene until noon.
- (32) **Inchoative achievement:** #[Joe started swimming] until noon.

These data lead us to conclude that, in a sentence of the form [**A** until **B**], **A_t** must be an interval with a poorly-defined termination point⁴. Note that this generalization is an improvement over the statement that **until** selects for a durative eventuality in that we can now include accomplishments in the class of eventualities which are infelicitous with **until**.

The only phrases acceptable as the prepositional object of **until** are those which introduce an eventuality true over an interval which is or contains a well-defined termination point:

- (33) **Point in time:** Joe kept working until [noon].
- (34) **Achievement:** Joe kept working until [he realized it was lunchtime].
- (35) **Accomplishment:** Joe was homeless until [Irene built him a house].
- (36) **Activity:** #Joe watched TV until [Irene kept working].

Until ignores any preparatory period and selects for the well-defined point within **B_t**. To distinguish the interval **B_t** (the entire interval over which **B_e** occurs) from that portion of **B_t** selected for by **until**, I'll refer to the well-defined point within **B_t** as **B_{t_w}**.

Until also orders its arguments. If the sentence [**A** until **B**] is true, then implying that **A_e** occurs after **B_{t_w}** is nonsensical, as in (37):

- (37) #Joe swam until noon, starting at 1:00 PM.

and implying that **A_e** occurs before **B_{t_w}** but doesn't continue to the point **B_{t_w}** is also nonsensical, as in (38):

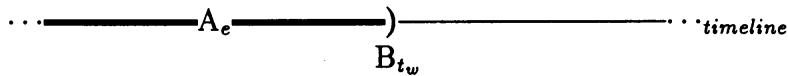
- (38) Joe swam until noon. #In fact, he swam until 11:30.

We can conclude that **until** combines with **B_{t_w}** to indicate a position in which to place **A_e**, and that that position is the interval whose final point is **B_{t_w}**.

This placement of **A_e** before **B_{t_w}** will create the (defeasible) implicature that **A_t** does not continue beyond **B_{t_w}**, i.e., **A_t** is supplied with a well-defined

termination point. Because of this, **until** does not combine with an \mathbf{A}_t which already has a well-defined termination point. The selectional properties of **until** can therefore be seen as a side effect of **until**'s ordering operation. The final analysis is as follows:

- (39) In a sentence of the form [\mathbf{A} until \mathbf{B}], **until** selects for a point \mathbf{B}_{t_w} which is well-defined. **Until** places \mathbf{A}_e in the interval terminating at \mathbf{B}_{t_w} . Schematically,



The ellipsis in the above diagram represents a poorly-defined endpoint, and the round bracket indicates a well-defined endpoint. I will use a square bracket to indicate inclusion of an endpoint in an interval and a round bracket to indicate exclusion of that endpoint.

In (40), for example, \mathbf{A}_e is the state of Joe being homeless, and **until** indicates that \mathbf{A}_e occurs in the interval terminating at \mathbf{B}_{t_w} , the point at which the house is complete. Dowty's definition of statives tells us that \mathbf{A} is true at all subintervals of that interval.

- (40) Joe was homeless until Irene built him a house.

This treatment correctly predicts that Joe is homeless while the house is being built and stops being homeless when the house is finished. This placement of \mathbf{A}_e implies that \mathbf{A}_e does not continue past \mathbf{B}_{t_w} . The implicature can be canceled, however, as in (41):

- (41) Joe worked until noon. In fact, he worked until 1:00.

Sentences such as (42) appear to falsify the claim that **until** subcategorizes for an \mathbf{A}_t with a poorly-defined endpoint:

- (42) Joe [drove around the block] for an hour.

It has been noted by Moens and Steedman [1988], however, that a verb may change aspectual class through a process they call **coercion**. The accomplishment in (42) has been coerced into an activity via iteration of that accomplishment. An activity can also be coerced into an achievement. In (43), for example, [he was hungry] conforms to **until**'s requirement that \mathbf{B}_t contain a well-defined termination point by taking on an inchoative interpretation.

- (43) Joe kept working until [he was hungry].

Negation

I'll now turn to the shift of focus noted by Karttunen, and show how my treatment of adverbials provides an explanation for this phenomenon.

As stated above, in a positive sentence containing an **until** adverbial the eventuality described by the matrix sentence, A_e , occurs before the time indicated by the **until** adverbial, but, in the corresponding negative sentence, A_e occurs at or after that time. In (44), for example, we are discussing an eventuality (i.e., the holding of the hostages) which occurs before the kidnapper's demands are met, and in (45) we are discussing an eventuality (i.e., the releasing of the hostages) which occurs after the demands are met.

- (44) The kidnapper will hold the hostages captive until his demands are met.
 (45) The kidnapper won't release the hostages until his demands are met.

As evidence of this shift of focus, Karttunen points out that the phrase [**at the earliest**] is acceptable with **until** only when the sentence is negated:

- (46) She slept until 9 #[**at the earliest**] / [**at the latest**].
 (47) She didn't wake up until 9 [**at the earliest**] / #[**at the latest**].

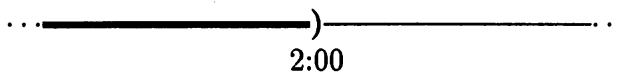
These data will support the notion that **until** aligns the eventuality introduced by the matrix sentence with an interval if we assume that the negation in (47) takes scope over the adverbial phrase (an assumption I'll discuss presently). I have argued that the preposition **until** combines with a B_t to produce an interval in which to place A_e . If negation takes scope over the **until** adverbial, it will affect the interval produced by that adverbial, thereby affecting the position in which **until** places A_e .

How does negation affect this interval? Consider the examples below:

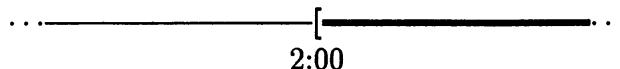
- (48) Joe realized the answer, but not at noon.
 (49) Joe was in his office, but not during the party.

In (48) the realization can occur at any point other than noon. In (49) Joe cannot be in his office during the interval over which the party takes place, and the implication is that he was in his office for some period before and/or after the party. I'll conclude that the effect of negation on an interval is to complement that interval, a conclusion consistent with Keenan and Faltz's treatment of negation as a complementation operator [Keenan and Faltz, 1985]. The complement of an interval will consist of all the points not included in that interval, schematically:

The interval before 2:00



The complement of the above interval

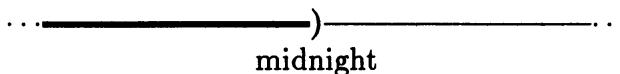


When negation takes scope over until, the interval that until indicates in which to place A_e is complemented, and A_e is placed in this new interval instead. This analysis correctly predicts that the focus of the sentence will shift to an event occurring on this new interval.

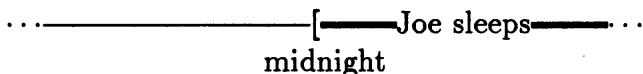
Consider the interpretation of sentence (50) where negation takes scope over the adverbial, as paraphrased in (51).

- (50) Joe didn't sleep until midnight.
- (51) Not until midnight did Joe sleep.

In (50), the phrase [until midnight] indicates that the potential placement of A_e is the interval terminating at midnight, as shown below.



When negation takes scope over the until phrase this interval will be complemented, producing an interval whose initial point is at midnight. Until places A_e in this new interval, as below:



This placement implies that A_e begins at midnight, but context may cancel this implicature, allowing until to place A_e later within the interval, as in (52):

- (52) Joe didn't sleep until midnight. In fact, he didn't sleep until 1:00AM.

Recall the difference in acceptability of the phrase [at the earliest] with negative and positive until sentences:

- (53) She slept until 9 #[at the earliest] / [at the latest].
- (54) She didn't wake up until 9 [at the earliest] / #[at the latest].

This contrast can be explained in light of my explanation of the shift of focus. Note that in (55a) [**at the earliest**] positions the initial point of Joe's swimming at noon, and in (55b) [**at the latest**] positions the final point.

- (55) Joe swam for two hours.
 - a. At the earliest he was swimming at noon.
 - b. At the latest he was swimming at noon.

In (53), it is the final point of \mathbf{A}_e that is aligned with \mathbf{B}_{t_w} , giving that point some measure of salience. The phrase [**at the earliest**] selects for an initial point and is therefore infelicitous. In (54), however, \mathbf{A}_e has been repositioned so that its initial point is aligned with \mathbf{B}_{t_w} . In this case, [**at the earliest**] is acceptable.

As for the claim that the negation in sentences such as (56) takes scope over the **until** phrase, sentence (56) cannot be paraphrased in a manner corresponding to the sentential scope of negation, as in (57):

- (56) Joe didn't wake up until noon.
- (57) #It is not true that Joe woke up until noon.

Also, if we let negation take scope over the verb phrase, we should get a reading in which there is no event of Joe's waking up. This reading is not available, however. The only remaining possibility is that the negation in (56) takes scope over the adverbial phrase⁵.

For

This treatment can be extended to **for**, avoiding certain problems with existing treatments. Dowty [1979] gives the following truth conditions for **for**:

- (58) **For** ($\in P_{(IV/IV)/(t_i:t_f)}$) translates into:

$$\lambda P_t \lambda P \lambda x [P_t n \wedge \forall t [t \subseteq n \rightarrow AT(t, Px)]]$$

If sentence (59) is true, for example, then there is a one hour interval **I** over which [**Joe jogs**] is true, and at all subintervals of **I** [**Joe jogs**] is also true.

- (59) Joe jogged for an hour.

As Dowty points out, (58) incorrectly predicts that activity sentences such as (59) will be ungrammatical because if an activity sentence is true over an interval **I** it is not true at all subintervals of **I**, but only at subintervals down to a certain size. Dowty also notes that habitual and repetitive readings are erroneously ruled out by his analysis; again, (58)

requires the \mathbf{A} phrase to be true at every subinterval of \mathbf{B}_t , disallowing gaps between repetitions of \mathbf{A}_e .

Moens and Steedman [1988] alternatively propose that a **for** adverbial selects for an activity⁶. This analysis incorrectly rules out the acceptability of stative sentences such as (60).

- (60) Joe was hungry for several hours.

In an earlier paper, they suggest that a stative may be coerced into an activity in order to be felicitous with a **for** adverbial [Moens and Steedman, 1986]. However, if, in (60), Joe is hungry for an interval of several hours then Joe is hungry at all subintervals of that interval, indicating that [Joe is hungry] remains a stative sentence by definition.

An analysis of **for** along the lines of that proposed for **until** avoids these problems. This analysis of **for** requires an \mathbf{A}_t of the same type as that of **until**: Eventualities which occur over an interval \mathbf{A}_t with a poorly-defined termination point are felicitous with **for**.

- (61) **Activity:** [Irene jogged] for an hour.
- (62) **Stative:** [Joe was in a coma] for ten days.

Conversely, eventualities which occur over an interval \mathbf{A}_t with a well-defined termination point are infelicitous with **for**:

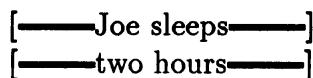
- (63) **Accomplishment:** #[Joe took off his hockey skates] for twenty minutes.
- (64) **Achievement:** #[Joe recognized George] for two hours.

For, unlike **until**, selects for a \mathbf{B}_t which is an interval rather than a point:

- (65) Joe managed to stay awake for [the whole meeting].
- (66) Joe swam for [two hours].
- (67) #[Joe swam for [noon]].

For aligns \mathbf{A}_e with \mathbf{B}_t , and \mathbf{A}_e must occupy the entire \mathbf{B}_t interval. For example, the operation of **for** in sentence (68) is to place the eventuality of Joe's sleeping concurrent with the two hour interval, as shown below:

- (68) Joe slept for two hours.



Dowty's definition of activities tells us that [Joe sleeps] is true at all subintervals of that two hour interval down to a certain size.

Sentence (68) implies that Joe slept for no longer than two hours, but, as with **until**, this implicature may be canceled, as in (69).

- (69) Joe slept for two hours. In fact, he slept for three.

As with **until**, when negation takes scope over the **for** phrase, the interval which **for** indicates in which to place A_e is complemented. Consider sentence (70), below:

- (70) Joe was happy, but not for the two hours his wallet was missing.

Complementing the two hour interval shown in (71), we get the interval in which **for** will place [Joe is happy], as shown in (72):

$$(71) \dots \text{---} [\text{---}] \text{---} \dots$$

$$(72) \dots \text{---} \text{Joe is happy---} (\text{---} \text{Joe is happy---} \dots$$

A common interpretation of a negated **for** sentence is that there are not two intervals during which A_e occurs, but only the later of the two intervals. One interpretation of sentence (73) is that I'll be in my office two hours from the **speech time** [Reichenbach, 1947].

- (73) I'll be in my office, but not for two hours.

- (74) I arrived at my office, but not for two hours.

In (74), I arrive at my office two hours after the **reference time**.

Hinrichs [1985] proposes an alternate solution to Dowty's problem. His truth conditions for **for** are based on a lattice-theoretic approach to events. Using an operator analogous to Carlson's [1977] **realization** operator, he breaks events into "event stages" and redefines Dowty's truth conditions for **for** and **in** to map these stages onto the interval specified by the **for** phrase. In this manner he allows gaps, such as those occurring in activities and habitus, in the eventualities selected for by **for** and **in**.

In the treatment of prepositions I have proposed, prepositions don't refer to the subintervals of an interval over which a sentence is true. Instead, the eventuality introduced by the sentence is placed in the interval indicated by the adverbial. Whether the sentence is true or false at certain subintervals of that interval depends on Dowty's definition of the aspectual class of that sentence. In this manner the correct predictions concerning activities are made, and yet the activity retains the properties specified by its definition.

The correct predictions are also made concerning habitual sentences. Using the test given in (12), we find that habitual sentences introduce eventualities which are true over intervals with poorly-defined termination points:

- (75) Irene [jogged] for five years. In fact, she still jogs.
 (= poorly-defined termination)

These sentences are correctly predicted to be acceptable with **for**-phrases.

In

In this section, I'll briefly describe how my treatment can be extended to deal with **in**.

In requires \mathbf{A}_t to be or contain a well-defined point \mathbf{A}_{t_w} (the same selectional property that **until** has for its \mathbf{B}_t), and \mathbf{B}_t to be a time segment (the same as **for**). **In** aligns \mathbf{A}_t with the last point of \mathbf{B}_t . The initial point of \mathbf{A}_t is constrained by speech time or by some contextually determined reference time. In (76), for example, there is some ten minute period \mathbf{B}_t beginning at a contextually determined reference time, and \mathbf{A}_{t_w} is placed at the end of \mathbf{B}_t , the point of realization.

- (76) Joe realized the answer in ten minutes.

$$\begin{array}{c} [] \Leftarrow \text{realizes} \\ [-\text{ten minutes}-] \end{array}$$

The ambiguity displayed by **in** in sentences with future tense is explained by this treatment. For example, consider (77):

- (77) Joe will build a house in two months.

This sentence has two interpretations: one in which Joe completes the building within a two-month period, as shown below:

$$\begin{array}{c} [-\text{builds house}-] \\ [-\text{two months}-] \end{array}$$

and the inchoative interpretation in which Joe begins the building at the end of a 2 month period:

$$\begin{array}{c} [] \Leftarrow \text{begin to build} \\ [-\text{two months}-] \end{array}$$

When negation takes scope over the **in** adverbial, the point indicated by **in** in which to place \mathbf{A}_{t_w} is complemented. In sentence (78), for example, the point at which **in** wants to place the culmination of Joe's building of the house is the final point of \mathbf{B}_t , as shown, enclosed in brackets, in (79).

(78) Joe didn't build the house in ten months.

(79) ...—————[.]—————..

The complement of this point is shown in (80):

(80) ...—————)(—————..

\mathbf{A}_{t_w} is placed somewhere in these new intervals. A paraphrase of such a placement is given in (81).

(81) Joe didn't build the house in ten months; he built it in nine.

Conclusions

In summary, I have proposed a treatment of the prepositions which head temporal adverbials as binary operators with selectional properties based on an extended version of the Dowty/Taylor definitions of the aspectual classes and as operators which order their arguments temporally. I have shown that this treatment avoids problems encountered by existing treatments of temporal adverbials, and explains certain facts with respect to the interaction of negation with these adverbials.

One issue raised by this treatment of adverbials is that of compositionality. If **until** selects for an \mathbf{A}_t with a poorly-defined termination point and supplies it with a well-defined termination point, this new interval should serve as acceptable input to **in** adverbials, which select for an \mathbf{A}_t with a well-defined termination point. Sentences such as (82) are unacceptable, however:

(82) #Joe slept until noon in two hours.

The difference between eventualities which culminate and eventualities which don't build to a culmination but simply terminate must be explored. How this difference can be formalized is a matter for future research.

Another issue is whether achievements should be characterized as having an associated preparatory period. Recall that, when negation takes scope over an **until** adverbial causing a shift in focus, eventualities of all aspectual

classes are acceptable as \mathbf{A}_e . The initial point of \mathbf{A}_t is placed concurrently with \mathbf{B}_{t_w} , causing that initial point to become well-defined. I have assumed that it is only possible for a poorly-defined endpoint to become well-defined, and my treatment depends on this assumption. As a result, I can only explain the acceptability of achievements in these contexts by assuming that achievements have a preparatory period, however negligible that period is. That preparatory period will be an interval whose final point is the culmination of the achievement and whose initial point is, crucially, poorly-defined.

This is not necessarily a problem, and, in fact, Dowty [1986] places achievements in the same class as accomplishments, which do have associated preparatory periods. Karttunen [1974], Mittwoch [1977], Moens and Steedman [1988], and Vendler [1967] treat achievements as punctual, however, and I thought it worth mentioning that doing so will create complications for my treatment.

Acknowledgements

I am grateful to Alessandro Zucchi, Greg Carlson and Massimo Poesio for their helpful advice and criticism during the development of this proposal.

This material is based upon work supported by the National Science Foundation user grant number IRI-9003841.

Footnotes

¹ I will use the symbol “#” to indicate a sentence in which the combination of the matrix clause and the adverbial (either in the same sentence or in the same context) is nonsensical or otherwise infelicitous.

² I will use the term *eventuality* (from Bach [1981]) to refer to an element of the set of achievements, accomplishments, activities, and statives.

³ In fact, it has been suggested by [Allen, 1983], and later proven by [Ladkin, 1987], that there are 13 ways for two intervals to relate temporally.

⁴ Kamp and Rohrer [1990] propose a similar analysis for *jusqu'à*, the French word for until.

⁵ It has been proposed ([Jackendoff, 1972], [Kratzer, 1989]) that negation may also “focus” on a phrase within its scope, e.g., on the subject, as in:

i. JOE didn't sleep until noon; IRENE did.

or on the prepositional object of until:

ii. Joe didn't sleep until NOON; he slept until THREE.

I believe that treating negation as a generalized complementation operator (as Keenan and Faltz [1985] do) may also explain these cases; however, given

that focus phenomena are still poorly understood (see, however, Rooth [1985], Krifka [1991], and Partee [1991]) I won't discuss this issue further.

⁶ Moens and Steedman refer to activities as *processes*.

References

- Allen, James (1983). Maintaining Knowledge About Temporal Intervals. *Communications of the ACM* 26(11):832–843.
- Bach, Emmon (1981). On Time, Tense, and Aspect: An Essay in English Metaphysics. In Cole, P., ed., *Radical Pragmatics*. Academic Press, New York.
- Carlson, Gregory N. (1977). A Unified Analysis of the English Bare Plural. *Linguistics and Philosophy* 1:413–457.
- Dowty, David R. (1979). *Word Meaning and Montague Grammar*. D. Reidel, Dordrecht, Holland.
- Dowty, David R. (1986). The Effects of Aspectual Class on the Temporal Structure of Discourse: Semantics or Pragmatics? *Linguistics and Philosophy* 9(1).
- Fillmore, C.J. (1968). Types of Lexical Information. In *Studies in Syntax and Semantics*. Dordrecht: Reidel.
- Heinämäki, Orvokki (1974). *Semantics of English Temporal Connectives*. Unpublished Ph.D. Dissertation, University of Texas at Austin.
- Hinrichs, Erhard W. (1981). Temporale anaphora in englischen. StaatsExamen thesis, Universität Tübingen.
- Hinrichs, Erhard W. (1985). *A Compositional Semantics for Aktionsarten and NP Reference in English*. Ph.D. Dissertation, The Ohio State University.
- Horn, Laurence (1971). Negative Transportation: Unsafe at Any Speed? In *Papers from the Seventh Regional Meeting of the Chicago Linguistics Society*, Chicago, IL.

- Horn, Laurence (1972). *On the Semantic Properties of Logical Operators in English*. Ph.D. Dissertation, University of California, Los Angeles. Unpublished.
- Jackendoff, Ray (1972). Semantic Interpretation in Generative Grammar. MIT Press, Cambridge, MA.
- Kamp, Hans and Rohrer, Christian (1990). Untitled manuscript on tense and texts.
- Karttunen, Lauri (1974). Until. Papers from the 10th Regional Meeting of the Chicago Linguistic Society, Chicago, IL.
- Keenan, Edward L., and Faltz, Leonard M. (1985). *Boolean Semantics for Natural Languages*. D. Reidel Publishing Company, Dordrecht, Holland.
- Kenny, Anthony (1963). *Actions, Emotion, and Will*. Humanities Press.
- Klima, Edward (1964). Negation in English. In *The Structure of Language*. J. Katz and J. Fodor, eds. Prentice-Hall, Inc., Englewood Cliffs, NJ.
- Kratzer, Angelica (1989). An Investigation of the Lumps of Thought. *Linguistics and Philosophy* 12:607 - 653.
- Krifka, Manfred (1991). A Compositional Semantics for Multiple Focus Constructions. In proceedings SALT-91, Cornell Working Papers.
- Ladkin, P. (1986). Time Representation: A Taxonomy of Interval Relations. In *Proceedings of the Fifth National Conference on Artificial Intelligence*, Philadelphia, Pennsylvania. pp. 360-366.
- Ladkin, Peter (1987). *The Logic of Time Representation*. Ph.D. Dissertation, University of California, Berkeley. Unpublished.
- Lakoff, Robin (1969). A Syntactic Argument for Negative Transportation. In *Papers from the Thirteenth Regional Meeting of the Chicago Linguistics Society*, Chicago, IL.
- Lindholm, James M. (1969). Negative Raising and Sentence

- Pronominalization. In *Papers from the Thirteenth Regional Meeting of the Chicago Linguistics Society*, Chicago, IL.
- Mittwoch, Anita (1977). How to Refer to One's Own Words. *Journal of Linguistics* 13:177–189.
- Moens, Marc and Steedman, Mark (1986). Temporal Information and Natural Language Processing. Technical Report EUCCSS/RP-2, Center for Cognitive Science, University of Edinburgh.
- Moens, Marc and Steedman, Mark (1988). Temporal Ontology and Temporal Reference. *Association for Computational Linguistics* 14(2):15–28.
- Partee, Barbara (1984). Nominal and Temporal Anaphora. *Linguistics and Philosophy* 7:243 – 286.
- Partee, Barbara (1991). Topic, Focus and Quantification. In proceedings SALT-91, Cornell Working Papers.
- Reichenbach, Hans (1947). *Elements of Symbolic Logic*. McMillan.
- Rooth, Mats (1985). *Association with Focus*. Ph.D. Dissertation, University of Massachusetts, Amherst.
- Ryle, Gilbert (1949). *The Concept of Mind*. Barnes and Noble, London.
- Seuren, P.A.M. (1974). Negative's Travels. In *Semantic Syntax*, P.A.M. Seuren, ed. Oxford: OUP.
- Smith, Steven B. (1970). *The Semantics of Negation*. Ph.D. Dissertation, University of California, Los Angeles. Unpublished.
- Taylor, Barry (1977). Tense and Continuity. *Linguistics and Philosophy* 1:199–220.
- Vendler, Zeno (1967). *Linguistics in Philosophy*. Cornell University Press, New York.

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A Compositional Semantics for Multiple Focus Constructions

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0. Introduction

The subject of this article is the semantics of focus, i.e. the development of a framework in which we can formulate the influence of focus on the semantic and pragmatic interpretation. In section (1), I will discuss such a framework, structured meanings. In section (2), I will point out some of its shortcomings, as it is currently worked out; they have to do with cases involving multiple foci. In (3), I develop a general representation format in which we can cope with these problematic cases. Finally, in (4) I will discuss some extensions and possible problems, among others a combined semantic treatment of focus and topic.

1. The Structured Meaning Approach to Focus

Some common assumptions of current theories on the syntax and semantics of focus, essentially going back to Jackendoff (1972), are the following:

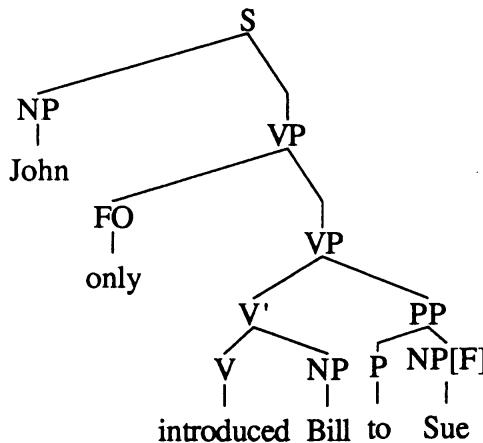
- Focus consists of a feature that is assigned to a node in the syntactic representation of a sentence (in theories that distinguish between different representation levels, focus is assigned at surface structure).
- The focus feature might be associated with a focus operator, such as *only*; the focus operator has to c-command its focus. We call this "bound focus".
- In phonology, the focus feature is spelled out by sentence accent (I disregard other ways of marking focus, such as cleft constructions). In case of a complex category, the position of the sentence accent may be sensitive to syntactic structure and to semantic properties such as givenness. For example, for English and German it has been argued that in a case where a head-argument structure is in focus, the accent is realized on the argument (cf. Selkirk 1984, von Stechow & Uhmann 1987). Also, it has been argued that constituents that refer to entities given in the context are deaccented, although they may be part of the focus (cf. Ladd 1980, Lötscher 1983).
- In semantics, the focus feature induces a partition of the semantic representation of the sentence into the part that is in focus and the complement part that is not in focus, commonly called the background. This partition is essential for the semantics and/or pragmatics of the sentence.

Let us get more specific by looking at an example:

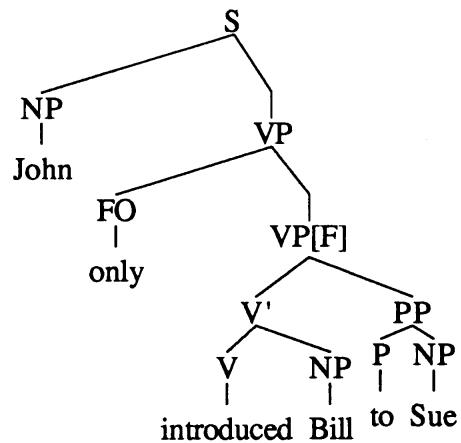
- (1) John only introduced Bill to SUE.

This sentence, with accent on *Sue*, has at least two readings: (i) The only person John introduced Bill to is Sue; (ii) the only thing John did is introducing Bill to Sue. For the first case, we can assume that *Sue* is in focus; in the second case, we can assume that *introduced Bill to Sue* is in focus. The rules of focus marking by accent lead to the same result in both cases (in the latter one, accent is realized on the last argument). The adverbial particle *only* c-commands the focus in both cases.

- (1') a.



- b.



There are essentially two representation formats that were designed to capture the contribution of the partitioning into focus and background to the semantic interpretation, namely STRUCTURED MEANINGS (cf. Klein & von Stechow 1982, Jacobs 1983, also Williams 1980) and ALTERNATIVE SEMANTICS (Rooth 1985). Here, I will concentrate on the structured meanings framework; see von Stechow (1989) for a comparison.

A structured meaning is a pair consisting of a background part and a focus part. The background is of a type that can be applied to the focus. If this application is carried out, we arrive at the ordinary semantic representation. Focus-sensitive operators are applied to these structured meanings. The two readings of our example are represented as follows:

- (2) a. $\text{only}(\langle \lambda x.\text{introd}(j,x,b), s \rangle)$
 b. $\text{only}(\langle \lambda P.P(j), \lambda x.\text{introd}(x,s,b) \rangle)$

Let us assume the following semantics for *only*. It says that the background representation applies to the focus representation, and that the background representation applies to no other entity that is comparable with the focus representation (see section 4.7 for a more refined treatment, distinguishing assertional meaning and presuppositional meaning). Comparability, which will be discussed shortly, is expressed by \approx .

- (3) $\text{only}(\langle \alpha, \beta \rangle) \leftrightarrow \alpha(\beta) \wedge \forall X[X \approx \beta \wedge \alpha(X) \rightarrow X = \beta]$,
 where X is a variable of the type of β .

For our two examples, we get the following representations:

- (4) a. $\text{introd}(j,s,b) \wedge \forall x[x \approx s \wedge \text{introd}(j,x,b) \rightarrow x = s]$
 b. $\text{introd}(j,s,b) \wedge \forall P[P = \lambda x.\text{introd}(x,s,b) \wedge P(j) \rightarrow P = \lambda x.\text{introd}(x,s,b)]$

This says that John introduced Bill to Sue, and (a) there is no individual comparable but not identical to Sue that John introduced Bill to, or (b) that there is no property comparable but not identical to introducing Bill to Sue that John has.

The limitation to comparable entities is meant to capture contextual and ontological restrictions. For example, the first reading might be true even if John introduced more persons to Sue, but these persons are not contextually salient (this is the case if the sentence is used to answer a question like *Did John introduce Bill and Paul to Sue?*). The second reading depends even more on this restriction; without it, it would express that introducing Bill to Sue is the only property John has, which of course cannot be true, as he has many additional properties, like being a man, or being identical to himself (cf. Lerner & Zimmermann 1983). The restriction can be expressed in various ways, as a condition formulated with respect to the meaning of the expression in focus, as suggested here (cf. also Rooth 1985), or alternatively as a condition formulated with respect to the meaning of the background expression, as suggested in Jacobs (1988). As the precise semantics of *only* and other operators is not at stake here, I will not elaborate on this point further.

We have seen how the partitioning into focus and background affects the interpretation of a sentence containing a focus-sensitive operator. Similarly, it may affect the interpretation of a sentence where no overt focus-sensitive operator is present. For example, the two interpretations of the sentence

- (5) John introduced Bill to SUE.

might be used in different contexts, depending on the focus; with focus on *Sue*, it might be an answer to *To whom did John introduce Bill?*, and with focus on *introduced Bill to Sue*, it might be an answer to *What did John do?*.

According to Jacobs (1984), cases of bound focus and unbound ("free") focus are actually not different at all. He proposes that the illocutionary operator that expresses the sentence mood (assertion, question, directive, optative etc.) may bind the focus. Let us assume ASSERT as assertion operator; then we get the following representations for the two readings:

- (6) a. ASSERT(< $\lambda x.\text{introd}(j,x,b)$, s>) b. ASSERT(< $\lambda P.P(j)$, $\lambda x.\text{introd}(x,s,b)$ >)

Assertion of a structured representation $\langle\alpha, \beta\rangle$ can be described as follows, following Jackendoff (1972): At the current point of discourse, the entities X for which $\alpha(X)$ holds are under discussion, and it is stated that, among these entities, it holds for β that $\alpha(\beta)$. For our example this means that in (a), the persons x for which it holds that John introduced Bill to x are under discussion, and in (b), the properties P that John has are under discussion. In both cases, it is stated that John introduced Bill to Sue. I skip here over different uses of free focus, like presentational vs. contrastive focus as argued for by Rochemont (1986); they might be handled by different illocutionary operators.

The meaning of assertion can be specified more formally, given the concept of an assertion as a modification of shared assumptions of speaker and hearer. Let us call the shared assumptions the "common ground", which is represented simply by a set of possible worlds (cf. Stalnaker 1979), and let us assume that the semantic representation of a sentence Φ is a set of possible worlds (Φ). Then we can give the following definition of assertion (cf. Krifka 1990):

- (7) ASSERT($\langle\alpha, \beta\rangle$) maps a common ground c to a common ground c' , where c' is the intersection of c with the set of possible worlds for which $\alpha(\beta)$ is true, i.e.
 $c' = c \cap [\alpha(\beta)]$

Felicity conditions (among others):

- a. $c \neq c$ (asserting $\alpha(\beta)$ makes a difference in the common ground),
- b. $c \neq \emptyset$ (the truth of $\alpha(\beta)$ must not be already excluded by c)
- c. There are X , with $X \approx \beta$ and $X \neq \beta$, such that $\alpha(X)$ could have been asserted with respect to c . That is, it would have changed c , $c \cap [\alpha(X)] \neq c$, it would not be excluded by c , $c \cap [\alpha(X)] \neq \emptyset$, and would have yielded a different output context, $c \cap [\alpha(X)] \neq c \cap [\alpha(\beta)]$.

Note that the partitioning between focus and background does not play any role for the semantics proper of the assertion operator, but affects only its felicity conditions. Conditions (a) and (b) guarantee that the proposition to be asserted is relevant -- it should not already be established or excluded by the current common ground. Condition (c) says that it is relevant which contextually salient alternative is asserted -- that is, the alternatives are assertable as well, and their assertion would make a difference. As usual, if the felicity conditions are not satisfied, they may give rise to accommodations in the sense of Lewis (1979).

2. Multiple Foci

The theory of structured meanings seems to work quite well in examples like the ones considered above. However, we also find cases in which a sentence has more than one focus.

One kind of multiple focus that has been discussed (cf. Taglicht 1984, Rooth 1985, von Stechow 1989, Jacobs 1988, to appear) are cases like the following one:

- (8) John only introduced BILL to SUE.

This sentence has a reading saying that the only pair of persons such that John introduced the first to the second is Bill and Sue. We clearly have two foci, on *Bill* and on *Sue*, that are related to only one focus operator, *only*.

It is relatively straightforward to account for cases like (8): We have to allow for backgrounds to be applied to more than one focus. There are different methods to implement this technically. Perhaps the most perspicuous way is to provide for LISTS in our semantic representation language. Sentence (8) then gets the following analysis:

- (9) $\text{only}(<\lambda x \bullet y. \text{introd}(j, y, x), b \bullet s)$

Here, $b \bullet s$ is a list of two names, and $x \bullet y$ is a list of two variables (which can be bound by a lambda-operator). If we represent a list variable by $h \bullet t$ (where h is the head and t is the tail), application is defined recursively as $\lambda h \bullet t. \Phi(\alpha \bullet \beta) = \lambda t[\lambda h. \Phi(\alpha)](\beta)$. Given the representation (9) and the interpretation of *only* in (3), we get the following interpretation:

- (10) $\text{introd}(j, s, b) \& \forall x \bullet y [x \bullet y = b \bullet s \& \text{introd}(j, y, x) \rightarrow x \bullet y = b \bullet s]$

This says that John introduced Bill to Sue, and that there is no pair comparable but not identical to Bill and Sue such that John introduced the first to the second. This is an adequate analysis of the natural interpretation of this sentence.

To distinguish this case of multiple foci from others discussed later, I will not call it multiple focus, but COMPLEX focus.

There are cases of true multiple foci, that is, cases with more than one focus operator, as shown by Jacobs (1984, 1988, to appear). To distinguish between different pairs of focus operator and associated focus, I will follow Jacobs in using a coindexing convention (although

there will be no coindexing in my final proposal). Perhaps the simplest case is exemplified by the following sentences:

- (11) Even₁ [JOHN]_{F1} drank only₂ [WATER]_{F2}.

Here we have one sentence that contains two focus operators and two foci. In this case, the foci do not overlap. Let us assume that *even* contributes to the meaning that there are alternatives to the focus for which it would be more probable that the proposition holds. For example, *even JOHN came* says that John came, and that there are persons for which it was more likely that they came. Then the meaning of (11) can be rendered as: John drinks water and no other comparable substance, and there are persons for which it would have been more likely that they drink water and no other comparable substance.

The next example shows that within one focus, we can have another pair of focus operator and focus:

- (12) [John, who is quite notorious as a party guest, did not only behave well at yesterdays party.]
he even₁ [only₂ [drank WATER]_{F2}]_{F1}.

(12) says that John drank water, that John did not do other, comparable things, and that there are activities comparable to drinking water and doing nothing else for which it is more probable that John performed them.

The next case we will consider are examples where two operators seem to share one focus:

- (13) [At yesterday's party, people stayed with their first choice of drink. Bill only drank WINE, Sue only drank BEER, and]
John even₁ only₂ drank [WATER]_{F2,F1}

The meaning of (13) can be rendered as: John drank water, John did not drink something that is comparable but not identical to water, and there are things X that are comparable but not identical to water such that it would be more likely that John drank X and only X.

Finally, we have cases where one focus operator forms the focus of another one:

- (14) [Most people drank water at some time during yesterday's party.]
John even₁ drank [ONLY₂]_{F1} [water]_{F2}

This means that John drank water and only water (i.e. nothing comparable to water), and that there are alternatives X to *only* such that *John drank X water* would be more probable. It seems that the only alternative to *only* is *also*; witness the common locution *not only..., but also...*. Hence the last part of the meaning has to be spelled out as: It was more likely that John drank also water (i.e. drank water in addition to other things), than that John drank only water.

The phenomenon of multiple focus is of course more widespread when we follow the analysis of "free" foci given in Jacobs (1984). Then every sentence that contains an overt focus operator actually will have at least two foci, one related to the overt operator, and one related to the illocutionary operator. Jacobs (to appear) discussed this case with the following example (15) to which he assigned the two structures (a, b).

- (15) Peter kennt nur einen Roman von GOETHE.
(Peter only knows a novel by GOETHE.)
- ASSERT₁ Peter kennt nur₂ einen Roman von [GOETHE]_{F1,F2}
 - ASSERT₁ Peter kennt [nur₂ einen Roman von [GOETHE]_{F2}]_{F1}

Jacobs proposes RECURSIVE STRUCTURED MEANINGS for the semantic representation of these cases. For example, the reading (a) is represented as follows:

- (16) **ASSERT**(< $\lambda x.$ only(< $\lambda y \exists z$ [novel(z) & by(y,z) & knows(p, z)], x>), g>)

Given the informal analyses of **only** and **ASSERT** developed above, we arrive at the following: It is asserted that John knows a novel by Goethe and that John does not know a novel by another, comparable person. And the felicity conditions are that those persons x are under discussion such that John knows only a novel by x . The other reading, (15.c), should make the same assertion, but with respect to a different felicity condition, namely that the properties of Peter are under discussion.

For a discussion of the accentual marking of sentences with multiple foci, see Jacobs (1988, to appear). In this article, I will try to give a compositional semantics of sentences with multiple foci, something which has not been done before -- for example, Lyons & Hirst (1990) exclude them explicitly from their discussion because they are "semantically complicated". I will presuppose the following assumptions, which are suggested by the examples we have seen so far:

- There is a one-to-one mapping between focus operators and foci. Remember that I assumed cases like (8) to contain only one, albeit complex, focus.
- Focus is assigned to constituents, or (in case of complex focus) to sets of non-overlapping constituents (see section 4.8 for potential counterexamples).
- Focus operators c-command their focus. This is obvious in the cases of overt operators we have considered so far. A potentially problem arises with illocutionary operators. Some illocutionary operators in some languages obviously c-command the whole sentence; one example is the interrogative *est-que ce* in French. In other cases, different sentence moods are expressed by distinctions in syntactic structure (inversion), intonation, or special categories of the finite verb. We have to assume that, on some level of syntactic representation, these markings are spelled out by operators with widest scope. Some potential problems with overt operators are discussed in section 4.2.
- If one focus operator c-commands directly (i.e. without intervening other focus operators) two or more foci, one including the others, then it is associated with the most comprehensive focus:

- (17) $FO_i/*_j [\alpha [\beta [\gamma]_{F_j} \beta]_{F_i} \alpha],$
where α does not contain focus operators that c-command β .

The only candidate of such a construction we have seen so far is (13), a case where two focus operators seem to be associated with the same focus. This example then has to be analyzed as: *John even₁ only₂ drank [[water]_{F1}]_{F2}*: The focus operator **only** is associated with the most comprehensive focus, F_2 . Of course, this example does not really motivate our assumption. However, the discussion of the issues involved here are relatively complicated, and I will come back to it in section 4.6.

- There is a certain tendency that a focus operator occurs as close as possible to its focus. However, it seems that there are no bounding nodes; witness the following example (which goes back to Jackendoff 1972):

- (18) Sam even₁ saw [NP the man [S who was wearing a [RED]_{F1} hat]].

In this example, the scope of *even* (not to be confused with its focus) is the phrase *saw the man who was wearing a red hat*; and as it has to c-command its scope, it cannot occur deeper

embedded in the syntactic tree. However, its focus *red* is embedded in an NP and an S, thus showing that the operator-focus association does not obey subjacency. Therefore an analysis of focus that implies movement of the focus constituent, such as Chomsky (1977), is questionable (cf. also the discussion in section 4.3).

- Focus-sensitive operators, especially grading particles like *only* and *even*, can be applied to a wide variety of categories - among them VPs and NPs (see examples above) and APs (cf. *an even bigger apple*).

3. Deriving Representations with Focus Compositionally

In this section, I will specify compositional rules for recursive structured meanings. The framework must be flexible enough to cover the cases of complex foci and multiple foci we have considered so far, represented by the following examples:

- (19)
- a. John only₁ introduced [Bill]_{F1} to [Sue]_{F1}.
 - b. Even₁ [John]_{F1} drank only₂ [water]_{F2}.
 - c. John even₁ [only₂ [drank water]_{F2}]_{F1}.
 - d. John even₁ only₂ drank [[water]_{F1}]_{F2}
 - e. John even₁ drank [only₂]_{F1} [water]_{F2}

Focus-background structures will be represented by pairs $\langle \alpha, \beta \rangle$ of a background meaning α and a focus meaning β . We must provide a type for these structures; if the type of α and β are σ and τ , respectively, the type of $\langle \alpha, \beta \rangle$ will be denoted by $\langle \sigma, \tau \rangle$. In general, we assume the following type system:

- (20) Definition of Types:
- a. e, t (entities, truth values)
 - b. If σ, τ are types, then
 - $\langle \sigma, \tau \rangle$ is a type (of functions from σ -denotations to τ -denotations);
 - $\sigma \cdot \tau$ is a type (of a list of σ -denotations and τ -denotations);
 - $\langle \sigma, \tau \rangle$ is a type (of a focus-background structure)

I assume that focus-sensitive operators always are applied to entities of a type that ends in t , such as intransitive predicates, type $(e)t$, predicate modifiers, type $((e)t)(e)t$, etc. The only case where this is problematic is names or pronouns, which arguably are of type e . But we can analyse names and pronouns, like NPs in general, as generalized quantifiers, type $((e)t)t$, and thus get a type ending in t . This assumption about the types of the operands of focus-sensitive operators will allow a relatively simple treatment, without employing rules of operator raising, quantifying in, or operator storage.

Semantic rules typically involve functional application. But functional application has to be generalized to cover focus-background structures. In particular, we must provide for a rule that allows for focus- background-information to be projected to higher nodes. So we have to define an extended version of functional application that takes care of this case.

- (21) Recursive definition of extended application " $()$:
- a. If α is of type $\langle \sigma, \tau \rangle$ and β is of type σ , then $\alpha(\beta)$ is of type τ and is interpreted as functional application.
 - b. Focus inheritance from operator:
If $\langle \alpha, \beta \rangle$ is of type $\langle \langle \sigma, \tau \rangle \mu, \sigma' \rangle$ and γ is of type τ , then $\langle \alpha, \beta \rangle(\gamma)$ is of type $\langle \langle \sigma, \tau \rangle \mu, \sigma' \rangle$, and is interpreted as $\langle \lambda X_\sigma. [\alpha(X)(\gamma)], \beta \rangle$.
 - c. Focus inheritance from argument:

If γ is of type $(\sigma)\tau$ and $\langle\alpha,\beta\rangle$ is of type $\langle(\mu)\sigma,\mu'\rangle$, then $\gamma(\langle\alpha,\beta\rangle)$ is of type $\langle(\mu)\tau,\mu'\rangle$, and is interpreted as $\langle\lambda X\mu.\gamma(\alpha(X)),\beta\rangle$.

- d. Focus inheritance from operator and argument:

If $\langle\alpha,\beta\rangle$ is of type $\langle(\sigma)(\tau)\mu,\sigma'\rangle$ and $\langle\gamma,\delta\rangle$ is of type $\langle(\nu)\tau,\nu'\rangle$, then $\langle\alpha,\beta\rangle(\langle\gamma,\delta\rangle)$ is of type $\langle(\sigma\bullet\nu)\mu,\sigma'\bullet\nu'\rangle$, and is interpreted as $\langle\lambda X\sigma\bullet Y\nu.[\alpha(X)(\gamma(Y))],\beta\bullet\delta\rangle$, where X, Y are distinct variables.

In these definitions, X_σ stands for a variable of type σ . (21.a) describes the basic case of functional application. (b) and (c) say that the focus is stored when a focus-background structure is combined with an argument, or a function that does not take focus-background structures. The variable X makes sure that the original focus can be recovered after the application. (d) is the rule for complex focus; it concatenates two foci and their corresponding variables to a list, which is stored. Note that I do not assume, in general, that the first argument of the background is of the same type as the focus; but in all real applications, these types will stand in the relation of BEING DERIVED FROM. For example, a focus-background structure of type $\langle(\sigma)\tau, \sigma\rangle$ should be said to be derived from τ (the type of the representation when the background is applied to the focus). Similarly, a complex focus-background structure of type $\langle(\mu)\langle(\sigma)\tau, \sigma\rangle, \mu'\rangle$ is said to be derived from type $\langle(\sigma)\tau, \sigma\rangle$, and ultimately derived from type τ . This suggests the following definition:

- (22) Definition of "be derived from":

- a. Every type τ is derived from τ .
- b. Every type $\langle(\sigma)\tau, \mu\rangle$ is derived from τ .
- c. If τ is derived from τ' , and τ' is derived from τ'' , then τ is derived from τ'' .

I give some examples to show how this framework can be used to formulate grammatical rules that cover focus-sensitive constructions. Let us assume the following rules; their syntactic part is deliberately kept simple. If A is a syntactic tree, then $[A]$ is the semantic representation of A in our semantic representation language. I take intransitive verbs to be of the category VP, transitive verbs to be of the category V', and ditransitive verbs to be of the category V. Let x, y, z, x' etc. be variables of type e; P, P' etc. variables of type (e)t; R, R' etc. variables of type (e)(e)t; S, S' etc. variables of type (e)(e)(e)t; and T, T' etc. variables of type ((e)t)t, which will be abbreviated by q. The variable O is used for focus-sensitive operators, which might be of different types; I use fo as an abbreviation of these types fo.

- (23) S₁ S -> NP VP;

$$[[S \text{ NP VP}]] = [[NP]]([[VP]]),$$

- S₂ VP -> V' NP;

$$[[VP \text{ V' NP}]] = \lambda R \lambda T \lambda x. T(\lambda y. R(x,y))([[V']][[NP]]),$$

- S₃ VP -> V_{to} to NP;

$$[[VP \text{ V}_{\text{to}} \text{ to NP}]] = \lambda R \lambda T \lambda x. T(\lambda y. R(x,y))([[V_{\text{to}}]][[NP]]),$$

- S₄ V_{to} -> V NP;

$$[[V_{\text{to}} \text{ V NP}]] = \lambda S \lambda T \lambda y \lambda x. T(\lambda z. S(x,y,z))([[V]][[NP]]),$$

- S_F C -> C_F (indexing of arbitrary category C by focus feature F);

$[[C_F]] = \langle \lambda X. X, [C] \rangle$, where X is of the type from which the type of [C] is derived that is not a focus-background type.

- S_O C -> FO C (FO: category of focus operators);

$\llbracket [C \text{ FO } C] \rrbracket = \lambda <X, Y> \lambda O [\lambda Z. O(<X, Z>)(Y)]([C])([FO])$, where $<X, Y>$ is a focus-background structure variable of the type of $[C]$, and O is a variable of the type of the operator $[FO]$.

The first four rules specify the binding of argument places of verbs by NPs. Rule S_F covers the focussing of a constituent. The feature F has to be realized appropriately by sentence accent. Rule S_O covers focus operators; its function will become clear below.

Let us now look at the derivation of some examples. I start with an example of complex focus, (19.a), which shows the use of lists. In the following derivation tree, I specify the syntactic expression, its category, its representation, and the type of its representation. I also give the syntactic/semantic rules (23), and sometimes the subclauses for the extended application which I use (21). The terms **John**, **Sue**, **Bill** are taken to be quantifiers; we have e.g. **John** = $\lambda P.P(j)$. In this and the following examples, I first give a representation using coindexing; this is for clarification only and has no theoretical status.

- (24) John only1 introduced [Bill]F1 to [Sue]F1.

```

Bill ; NP ; Bill ; ((e)t)t (abbrev. q)
|
SF Bill ; NPF ; < $\lambda T.T$ , Bill> ; <(q)q, q>
|
| introduced ; V ; introd ; (e)(e)(e)t
|/
S4 introduced Bill ; Vto ;
 $\lambda S \lambda T \lambda y \lambda x. T(\lambda z. S(x, y, z))(\text{introd})(<\lambda T.T, \text{Bill}>)$ 
a =  $\lambda T \lambda y \lambda x. T(\lambda z. \text{introd}(x, y, z))(<\lambda T.T, \text{Bill}>)$ 
c = < $\lambda T[\lambda T \lambda y \lambda x. T(\lambda z. \text{introd}(x, y, z))(\lambda T.T(T))]$ , Bill>
a = < $\lambda T \lambda y \lambda x. T(\lambda z. \text{introd}(x, y, z))$ , Bill> ; <(q)(e)(e)t, q>
|
| Sue ; NP ; Sue ; q
| |
| SF Sue ; NPF ; < $\lambda T.T$ , Sue> ; <(q)q, q>
|/
S3 introduced Bill to Sue ; VP
 $\lambda R \lambda T \lambda x. T(\lambda y. R(x, y))(<\lambda T \lambda y \lambda x. T(\lambda z. \text{introd}(x, y, z)), \text{Bill}>) (<\lambda T.T, \text{Sue}>)$ 

Application of first argument:
c < $\lambda T[\lambda R \lambda T \lambda x. T(\lambda y. R(x, y)) (\lambda T \lambda y \lambda x. T(\lambda z. \text{introd}(x, y, z))(T))]$ , Bill>
a = < $\lambda T[\lambda R \lambda T \lambda x. T(\lambda y. R(x, y)) (\lambda y \lambda x. T(\lambda z. \text{introd}(x, y, z)))]$ , Bill>
a = < $\lambda T \lambda T' \lambda x. T'(\lambda y[\lambda y \lambda x. T(\lambda z. \text{introd}(x, y, z))(x, y)])$ , Bill>
a = < $\lambda T \lambda T' \lambda x. T'(\lambda y. T(\lambda z. \text{introd}(x, y, z)))$ , Bill>

Application of second argument:
< $\lambda T \lambda T' \lambda x. T'(\lambda y. T(\lambda z. \text{introd}(x, y, z)))$ , Bill> (< $\lambda T.T, \text{Sue}>)
d = < $\lambda T \bullet T'[\lambda T \lambda T' \lambda x. T'(\lambda y. T(\lambda z. \text{introd}(x, y, z)))(T)(\lambda T.T(T'))]$ , Bill•Sue>
a = < $\lambda T \bullet T' \lambda x. T'(\lambda y. T(\lambda z. \text{introd}(x, y, z)))$ , Bill•Sue> ; <(q•q)(e)t, q•q>
|$ 
```

| *only* ; FO ; **only** ; fo
 | /
 S_O *only introduced Bill to Sue* ; VP ;
 $\lambda<X,Y>\lambda O[\lambda Z.O(<X,Z>)(Y)](<\lambda T\bullet T'\lambda x.T'(\lambda y.T(\lambda z.introd(x,y,z))), \text{Bill}\bullet \text{Sue}>)$
(only)

- Application of first argument:
 a $\lambda O[\lambda Z.O(<\lambda T\bullet T'\lambda x.T'(\lambda y.T(\lambda z.introd(x,y,z))), Z>)(\text{Bill}\bullet \text{Sue})]$
 a $= \lambda O.O(<\lambda T\bullet T'\lambda x.T'(\lambda y.T(\lambda z.introd(x,y,z))), \text{Bill}\bullet \text{Sue}>)$
 Application of second argument:
 a $\text{only}(<\lambda T\bullet T'\lambda x.T'(\lambda y.T(\lambda z.introd(x,y,z))), \text{Bill}\bullet \text{Sue}>)$

Let us assume a meaning postulate for **only** that is like (3) but allows **only** to be applied to all expressions of a type that ends in t:

- (25) $\text{only}(<\alpha, \beta>) :\leftrightarrow \lambda v[\alpha(\beta)(v) \ \& \ \forall X[X=\beta \ \& \ \alpha(X)(v) \rightarrow X=\beta]]$,
 where X is a variable of the type of β and v is a (vector of) variable(s) of the types of the arguments of $\alpha(\beta)$.

Then example (24) can be spelled out as follows:

- (24') *only introduced Bill to Sue* ; $\lambda x[\text{Sue}(\lambda y.\text{Bill}(\lambda z.introd(x,y,z)))] \ \&$
 $\forall T\bullet T'[T\bullet T'=\text{Sue}\bullet \text{Bill} \ \& \ T(\lambda y.T'(\lambda z.introd(x,y,z))) \rightarrow T\bullet T'=\text{Sue}\bullet \text{Bill}]$; (e)t

Application of the subject yields the following result:

- (24'') | *John* ; NP ; **John** ; q
 | /
 S₁ *John only introduced Bill to Sue* ; S ; $\text{John}(\lambda x[\text{Sue}(\lambda y.\text{Bill}(\lambda z.introd(x,y,z)))] \ \&$
 $\forall T\bullet T'[T\bullet T'=\text{Sue}\bullet \text{Bill} \ \& \ T(\lambda y.T'(\lambda z.introd(x,y,z))) \rightarrow T\bullet T'=\text{Sue}\bullet \text{Bill}]$; t

Spelling out the quantifiers will yield the following:

- (24''') $\text{introd}(j,s,b) \ \& \ \forall T\bullet T'[T\bullet T'=\lambda P.P(s)\bullet \lambda P.P(b) \ \& \ \text{introd}(j,x,y) \rightarrow$
 $T\bullet T'=\lambda P.P(s)\bullet \lambda P.P(b)]$

Now we can assume that quantifiers generated by an individual, such as $\lambda P.P(s)$, are comparable only to quantifiers that are generated by an individual as well (note that a sentence like *only John has a car* cannot be refuted by *No, a man has a car, too.*). Furthermore, we should assume that if two lists are comparable, then their respective elements are comparable. Then we can reduce (24''') to the following interpretation:

- (24''') $\text{introd}(j,s,b) \ \& \ \forall x\bullet y[x\bullet y=s\bullet b \ \& \ \text{introd}(j,x,y) \rightarrow x\bullet y=s\bullet b]$

This says: John introduced Bill to Sue, and that there is no pair x and y comparable, but not identical to Sue and Bill such that John introduced y to x.

Next, we will look at an example with two independent focus operators, (19.b). We assume here the following semantics of **even**:

- (26) $\text{even}(<\alpha, \beta>) :\leftrightarrow \lambda v[\alpha(\beta)(v) \ \& \ \exists X[X=\beta \ \& \ \alpha(\beta)(v) <_p \alpha(X)(v)]]$,
 where v and X as in (25) and $<_p$ is a probability relation.

Thus, **even** contributes to the meaning that there are alternatives X to the focus β such that $\alpha(\beta)(v)$ is less probable than $\alpha(X)(v)$. In addition, we could try to incorporate that $\alpha(\beta)(v)$ is considered "unlikely" in general; however, the proposed analysis should suffice for our purpose, as we are not concerned with a detailed analysis of the semantics of **even** (see Jacobs 1983, Kay 1990 for that).

Our example can now be derived as follows, given an analysis of **water** as generalized quantifier $\lambda P \exists x [P(x) \& W(x)]$, where **W** is a predicate applying to water quantities.

- (27) Even₁ [John]_{F1} drank only₂ [water]_{F2}.

```

water ; NP ; water ; q
|
SF water ; NPF ; < $\lambda T.T$ , water> ; <(q)q, q>
|
| only ; FO ; only ; fo
| /
SO only water ; NP ; only(< $\lambda T.T$ , water>)
=  $\lambda P[\text{water}(P) \& \forall T[T \approx \text{water} \& T(P) \rightarrow T = \text{water}]] ; q$ 
|
| drank ; V' ; drank ; (e)(e)t
| /
S2 drank only water ; VP ;
=  $\lambda x[\lambda P[\text{water}(P) \& \forall T[T \approx \text{water} \& T(P) \rightarrow T = \text{water}]](\lambda y.\text{drank}(x,y))]$ 
=  $\lambda x[\text{water}(\lambda y.\text{drank}(x,y)) \& \forall T[T \approx \text{water} \& T(\lambda y.\text{drank}(x,y)) \rightarrow T = \text{water}]]$ 
=  $\lambda x[\exists y[\text{drank}(x,y) \& W(y)] \& \forall P[P \approx W \& \exists y[\text{drank}(x,y) \& P(y)] \rightarrow P = W]] ; (e)t$ 
|
| John ; NP ; John ; q
| |
| SF John ; NPF ; < $\lambda T.T$ , John> ; <(q)q, q>
| |
| | even ; FO ; even ; fo
| | /
| SO even John ; NP ; even(< $\lambda T.T$ , John>)
| =  $\lambda P[\text{John}(P) \& \exists T[T \approx \text{John} \& \text{John}(P) <_p T(P)]]$ 
| =  $\lambda P[P(j) \& \exists x[x \approx j \& P(j) <_p P(x)]] ; q$ 
| /
S1 even John drank only water ; S ;
=  $\exists y[\text{drank}(j,y) \& W(y) \& \forall P[P \approx W \& \exists y[\text{drank}(j,y) \& P(y)] \rightarrow P = W]] \&$ 
=  $\exists x[x \approx j \& \exists y[\text{drank}(j,y) \& W(y) \& \forall P[P \approx W \& \exists y[\text{drank}(j,y) \& P(y)] \rightarrow P = W]] <_p$ 
=  $\exists y[\text{drank}(x,y) \& W(y) \& \forall P[P \approx W \& \exists y[\text{drank}(x,y) \& P(y)] \rightarrow P = W]]]$ 
```

This says (a) that John drank water, and no other comparable substance, and (b) that there are comparable individuals x' for which it is more probable that they drank only water. This is a correct interpretation of our example. We assumed here that indefinite quantifiers like $\lambda P[P(x) \& W(x)]$ are compatible only to other indefinite quantifiers, hence we can reduce the condition $T \approx \text{water}$ to $P \approx W$.

To obtain this reading, it is crucial that **even** gets scope over **only**. This scope relationship is a consequence of the fact that the NP to which **even** is adjoined has **only** in its scope (or syntactically, **only** is c-commanded by that NP). The syntactic rules guarantee the right scoping.

We have seen how cases are handled in which one operator is in the scope of another. Our next example concerns a case in which one operator is not only in the scope, but also in the focus, of another, namely (19.c).

(28) John even₁ [only₂ [drank water]_{F2}]_{F1}.

```

drank water ; VP ;  $\lambda x \exists y [\text{drank}(x,y) \ \& \ W(y)]$  ; (e)t
|
SF drank water ; VPF ; < $\lambda P.P$ ,  $\lambda x \exists y [\text{drank}(x,y) \ \& \ W(y)]$ > ; <((e)t)(e)t, (e)t>
|
| only ; FO ; only ; fo
| /
SO only drank water ; VP ;
only(< $\lambda P.P$ ,  $\lambda x \exists y [\text{drank}(x,y) \ \& \ W(y)]$ >)
=  $\lambda x [\exists y [\text{drank}(x,y) \ \& \ W(y)] \ \& \ \forall P [P \approx \lambda x \exists y [\text{drank}(x,y) \ \& \ W(y)] \ \& \ P(x) \rightarrow$ 
 $P = \lambda x \exists y [\text{drank}(x,y) \ \& \ W(y)]]$  (= [1], for short) ; (e)t
|
SF only drank water ; VPF ; < $\lambda P.P$ , [1]> ; <((e)t)(e)t, (e)t>
|
| even ; FO ; even ; fo
| /
SO even only drank water ; VP ;  $\lambda x [[1](x) \ \& \ \exists P [P \approx [1] \ \& \ [1](x) <_p P(x)]]$  ; (e)t
|
| John ; NP ; John ; e
| /
S1 John even only drank water ; S ; [1](j) &  $\exists P [P \approx [1] \ \& \ [1](j) <_p P(j)]$  ; t

```

This says that John drank water, that he did nothing comparable, and that there are properties comparable to the property of drinking water and doing nothing else such that it would have been more likely that John had them. This is a correct representation of the reading of our example.

Let us now look at the treatment of (19.d), where two operators seem to share one focus. In our reconstruction, a focus operator can be associated with only one focus. But we may apply the focussation rule to one constituent twice, one time for each operator, and get an adequate interpretation:

(29) John even₁ only₂ drank [[water]_{F1}]_{F2}

```

water ; NP ; water ; q
|
SF water ; NPF ; < $\lambda T.T$ , water> ; <(q)q, q>
|
SF water ; NPFF ; < $\lambda T.T$ , < $\lambda T.T$ , water>> ; <(q)q, <(q)q, q>>
|
| drank ; V' ; drank ; (e)(e)t
| /
S2 drank water ; VP ;
 $\lambda R \lambda T \lambda x. T(\lambda y R(x,y)) (\text{drank})(\lambda T.T, <\lambda T.T, \text{water}>>)$ 
c = < $\lambda T \lambda x. T(\lambda y. \text{drank}(x,y))$ , < $\lambda T.T$ , water>> ; <(q)(e)t, <(q)q, q>>
|
```

| *only* ; FO ; **only** ; fo
 | /
SO *only drank water* ; VP ;
 $\lambda<X,Y>\lambda O[\lambda Z.O(<X,Z>)(Y)](<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), <\lambda T.T, \text{water}>>)(\text{only})$
a = $\lambda Z.\text{only}(<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), Z>)(<\lambda T.T, \text{water}>)$
c = $<\lambda T.\text{only}(<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), T>), \text{water}> ; <(q)(e)t, q>$
 |
 | *even* ; FO ; **even** ; fo
 | /
SO *even only drank water* ; VP ;
 $\lambda<X,Y>\lambda O[\lambda Z.O(<X,Z>)(Y)](<\lambda T.\text{only}(<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), T>), \text{water}>>)(\text{even})$
= $\text{even}(<\lambda T.\text{only}(<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), T>), \text{water}>)$

Spelling out **even** yields

$\lambda x[\text{only}(<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), \text{water}>)(x) \ \&$
 $\exists T[T=\text{water} \ \& \ \text{only}(<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), \text{water}>)(x) <p$
 $\text{only}(<\lambda T\lambda x.T(\lambda y.\text{drank}(x,y)), T>)(x)]]]$

Spelling out **only** yields

$\lambda x[\text{water}(\lambda y.\text{drank}(x,y)) \ \& \ \forall T[T=\text{water} \ \& \ T(\lambda y.\text{drank}(x,y)) \rightarrow T=\text{water}] \ \&$
 $\exists T'[T'=\text{water} \ \&$
 $[\text{water}(\lambda y.\text{drank}(x,y)) \ \& \ \forall T[T=\text{water} \ \& \ T(\lambda y.\text{drank}(x,y)) \rightarrow T=\text{water}] <p$
 $[T'(\lambda y.\text{drank}(x,y)) \ \& \ \forall T[T=T' \ \& \ T(\lambda y.\text{drank}(x,y)) \rightarrow T=T']]]]$

Spelling out **water** and binding the subject argument by *j* (via rule S₁) yields as representation of *John even only drank water*:

$\exists y[\text{drank}(j,y) \ \& \ W(y)] \ \& \ \forall P[P=W \ \& \ \exists y[\text{drank}(j,y) \ \& \ P(y)] \rightarrow P=W] \ \&$
 $\exists P'[P'=W \ \&$
 $\exists y[\text{drank}(j,y) \ \& \ W(y) \ \& \ \forall P[P=W \ \& \ \exists y[\text{drank}(j,y) \ \& \ P(y)] \rightarrow P=W]] <p$
 $\exists y[\text{drank}(j,y) \ \& \ P'(y) \ \& \ \forall P[P=P' \ \& \ \exists y[\text{drank}(j,y) \ \& \ P(y)] \rightarrow P=W]]]$

This says (a) that John drank water and no other comparable substance, and (b) that there is a substance *P* comparable to water such that it would have been more probable that John drank only that substance. This renders the reading of our example adequately.

It is crucial for this derivation that the first focus operator, *only*, is associated with the last focus feature of the NP, leaving additional focus features to other operators. This is accomplished by the semantic rule for the combination of a focus operator with a constituent (23, SO). This rule expects a focus-background structure, but allows for the focus to consist itself of a focus-background structure, which would then be passed to the complex semantic representation, such that it can be submitted to higher operators. Also, with this example it becomes obvious why the semantic part of rule SF was formulated in that complicated way ("X is of the type from which the type of (A) is derived that is not a focus-background type").

Finally, let us look at a case in which one operator is the focus of another, (19.e).

(30) John even₁ drank [only₂]F₁ [water]F₂

```

water ; NP ; water ; q
|
SF water ; NPF ; <λT.T, water> ; <(q)q, q>
|
|   only ; FO ; only ; fo
|   |
|   SF only ; FOF ; <λO.O, only> ; <(fo)fo, fo>
|
SO only water ; NP ;
    λ<X,Y>λO[λZ.O(<X,Z>)(Y)](<λT.T, water>)(<λO.O, only>)
    = <λO.O(<λT.T, water>), only> ; <(fo)q, fo>
|
|   drank ; V' ; drank ; (e)(e)t
|
S2 drank only water ; VP ;
    <λO.O(<λTλx[T(λy.drank(x,y)), water>), only> ; <(fo)(e)(e)t, fo> ;
    abbr. <λO.O([1]), only>
|
|   even ; FO ; even ; fo
|
SO even drank only water ; NP ; even(<λO.O([1]), only>)
    = λx[only([1])(x) & ∃O[O=only & only([1])(x) <p O([1])(x)]] ; q ; abbr. [2]
|
|   John ; NP ; λP.P(j) ; q
|
S1 John even drank only water ; S ; [2](j)
    = only([1])(j) & ∃O[O=only & only([1])(j) <p O([1])(j)]]
    = ∃y[drank(j,y) & W(y) & ∀P[P=W & ∃y[drank(j,y) & P(y)] → P=W]] &
    ∃O[O=only &
    ∃y[drank(j,y) & W(y) & ∀P[P=W & ∃y[drank(j,y) & P(y)] → P=W]] <p
    O(<λT.T, W>)(λy.drank(j,y))]]

```

This says (a) that John drank water, and no other comparable substance, and that the proposition (a) is less probable than another one where **only** is replaced by a focus operator comparable with **only**. Let us assume that the only comparable operator is **also**, and let us specify the meaning of **also** as follows:

$$(31) \quad \text{also}(<\alpha, \beta>) : \leftrightarrow \lambda v[\alpha(\beta)(v) \& \exists X[X=\beta \& \neg X=\beta \& \alpha(X)(v)]], \\ \text{where } v \text{ and } X \text{ as in (25).}$$

That is, **also** says that the background representation applies to the focus representation, and that in addition there is an entity comparable with, but different from the focus representation to which the background representation applies as well. Then we get the following representation for our example:

$$(32) \quad \exists y[drank(j,y) \& W(y) \& \forall P[P=W \& \exists y[drank(j,y) \& P(y)] \rightarrow P=W]] \& \\ \exists y[drank(j,y) \& W(y) \& \forall P[P=W \& \exists y[drank(j,y) \& P(y)] \rightarrow P=W]] <_p \\ \exists y[drank(j,y) \& W(y) \& \exists P[P=W \& \neg P=W \& \exists y[drank(j,y) \& P(y)]]]$$

This says that John drank water, and only water, and that the probability that John drank water and only water is smaller than the probability that John drank water and also some other salient substance comparable with water. This is a correct representation of (19.e).

Let us now turn to illocutionary operators. We assume that they get the widest scope, by a rule like the following one that combines a sentence (S) with an illocutionary operator (IO) to an illocutionary complete sentence (SI):

- (33) $S_I \quad SI \rightarrow IO \ S$ (alternatively, $S \ IO$);
 $\llbracket [SI \ IO \ S] \rrbracket = \llbracket IO \rrbracket ([S])$,

I give one simple example with the illocutionary operator **ASSERT**, represented orthographically by suffixing a fullstop ".", as the only focus operator:

- (34) $John \ [drank \ water]_F ; S ; \langle \lambda P.P(j), \lambda x \exists y [drank(x,y) \ \& \ W(y)] \rangle ; \langle ((e)t)t, (e)t \rangle$
|
| . ; IO ; **ASSERT** ; fo
|/
 $S_I \ John \ drank \ water. ; SI ; \text{ASSERT}(\langle \lambda P.P(j), \lambda x \exists y [drank(x,y) \ \& \ W(y)] \rangle) ; t$

Let us assume an analysis of assertion like in (7). We arrive at the following result:

- (35) $\text{ASSERT}(\langle \lambda P.P(j), \lambda x \exists y [drank(x,y) \ \& \ W(y)] \rangle)$ maps a common ground c to a common ground c' , where c' is the intersection of c with the set of possible worlds for which $\exists y [drank(j,y) \ \& \ W(y)]$ is true.
Felicity conditions: $c \neq c'$, $c \neq \emptyset$, and there are salient P with $P \approx \lambda x \exists y [drank(x,y) \ \& \ W(y)]$ and $P \neq \lambda x \exists y [drank(x,y) \ \& \ W(y)]$ such that the intersection of c with the set of worlds for which $P(j)$ holds neither equals c , nor \emptyset , nor c' .

Thus, the assertion of $John \ [drank \ water]_F$ changes the common ground to those worlds in which John drank water. The felicity conditions say that this assertion is informative at the current point of discourse, that it is not excluded already, that there are other, salient properties comparable with the property of drinking water that could have been asserted of John as well, and that they would have made a difference.

If the sentence which is asserted contains a focus operator, then it is necessary to introduce another focus; otherwise the application conditions for **ASSERT** could not be met. One example:

- (36) $only \ [drank \ water]_F ; VP ;$
 $\lambda x [\exists y [drank(x,y) \ \& \ W(y)] \ \& \ \forall P [P \approx \lambda x \exists y [drank(x,y) \ \& \ W(y)] \ \& \ P(j) \rightarrow P = \lambda x \exists y [drank(x,y) \ \& \ W(y)]]] \ (= [1], \text{for short}) ; (e)t$
|
 $S_F \ only \ drank \ water ; VPF ; \langle \lambda P.P, [1] \rangle ; \langle ((e)t)(e)t, (e)t \rangle$
|
| $John ; NP ; John ; q$
|/
 $S_I \ John \ only \ drank \ water ; SI ; \langle \lambda P.P(j), [1] \rangle ; \langle ((e)t)t, (e)t \rangle$
|
| . ; IO ; **ASSERT** ; fo
|/
 $S_I \ John \ only \ drank \ water. ; SI ; \text{ASSERT}(\langle \lambda P.P(j), [1] \rangle) ; t$

We get the following representation:

- (37) (36) maps a common ground c to a common ground c' , where c' is the intersection of c with the set of possible worlds for which $[1](j)$ is true.

Felicity conditions: $c \neq c'$, $c \neq \emptyset$, and there are salient P' with $P' \neq [1]$ such that the intersection of c with the set of worlds for which $P'(j)$ neither equals c , nor \emptyset , nor c' .

The assertion of (36) changes the common ground to those worlds in which John drank only water, under the felicity conditions that this proposition is possible at the current point of discourse and is informative, and that there are salient properties comparable with the property of drinking only water such that it would have been possible to assert them of John, and they would have made a difference.

In concluding this section, I want to point out that we did not use any coindexing between focus operators and their focus. We could do without that because the function of indexing is inherent in the syntactic-semantic rules. They guarantee that each focus (which might be complex) is related to exactly one focus operator. If there were more focus operators than foci, then some operators could not be applied to a focus-background structure, thus yielding an illformed semantic representation. On the other hand, if there were more foci than focus operators to bind them, the final representation would consist of uninterpreted focus-background structures, which again is illformed. The rules guarantee, furthermore, that a focus operator has scope over its focus. We can conclude that the proposed syntactic coindexing is both motivated and made redundant by the syntactic-semantic rules.

4. Further Adaptations

In this section, I will discuss some constructions that are problematic for the representation format developed above, and I will propose possible solutions.

4.1. DISCONTINUOUS CONSTITUENTS. -- We have assumed that non-complex focus applies to syntactic constituents. There are, however, examples that show that this is not always the case.

First, certain constructions suggest that focus may apply to discontinuous constituents. I give three examples, two from German and one from English:

- (38) a. Er hat [sich]_{F1} nur₁ [RASIERT]_{F1}
He has only shaved himself.
- b. Diese Tat [forderte]_{F1} seinen Ehrgeiz geradezu₁ [HERAUS]_{F1}.
This act really challenged his ambition.
- c. John only₁ [turned]_{F1} it [OFF]_{F1}.

In (38.a), a variation of an example in Jacobs (1983), the particle *nur* clearly can focus on *sich rasiert*, but note that this forms a discontinuous constituent on surface structure. Also, in (38.b) the particle *geradezu* focusses on the verb *herausforderte*, which is discontinuous. Similarly, in (38.c) *only* may focus on *turn off*, which again does not form a constituent on surface structure.

One way to cope with such cases is to assume that certain transformations may follow focus assignment, that is, focus assignment does happen at a representation level prior to surface structure (cf. 39.a for the case of 38.b).

- (39) a. e e diese Tat seinen Ehrgeiz geradezu₁ [HERAUS [forderte]]_{F1}

- b. [diese Tat]; [forderte]; t_1 seinen Ehrgeiz geradezu1 [HERAUS [t_1]]F1

Another indication that focus marking may apply to some level of deep structure is that in some cases the operator does not seem to c-command its focus. One example mentioned by Jackendoff (1972) is that *even* (but not, e.g., *only*) might be associated with the subject as focus in (40):

- (40.a) JOHN (even) will (even) have given his daughter a new bicycle.

According to Jackendoff, *even* c-commands the subject in both positions, as he assumed a "flat" structure [S NP (*even*) [AUX*will*] (*even*) VP]. Alternatively, we might assume that the c-command condition is checked at an underlying level of syntactic representation, or at a surface structure that contains traces, where it suffices that an operator c-commands the TRACE of its focus. The latter option was proposed by Jacobs (1986) for similar constructions in German.

In any case, the syntactic and semantic rules specified above are strictly surface-oriented and hence cannot treat the phenomena discussed here as they stand. Changes along the lines suggested here are possible (that is, semantic rules that apply to non-surface structures or to enriched surface structures), but I will not carry out these modifications.

4.2. FOCUS AND ILLOCUTIONARY OPERATORS. -- We have assumed above that illocutionary operators always are associated with their own focus. This assumption probably must be qualified in several respects. For one thing, it is often difficult to determine, in a running text, where the foci should be. We might take this as an indication that illocutionary operators do not need to be associated with a focus. There are other cases of operators that apparently can or cannot be associated with a focus, for example negation (sentence negation vs. constituent negation). Another reason to assume illocutionary operators that are not focussing is that it sometimes seems artificial to propose for a sentence that already has an overt focus operator an additional illocutionary focus.

In some cases, we can argue that operators that seem to have their own focus actually modify or specify the illocutionary operator, so that their apparent focus actually is the focus of that operator. This was proposed by Jacobs (1988) for sentence mood particles in German. A case which might be explained along the same lines is English *even* (deviating from the analysis given in the previous section). *Even* has several properties which distinguishes it from apparent counterparts like *only*. First, *even* always must have wide scope over other focus operators, like *only* (cf. 41). Second, adverbial *even* might be related to subject focus, in contrast to adverbial *only* (cf. Jackendoff 1972, 42). Third, focus on *even* seems to be barred, except in correction contexts (43). Finally, sentences with multiple *even* are considerably more difficult to get than sentences with multiple *only*; they have even been considered ungrammatical (cf. Kay 1990, 44).

- (41) a. John even only drank water.
 b. *John only even drank water.

- (42) a. JOHN (even) will (even) have given his daughter a new bicycle.
 b. *JOHN (only) will (only) have given his daughter a new bicycle.

- (43) a. John ONLY drank water.
 b. ??John EVEN drank water.

- (44) a. Only JOHN drank only water.
 b. ??Even JOHN drank even water.

One possible explanation for this behaviour of *even* might be along the lines in which Jacobs (1983) explained the possible scope relations between German *sogar* and *nur*, which are parallel to *even* and *only*. He showed that *sogar* is an affirmative polarity item, and that *nur* does not license these items. However, English *even* may be (part of) a negative polarity item; cf. *if this costs even so much as a dime, I would not buy it* (note that German would use *auch nur* instead of *sogar* in these contexts).

The observations given above fall in their place if we assume that *even* actually modifies the illocutionary operator. Then it must have wide scope over other overt operators (we have assumed this for illocutionary operators in general), it may focus on the subject (because the illocutionary operator has the subject in its scope), it could never receive focus from the illocutionary operator (in a sense, it is part of that operator), and we should not expect multiple *even*, as the illocutionary operator is associated with only one focus. Concerning this latter point, it is interesting to note that the examples with multiple *even* are generally such that we have to put equal stress on both foci; such as the following one, going back to Fraser 1970 (cf. Kay 1990):

- (45) Even WORDS give trouble to even LINGUISTS.

But this would mean that the foci of *words* and *linguists* are not ordered with respect to each other; hence they should be described as one, complex, focus of the illocutionary operator modified by *even*.

4.3. FOCUS AND MOVEMENT. -- The theory of focus developed here does not imply any movement of the focus constituent. Jackendoff (1972), and later Rooth (1985), argued against a movement analysis, as association with focus does not obey island constraints (cf. 18). Not obeying syntactic constraints, focus should preferably be treated in the semantic representation language. The reason why Chomsky (1977) proposed an analysis of focus that involves LF-movement is that coreference between a pronoun and a NP in focus seems to obey the same restrictions as coreference between a pronoun and a quantified NP. Quantified NPs, it is argued, have to move at LF, and preceding pronouns cannot be bound by them as this leads to crossover constellations. The relevant data are as follows; (46.a) shows that binding is o.k. with (non-moving) names, (b) shows that a focused NP cannot bind the pronoun, and (c) shows that quantified NPs behave similarly:

- (46) a. After he_i came home, John_i went to bed.
 b. *After he_i came home, JOHN_i went to bed.
 John_i [after he_i went home, t_i went to bed]
 c. *After he_i came home, someone_i went to bed.
 Someone_i [after he_i went home, t_i went to bed]

A different explanation for the unavailability of (46.b), which does not recur to movement, is that expressions with a focus feature cannot refer to something that is given in the immediate context (47.a), except when used contrastively (47.b).

- (47) a. *John and Mary came in. JOHN kissed Mary.
 b. John kissed Mary, and then MARY kissed JOHN.

One observation that supports this reinterpretation of (46.b) is that these sentences get much better in the case of contrastive focus (cf. also Lujan 1986 for related data):

- (48) After he_i had kissed her_j, MARY_j kissed JOHN_i

Another phenomenon that *prima facie* calls for a movement analysis was presented by Kratzer (1989) with examples like the following:

- (49) (What a copycat you are! You visit all the nice places I have visited.)
No, I only₁ went to TANGLEWOOD_{F1} because you did.

Kratzer shows that in Rooth's original approach, the VP anapher would be spelled out as in: *I only went to TANGLEWOOD because you went to TANGLEWOOD*. This implies two foci that are, in principle, independent of each other, or a complex focus. However, example (49) involves only one simple focus; its reading can be rendered as: Only for $x = \text{Tanglewood}$ it holds that I went to x because you went to x . Kratzer develops a theory, based on a version of alternative semantics mentioned in Rooth (1985), that generates this reading without assuming LF-movement, but with the help of a separate process of variable binding.

The current framework allows for other solutions within structured meanings, assuming certain conditions for comparability. First, look at the following derivation, where we assume that the antecedent VP replaces the anaphor.

- (50) *went to [Tanglewood]_F ; VP ; < $\lambda y \lambda x. \text{went-to}(x,y)$, t>*
 |
 | *you did (= went to [Tanglewood]_F) ; S*
 | < $\lambda y \lambda x. \text{went-to}(x,y)$, t>(you) = < $\lambda y. \text{went-to}(you,y)$, t>
 | |
 | | *because ; $\lambda p \lambda P \lambda x. \text{because}(P(x), p)$*
 | | /
 | | *because you did ; < $\lambda y \lambda P \lambda x. \text{because}(P(x), \text{went-to}(you,y))$, t>*
 | |/
went to Tanglewood because you did ; VP
< $\lambda y \bullet y \lambda x. \text{because}(\text{went-to}(x,y), \text{went-to}(you,y'))$ >
 |
 | *only ; FO ; only*
 |/
only went to Tanglewood because you did ; VP ; $\lambda x[\text{because}(\text{went-to}(x,t), \text{went-to}(you,t)) \& \forall y \bullet y[y \bullet y' \approx t \& \text{because}(\text{went-to}(x,y), \text{went-to}(you,y')) \rightarrow y \bullet y' \approx t]]$
 |
 | *I ; NP ; I*
 |/
I only went to Tanglewood because you did ; S ; $\text{because}(\text{went-to}(I,t), \text{went-to}(you,t)) \& \forall y \bullet y[y \bullet y' \approx t \& \text{because}(\text{went-to}(I,y), \text{went-to}(you,y')) \rightarrow y \bullet y' \approx t]$

Let us assume that the interpretation of conditions like $y \bullet y' \approx t \bullet t$ implies not only that $y=t$ and $y'=t$, but also that $y=y'$, as the elements of the right-hand side are equal. In general, we require that whenever $X_1 \bullet X_2 \bullet \dots \bullet X_n \approx Y \bullet Y \bullet \dots \bullet Y$, then $X_1 = X_2 = \dots = X_n$. Given that, we can reduce the second part of the final representation as: $\forall y[y \approx t \& \text{because}(\text{went-to}(I,y), \text{went-to}(you,y)) \rightarrow y \approx t]$. The reading we get, then, can be paraphrased as: I went to Tanglewood because you went to Tanglewood, and there is no alternative y to Tanglewood such that I went to y because you went to y .

An objection against this analysis is that it would treat cases like (50) similar to cases where the anaphor is fully spelled out, as in

- (51) I only went to TANGLEWOOD because you went to TANGLEWOOD.

The only plausible interpretation of (51) is one in which the first occurrence of *Tanglewood* is, or is contained in, the focus of *only*, and the second one is the focus of the illocutionary operator, which can be paraphrased by: The reason why I only went to Tanglewood is because you went to Tanglewood. This suggests a principle saying that a complex focus (whose parts are associated with the same operator) cannot contain identical overt foci. Note that one would need an explanation of this phenomenon even if one would adopt Kratzer's solution, as her theory only makes a claim about anaphors in focus and would allow for *only* to be associated with both foci in (51).

4.4. THE SCOPE OF FOCUS OPERATORS. -- In section (3), we didn't assume any particular scoping rules for focus operators. Although they are essentially propositional operators, we claimed that it is sufficient that the representations they operate on have a type that ends in t.

This guarantees that a focus operator always has the most narrow possible scope. To see this, consider at a case where an focus operator has an AP in scope. As such constructions are marginal in English (except with comparatives, e.g. *an even bigger car*), I will discuss a German example:

- (52) Peter kaufte ein nur₁ [MITTELMÄSSIGES]_{F1} Auto
Peter bought an only average car

The crucial thing is that *nur* has scope over the adjective and has to be prevented from taking wide scope, over the whole NP, the VP, or the sentence. This is done naturally when we assume that adnominal APs are nominal modifiers of the type ((e)t)(e)t. Given an obvious rule for the combination of AP's with N's, we get the following interpretation, where M is a variable of type ((e)t)(e)t and semantic combination is by functional application:

- (53) mittelmäßiges ; AP_F ; <λM.M, average>
 |
 | nur ; FO ; only
 |/
 nur mittelmäßiges ; AP ; only(<λM.M, average>)
 $= \lambda P \lambda x [\text{average}(P)(x) \& \forall M [M = \text{average} \& M(P)(x) \rightarrow M = \text{average}]]$
 |
 | Auto ; N ; car
 |/
 nur mittelmäßiges Auto ; N
 $\lambda x [\text{average}(\text{car})(x) \& \forall M [M = \text{average} \& M(\text{car})(x) \rightarrow M = \text{average}]]$
 |
 | ein ; Det ; $\lambda P' \lambda P \exists x [P(x) \& P'(x)]$
 |/
 ein nur mittelmäßiges Auto ; NP ;
 $\lambda P \exists x [P(x) \& \text{average}(\text{car})(x) \& \forall M [M = \text{average} \& M(\text{car})(x) \rightarrow M = \text{average}]]$

Thus, the focus operator *nur* is applied directly to the AP. We get a predicate that applies to average cars, but not to cars that have another property comparable to *average*. Given a more refined analysis of *only* that considers its scalar properties (cf. e.g. Jacobs 1983), this means that the predicate applies to cars that are maximally of average quality, but not of a higher quality.

One observation that might be a counterexample to the claim that focus operators have the most narrow scope possible was reported by Taglicht (1984). According to him, the following sentence has two readings:

- (54) We are required to study only syntax.
 a. It is required that we study syntax and no other subject.
 b. Only for syntax and for no other subject it is required that we study it.

In the latter reading, the expression *only syntax* gets wide scope over *required*. Note that the wide scope interpretation of *only* is not possible when it is an adverbial modifier, as in *we are required to only study syntax*. A plausible explanation of this phenomenon was put forward by Rooth (1985): NPs in general can have wide-scope reading (witness the specific interpretation of *a book* in *we are required to read a book*), and NPs with focus operators take part in that. That is, focus operators do not get wide scope on their own, but only when carried "piggy-back" by an expression that can get wide scope. However we will implement wide-scope readings of NPs -- LF-movement, quantifying-in, or operator storage --, this should carry over to cases like (54).

4.5. FOCUS ON REFLEXIVES AND RECIPROCALS. -- Interesting problems arise in cases like the following, where a focus operator is associated with a reflexive or reciprocal pronoun:

- (55) a. John_i loves only himself_i.
 b. [John and Mary]_i love only each other_i.

The analysis of (54.a) is relatively straightforward if we assume that reflexives are terms $\lambda P.P(x_i)$, where the variable x_i has to be bound by its antecedent (in the case at hand, the subject). Without going deeper into the modelling of this binding, let us assume that the subject in (55.a) is represented by a term $\lambda P \exists x_i[P(x_i) \& x_i=j]$ that binds the variable x_i (where a free variable x_i in the argument doesn't get replaced during application). Then we get the following interpretation, which says that John loves John, and John loves no alternative to John.

- (56) *himself ; NP_i ; $\lambda P.P(x_i)$*
 |
 himself ; NP_{iF} ; < $\lambda T.T$, $\lambda P.P(x_i)$ >
 |
 | *only ; FO ; only*
 |/
 only himself ; NP ; $\lambda P[P(x_i) \& \forall y[y=x_i \& P(y) \rightarrow y=x_i]]$
 |
 | *loves ; V' ; love*
 |/
 loves only himself ; VP ; $\lambda x[\text{love}(x,x_i) \& \forall y[y=x_i \& \text{love}(x,y) \rightarrow y=x_i]]$
 |
 | *John ; NP_i ; $\lambda P \exists x_i[P(x_i) \& x_i=j]$*
 |/
 John loves only himself ; S ; $\exists x_i[\text{love}(x_i,x_i) \& \forall y[y=x_i \& \text{love}(x_i,y) \rightarrow y=x_i] \& x_i=j]$
 | *= love(j,j) \& $\forall y[y=x_i \& \text{love}(j,y) \rightarrow y=j]$*

The treatment of reciprocals requires some more effort. I will sketch one way how it can be done. Let us assume that we have a sum formation on individuals, \oplus , such that whenever x, y are individuals, so is $x \oplus y$; \oplus should be the join operation of a join semi-lattice (cf. Link 1983). In particular, \oplus is a symmetric operation, that is, $x \oplus y = y \oplus x$. We also assume a list operation • that is asymmetric. Verbal predicates and relations in natural language typically are cumulative with respect to \oplus in the sense that whenever $P(x)$ and $P(y)$, then $P(x \oplus y)$, and whenever $R(x, x')$ and $R(y, y')$, then $R(x \oplus x', y \oplus y')$. Furthermore, we assume that natural-language predicates and relations in general are cumulative and distributive with respect to list formation; that is, $P(x) \& P(y) \leftrightarrow P(x \otimes y)$ and $R(x, x') \& R(y, y') \leftrightarrow R(x \otimes x', y \otimes y')$. All this can be imposed by suitable meaning postulates.

The reciprocal anaphor *each other*, just like the reflexive, is bound by an antecedent. It requires that this antecedent is a list l , and it imposes that the verbal predicate applies to the RECIPROCAL VARIANT of that list. Before I give a general definition of this notion, let us look at two examples: The reciprocal variant of the list $j \bullet b$ is $b \bullet j$, and the reciprocal variant of $j \bullet b \bullet s$ is $b \oplus s \bullet j \oplus s \bullet j \oplus b$. In general, l' is the reciprocal variant of l iff l and l' have the same length, and the n -th element of l' is the sum individual of all elements of l with the exception of its n -th element. Let us assume a function rec that maps lists to their reciprocal variants. Then the meaning of each other_i is the term $\lambda P.P(\text{rec}(x_i))$. Let us assume that coordination can be interpreted as list formation. I give an example that shows the treatment of sentences with the reciprocal in focus:

- (57) *each other ; NP_i ; $\lambda P.P(\text{rec}(x_i))$*
 |
 each other ; NPF ; < $\lambda T.T, \lambda P.P(\text{rec}(x_i))>$
 |
 | *only ; FO ; only*
 |/
 only each other ; NP ; $\lambda P[P(\text{rec}(x_i)) \& \forall y[y = \text{rec}(x_i) \& P(y) \rightarrow y = \text{rec}(x_i)]]$
 |
 | *love ; V', love*
 |/
 love only each other ; $\lambda x[\text{love}(x, \text{rec}(x_i)) \& \forall y[y = \text{rec}(x_i) \& \text{love}(x, y) \rightarrow y = \text{rec}(x_i)]]$
 |
 | *John, Bill and Sue ; NP ; $\lambda P \exists x_i[P(x_i) \& x_i = j \bullet b \bullet s]$*
 |/
 John, Bill and Sue love only each other ; $\exists x_i[\text{love}(x_i, \text{rec}(x_i)) \& \forall y[y = \text{rec}(x_i) \& \text{love}(x_i, y) \rightarrow y = \text{rec}(x_i)] \& x_i = j \bullet b \bullet s]$
 = *love(j \bullet b \bullet s, b \oplus s \bullet j \oplus s \bullet j \oplus b) \& \forall y[y = b \oplus s \bullet j \oplus s \bullet j \oplus b \& \text{love}(j \bullet b \bullet s, y) \rightarrow y = b \oplus s \bullet j \oplus s \bullet j \oplus b]*

Under the assumption that only lists with the same number of elements are comparable, that *love* is divisive for both lists and sums, and that all atomic individuals are comparable to each other, this amounts to the following:

$$\begin{aligned} & \text{love}(j, b) \& \text{love}(j, s) \& \forall y[\text{love}(j, y) \rightarrow y = b \vee y = s] \& \\ & \text{love}(b, j) \& \text{love}(b, s) \& \forall y[\text{love}(b, y) \rightarrow y = j \vee y = s] \& \\ & \text{love}(s, j) \& \text{love}(s, b) \& \forall y[\text{love}(s, y) \rightarrow y = j \vee y = b] \end{aligned}$$

This gives the reason of our example. However, the treatment of reciprocals is still incomplete in several respects: I have showed only how the "strict" interpretation of reci-

procalcs can be modelled, leaving aside the more liberal interpretation which is predominant in cases like *John, Bill and Mary took each other by the hand*; I did not say anything about the formation of coordinated NPs; and I did not talk about cases with plural subjects, such as *The children love only each other*. However, it should have become clear that a treatment of reciprocals with the help of list individuals is feasible, and can be combined with a semantics for focus operators like *only* in a straightforward way.

4.6. DO WE NEED COINDEXING? -- In the framework developed above, we did without coindexing between focus operators and focus. The rules that restrict the association between focus operator and focus are such that they narrow down possible choices. There are two potential problems with this approach: First, the principles may not be restrictive enough for some cases, and second, they might be too restrictive.

As for the first case, note that we can generate examples like the following (I use coindexing here simply as a convenient description device):

- (58) John even₁ [VP only₂ [V_{to} introduced [Bill]_{F2}] [to Sue]_{F1}

We arrive at this interpretation by focusing on *Bill*, combining *only* with the V_{to}-expression, focusing on *Sue*, and combining *even* with the VP. The resulting meaning can be described as follows: John introduced Bill to Sue, he did nothing else to Sue, and there are persons x besides Sue for which it is more likely that John introduced Bill to x and did nothing else to x. Does the sentence have this reading? It seems to me that it has it, especially if stressed on *Sue*, and uttered without pause in *only introduced Bill*.

As for the second case, the most serious objection may be raised against the assumption that a focus operator is associated with the most comprehensive focus in its scope (cf. 17). We haven't seen evidence that supports that claim, so let us look at relevant cases. It is not easy to come up with convincing examples, but perhaps the following will do. The adverb *preferably* is focus-sensitive, which can be seen with examples like *John preferably drinks WINE*, which means that of all the drinks, John prefers to drink wine. Now look at the following example:

- (59) [Bill preferably₁ drinks [Australian WINE]_{F1}, and]
John even₀ preferably₁ drinks [[TASMANIAN]_{F0} wine]_{F1}.

Here, it is said that John prefers Tasmanian wine to other drinks, and that there are modifiers X such that it would be more likely that John prefers X wine to other drinks. This seems to be a valid reading of our example, especially in the given context. -- Now let us look at the opposite case:

- (60) [Bill preferably₁ drinks [TASMANIAN]_{F1} beer, and]
? John even₀ preferably₁ drinks [[Tasmanian]_{F1} wine]_{F0}

Here we would expect the interpretation: John prefers Tasmanian wine to other wines, and it is more likely that there is some drink X such that John prefers Tasmanian X to other X. It is at least questionable whether there is such a reading. Of course, we get a reading for *John even₀ preferably₁ drinks [Tasmanian [WINE]_{F0}]_{F1}*, as predicted: John prefers Tasmanian wine to other drinks, and there are drink types X (e.g. beer) such that it would be more likely that John prefers Tasmanian X to other drinks.

There is, however, one class of examples that sheds doubt on our assumption (Hubert Truckenbrodt, personal communication). It is known that gapping is a focus-sensitive process, in the sense that the gap in one coordination part corresponds to the background in the other

coordination part (cf. Sag 1977, Truckenbrodt 1988). Assuming that coordination expresses two assertions (alternatively, coordination itself can be analyzed as focus-sensitive), we can analyze gapping as in the following example:

- (61) JOHN met MARY and BILL, SUE.
 $\text{ASSERT}_0 [\text{JOHN}]_{F0} \text{met} [\text{MARY}]_{F0}$ and $\text{ASSERT}_0 [\text{BILL}]_{F0}$ gap $[\text{SUE}]_{F0}$
 $\text{ASSERT}(<\lambda x \bullet y. \text{met}(x,y), j \bullet m>) \& \text{ASSERT}(<[\text{copy}], b \bullet s>)$
-

Now let us look at an example that contains, in addition, an overt focusing operator:

- (62) JOHN drank only TASMANIAN wine, and BILL, AUSTRALIAN BEER.
 $\text{ASSERT}_0 [\text{JOHN}]_{F0} \text{drank only}_1 [[\text{TASMANIAN}]_{F1} \text{wine}]_{F0}$ and
 $\text{ASSERT}_0 [\text{BILL}]_{F0}$ gap $[[\text{AUSTRALIAN}]_{F1} \text{BEER}]_{F0}$

We are interesting in an interpretation where the second conjunct has to be spelled out as: *Bill drank only AUSTRALIAN beer*. If this interpretation exists, then we have a counterexample to our assumption, as *only* focusses not on the most comprehensive focus in its scope. It is not entirely clear, however, whether examples like (62) are grammatical, with the intended interpretation.

In this section, I could give only limited evidence for our assumption that a focus operator is associated with the most comprehensive focus in its domain. If further data shows that this is not the case, then the focus rule SF has to be formulated in an indeterministic way. If, on the other hand, cases of embedded foci that neither contain intervening focus operators, such as (19.c), nor focus on one and the same constituent, such as (19.d), are considered to be in general bad, than SF has to be reformulated in such a way that it can never apply to a focus-background representation to begin with, but may apply to one constituent and generate a multiple focus on that constituent at once (to cover indisputable cases like 19.d).

4.7. ASSERTIONAL MEANING AND PRESUPPOSITIONS. -- The analysis of focus-sensitive operators like *only* and *even* we have given so far neglects one well-known aspect of their semantics, namely that we have to distinguish between the assertional meaning on the one hand and the presupposition or conventional implicature on the other (cf. Horn 1969) Taking constancy under negation as a test for presuppositions, we can observe that a sentence like *John only drank water* asserts that John didn't drink anything but water, and presupposes that John drank water. And we observe that a sentence like *John drank even water* asserts that John drank water, and presupposes that it would have been more likely for John to drink something else.

- (63) a. - John drank only water.
 - No. (i.e., John drank something besides water, too; not; John didn't drink water.)
- b. - John drank even water.
 - No. (i.e., John didn't drink water; not: it was likely for John to drink water).

We might ask whether it is possible to extend the framework developed above so that it incorporates the distinction between assertion and presupposition, something that was done by Lyons & Hirst (1990) for Alternative Semantics. Cases with complex foci will naturally be of particular interest. For example, consider (12), here repeated as (64):

- (65) - John even₁ [only₂ [drank WATER]_{F2}]_{F1}.

- No. (i.e., John did other, comparable things as well).

As the negation test shows, this sentence asserts that John did not do other things comparable to drinking water. Its other meaning components listed under (12), then, must be its presuppositions -- viz., that John drank water (coming from *only*), and that there are activities comparable to drinking water and doing nothing else for which it is more probable that John performed them (coming from *even*). Note that we have to refer to both the assertional meaning and the presupposition coming from *only* to express this second presupposition.

How can we spell out the semantics of focusing operators like *only*, taking into account the assertional part and the presuppositional part? Perhaps the most explicit theory that was designed to treat assertional meaning and presuppositional meaning in a compositional way is Karttunen & Peters (1979). In particular, they include a treatment of *even*, although they disregard the influence of focus-background structures. Here I want to show how their theory can be combined with the framework of structured meanings.

Karttunen & Peters represent (assertional) meanings and presuppositions on two separate levels, which contain what the sentence EXPRESSES and what it IMPLICATES. (i.e., presupposes). This is rendered formally as a pair $\langle E, I \rangle$, where E and I are of the same type. Karttunen & Peters show how meanings and presuppositions of complex expressions can be computed from the meanings and presuppositions of their parts, using a special "heritage function".

How are meaning-presupposition structures and focus-background structures related to each other? Examples like (65) suggest that focus-background structures always have "wide scope" over meaning-presupposition structures. Here I will not introduce a formal semantic framework for meaning-presupposition structures, as this would lead us too far astray. I will restrict the discussion to one illustrative example that shows how cases with several focusing operators can be treated in principle.

In the following, I assume, for the sake of exposition, that *drink* presupposes that the agent of the drinking is animate, and that the substance that is drunk is fluid. These presuppositions are projected to the complex expression, *drank water*, with a mechanism like the one given by Karttunen & Peters. The alternatives of focus-sensitive operators, like *even*, then may be determined by the conjunction of the meaning and the presupposition of the focus element; note that we have to assume a conjunction generalized for all types based on t , as the focus often will not be of a sentential type. The revised meaning postulates for *only* and *even* are obvious from the following example, so I will not specify them separately.

```
(66)   drank water; V ;  $\langle \lambda x \exists y [\text{drank}(x,y) \& W(y)], \lambda x [\text{anim}(x) \& \text{fluid}(W)] \rangle$ , abbr.  

      <[1], [2]>  

      |  

      SF drank water ; VPF ;  $\langle \lambda P.P, <[1], [2]> \rangle$   

      |  

      | only ; FO ; only  

      | /  

      SO only drank water ; VP ; only( $\langle \lambda P.P, <[1], [2]> \rangle$ )  

      =  $\langle \lambda x \forall P [P \approx [1] \& P(x) \rightarrow P = [1]], [1] \& [2] \rangle$ , abbr. <[3], [4]>  

      |
```

```

SF only drank water ; VPF ; <λP.P, <[3], [4]>>
  |
  | even ; FO ; even
  |
  SO even only drank water ; VP ; even(<λP.P, <[3], [4]>>)
        = <[3] , λx∃P[P=[3]&[4] & [3]&[4](x) <P P(x) ] >
  |
  | John ; NP ; λP.P(j)
  |
  John even only drank water ; S ; <[3](j) , ∃P[P≈[3]&[4] & [3]&[4] (j) <P P(j)]>

```

The meaning part of this pair, [3](j), expresses that everything that John did was drinking water, or more correctly, that no property P comparable, but not identical to the property of drinking water applies to John. Note that this is also the meaning of the simpler sentence *John only drank water*, which shows that *even* does not change the meaning of an expression.

The presupposition part of that pair says that there is a property P comparable to the property of only drinking water such that this property would more likely apply to John. More precisely, it claims this of a property P that applies to persons that didn't do anything comparable, but not identical to drinking water, that drank water, that are animate, and for which it holds that water is a fluid. It seems unclear whether the latter two properties (abbreviated as [2]) should be part of the determination of the alternatives. However, we need at least the presupposition introduced by *only* (abbreviated as [1]), and as it is not plausible that we keep track of the origins of a presupposition, we are forced to take all presuppositions accumulated so far (here represented by [4]). Note, again, that it is crucial that the determination of the alternatives may refer to both the meaning and the presuppositions of the semantic representation of its focus. We have assumed this for the alternatives for *even*; we may assume the same for the alternatives for *only*, for the sake of greater homogeneity.

4.8. TOPIC-COMMENT STRUCTURES. -- Let us finally turn to a particularly vexing problem. It was pointed out by Jacobs (1988, to appear) with examples like the following one:

(67) SUE KISSED John.

There is a reading involving a complex focus on *Sue* and *kissed*, as an answer to a question like *Who did what to John?*, which can be derived in a standard way (cf. 67'.a). In addition, there is also a reading where *Sue* and *kissed* seem to form a simple focus, at least semantically: (67) may be an answer to *What happened to John?*, where the focus is equivalent to *was kissed by Sue*. For this case, we would be inclined to assume the representation (67'.b):

- (67') a. ASSERT(<λx•R.R(j,x), s.kissed>)
 b. ASSERT(<λP.P(j), λx.kissed(s,x)>)

The problem here is how to arrive at representation (b) in a compositional way, given that the parts of the sentence that correspond to the focus do not form a syntactic constituent at any level, according to standard analyses of these sentences.

One way to do overcome this problem is to assume that the sentences in question indeed have an analysis in which the parts in focus form a syntactic constituent. This could be expressed quite naturally in a syntactic framework like categorial grammar with liberal rules of category composition. Advocates of categorial grammar may welcome these facts as another

argument for flexible combination rules, in addition to coordination data like right node raising, as in *Sue kissed and Mary teased John* (cf. Steedman 1985, Dowty 1987).

Another way is to analyze these cases not as involving peculiar focus-background structures, but as rather regular TOPIC-COMMENT structures. The relevant examples of purported non-constituent focus all have a purported background that IS a constituent, and they are examples that answer questions like *What happened to x?* So we might analyze them as cases where the purported background is, in fact, the topic of the sentence, and the purported focus is the comment.

Topic-comment structures can be captured with the same technique as focus-background structures, namely structured meanings. Actually, Dahl (1974) proposed both a separate treatment of focus-background structures and topic-comment structures, and a way to model them that can be seen as a precursor of structured meanings.

One crucial question at this point is how topic-comment structures and focus-background structures interact. It seems that we should allow for both the comment and the topic to consist of focus-background structures (cf. Jacobs 1984); witness the following examples:

- (68) a. -Who(m) did Sue kiss?
-[Sue]T [kissed [John]F]C
- b. -What did Bill's sisters do?
-[Bill's [youngest]F sister]T [kissed John]C.

In (68.a), *kissed John* arguably is the comment, and it contains a focus, *John*. And in (68.b), *Bill's youngest sister* arguably is the topic, and it contains a focus, *youngest*. We also might analyze *kissed John* as a focus of the comment in this case; alternatively, we might skip assignment of focus, given a rule that whenever the comment does not contain any focus feature, it should be considered as focus itself.

This suggests the following framework for topic-comment structures: Topic-comment structures are labelled pairs $\langle T\alpha, \beta \rangle$, where α is the comment and β is the topic. Both α and β may be simple, or they may contain focus-background structures. Illocutionary operators, like assertion, may take topic-comment-structures as their argument. We have the following rule for assertions applying to simple topic-comment structures:

- (69) If α, β are not focus-background structures, then:
 $\text{ASSERT}(\langle T\lambda X.\alpha, \beta \rangle)$ maps a common ground c to a common ground c' , where c' is the intersection of c with the set of possible worlds for which $\lambda X.\alpha(\beta)$ is true, i.e.
 $c' = c \cap [\lambda X.\alpha(\beta)]$
- Felicity conditions:
 - $c' \neq c$, $c' \neq \emptyset$, and there are salient Y , $Y = \lambda X.\alpha$, $Y \neq \lambda X.\alpha$, such that Y could have been asserted of β . That is, it would have changed c , $c \cap [Y(\beta)] \neq c$, it would not be excluded by c , $c \cap [Y(\alpha)] \neq \emptyset$, and would have yielded a different output context, $c \cap [Y(\beta)] \neq c \cap [\lambda X.\alpha(\beta)]$;
 - β is a possible topic in c , that is, β , or something closely related to β , was mentioned in the immediately preceding discourse, or is part of the environment of speaker and hearer, or is something the speaker and hearer talk regularly about.

The first set of felicity conditions covers the conditions specified in (7); the only difference is that now the first member of the pair $\langle T\alpha, \beta \rangle$ counts as "focus". The second set of felicity

conditions is concerned with the topic; it leaves much to be explained, but should give an idea of a possible way to spell out the semantic impact of topics.

We have to change (69) slightly for complex topic-comment structures. I propose the following:

- (70) a. **ASSERT(< $T\lambda X.\langle\alpha,\beta\rangle, \gamma\rangle)$** maps a common ground c to a common ground c' , where $c' = c \cap [\lambda X[\alpha(\beta)](\gamma)]$. Felicity conditions:
 - $c' \neq c$, $c' \neq \emptyset$, and there are salient Y , $Y \approx \beta$, $Y \neq \beta$ such that $\lambda X[\alpha(Y)]$ could have been asserted of γ ;
 - γ is a possible topic in c .
- b. **ASSERT(< $T\lambda X.\alpha, \langle\beta,\gamma\rangle\rangle)$** maps a common ground c to a common ground c' , where $c' = c \cap [\lambda X.\alpha(\beta(\gamma))]$. Felicity conditions:
 - $c' \neq c$, $c' \neq \emptyset$
 - $\beta(\gamma)$ is a possible topic in c , and there are salient Y , $Y \approx \gamma$, $Y \neq \gamma$ such that $\beta(Y)$ is a possible topic in c as well.
- c. **ASSERT(< $T\lambda X.\langle\alpha,\beta\rangle, \langle\gamma,\delta\rangle\rangle)$** maps a common ground c to a common ground c' , where $c' = c \cap [\lambda X[\alpha(\beta)](\gamma\delta)]$. Felicity conditions:
 - $c' \neq c$, $c' \neq \emptyset$, and there are salient Y , $Y \approx \beta$, $Y \neq \beta$ such that $\lambda X[\alpha(Y)]$ could have been asserted of $\gamma\delta$;
 - $\gamma\delta$ is a possible topic in c , and there are salient Y , $Y \approx \delta$, $Y \neq \delta$ such that $\gamma(Y)$ is a possible topic in c as well.

So the focus-background structure in the comment determines alternative comments that could have been made about the topic, and the focus-background structure in the topic determines alternative topics that could have been "commented" upon. We should also account for the possibility of topic-less sentences (so-called thetic sentences); in this case, we may assume our old assertion rule (7).

Topic-comment structures and focus-background structures do interact in the derivation of a complex semantic representation. The basic principle is that topic-comment structures take precedence over focus-background structures. Furthermore, topic-comment structures are not recursive; we should allow, however, for the possibility of complex topics, as attested e.g. in Hungarian (Kiss 1986). This leads to the following rules of functional application, in addition to the rules given in (21):

- (71) a. $\langle T\alpha, \beta \rangle(\gamma) = \langle T\lambda X.\alpha(X)(\gamma), \beta \rangle$
- b. $\delta(\langle T\alpha, \beta \rangle) = \langle T\lambda X.\delta(\alpha(X)), \beta \rangle$ (if δ is simple)
- c. $\langle T\alpha, \beta \rangle(\langle \gamma, \delta \rangle) = \langle T\lambda X[\alpha(X)(\langle \gamma, \delta \rangle)], \beta \rangle$
- d. $\langle \gamma, \delta \rangle(\langle T\alpha, \beta \rangle) = \langle T\lambda X[\langle \gamma, \delta \rangle(\alpha(X))], \beta \rangle$
- e. $\langle T\alpha, \beta \rangle(\langle T\gamma, \delta \rangle) = \langle T\lambda X \bullet X'[\alpha(X)(\gamma(X'))], \beta \bullet \delta \rangle$
(where X, X' are variables of the types of β, δ)

I assume the rule S_T for topicalization of a constituent of category C :

- (72) $S_T : C \rightarrow C_T$ (indexing of arbitrary category Y by topic feature T)
 $(C_F) = \langle T\lambda X.X, [C] \rangle$, where X is a variable of the type of $[C]$.

The topic feature can be spelled out in various ways, for example in the *as for NP*-construction, or in languages like Japanese and Korean by affixation of particles. As for accentual markings, the basic rule seems to be that topical constituents are de-accented (as a whole; they may

contain accents in case they contain a focus constituent, as in 68.b). This implies that the non-topical constituents get accent (or "neutral stress", in the theory of Jacobs 1988, to appear).

It is time to look at an example. Let's take one with a simple topic, *John*, and a comment, *drank water*, that contains a focus, *water*:

- (73) -What did John drink?
 -John_T drank WATER_F

```

drank [water]F ; VP ; <λTλx.T(λy.drunk(x,y)), water>
|
|   John ; NP ; John
|   |
|   | ST John ; NPT ; <TλT.T, John>
|   |
S1  John drank water ; <TλT.T, John>(<λTλx.T(λy.drunk(x,y)), water>)
= <TλT[λT.T(T)(<λTλx.T(λy.drunk(x,y)), water>), John>
= <TλT.T(<λTλx.T(λy.drunk(x,y)), water>), John>
= <TλT.<λT'.T(λx.T(λy.drunk(x,y))), water>), John>
|
SI   |   .; IO ; ASSERT
|
|/
ASSERT(<TλT.<λT'.T(λx.T'(λy.drunk(x,y))), water>), John>

```

Spelling out ASSERT:

(69) maps a common ground c to a common ground c', where c' is the intersection of c with the worlds in which $\lambda T[\lambda T'.T(\lambda x.T'(\lambda y.\text{drank}(x,y)))(\text{water})](\text{John})$ is true, that is, in which $\text{John}(\lambda x.\text{water}(\lambda y.\text{drank}(x,y)))$ is true, that is, in which $\exists y[\text{drank}(j,y) \ \& \ W(y)]$ is true.

Felicity conditions:

- $c' \neq c$, $c' \neq \emptyset$, and there are salient Y, $Y \approx \text{water}$, $Y \neq \text{water}$ such that $\text{John}(\lambda x.Y(\lambda y.\text{drank}(x,y)))$ could have been asserted;
- *John* is a possible topic in c.

Now let us come back to our original example, (67). The two analyses can be given as follows. Note that in both cases, *John* is supposed to be the topic.

- (74) kissed ; V' ; kiss
- ```

|
| John ; NPT ; <TλTT, John>
|
S2 kissed John ; VP ; <TλTλx.T(λy.kiss(x,y)), John>
|
| Sue ; NP ; Sue
|
S1 Sue kissed John ; S ; <TλT.Sue(λx.T(λy.kiss(x,y))), John>

```

Application of the assertion operator yields the following result: It is asserted that Sue kissed John, with the felicity condition that other salient properties Y that are comparable to  $\lambda T.\text{Sue}(\lambda x.T(\lambda y.\text{kiss}(x,y)))$  (that is, be kissed by Sue) could have applied to John at the

current point in discourse. In addition, John must be a possible topic at the current point in discourse.

- (75)      *kissed* ; V'F ; < $\lambda RR$ , *kiss*>
  - |
  - | *John* ; NPT ; < $T\lambda TT$ , *John*>
  - | /
  - S<sub>2</sub> *kissed John* ; VP ; < $T\lambda T<\lambda R\lambda x.T(\lambda y.R(x,y), \text{kiss})$ , *John*>
  - |
  - | *Sue* ; NPF ; < $\lambda TT$ , *Sue*>
  - | /
  - S<sub>1</sub> *Sue kissed John* ; S ;
    - < $T\lambda T<\lambda T\bullet R.T(\lambda x.T(\lambda y.R(x,y)))$ , *Sue*•*kiss*>, *John*>

Now the application operator yields the following result: It is asserted that Sue kissed John, with the felicity condition that there are salient pairs of representations  $T'\bullet R$  that are comparable to *Sue*•*kiss* such that  $\lambda T\bullet T'(\lambda x.T(\lambda y.R(x,y)))$  (roughly,  $T'$  did  $R$  to him) could have been asserted of John as well at the current point in discourse. Again, John must be a possible topic at the current point in discourse.

## 5. Conclusion

In this article, I have tried to develop a coherent semantic framework that can capture sentences with multiple focus, both free focus and focus bound by overt operators. Structured meanings turned out to be a suitable representation format, and I have shown how a compositional semantics can be developed for those sentences within that format. In doing this, we have seen that much of the burden that was assigned to syntax in coindexing approaches such as Jacobs (1984, 1988, to appear) can in fact be taken over by well-formedness principles in the semantic component.

There are several directions into which this approach can be extended. One is to see whether we indeed need the full expressibility of structured meanings, or whether the more parsimonious framework of alternative semantics (cf. Rooth 1985) can be worked out to cover multiple focus constructions as well. Secondly, we should address the various shortcomings mentioned in section (4) above, such as focus assignment to expressions that are not surface constituents, focus assignment to expressions that are not in the scope of their operator on surface structure, and a combination of the structured meaning framework with a way to express different scopings of NPs. Also, the proposed interaction between topic-comment structures and focus-background structures needs much more work; it might turn out that insights of the theory of communicative dynamism, as developed in the Czech school by Firbas, Hajicova, Sgall and others are expressible in this framework. Finally, it is necessary to extend the framework such that it can cover the impact of focus on the interpretation of quantifiers, such as *always* (cf. Rooth 1985, 1988) or the genericity operator (cf. Krifka, to appear). To do this with the required generality, we must provide for a mechanism to express anaphoric bindings, which requires a dynamic semantic framework, such as discourse representation theory or one of its alternatives.

I had the opportunity to discuss issues of this article with several colleagues. Without the comments and challenges of Gennaro Chierchia, Jochen Geilfuß, Joachim Jacobs, Uwe Mönnich, Richard Oehrle, Manfred Pinkal, Arnim von Stechow, Hubert Truckenbrodt, Dietmar Zaefferer, and Ede Zimmermann, flaws would be more abundant, and coverage would be less broad. Thanks to them all.

This article will be published also in *Linguistische Berichte, Sonderheft 4: Informationsstruktur und Grammatik*, ed. J. Jacobs.

## Reference

- Chomsky, N. (1977): "On Wh-Movement". In *Formal Syntax* (P. W. Culicover, T. Wasow, & A. Akmajian, Ed.). New York: Academic Press.
- Dahl, Ö. (1974): "Topic-comment structure revisited", in Dahl (ed.), *Topic and comment, contextual boundedness and focus*, Hamburg: Buske Verlag.
- Dowty, D. (1987): "Type raising, functional composition, and non-constituent conjunction". In *Categorial Grammar and Natural Language Structures* (R. Oerle, E. Bach, & D. Wheeler, Eds.) (pp.153-98). Dordrecht: Reidel.
- Hirst, G. & D. Lyons (1990): "A Compositional Semantics for Focusing Subjuncts". In *Proceedings of the 28th Annual Meeting of the Association of Computational Linguistics*, 54-61.
- Horn, L.A. (1969): "A presuppositional analysis of *only* and *even*". In *CLS 5: Papers from the Fifth Regional Meeting*. Chicago: Chicago Linguistic Society, 98-107.
- Jackendoff, R. (1972): *Semantic Interpretation in Generative Grammar*. Cambridge, Mass.: MIT Press.
- Jacobs, J. (1983): *Fokus und Skalen, Zur Syntax und Semantik von Gradpartikeln im Deutschen*. Tübingen:Niemeyer.
- Jacobs, J. (1984): "Funktionale Satzperspektive und Illokutionssemantik". *Linguistische Berichte*, 91, 25-8.
- Jacobs, J. (1986): "The Syntax of Focus and Adverbials in German". In *Topic, focus and configurationality* (W. Abraham & S. D.Meij, Eds.) (pp. 103-27). Amsterdam: John Benjamins.
- Jacobs, J. (1988): "Fokus-Hintergrund-Gliederung und Grammatik". In *Intonationsforschungen* (H. Altmann, Ed.) (pp. 89-34). Linguistische Arbeiten. Tübingen: Niemeyer.
- Jacobs, J. (to appear): "Focus ambiguities". In *Proceedings of the Conference on Focus and Intonation, Fraunhofer-Institut Stuttgart* (J. Hoepelman, Ed.).
- Karttunen, L. & S. Peters (1979): "Conventional Implicature". In *Syntax and Semantics 11: Presuppositions*, (Ch.-K. Oh & D. A. Dinneen, Eds.). New York: Academic Press, 1-56.
- Kay, P. (1990): "Even". *Linguistics and Philosophy* 13: 59-112.
- Kiss, K. E. (1986): *Configurationality in Hungarian*. Dordrecht: Reidel.
- Klein, W., & von Stechow, A. (1982): *Intonation und Bedeutung von Fokus*. Arbeitspapier des SFB 99, No. 77, Konstanz.
- Kratzer, A. (1989): "The representation of focus". Manuscript, Tucson.
- Krifka, M. (1990): "Polarity phenomena and alternative semantics". In *Proceedings of the Seventh Amsterdam Colloquium* (M. Stokhof & L. Torenvliet, Eds.) (pp. 277-02): Amsterdam: Institute for Language, Logic and Information, Universiteit van Amsterdam.
- Krifka, M. (to appear): "Focus and the Interpretation of Generic Sentences", in *The Generic Book* (Carlson, G. & Pelletier, F., Eds.), Chicago University Press.

- Ladd, D.: 1980, *The Structure of Intonational Meaning: Evidence from English* Bloomington: Indiana University Press.
- Lerner, J. -Y., & Zimmermann, T. E. (1983): "Presupposition and quantifiers". In *Meaning, Use and the Interpretation of Language* (R. Bäuerle, C. Schwarze & A. von Stechow, Eds.) (pp. 290-01). Berlin: Walter de Gruyter.
- Lewis, D. (1979): "Scorekeeping in a language game". *Journal of Philosophical Logic*, 8, 339-59.
- Link, G. (1983): "The logical analysis of plurals and mass terms", in R. Bäuerle et al., eds, *Meaning, Use and the Interpretation of Language*, de Gruyter, Berlin.
- Lötscher, A. (1983): *Satzakzent und funktionale Satzperspektive im Deutschen*. Tübingen: Niemeyer.
- Lujan, M. (1986): "Stress and bindings of pronouns". *Chicago Linguistics Society Meeting* 22, Vol. 2.
- Rochemont, M. S. (1986): *Focus in Generative Grammar*. Amsterdam: John Benjamins.
- Rooth, M. E. (1985): *Association with Focus*. Ph.D.-Dissertation, University of Massachusetts at Amherst.
- Rooth, M. E. (1988): "Restrictive Quantificational Adverbials with Focus Semantics", talk presented at the Tübingen Conference on Genericity.
- Sag, I.A. (1977): *Deletion and Logical Form*. IULC, Bloomington.
- Selkirk, E. O. (1984): *Phonology and Syntax. The Relation between Sound and Structure*. MIT Press.
- Stalnaker, R. (1979): "Assertion". In *Syntax and Semantics 9 - Pragmatics* (P. Cole, Ed.) (pp. 315-32). New York: Academic Press.
- Stechow, A. v. (1989): *Focusing and backgrounding operators*. Universität Konstanz, Fachgruppe Sprachwissenschaft, Arbeitspapier Nr. 6. Konstanz.
- Stechow, A. v., & Uhmann, S. (1986): "Some remarks on focus projection". In *Topic, Focus and Configurationality* (W. Abraham & S. de Meij, Eds.). Amsterdam: John Benjamins.
- Steedman, M. (1985): "Dependency and coordination in the grammar of Dutch and English". *Language*, 61, 523-68.
- Taglicht, J. (1984): *Message and Emphasis*. London: Longman.
- Truckenbrodt, H. (1988): "Zur Syntax der Koordination". SNS-Bericht 88-41. Seminar für natürliche-sprachliche Systeme, Universität Tübingen.
- Williams, E. (1980): "Remarks on stress and anaphora". *Journal of Linguistic Research*, 1, 1-6.

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## **Topic, Focus and Quantification**

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**Abstract.** In this working paper I explore the possibility of fruitfully combining some aspects of the contemporary Prague School perspectives on topic and focus (Hajičová and Sgall et al), and other contemporary work such as Rooth's, Krifka's, and Kratzer's on focus-sensitive constructions, with the kind of analysis of quantificational structures found in the work of Heim and Kamp. In particular I am interested in seeing how far one can push the thesis that topic (or probably rather "focus-frame") corresponds to restrictive clause (or domain restriction) and focus to nuclear scope in tripartite structures. In surveying a range of focus-sensitive constructions, we observe that most of them are quantificational in some sense, and require something like a tripartite structure for their interpretation. I pursue the suggestion that the quantificational role of focus and focus-frames is a natural extension of their discourse role: in a discourse context, the set of alternatives provided by the focus-frame locates the ("new") conversational content with respect to common ground or background; with focus-sensitive operators, the focus-frame's set of alternatives contributes to the specification of the domain to be quantified over (or of some analogous argument of other essentially binary operators.) I will discuss some apparent problems and possibly conflicting generalizations. I will not claim to settle the issue of the extent to which the correlation between focus-frame/focus and restrictive clause/nuclear scope is grammaticalized in languages like English, and in fact most of the hard questions relating to how and where focus relates to the grammar are left open by the informal observations discussed here.

## 0. Introduction.

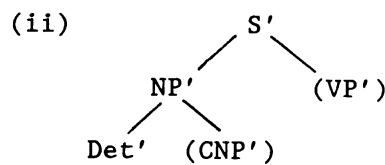
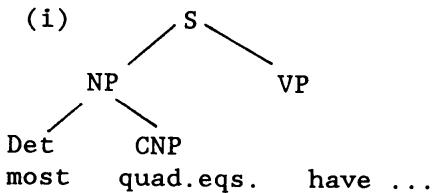
I begin with some brief background comments about quantification, principally in order to be able to presuppose in what follows the notion of tripartite structures and their division into operator, restrictive clause, and nuclear scope. The central section of the paper, section 2, is concerned with an examination of the claim that there is a linguistically significant correlation between restrictive clause and focus-frame on the one hand and nuclear scope and focus on the other. That section includes some informal discussion of the notions of topic and focus, mentions the Prague school claim that such notions are basic in the determination of such matters as quantifier scope, proceeds to an annotated inventory of focus-sensitive constructions which seems to substantiate the central correlation, and concludes with some speculations about the possible explanatory basis of the correlation. The brief section 3 notes some limits to the correlation and suggests that the correlation has the status of a kind of "default", one that can be overruled by the syntax. Section 4 takes up some apparent problems and possibly conflicting generalizations which I believe can be largely explained away, either by clarifying the notion of contrastive topic or by suitably articulating the recursive properties of focus constructions and the possibility of contextual "inheritance" of focus structure across sentences in a discourse. The paper ends with some brief concluding remarks and pointers towards some of the many open problems left untouched or unresolved.

## 1. Quantificational Structures

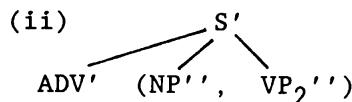
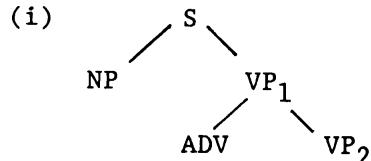
### 1.1 A-Quantifiers vs. D-quantifiers.

Partee, Bach and Kratzer 1987 introduce the terminology "D-quantifier" for determiner quantifiers and "A-quantifier" for adverbial quantifiers (and some other "verb-oriented" quantificational devices not of direct concern here). D-quantification, well-studied since Lewis (1970) and Montague 1973 and subsequent work on generalized quantifiers, is illustrated in (1); A-quantification, brought to prominence by Lewis 1975 and richly exploited in subsequent work by Kamp 1981 and Heim 1982, are illustrated in two different constructions in (2) and (3). In each case, a rough syntactic structure is given in (i) and a rough semantic function-argument structure in (ii). Sentences (1) and (2) have virtually identical truth conditions although syntactically structured in rather different ways; sentence (3) is a classic donkey-sentence whose analysis in a Kamp-Heim framework exploits the "unselective binding" properties of adverbs of quantification, first noted by Lewis.

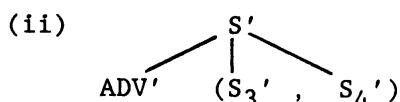
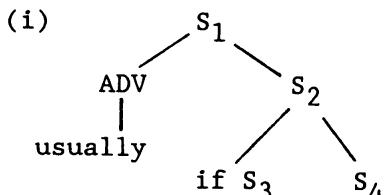
- (1) Most quadratic equations have two different solutions.



- (2) (a) A quadratic equation usually has two different solutions.  
 (b) Usually,  $x$  is a quadratic equation,  $x$  has two different solutions

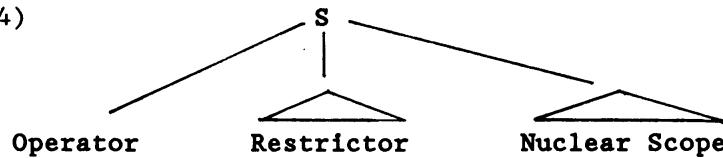


- (3) (a) Usually, if a man owns a donkey, he beats it.  
 (b) Usually,  $x_1$  is a man and  $x_2$  is a donkey and  $x_1$  owns  $x_2$ ,  $x_1$  beats  $x_2$



**1.2 Tripartite Structures as a unifying generalization.** The terminology of tripartite structures shown in (4), used by Heim to represent what the D-quantification and A-quantification structures have in common, is useful at least at a metalevel in discussing the properties of various kinds of quantificational structures. The concept of restricted quantification which lies behind such structures is of course much older (back to Aristotle, at least) and has a long history in logic, philosophy, and linguistics.

(4)



It is possible that these tripartite structures do not actually represent the linguistic structure of any of the examples; it could be the case, for instance, that there is always some binary-branching nested structure in each instance. So I use the tripartite structure for the purposes of discussing certain generalizations without intending any further commitment to its application within the grammar of any particular construction in English or any other language.

Among the issues concerning tripartite structures that we will be concerned with in what follows are the following: What aspects of linguistic structure determine/constrain logical structure? And among the relevant aspects of structure to consider, there are at least constituent structure, function-argument structure, and focus structure. It is the role of the latter that will be our central concern.

## 2. The correlation: Restrictive Clause : Focus-frame :: Nuclear Scope : Focus

### 2.0. Some background for the correlation.

2.0.1. **The parts of tripartite structures: what goes into restrictors?** The following generalized picture of tripartite structures mentions a number of hypothesized syntactic, semantic, and pragmatic structures that can be argued to be correlated with each other and with the basic tripartite scheme; some will be discussed below, others are discussed in Partee, Bach and Kratzer (1987) or in Partee (1991), and others will be discussed in work that is still in preparation. The main claim here, which will be illustrated in subsequent sections, is that the syntax (if we don't count focus structure as part of the syntax) sometimes leaves unspecified or underspecified what goes into the restrictor clause of a tripartite structure, and focus structure frequently plays an important role in determining how the parts of the meaning of a sentence are divided up in tripartite structures, information that can be essential to assigning truth-conditions to a sentence.

(5)

| Operator     | Restrictor                                                                          | Nuclear Scope    |
|--------------|-------------------------------------------------------------------------------------|------------------|
| V            | "cases"                                                                             | main clause      |
| must         | <u>if</u> -clause                                                                   | assertion        |
| not          | subordinate clauses                                                                 | focus            |
| almost every | common noun phrase                                                                  | consequent       |
| always       | topic                                                                               | main predication |
| mostly       | presuppositions                                                                     | comment          |
| Generic      | focus-frame<br>domain restrictions<br>reset default values<br>antecedent<br>context |                  |

**2.0.2. Topic-comment; Topic-focus; focus-presupposition; focus-focus-frame; focus-background; theme-rheme.** Now comes the part that makes me most nervous: trying to say what I think I mean by notions such as topic and comment. There is a very large literature on the subject, only some of which I am acquainted with, but it is evident to anyone who reads even only a few works on the subject(s) that different authors use terminology quite differently, in part because there is not agreement about how to carve up the phenomena under study in the most appropriate way, and in part because even authors who are not necessarily in disagreement are following varied precedents in choice of terminology.

To begin very informally, I take the core of the notion of "topic" to be roughly characterized by such expressions as "old", "given", "known", "what the sentence is about", "anchor (for the hearer)". Equally roughly, the "comment" is then the "new" part; or what is being said about the topic.

I must immediately invoke lots of caveats -- this is a simplistic characterization for some discourse contexts, which doesn't cover recursive structures, and which glosses over many distinctions and necessary refinements; just to pick one interesting observation about the limited utility of the "old"- "new" dimension, take the observation of Selkirk 1984 on the differences between focused arguments and focused verbs: only focused ARGUMENTS must be new (if anything must), not focused verbs.

Looking at what has been said under the label of "focus vs. something" rather than "topic-comment", I offer the following from Rooth 1989 as a clear expression of a central and fruitful idea behind the notion of focus: "The focus structure of a sentence expresses contrast with or alternatives to the proposition denoted by the sentence".

Rooth 1985 argues that the principal contribution of focus structure is a set of alternatives; the corresponding existential presupposition (invoked by Chomsky 1971 and Jackendoff 1972 and many subsequent authors) can be derived as the union (disjunction) of all the alternatives in the given set. Kratzer 1991 notes that a question meaning on some theories (e.g. Hamblin 1973) is likewise a set of alternatives: the set of propositions that count as possible direct answers. The traditional presupposition of a WH-question comes out as similarly as the union of this set of alternatives, the same set of alternatives as would arise for a declarative sentence with a focused element in place of the WH-phrase.

What to call the antithesis of focus is not clear; even authors who show close agreement on ideas differ in terminology. If the set of alternatives is more fundamental than the presupposition that can be generated by taking their union, the terminology "focus-presupposition" is not ideal; I will alternate among "focus-background", "focus - focus-frame", and sometimes just "focus structure"; I am not sure where these terms originated.

Now how do we want to relate the topic-comment distinction to the focus-background distinction: topic = background? focus = comment? Perhaps the two distinctions are quite similar, but when the topic or background part is local and the focus or comment broad, the notions "topic-comment" are more salient, and conversely when the topic or background is broad and the focus or comment is local, the notion "focus" is more salient. But it seems that one can have both marked on local constituents (e.g. in Hungarian, or in English in a topicalized structure with focus somewhere inside the non-topicalized part), with the rest of the sentence relatively neutral, suggesting that there are (at least) two separate distinctions to be made.

Perhaps some of what they have in common can be seen by relating "topic" to Rooth's remarks about focus structure: topic and focus-frame establish a set of alternatives having some things in common. In their discourse functions, that much should be known or uncontroversially acceptable by the discourse participants. In the case of a typical NP topic, knownness may amount to acquaintance with an individual and the alternatives may be of the vague "what about John?" sort; in the case of a typical focus-frame, the alternatives are propositions that differ in the values filled in for what we usually think of as a variable standing in place of the focused element.

Krifka (this volume), citing Dahl and Jacobs in part, suggests that one can capture both topic-comment and focus-background with structured meanings. On his view some of the differences are as follows: a topic must be a constituent (comment need not be); focus must be a constituent or a "list"

of constituents (background need not be). Felicity conditions also differ: in the case of topic-comment, they include the requirement that the topic is established as such in the discourse, while both comment and focus include a requirement of existence of relevant alternatives. Topic-comment structures "take precedence" over focus-background structures; both topic and comment may contain focus-background structures, as discussed in Carlson (1983); example (6) below is from Krifka (this volume).

- (6) -What did Bill's sisters do?  
 -[Bill's [youngest]<sub>F</sub> sister]<sub>T</sub> [kissed John]<sub>C</sub>.

The focus within the topic is providing a "contrastive topic"; the whole of the comment part in the top-level topic-comment structure is presumably also by default the focused part of the entire sentence.

Another recent study which suggests a different way of organizing the topic-comment and focus-background distinctions is Vallduví 1990; Vallduví reverses the precedence suggested by Krifka, giving arguments that are centered in pragmatics and expressing some scepticism about the recursive focus structures advocated by Krifka and defended below in section 4.

### **2.1 Prague school: Topic-Focus Articulation (TFA) and Scale of Communicative Dynamism (CD).**

Linguists in the Prague school have been taking focus structure and its place in the grammar very seriously for many years. A recent statement relevant to the central concerns of this paper is the following:

Instead of such means as parentheses, variables, and prenex quantifiers, natural languages exhibit, at TL [the "tectogrammatical level", comparable to deep structure. -BHP], the topic-focus articulation, the scale of CD ('deep word order'), and other features from which the scopes of operators can be derived."

-Hajičová and Sgall (1987) "The Ordering Principle".

I must confess to having been deeply skeptical about this claim when Professors Hajičová and Sgall and I began discussing it in the fall of 1989; but over the course of our discussions my attitude changed first to grudging agnosticism and then to a position (where I am now) of believing that some form of such a principle is likely to be true, and the challenge I have put to myself is to see if I can find a way of understanding and articulating the Prague school work (perhaps with some modifications) and of understanding and articulating the various

kinds of quantificational and other relevant semantic structures so that one can test the scope and the explanatory bite of some version of the principle. I take the correlation enunciated in section 2.0 as an instantiation of one aspect of this principle.

## **2.2 Which constructions are focus-sensitive?**

As a first step toward testing the claimed correlation, I offer a tentative inventory of focus-sensitive constructions, constructions which contain some operator which, in Rooth's terminology, "associates with focus", and is such that different choices of focus can result in sentences with different truth conditions. This semantic effect is different from, but sometimes confusable with, two other possible effects of focus, a normal contrastive discourse function, and a disambiguating effect. I am not sure I have succeeded in listing all and only real "association with focus" cases, but in order to try to make it clear what I'm trying to do, I will occasionally mention minimal pairs or triples contrasting a case of the kind of focus-sensitivity I do want to count with cases of the other two sorts of focus effects. Roberts 1990 discusses a number of the same classes of cases, and I have benefitted from her observations.

**2.2.1 Adverbs of quantification and of frequency.** The first kinds of cases I will discuss come from Rooth 1985, one of the principal starting points (along with work by such authors as Jacobs and von Stechow) for contemporary work on the formal semantics of association with focus. Drawing on Stump's 1985 analysis of the argument structure of frequency adverbs, Rooth noted that focus can make a crucial difference in establishing what material from the sentence ends up in the restrictive clause and what in the nuclear scope, hence critically affecting the resulting truth conditions. Thus examples (7a-c) below all have different truth conditions.

- (7) (a) Mary always took JOHN to the movies.
- (b) Mary always took John to the MOVIES.
- (c) MARY always took John to the movies.

Note that if we replace the quantificational adverb always by a specific adverb such as yesterday, the resulting sentences may differ in their felicity conditions and their presuppositions or implicatures, but they do not differ in truth conditions; thus (7) vs. (8) is an instance of truth-conditional vs. merely discourse-related effects of focus.

- (8) (a) Mary took JOHN to the movies yesterday.  
 (b) Mary took John to the MOVIES yesterday.  
 (c) MARY took John to the movies yesterday.

**2.2.2 Only, even, also.** The focus-sensitivity of the particles only, even, and also, also analyzed by Jacob 1983 and Rooth 1985, is even more well-known. The sentences (9a) and (9b) have very clear differences in truth-conditions. In the case of even and also the differences are in presupposition rather than truth-conditions but are otherwise very similar. Again note that if one were to remove the operator only from (9a) and (9b), focus would then have an effect only at the discourse level, but no effect on truth conditions.

- (9) (a) John only introduced Bill to SUE. [even, also]  
 (b) John only introduced BILL to Sue.

**2.2.3 Counterfactuals.** Philosophers of language have argued in a number of contexts about whether focus plays a role in truth conditions or only with respect to language use and the pragmatics of discourse; the nature of the contribution of focus to sentences about causation has been particularly problematic and controversial. Dretske 1972 pointed out a number of philosophically interesting cases where focus seems undeniably to play a role in determining truth conditions, particularly notably in the case of counterfactual conditionals. Examples (10a-b) are Dretske's.

- (10) (a) If Clyde hadn't married BERTHA, he would not have been eligible for the inheritance.  
 (b) If Clyde hadn't MARRIED Bertha, he would not have been eligible for the inheritance.

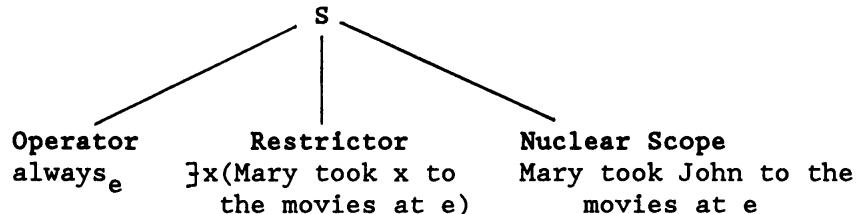
An example of a case in which (10b) would be true and (10a) would be false is a situation in which Clyde did marry Bertha, Clyde and Bertha had been living together but hadn't decided whether they wanted to get married or not, and Clyde's father's will specified only that Clyde must be married to receive the inheritance, with no restrictions on who Clyde must marry. One can construct a case where (10a) would be true and (10b) false by considering a will that specified that Clyde should either remain a bachelor or, if he married, it must be to someone with some particular characteristics, characteristics that Bertha had but another woman in Clyde's life whom he might have married did not have.<sup>1</sup>

**2.2.4 Some discussion of the cases so far.** Before proceeding to other kinds of examples, I should say a word about the semantic analysis of some of the constructions we have looked at so far. There are by now several alternative proposals for formalizing the semantics of focus and of focus-sensitive operators. There are interesting differences among these analyses and it is far from clear what the best analysis is. Here I am contenting myself with a very rough analysis that represents only some of the most central features of what I believe the currently competing analyses more or less have in common.

The tripartite structure in (11) below gives an approximate analysis of the semantics of sentence (7a), repeated below with focus explicitly marked.

(7a) Mary always took [John]<sub>F</sub> to the movies

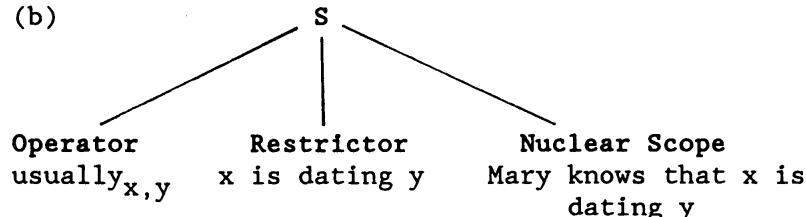
(11)



It is interesting to compare this with the work of Berman (1989, 1991) on the interaction of adverbs of quantification with embedded questions, free relatives, concealed questions, and definites (the quantificational variability of definites is also discussed in Kratzer 1989b). Berman notes that a sentence such as (12a) below has an interpretation that can be represented by the tripartite structure in (12b), and he offers an explanation for this phenomenon making crucial use of the accommodation of presuppositions.

(12) (a) Mary usually knows who is dating whom

(b)



Berman notes that since know is factive, a sentence of the form "Mary knows that S" presupposes the truth of S; and given the independent motivation for accommodating presuppositions of the nuclear scope of quantificational structures into the restrictor

clause (some of which motivation I will mention just below), together with his analysis of WH-words as variables, the restrictor in (12b) is derived as shown.

An example illustrating the independent need to assume that presuppositions of the nuclear scope are readily accommodated into the restrictive clause is Schubert and Pelletier's classic example from their 1988 paper, (13). The basic principle is articulated in Heim (1983).

(13) Cats always land on their feet.

The question that I want to raise about the relation of Berman's analysis to the analysis of focus-sensitive operators is whether the two phenomena are somehow fundamentally the same and whether the analyses are in effect already virtually the same. Certainly in the literature there has always been a strong parallel between "focus and presupposition" and "question and presupposition", and appropriateness as an answer to various WH-questions has routinely been taken as a central diagnostic of focus. If we assume that WH-words are necessarily foci of the questions they head, it would seem that it must be possible to see these two phenomena as basically the same; perhaps this is already explicit in some part of the literature that I have overlooked.

**2.2.5 Modals.** Halliday 1970 tells of a sign in the London underground saying "Dogs must be carried" and describes a hypothetical hapless character who sees the sign and is worried because he has no dog. The character is presumably reading the sign with focus on dogs and interpreting it as represented roughly in (14b) rather than as the presumably intended (14a).

(14) (a) Dogs must be CARRIED

MUST ( dog(x) & here(x) , x is carried )

(b) DOGS must be carried

(?) MUST ( here(e) , a dog or dogs is/are carried at e)

or: MUST (you carry x here, you carry a dog here)

Note that if the sign had said "Shoes must be worn", the (b)-type analysis would indeed have been the appropriate one.

Examples of this kind, and the probable relatedness of the focus sensitivity of modals, D-quantifiers, and A-quantifiers, are discussed in Partee, Bach and Kratzer (1987). Kratzer 1989b

and Diesing 1989 have developed analyses that capture the fact that only stage-level predicates or other cases of what they analyze as VP-internal subjects allow the subject to map into the nuclear scope as in the (b) case above. Thus while one has a choice of subject or predicate focus in (out-of-the-blue utterances of) (15), with the stage-level predicate "available", one cannot (except in a context allowing a contrastive interpretation) focus the subject of (16), with the individual-level predicate "expensive".

- (15) (a) TICKETS are available.
- (b) Tickets are AVAILABLE.
- (16) (a) \*TICKETS are expensive.
- (b) Tickets are EXPENSIVE.

**2.2.6 Frequency adverbs.** Sgall et al (1986) discuss quite a range of examples where choice of focus affects truth conditions, including examples like (17) below. These are similar to the cases of quantificational adverbs discussed above.

- (17) (a) LONDONERS most often go to Brighton.
- (b) Londoners most often go to BRIGHTON.

**2.2.7 Generics.** The effect of focusing on the interpretation of generic sentences is well known and much discussed; since generics have posed challenging problems for semantic analysis in general, it is not surprising that the analysis of the interaction of focus and genericity is still a matter of debate. One way of understanding many relatively straightforward cases such as (18) and (19) below, from Sgall et al (1986), is as basically similar to the cases with adverbs of quantification, with an understood generic operator of some sort in place of the quantificational operator. The focus-frame goes into the restrictive clause, thus delimiting what sorts of contrasting cases are being quantified over by the implicit generic operator- e.g. in (18) over possible activities that one might carry out when one is in the hallway or over possible places where one might do one's smoking.

- (18) (a) One SMOKES in the hallway.
- (b) One smokes in the HALLWAY.
- (19) (a) English is spoken in the SHETLANDS.
- (b) ENGLISH is spoken in the Shetlands.

**2.2.8 WHY-questions.** It has been pointed out by Hajičová and others (see Dretske 1972, 1975, Hajičová 1984, Bromberger 1987,

Engdahl 1985) that WHY-questions are focus-sensitive in a way that other WH-questions are not. While one cannot speak of truth-conditions of questions directly, one can speak of truth-conditional effects of focus in terms of what counts a true answer. The two WHY-questions in (20) below can in principle have different true answers; e.g. one can imagine a scenario where Clyde had to make both a choice between two women and in either case there was a question of getting married or just living together, and where "in order to be eligible for Social Security benefits" might be a true answer to the second but not the first while "because Bertha could stand his snoring and Agatha couldn't" might be a true answer to the first but not to the second.

- (20) Why did Clyde marry BERTHA?/ Why did Clyde MARRY Bertha?

By contrast, a WHEN-question may show "discourse effects" of focus, but different choices of focus do not directly affect what counts as a true answer (although they could indirectly do so by disambiguating an ambiguous structure, for instance).

- (21) When did your BROTHER visit Paris?/ When did your brother visit PARIS?

These two questions may have different felicity conditions in a discourse and suggest different states of background knowledge or interest on the part of the speaker, but a true answer to one is necessarily a true answer to the other.

As far as I know, WHY-questions are the only class of questions for which focus actually affects truth conditions.<sup>2</sup> The question of why this should be so is raised below (but not answered.)

**2.2.9 Emotive factives and attitude verbs.** It may be controversial that the actual truth-conditions of sentences containing emotive factive verbs and verbs of propositional attitude are affected by changes in focus, but that appears to be the case, as evidenced by examples like the following:

- (22) (a) It's odd that Clyde married BERTHA/... MARRIED Bertha/ etc.  
 (b) I found out that OTTO shot Lefty/ that Otto shot LEFTY/ etc. (Dretske 1975)

An analysis of such cases has recently been developed by Kratzer (class notes Spring 1991, UMass, Summer 1991, Santa Cruz, and 1991a).

**2.2.10 Presupposition vs. allegation under negation.** The following case, from Hajičová 1984b, is not exactly a truth-conditional shift. But it does show a related effect, an alternation between presupposition and what Hajičová calls "allegation". Consider the NP "our defeat" in (23a-b): in (23a) it is part of the (Pragian) topic, in (23b) part of the focus.

- (23) (a) This time our defeat wasn't caused by HARRY.
- (b) This time Harry didn't cause our DEFEAT.

On Hajičová's analysis, the proposition that we were defeated (or, equivalently, that the NP "our defeat" has a referent) is a presupposition of the whole sentence only when the NP "our defeat" is part of the topic; but when the NP is part of the focus, that proposition is merely an allegation, something that would be entailed in the corresponding positive sentence but neither it nor its negation entailed under negation.

**2.2.11 Superlatives, "first", etc..** Superlatives and related expressions such as ordinals, "principal", etc., have a "domain" argument which is frequently left implicit, in which case the placement of focus can be decisive in determining it and consequently in determining the truth conditions of the sentence. Example (24) below can have a variety of truth conditions depending on where focus is placed.

- (24) The largest demonstrations took place in Prague in November (in) 1989.

If one focuses "Prague", then the claim concerns a comparison of the sizes of the demonstrations in all the places where there were demonstrations in November 1989; if "November", then we are comparing the sizes of demonstrations in Prague in all the months in 1989; if "1989" then we are comparing the sizes of the demonstrations in Prague in November in all the different years.

One can construct interesting minimal pairs involving on the one hand the determiner "most" and on the other hand the superlative structure "the most" (superlative of "much" or "many"): see (25a-c) below.

- (25) (a) Most students got between 80 and 90 on the first quiz.
- (b) The most students got BETWEEN 80 AND 90 on the first quiz.
- (c) The most students got between 80 and 90 on the FIRST quiz.

In the case of the determiner "most", in (25a), the truth conditions are unaffected by topic-focus structure; more than half of the students must have gotten between 80 and 90 on the first quiz, period. But in the case of the superlative structure in (25b-c), focus does affect truth conditions. For (25b) to be true, the relevant partition of ranges of scores on the first quiz must be such that more students scored in the 80-90 range than in any other range (a plurality of the students, not necessarily a majority). For (25c), on the other hand, the comparison involves different quizzes: more students must have gotten between 80 and 90 on the first quiz than on any other quiz.

The claim that truth conditions are unaffected by focus structure in the case of the determiner "most" is slightly too strong, by the way: many authors have noted that focus structures involving adjuncts as in (26) can contribute to the determination of what goes into the restrictive clause.

- (26) Most ships pass through the lock [at night]<sub>F</sub>.

It is still the case for all possible readings of (26) that the common noun phrase with which the determiner is in construction must go into the restrictive clause and the whole verb phrase goes into the nuclear scope; however, in addition to one reading in which that is all there is to the assignment of tripartite structure, represented in (27a), there is another reading in which the "focus frame" part of the verb phrase interpretation is accommodated into the restrictive clause as well, as represented in (27b).

- (27) (a) MOST, x is a ship, x passes through the lock at night  
 (b) MOST, x is a ship and x passes through the lock sometime, x passes through the lock at night

This phenomenon is a normal instance of the accommodation of presuppositions into the restrictive clause seen above in the discussion in section 2.2.4 of Berman's treatment of the quantificational force of embedded questions and also discussed in Heim 1982 and Kratzer 1989b.

### **2.3 Explanatory basis of the correlation?**

The examples we have seen include: modal verbs (must, should, would, and other "universals"), counterfactuals, frequency adverbs/adverbs of quantification (most often, always), the implicit generic operator, WHY questions, negation, only, even, also, superlatives, attitude verbs and emotive factives.

If we count quantification over possible worlds (for the modals, attitude verbs and emotive factives), over degrees of various kinds (for the superlatives), and over various implicit sets that contrast with the given focus (for only, even, also), then all except perhaps the WHY-questions can be considered as operators with some quantificational force.

Why do WHY-questions and not other WH-questions work the same way? Is it because WHY doesn't bind a trace of its own (cf. Bromberger 1987) and the others do? Is it because the question isn't even interpretable without a specification of relevant alternatives? Is it because of the implicit counterfactuality involved in asking and answering WHY questions? I don't know the answer, although I am inclined to favor a possible combination of the second and third alternatives: a WHY-question, unlike other WH-questions, isn't even a well-defined question without a specification of "why this instead of what?", and that may in turn be related to the fact that in order to answer such a question one must counterfactually entertain some family of alternative possible states of affairs and explain why the actual state of affairs is the case rather than any relevant alternative possible state of affairs.

I should also put in a caveat on attitude verbs: it may not be quantification that explains which of them show strongest focus effects - e.g. "just found out", "realize" show stronger effects than "know" and "believe". Also see Kratzer's work in progress (seminar handouts spring 1991) on attitude verbs, and the work of Cresswell and von Stechow (1982) on structured meanings and their role in explicating the relation of focus to semantics of propositional attitude verbs. The structured meaning approach to focus is also pursued in the recent work of Krifka (this volume).

But if we leave aside these possible worries, the main generalization that seems to emerge is the following:

In all the above cases, the tripartite structure is essential to the interpretation, even truth-conditionally, and in all those cases the focus structure appears to be contributing to the tripartite structure as specified in the basic correlation: focus-frame to the restrictive clause and focus to the nuclear scope.

The relation of these semantic effects of focus structure to the pragmatic role of focus structure in discourse seems to have been becoming clearer in recent years. In discourse, the set of alternatives associated with the focus-frame locates the conversational contribution with respect to common ground or background; and it is the union of all those alternatives that

identifies the existential presupposition that is normally identified in cases construed as "focus-presupposition". (See Krifka (this volume) and the work of Jacobs cited therein on the interpretation of "ASSERT" operator, going back to early work of Dahl, among others.)

In the case of the focus-sensitive operators, the focus-frame's set of alternatives contributes to restricting the domain to be quantified over or the analogous first argument of other essentially binary operators. (See Rooth 1985, ms. 1989, ms. 1991, Kratzer ms. 1989, ms. 1991, Krifka this volume)

These generalizations leave many open questions about focusing as a device, e.g. about degrees of grammaticalization of different syntactic and prosodic means of identifying focus structures, both within and across languages. Rooth (1991) suggests that neither syntax nor semantics makes explicit reference to intonationally marked focused constituents in English, as opposed to e.g. the cleft construction, which is a grammaticalized structure that is obligatorily interpreted as marking focus. What are the differences in properties of focus marked intonationally as in English, by word order as in the Slavic languages, by a distinct focus constituent position as in Hungarian, etc.? Is the ability of focus to "escape islands" limited to intonationally marked or contextually inferred focus? And how does that property relate to what focus is used for?

### **3. Limits to the correlation; the correlation as default.**

From the cases that we looked at in section 2 and the discussion in section 2.3., we have at least gathered some support for the plausibility of the basic correlation "focus-frame : restrictive clause :: focus : nuclear scope". But at the same time it is clear that the correlation is not absolute, and in this section we briefly mention some of the limits and qualifications that must be taken into account as we try to establish the place of the correlation in an overall theory of grammar.

#### **3.1. Syntax wins.**

We have already seen some cases where tripartite structures are determined by the syntax and focus may in some cases contribute to the addition of material to a restrictive clause but it cannot override what the syntax explicitly requires. Determiner quantifiers were a case in point, as noted in the discussion of most in section 2.2.11 above. Additional cases of this sort include some cases of constituent negation and some cases of constituent-attached only, even, also.

### 3.2. "Weak" operators.

In analogy with the "weak quantifiers" (Milsark 1977, Barwise and Cooper 1981), we can identify "weak" modals and other operators. Roughly, these are operators which in some sense have existential-like rather than universal or quasi-universal force -- quantifiers like some, several, three, adverbs of frequency or quantification like sometimes, occasionally, modals like may and can. As discussed in Partee (1988), these have no essential tripartite structure; while they can be represented as binary operators, these operators are (at least in basic truth-conditional respects) symmetrical in their two arguments, which may be thought of as conjoined. Hence with such operators, it is not crucial to determine which material belongs in the restrictor and which in the nuclear scope, at least not for determining the basic truth conditions.

There are also many sentence adverbials discussed by Koktova (1986, 1987) which are not quantificational at all, for which no tripartite structures are needed in the semantics; focus effects in connection with such adverbs appear to be limited to the normal discourse functions of focus.

One interesting operator which I am not certain where to classify is the connective because. On the one hand, it seems in some respects like a factive variant of if (see Frege 1892) but its behavior with respect to the establishment of tripartite structures differs markedly from that of if; material in a because-clause does not automatically get added to the restrictor of some salient operator the way material in an if-clause invariably does (see Carlson 1979 and Farkas and Sugioka 1983), as witnessed by the difference between (28a) and (28b).

- (28) (a) Wolves are always mean if they have blue eyes.
- (b) Wolves are always mean because they have blue eyes.

This difference would be explainable if because is itself an operator while if is not, a plausible assumption on the Lewis-Kratzer-Heim view of the function of if-clauses.

But there are several further aspects of the behavior of because that need to be examined in connection with topic and focus and the principles for building or disambiguating quantificational structures. One is the interaction of because-clauses with negation, a matter that has been subject to great controversy since the early days of generative semantics and which has been given an elegant formalization in terms of Hajičová and Sgall's treatment of topic-comment structure (integrated with a mapping into intensional logic) by Vlk (1988a,b).

In both of the respects mentioned above, because does not act like a focus-sensitive operator. But there is also an obvious affinity among counterfactuals, why-questions, sentences with the

verb cause, and constructions with because; the question of whether any or all of these are showing genuinely truth-conditional effects in association with focus or some more indirect effects having to do with differentially calling up alternative backgrounds against which they are intended to be evaluated is a knotty question which I have not really explored.

### 3.3 Theoretical challenges.

In work which is too recent for me to try to evaluate, Rooth (ms. 1991) proposes constraints against stipulative rules of association with focus: "Neither the syntax of lexical entries nor syntactic rules refer to the focus feature  $[]_{Ff} \dots$  Lexical and constructional meanings do not manipulate  $[[]]_{Ff}$ ." Rooth's position has been challenged by Krifka (this volume) with arguments concerning multiple focus, but Krifka also believes that the principles of association with focus are highly constrained and that the syntax will not require explicit coindexing of focus-sensitive operators with focused constituents. On Rooth's position, the contribution of focus structure to the determination of tripartite structures in the semantics would all have to be indirect, on a par perhaps with the role of local and global accommodation of salient presuppositions discussed by Heim 1983.

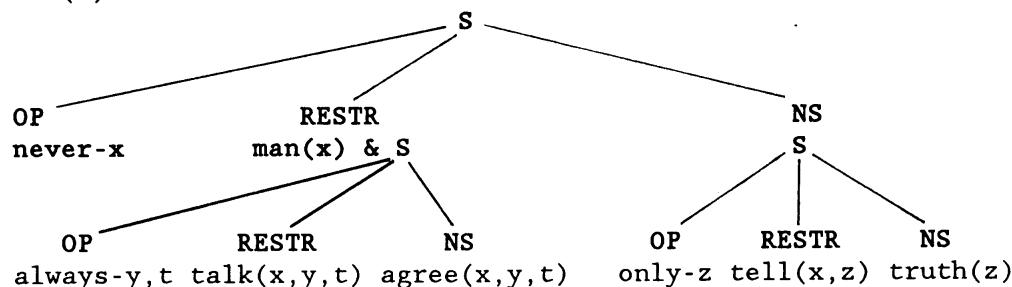
## 4. Apparent problems and possibly conflicting generalizations.

### 4.1. Recursion

According to Prague school analyses, a sentence has a single division into topic and focus (plus a linear scale of communicative dynamism (CD) within each); but tripartite structures are recursive, and further tripartite structures can occur within either the restrictor or the nuclear scope. An example with both is (29a), whose structure is shown in (29b).

- (29) (a) A man who always agrees with whoever he is talking to never tells only the truth.

(b)



Wherever one puts the topic-focus boundary, it is clear that for at most one of the operators can the basic correlation hold.

I believe that the basic correlation holds recursively. With respect to a non-recursive Praguian topic-focus structure, I believe the correlation holds directly for the highest operator and indirectly for the embedded ones; the Praguian "scale of communicative dynamism" might therefore better be looked upon as resulting from a recursively nested binary structure rather than being intrinsically linear; compare metrical trees and their determination of linear degrees of stress, etc. See also Selkirk (1984) on recursive focus structures in a different sense, and Krifka (this volume) for explicit treatment of recursive structures using a recursive "structured meanings" approach.

#### **4.2. Counterexamples explainable by "contrastive" emphasis.**

Another class of apparent counterexamples is the following. Contrary to the claimed correlation of focus with nuclear scope, it is evident that one can sometimes focus (all or part of) the restrictor. There are two subcases with different explanations.

**4.2.1. Tripartite structure determined by syntax.** Consider the little dialogue in (30):

- (30) A: Most logicians like linguistics.
- B: Most NICE logicians like linguistics.

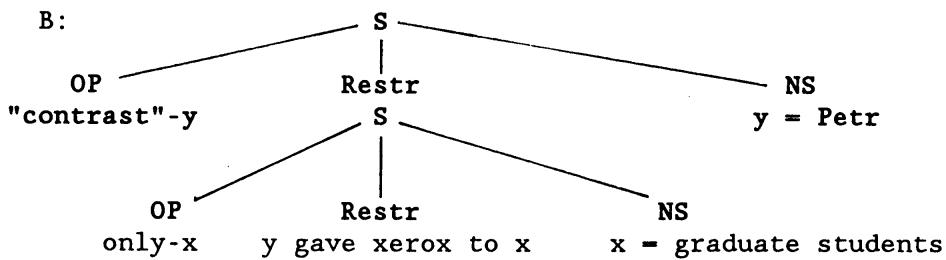
Here the word nice is focused in B's utterance, but it still must remain part of the restrictive clause. This example further reinforces the observation already made above that at least in English, focus structure or topic-focus articulation marked by intonation does not override syntax. In examples like this where syntax dictates the tripartite structure, focus associates with discourse functions such as "ASSERT". This example is similar to example (6) in section 2, an example of focus within topic: its function is to present one topic among alternative possible topics, in some sense a "contrastive topic".

**4.2.2 Tripartite structure normally determined (at least partly) by focus structure.** But there are also apparent violations of the claimed correlation even in constructions in which the topic-focus articulation does normally determine tripartite structures, e.g. in examples containing focus-sensitive operators such as only. (Examples similar to (31) below can be found in Gussenhoven 1984, Roberts 1990, Rooth ms. 1991, Krifka this volume.)

- (31) A: Eva only gave xerox copies to the GRADUATE STUDENTS.  
 B. (No,) PETR only gave xerox copies to the graduate students.

This is an apparent counterexample to the association of only with focus. Without focus marking, (31A) and (31B) would both be potentially ambiguous as to whether the nuclear scope of only is xerox copies or graduate students; structural constraints eliminate the possibility of the nuclear scope being the subject. Sentence A is disambiguated by intonation, and focus corresponds to nuclear scope, as expected; sentence B is disambiguated by the context of the preceding sentence. I would claim that graduate students is still focused in B although the focus is not marked intonationally; the inheritance of focus structure from prior context might be modelled as a higher-order type-shifting operation, where an entire structure like that in (31A) is abstracted on in the subject position to set up a new contrastive topic. (The representation in (32) is very primitive; I have represented things in a way that I hope is intuitively clear, in hopes that the non-specialist can readily grasp the main features of the intended interpretation and the specialist will know what has to be done to turn this into a representation in any one of the currently competing formal theories, since nothing here hangs on the differences among such theories, as far as I can see.)

- (32) A: ONLY-x (Eva gave xerox copies to x, x=graduate students)



On this account, the intonationally marked focus in (31B) has a discourse function of marking a correction, and may perhaps be another case that should be analyzed as contrastive topic. Only still associates with focus, but the focus it associates with in (31B) is one that may not be intonationally marked at all but is "inherited" from the structure of the previous utterance and imputed to the current one. If this sort of type-shifting or focus-inheritance is allowed, we must worry about how to keep generative power and predicted processing loads from growing explosively. As preliminary vague suggestions towards constraints, I would speculate that such shifting must

be either (a) "easy", (b) positively marked as a "shifted" structure, either in a grammaticalized way or not; or (c) triggered by failure (of some kind) of unmarked case and itself be the "next least marked" structure or nearly so. Suggestions by Rooth (ms. 1991) would take such problems largely out of the grammar of only, etc., and assimilate them to the problem of finding appropriate antecedents for anaphoric elements.

#### **4.3 Conclusions and open problems.**

The basic correlation of focus-frame with restrictive clause and focus with nuclear scope appears to have some reality at least as a default option when not overridden by the syntax. The explanatory basis for the correlation may be found in Rooth's basic idea that the principal semantic contribution of the focus-frame is a set of alternatives; this set of alternatives is typically used to restrict the domain of a focus-sensitive operator.

Looking at a range of focus-sensitive operators, we find that they tend to be higher-order operators which are essentially binary (i.e. require tripartite structures and are not symmetrical in their two arguments), and which are either explicitly quantificational or at least require a set of alternatives as their first argument (restrictive clause). They tend to be cross-categorial operators (like even and only), or operators that syntactically combine with a full sentence or VP but are semantically looking for an open proposition or property to quantify over.

These generalizations leave open many of the hardest questions about how and where focus relates to the grammar, with alternatives ranging from Hajičová and Sgall's proposals where Topic-Focus Articulation is an integral part of the deep structure to Rooth (ms. 1991) where the syntax has no access to  $[ ]_F$ -marking at all. But like correlations between thematic roles and syntactic structure, there may be strong default correlations which may become grammaticalized and then take on a life of their own. It would probably be fruitful to investigate both the broad correlations and the language-specific differences in grammaticalization. And quantification appears to be a very fruitful domain for investigating such correlations, undoubtedly expanding our understanding of quantification in the process.

#### **Acknowledgements**

I am grateful first of all to Petr Sgall and Eva Hajičová and their colleagues and students at the Charles University in Prague, both for their wonderful hospitality during my stay there during the momentous fall of 1989 and for our many hours of (not only) linguistic discussions, the linguistic parts of

which not only helped me overcome my initial nervousness about even trying to broach the area of topic and focus but gradually led me to the view that I could not continue to work responsibly in the area of the semantics of quantification without paying active attention to the phenomena which the Prague school linguists have been studying for many years under such names as "functional sentence perspective", "topic-focus articulation", and "scale of communicative dynamism". We hope to eventually write a joint article on these issues, but this isn't yet that.

The earliest version of the present paper was presented as my last seminar presentation in Prague in January 1990; subsequent presentations were made in a seminar on focus conducted by Angelika Kratzer, Irene Heim and Ede Zimmermann at UMass, Amherst, in February 1990; in a seminar at El Colegio de México in the spring of 1990; at a colloquium at Brown University in September 1990; at a UMass colloquium in March 1991; at the SALT conference at Cornell in April 1991 [this volume]; and as a Forum Lecture at the Linguistic Institute at UC Santa Cruz in July 1991. I have benefitted enormously from challenges, questions, ideas, and references provided by students and colleagues, many much more knowledgeable about focus than I and most generous and sympathetic in helping me to find accessible entryways into this area where I still feel in many respects an amateur. Besides Professors Hajičová and Sgall, my greatest debt is to Angelika Kratzer; I am also grateful for comments and suggestions received from Jaroslav Peregrin, Pavel Materna, Tomás Vlk, Irene Heim, Josefina García Fajardo, Elisabeth Selkirk, Roger Higgins, Leonard Babby, Susan Rothstein, Fred Landman, Manfred Krifka, Stephen Isard, Chris Barker, Minoru Nakau and Julia Hirschberg.

I was also fortunate to have the chance to hear Mats Rooth, Manfred Krifka, and Angelika Kratzer talk about their most recent work on focus on separate occasions during the spring of 1991 (Krifka at the SALT conference itself), not in time to have very much effect on the presentation I made at Cornell, but in time to influence my July presentation and the present writeup.

Support for the research provided herein was provided in part by NSF Grant BNS-8719999 to B. Partee, E. Bach and A. Kratzer for a project on Quantification: A Cross-Linguistic Investigation, and by a sabbatical leave granted by the University of Massachusetts, Amherst in 1989-90. Research for this article was also supported in part by a grant from the International Research and Exchanges Board (IREX), with funds provided by the National Endowment for the Humanities and the United States Information Agency. None of these organizations is responsible for the views expressed.

Under great pressure of time, Angelika Kratzer managed to read most of the draft of this paper and gave me valuable

comments; time constraints and being away from home made it impossible for me to follow up as I would have liked to on many of her suggestions, and I bear full responsibility for remaining inadequacies.

#### **FOOTNOTES**

1. Julia Hirschberg (p.c.) was not convinced by my oral presentation of the counterfactual case in Santa Cruz in July 1991 that the counterfactual case is really a truth-conditional effect. Here I have tried to construct scenarios in which either sentence could be felicitously used, but one of them would be true and the other false, to try to make it convincing that the difference really does directly affect truth-conditions. But of course it is still possible that the effect is an indirect one. If one thinks of the Lewis or Stalnaker or Kratzer treatments of counterfactuals, it is clear that where focus has its effect in these examples is in how we partition the relevant possible worlds to see what is true in those that are closest to the actual one; in one case we presumably compare worlds where Clyde marries Bertha to worlds where he marries someone else, holding constant his getting married, and in the other case we hold constant Clyde's having some sort of relationship with Bertha and vary the particular relationships.

An explicit analysis of the interaction of focus with the semantics of counterfactuals can be found in Kratzer (1989a); see that paper for fuller discussion of the sorts of cases mentioned here and careful attention to many difficulties and complications that I am neglecting here.

Rooth (ms. 1991) in fact suggests making all association with focus effects somewhat more indirect than they were in the treatment of Rooth 1985; I will continue here to count as truth-conditional effects of association with focus all those cases for which I believe there are truth-conditional differences and for which I cannot see an explanation of them as a byproduct of some other kind of disambiguation effect.

2. Lauri Karttunen suggested after my July talk in Santa Cruz that Yes-No questions should perhaps also be regarded as focus sensitive, on the grounds that while a pair like (ia-b) would not differ in their answers if the answer were "yes", they would differ in their "no" answers, since a full "no" answer would normally be construed differently in the two cases, as in (iia-b).

- (i) (a) Did you send your BROTHER to Paris?
- (b) Did you send your brother to PARIS?

- (ii) (a) No, I didn't send my BROTHER to Paris.  
 (b) No, I didn't send my brother to PARIS.

At the time I rejected this as an argument that Yes-No questions should be construed as truth-conditionally focus-sensitive, arguing that the relevant notion of truth-conditional effects for questions is just what constitutes a true answer, and that for Yes-No questions the issue is just whether the true answer is "yes" or "no". In the case of a "No" answer, filled out into a full sentence with preservation of the original focus structure, one would indeed expect further contrasting information (e.g. "rather my cousin" vs. "rather to London"), but this could simply reflect the pragmatic influence of the differing sets of alternatives evoked by the different focus structures: a helpful answerer will try to provide further information relevant to the speaker's interests as signalled by the choice of focus.

But I am not fully content with the answer I gave then, since on the one hand negation is normally considered to be an operator that associates with focus, but the same sorts of arguments I just gave would seem to show that the effect of focus on negation is not truth-functional. But Heim and Kratzer have argued that negation may often carry implicit quantificational force, in which case it can be truth-functionally affected by focus, but perhaps not in examples like the preceding. At this point I am hampered by not having Kratzer 1989a with me; I know there is an explicit analysis of negation with relevant discussion there, and I think there are examples that would come out with different truth-conditions under different focus structures, but I don't remember what they are and so can't test to see if they can be converted into yes-no questions for which a difference in focus could lead to a "yes" answer for one and a "no" answer for the other.

## **REFERENCES**

- Ahn, Sung-Ho (ms.1989) "Restrictive Terms", Ling. Inst., Tucson, and U.Conn.  
 Barwise, J., & Cooper, R. (1981) "Generalized Quantifiers and Natural Language," Linguistics and Philosophy 4, 159-219.  
 Berman, S. (1987) "Situation-based semantics for adverbs of quantification", WCCFL 6.  
 Berman, S. (1989) "An Analysis of Quantificational Variability in Indirect Questions", MIT Working Papers in Linguistics 11.  
 Berman, S. (1991) On the Semantics and Logical Form of Wh-Clauses Ph.D. dissertation University of Massachusetts.

- Bromberger, S. (1987) "What we don't know when we don't know why", in N. Rescher, ed., Scientific Inquiry in Philosophical Perspective, Univ. Press of America (75-104).
- Carlson, G. (1979) "Generics and Atemporal When," Linguistics and Philosophy 3, 49-98.
- Carlson, L. (1983) Dialogue Games: an Approach to Discourse Analysis. Dordrecht:Reidel.
- Chierchia, G. (1988) "Dynamic Generalized Quantifiers and Donkey Anaphora", in M. Krifka, ed., Genericity in Natural Language, Univ. of Tübingen.
- Chomsky, N. (1971) "Deep structure, surface structure, and semantic interpretation", in D. Steinberg and L. Jakobovits, eds., Semantics. Cambridge:Cambridge University Press (183-216).
- Cresswell, M.J. and A. von Stechow (1982) "De re belief generalized", Linguistics and Philosophy 5, 503-535.
- Dahl, O. (1974) "Topic-comment structure revisited", in Dahl (ed.), Topic and Comment. Contextual Boundedness and Focus, Hamburg: Buske Verlag.
- Diesing, M. (1989) "Bare Plural Subjects, Inflection, and the Mapping to LF", in Bach, Kratzer, and Partee, eds., Papers on Quantification, NSF report, UMass, Amherst.
- Dretske, F. (1972) "Contrastive Statements", Phil. Review, 411-437.
- Dretske, F. (1975) "The Content of Knowledge", in B. Freed et al (eds.), Forms of Representation, North-Holland, Amsterdam, 77-93.
- Farkas, D. F., & Sugioka, Y. (1983) "Restrictive if/when-clauses," Linguistics and Philosophy 6, 225-258.
- Frege, Gottlob (1892) "Über Sinn und Bedeutung", Zeitschrift für Philosophie und philosophische Kritik 100 (25-50). English translation, "On sense and reference" in P.T. Geach and M. Black eds., Translations from the philosophical writings of Gottlob Frege. Oxford:Blackwell, 1952 (56-78).
- 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, 3-48.
- Groenendijk, J. and M. Stokhof (1991), "Dynamic Predicate Logic", Linguistics and Philosophy 14.
- Gussenhoven, C. (1984) On the Grammar and Semantics of Sentence Accents, Foris, Dordrecht.
- Haiman, J. (1978) "Conditionals are Topics," Language 54, 564-589.
- Hajičová, E. (1973) "Negation and Topic vs. Comment", Philologia Pragensia 16, 81-93.
- Hajičová, E. (1983) "Topic and Focus", Theoretical Linguistics 10, 268-276. (Also in P.Sgall, ed. (1984), 189-202.)

- Hajičová, E. (1984a) "Presupposition and Allegation Revisited", Journal of Pragmatics 8, 155-167.
- Hajičová, E. (1984b) "On Presupposition and Allegation", in P. Sgall, ed. (1984), 147-188. [modified version of Hajicová 1984a]
- Hajičová, E. and P. Sgall (1987) "The Ordering Principle", Journal of Pragmatics 11, 435-454.
- Halliday, M.A.K. (1970) A Course in Spoken English: Intonation, Oxford University Press, Oxford.
- Hamblin, C.L. (1973) "Questions in Montague grammar", Foundations of Language 10, 41-53. Reprinted in B. Partee (ed.) Montague Grammar, N.Y.: Academic Press, 247-259.
- Heim, I.R. (1982) The Semantics of Definite and Indefinite Noun Phrases, Ph.D. dissertation, University of Massachusetts, Amherst. Heim, I.R. (1983) "On the projection problem for presuppositions", WCCFL 2, Stanford, CA: Stanford Linguistics Association.
- Jackendoff, R. (1972) Semantic Interpretation in Generative Grammar, Cambridge, MA: MIT Press.
- Jacobs, J. (1983) Fokus und Skalen. Zur Syntax und Semantik von Gradpartikeln im Duetschen Tübingen: Niemeyer.
- Jelinek, E. (1988) "Quantification Without Nouns in Salish" presented at Symposium on Cross-Linguistic Quantification, LSA 1988
- Kamp, H. (1981) "A Theory of Truth and Semantic Representation," reprinted in J. Groenendijk, T.M.V. Janssen and M. Stokhof, eds. (1984) Truth, Interpretation and Information, GRASS 2, Foris, Dordrecht.
- Koktova, E. (1986) Sentence Adverbials, John Benjamins, Amsterdam.
- Koktova, E. (1987) "On the Scoping Properties of Negation, Focusing Particles and Sentence Adverbials", Theoretical Linguistics 14, 173-226.
- Kratzer, A. (1980) "The Notional Category of Modality," in H. J. Eikmeyer and H. Rieser, eds., Words, Worlds and Contexts: New Approaches in Word Semantics, de Gruyter, Berlin.
- Kratzer, A. (1986) "Conditionals," In A.M. Farley et al, eds., Papers from the Parasession on Pragmatics and Grammatical Theory, CLS 22.
- Kratzer, A. (1989a), "An investigation of the lumps of Thought", Linguistics and Philosophy 12, 607-53.
- Kratzer, A. (1989b) "Stage-Level and Individual-Level Predicates" in Bach, Kratzer, and Partee, eds., Papers on Quantification, NSF report, UMass. Kratzer, A. (ms. 1989) "The representation of focus", handout, Ling. Institute, Univ. of Arizona, Tucson.
- Kratzer, A. (1991a) "Pseudo-scope", talk given at ASL/LSA Conference on Logic and Linguistics, Santa Cruz.

- Kratzer, A. (ms. 1991) "Focus tutorial", handout, Linguistic Institute, UC Santa Cruz.
- Krifka, M. (this volume) "A compositional semantics for multiple focus constructions", Univ. of Texas, Austin.
- Landman, F. (1986) "Pegs and Alecs" in F. Landman, Towards a Theory of Information, GRASS 6, Foris, Dordrecht.
- Lee, Hyunoo (ms. 1989) "Towards a Formal Characterization of the Korean Topic Construction", Linguistic Institute, Tucson, and UCLA.
- Lewis, D. (1970) "General semantics", Syntheses 21.
- Lewis, D. (1973) Counterfactuals, Blackwell, Oxford.
- Lewis, D. (1975) "Adverbs of Quantification," in E. L. Keenan, ed., Formal Semantics of Natural Language, Cambridge University Press.
- Materna, P., Hajíčová, E. and Sgall, P. (1987), "Redundant Answers and Topic/Focus Articulation", Linguistics and Philosophy 10, 101-113.
- Milsark, G. (1977) "Toward and explanation of certain peculiarities of the existential construction in English", Linguistic Analysis 3, 1-30.
- Montague, R. (1973) "The Proper Treatment of Quantification in Ordinary English," in Montague (1974), Formal Philosophy, Yale University Press. Partee, B. (1988) "Many Quantifiers", Proc. of ESCOL '88.
- Partee, B. (1989) "Binding Implicit Variables in Quantified Contexts, CLS 25
- Partee, B., E. Bach, and A. Kratzer (1987) "Quantification: A Cross-Linguistic Perspective", NSF proposal, UMass, Amherst.
- Roberts, Craige (1990) "Domain Restriction in Dynamic Semantics", talk presented at the Symposium on Logic and Language, Revfülöp, Hungary, August 27, 1990.
- Rochemont, M. (1986) Focus in Generative Grammar, John Benjamins, Amsterdam.
- Rooth, M. (1985) Association with Focus, Ph.D. diss., UMass, Amherst.
- Rooth, M. (ms. 1989) "Indefinites, Adverbs of Quantification, and Focus Semantics"
- Rooth, M. (handout 1991) "A Restrictive Theory of Focus Interpretation, or What is the Source of Association with Focus Ambiguities?", talk, UMass, Amherst, April 1991.
- Schubert, L. and F.J. Pelletier (1988) "Generically Speaking, or, Using Discourse Representation Theory to Interpret Generics", in Chierchia, Partee, and Turner, eds., Properties, Types, and Meaning, v.2, Reidel.
- Schwarzchild, R. (1989) "Adverbs of Quantification as Generalized Quantifiers", NELS 19.
- Sekirk, E. (1984) Phonology and Syntax: The Relation Between Sound and Structure, MIT Press, Cambridge.

- Sgall, P.(ed.) (1984) Contributions to Functional Syntax, Semantics, and Language Comprehension, Academia, Praha.
- Sgall, P., E. Hajičová, and J. Panevová (1986), The Meaning of the Sentence in Its Semantic and Pragmatic Aspects, Academia, Prague and Reidel, Dordrecht.
- Stalnaker, R. (1978) "Assertion", in P. Cole (ed.) Syntax and Semantics 9, Academic Press, New York.
- Stump, G. (1985) The Semantic Variability of Absolute Constructions, D. Reidel Publishing Company, Dordrecht.
- Szabolcsi, A. (1981a) "The Semantics of Topic-Focus Articulation", in J. Groenendijk, T. Janssen, M. Stokhof (eds.), Formal Methods in the Study of Language, Part 2, Mathematisch Centrum, Amsterdam (513-540).
- Szabolcsi, A. (1981b) "Compositionality in Focus", Folia Linguistica 15, 141-161.
- Szabolcsi, A. (1983) "Focussing properties, or the trap of first order", Theoretical Linguistics 10.
- Vallduví, Enric (1990) The Informational Component, Ph.D. dissertation, University of Pennsylvania.
- Vlk, T. (1988a) "Topic/Focus Articulation and Intensional Logic", in D. Vargha (ed.), COLING'88, ACL, Budapest. 720-725.
- Vlk, T. (1988b) "Towards a Transduction of Underlying Structures Into Intensional Logic", The Prague Bulletin of Mathematical Linguistics 50, 35-70.

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## **Gerunds and Types of Events\***

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### **I. Introduction**

It has often been suggested that gerunds can refer to events. Examples (1)-(3) seem to suggest this analysis.

- (1)     Reading *Bellefleur* was not very exciting.
- (2)     Jaye liked reading *Bellefleur*.
- (3)     Sarah stopped reading *Bellefleur*.

However, this cannot be quite right, since gerunds may be quantified over, as seen in (4).

- (4)     Reading *Bellefleur* is usually rewarding.

The fact that there are sentences, like (4), in which the events in a gerund's denotation are quantified over seems to indicate that gerunds may denote properties of events, and such a meaning is also workable for (1)-(3). (1) and (2), as well as (4), can be analyzed in a theory closely related to those proposed by Kamp (1981) and Heim (1982) for indefinites. And (3)--whose gerund is the complement of an aspectual verb--can also be analyzed if gerunds denote properties of events. It claims that there was a change from the presence of an event of Sarah reading *Bellefleur* to the lack of such events (Dowty (1979), von Wright (1963)).

In this paper I will argue that, if events are to be used in analyzing (1)-(4), we must contemplate generic events, events which are constituted by a repetition of simpler events. (This is something like Montague's (1960) distinction between generic and individual events.) Gerunds which involve internal event quantification show exactly the same range of meanings as those which do not. So consider the following:

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\* I would like to thank E. Bach, K. von Fintel, A. Kratzer, B. Partee, and H. Rullmann for discussion and comments. This work was partially supported by NSF grant BNS 8719999 and by an NSF graduate fellowship.

- (5) Always eating cabbage when I had dinner was never fun.
- (6) Eating cabbage whenever I ate corned beef made me very unhappy.
- (7) Always eating cabbage was usually rewarding for me.
- (8) Always eating cabbage was not very exciting.
- (9) Jaye liked always eating cabbage.
- (10) Sarah stopped always eating cabbage.

In these examples, internal to the gerund there seems to be quantification over events. In (5), for example, the gerund denotes the set of possible events--i.e. the property of events--such that, for each of my eatings of dinner which is a mereological part of one of these events, I eat cabbage at that dinner. These "generic events" are subsequently quantified over by the adverb *never*; this example is therefore parallel to (4). The type of quantification in (7)-(10) is similar but highly dependent on focus. With focus on *cabbage* the gerund in (7) seems to denote the set of events  $e'$  such that all my eating events  $e'$  which are part of  $e$  are cabbage-eating events. The sentence as a whole then means that most events  $e$  such that, whenever I eat in  $e$ , I eat cabbage in  $e$ , are rewarding. This can be represented as in (11).

- (11) [usually<sub>e</sub> [ $\forall e'[(e' < e \wedge \exists x(\text{eat}(I,x) \text{ in } e')) \supset$

eat(I,cabbage) in  $e']]$  [rewarding-for-me( $e$ )]]

$e' < e$  represents the idea that the event  $e'$  is a part of  $e$ . In (11) the  $e$ 's are in a sense collections of cabbage-eating events. The easiest way of organizing these cabbage-eating events into groups seems to be by time. Thus (7) is easily preceded by

- (12) Every winter we always ate CABBAGE.

As we will see, the availability of this kind of reading poses problems for a Davidsonian approach to the semantics of gerunds. A Davidsonian approach says that events come into the semantics for gerunds by way of an implicit event argument of the verb--this event argument is on a par with the subject and other arguments. The reason for the difficulty is clear: if the Davidsonian event argument of the VP which forms the gerund is bound by a quantifier internal to the gerund (*always* in (7)), it will not be available for binding by another quantifier (i.e. *usually*) at the matrix level. Instead, a situation-based semantics will turn out to be more appropriate. A situation-based theory treats propositions as sets of possible situations. Some of these situations can play the role of events.

## II. A Categorization of Gerund Meanings

Now I will attempt to outline a categorization of gerunds while indicating how treating gerunds as denoting properties of events in a Kamp/Heim-style theory allows an account of their range of readings. For more details, see Portner (1991). The fact that, across a wide range of contexts, internally quantified gerunds and simple gerunds show the same types of readings argues strongly that they should be given a unified treatment. After the categorization we will look at how a Davidsonian and a situation-based semantics can each give a formal theory of the meanings of gerunds.

In analyzing the various gerunds I will make use of a Government and Binding theory syntax with a level of Logical Form. In deriving Logical Forms a process of quantifier raising may be used. QR is a consequence of semantic type-mismatch. It occurs when a function selects for an argument of one semantic type but finds itself with an element of a different type. So, for instance, if a verb selects for an individual as its object, but there is a quantifier there, the quantifier will have to move, leaving behind a trace of the right type. This idea is similar to one of Partee (1987).

In subject position, both internally quantified and simple gerunds can be interpreted as definite, quantified, or event-kind.

### definite

- (13a) Eating green beans was not very exciting.
- (13a') [S [NP1 PRO eating green beans] [S e<sub>1</sub> was not very exciting]]
- (13b) Always eating GREEN beans was not very exciting.

(13a) will receive the Logical Form shown. The gerund introduces a free variable, e<sub>1</sub>, as on Kamp's and Heim's analyses, which will be interpreted like a discourse pronoun. The sentence will be interpreted as claiming that e<sub>1</sub> was an event of eating green beans and e<sub>1</sub> was not very exciting. Just how (13b) is interpreted is dependent on the focus structure of the gerund. With focus on *green*, the sentence claims that some particular past situation such that, whenever I ate beans in that situation I ate green beans, was not very exciting.

In (14) there is quantification over the events in the denotation of the gerund.

quantified

- (14a) Eating green beans was never exciting.
- (14a') [S never<sub>1</sub> [NP<sub>1</sub> PRO eating green beans] [S e<sub>1</sub> was very exciting]
- (14b) Always eating GREEN beans was never exciting.

In the LF shown in (14a') the adverb of quantification compares the sizes of its two sisters, and it asserts that nothing which is an event of eating green beans was very exciting. By varying the adverb of quantification, different quantificational forces can be arrived at; Lewis (1975) uses this fact to argue for the type of semantic structure shown.

In some cases no particular events seem to be picked out by the gerund, but instead something like a practice or activity is at issue. This can be seen in (15).

event-kind

- (15a) Eating green beans is getting very popular.
- (15b) Always eating GREEN beans is getting very popular.

Chierchia's (1984) treatment of activities--what I call event-kinds in view of their similarity to natural kinds--is to claim that they are abstract individuals correlated with the property which is the gerund's ordinary meaning. I will follow him in treating these gerunds as names for such abstract objects.

As the complement of a factive verb, definite and quantified structures are available for both internally quantified and simple gerunds.

definite

- (16a) Lisa didn't enjoy eating green beans.
- (16a') [S [NP<sub>1</sub> PRO eating green beans] [S Lisa didn't enjoy e<sub>1</sub>]]
- (16b) Lisa didn't enjoy always eating GREEN beans.

quantified

- (17a) Julie never enjoyed eating green beans.
- (17a') [S never<sub>1</sub> [NP<sub>1</sub> PRO eating green beans] [S Julie enjoyed e<sub>1</sub>]]
- (17b) Julie never enjoyed always eating GREEN beans.

These get the kind of LF's shown, which are in relevant respects the same as those for subject gerunds.

Certain nonfactive verbs seem to result in a reading on which there is an attitude towards a particular possible event. This can be seen in (18).

- (18a) Nick dreamt about eating green beans.
- (18a') [S Nick [VP  $\exists_1$  [VP [NP<sub>1</sub> PRO eating some green beans] [VP dreamt about e<sub>1</sub>]]]]]

(18b) Nick dreamt about always eating GREEN beans.  
Such a reading can be arrived at if, after QR, the gerunds are bound by a process of existential closure.<sup>1</sup> (Such an analysis is similar to that of Bennett (1974).) In this way these gerunds differ from the complements of factives, which are not bound by existential closure. The difference is due to the combination of hypotheses due to Diesing (1990) and Berman (1989).

According to Diesing, existential closure--a process first proposed by Kamp and Heim--is limited to unbound indefinites inside the VP. Thus we should hypothesize that the gerunds in (18) are moved by QR only onto the VP. Berman argues that a process of presupposition accommodation can copy an indirect question which is the complement of a factive into a position outside the VP. Adopting this proposal for gerunds will, after QR onto the VP, copy the factive gerunds in (16) and (17) into a position in which they can be bound by an adverb of quantification and outside the domain of existential closure. The true LF of (16a) will therefore be:

- (16a'') [S [NP<sub>1</sub> PRO eating green beans] [S Lisa didn't [VP [NP<sub>1</sub> PRO eating green beans] [VP enjoy e<sub>1</sub>]]]]]

Some gerund complements of nonfactives are interpreted nonspecifically.

- (19a) Carter avoided eating green beans.
- (19b) Carter avoided always eating GREEN beans.

These are simply interpreted in their S-structure positions.

There is no QR.

Finally, aspectual verbs can take both internally quantified and simple gerunds:

- (20a) Pete stopped eating green beans.
- (20b) Pete stopped always eating GREEN beans.

This class of verbs is clearly related to the progressive, which has been argued by, for example, Vlach (1981), Bach (1977), Parsons (1990), and Landman (1990) to involve reference to events. The imperfective character of the events in these

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<sup>1</sup>As a syntactic process, it is possible to dispense with existential closure, but I show it explicitly for clarity.

gerunds' denotations needn't be of worry, since in many other cases gerunds may be interpreted imperfectively, as seen by (21).

- (21) I enjoyed building that house, even though I didn't finish.

I will assume that aspectual verbs are raising verbs, taking a single gerund argument. Here too the gerund is interpreted in place, with no QR.

From the examples in this section, we can conclude that an adequate semantic theory must be able to accommodate gerunds with internal quantification as well as simple gerunds, and that it should provide them with essentially the same semantics. If it does not postulate the same kind of semantic structure, the fact that the range of readings available for the two classes is identical would go unexplained.

### **III. Two Theories of Events**

Now we will consider a Davidsonian and a non-Davidsonian approach to the semantics of gerunds. A Davidsonian system claims that events get into the semantic values for gerunds by way of an extra argument of the verb inside the gerund. Parsons (1990) is a recent advocate of this view. An intransitive verb like *run* will really be of type  $\langle e, \langle e, t \rangle \rangle$ ; it is a relation between individuals (runners) and events (runnings). What I will call the situation-based account leaves *run* of type  $\langle e, t \rangle$ , but builds events into the denotation of the verb via the definition of the type *t*. According to the situation-based theory, instead of the possible denotations of expressions of type *t* being all sets of possible worlds, it will be all sets of possible situations. Some of these situations can play the role of "events" in the previous discussion. Though I use the term "situation" when discussing the second theory, and the term "event" when discussing the first, I don't mean to presuppose any difference between the objects referred to.

#### **III.1. The Davidsonian Theory**

A Davidsonian theory will treat gerunds as being of type  $\langle e, t \rangle$ . The "e" is the event argument of the verb, so far unsaturated.<sup>2</sup> We should look at a more concrete version of this

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<sup>2</sup>*t* is the type of propositions--sets of possible worlds--not truth values.

idea. Consider the following translation rules that can apply to the Logical Forms of a few gerunds:

*run* translates as **run**, which is of type  $\langle e, \langle e, t \rangle \rangle$   
*eat* translates as **eat**, which is of type  $\langle e, \langle e, \langle e, t \rangle \rangle \rangle$   
*like* translates as **like**, which is of type  $\langle e, \langle e, \langle e, t \rangle \rangle \rangle$   
*-ing* translates as **-ing**, which is of type  $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$   
*some* translates as **some**, which is of type  $\langle \langle e, t \rangle \rangle \langle \langle e, t \rangle, t \rangle$   
*beans* translates as **beans**, which is of type  $\langle e, t \rangle$   
 $PRO_i$  translates as  $\lambda P[P(x_i)]$ , which is of type  $\langle \langle e, t \rangle, t \rangle$   
*Jack* translates as  $\lambda P[P(j)]$ , which is of type  $\langle \langle e, t \rangle, t \rangle$   
 $t_i$  translates as  $x_i$ , which is of type  $e$

### Functional Application

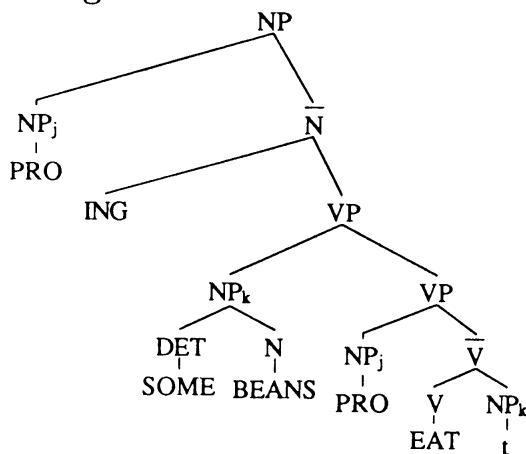
with  $[_C A B]$ ,  
**A** of type  $\langle b, c \rangle$ ,  
**B** of type  $b$ ,  
**C** is of type  $c$ ,  
**C=A(B)**.

### Quantifying In

with  $[_C A_i B]$   
**A** of type  $\langle \langle e, t \rangle, t \rangle$   
**B** of type  $\langle e, t \rangle$   
**C** is of type  $\langle e, t \rangle$   
**C=  $\lambda x_j[A(\lambda x_i[B(x_j)))]$**

For the LF (22), this fragment gives a translation equivalent to (23).

(22) eating some beans



(23)  $\lambda e[\text{ing}(\text{some}(\text{beans})(\lambda x_k[\text{eat}(x_k)(x_j)(e)]))]$

Now consider what happens when a gerund figures in a structure like that in (24), whose LF is (24').

(24) Jack always likes eating some beans.

(24') [ $S_{\text{always}_1} [NP_1 \text{ PRO eating some beans}] [S_{\text{Jack}} \text{ likes } e_1]$ ]

$\text{always}_1$  has two arguments--one of type  $\langle e, t \rangle$  and one of type  $t$ . Its translation and semantics can be given by

**Adverbial Quantification** (this can be generalized)

with  $[C \text{ always}_1 A_1 B]$ ,

$A$  of type  $\langle e, t \rangle$ ,

$B$  of type  $t$

$C$  is of type  $t$ ,

$C = \text{always}_1(A(x_i))(B)$

The meaning of **always** is given by:

$[\text{always}_1 (\alpha)(\beta)]g =$

{ $w : \text{for all } g' \text{ differing from } g, \text{ if at all, only in what it assigns to } x_i, \text{ if } w \in [\alpha]g', \text{ then } w \in [\beta]g'$ }.

(24) is now given the translation (25):

(25)  $\text{always}_1 [\text{ing}(\text{some}(\text{beans})(\lambda x_k[\text{eat}(x_k)(j)(e_1)]))]$   
 $[\text{like}(e_1)(j)(e_2)]$

$e_2$  is the event argument of *like*, and is given a value contextually.<sup>3</sup> (25) denotes the set of worlds in which every entity which is an event of Jack eating some beans is liked by Jack (in  $e_2$ ).

The rules needed for definite and specific (existential) gerunds are quite simple. Along with an ordinary rule for existential quantification, what is needed are rules for gerunds adjoined to S and VP.

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<sup>3</sup>I assume the event argument of *like* to be saturated by I, the head which projects S (=IP) and which takes VP as an argument.

**Adjunction to S**

with  $[C A_i B]$ ,  
**A** of type  $\langle e, t \rangle$ ,  
**B** of type  $t$   
**C** is of type  $t$ ,  
**C**= $(A(x_i) \ \& \ B)$

**Adjunction to VP**

with  $[C A_i B]$ ,  
**A** of type  $\langle e, t \rangle$ ,  
**B** of type  $\langle e, t \rangle$   
**C** is of type  $\langle e, t \rangle$ ,  
**C**= $\lambda y[A(x_i) \ \& \ B(y)]$

I am assuming that VP's denote properties of events, like gerunds, because the subject argument has been saturated inside the VP. This follows from the hypothesis that subjects are base-generated within the VP (Sportiche (1988), Kitagawa (1986) among others). As an example, the adjunction to S rule associates with (2) the translation (26):

- (2) Jaye liked reading *Bellefleur*.  
(26) **ing(read(B)(Jaye)(e<sub>1</sub>) & liked(e<sub>1</sub>)(Jaye)(e<sub>2</sub>)**

Both free variables are given values from context. It denotes the set of worlds such that  $e_1$  is an event of Jaye reading *Bellefleur* and  $e_2$  is an event of Jaye liking  $e_1$ .

Lastly, aspectual predicates and nonspecific complement-taking verbs combine with their gerunds via functional application, with no movement. The semantics for *stop* can be analyzed by (27). Ignoring tense, an example is (28).

- (27) stops G in e = {w :  $\exists e'[e' \text{ is in } w \ \& \ G(e') \ \& \ e'$   
immediately precedes e &  $\neg \exists e''[e'' \text{ is in } w \ \& \ G(e'') \ \& \ e'' \text{ immediately follows } e]]$   
(28) [S Herman [VP stop [NP1 PRO building the house]]]  
{w : there is a building of the house by Herman in w just before e and there is no building of the house by Herman in w just after e]}

Now comes the hard part: What to do about the gerund in (29).

- (29) Jack liked always eating some BEANS.

For simplicity, let's only consider the reading with focus on *beans*, so that intuitively the gerund denotes the set of events in which, whenever Jack eats, he eats some beans.

At first, with this Davidsonian system, one is tempted to derive a structure in which *always* can quantify over the verb's event argument, yielding a propositional entity. This would mean that the gerund in (29) gets a semantic structure like

- (30) [always<sub>1</sub> [PRO eats something in e<sub>1</sub>] [PRO eats beans in e<sub>1</sub>]]

However, if we do so, that argument will be bound off and no longer available to provide the semantics for the gerund as a whole.<sup>4</sup> The gerund as a whole is consequently of type t and so the event reference of the gerund in (29) will presumably have to come from the definition of the type t. That is, a situation-based approach to the semantics for gerunds will have to be used for this case.

If this approach is followed, it will also be impossible to provide a uniform semantics for any of the pairs in (13)-(20). In the case of a non-internally quantified gerund, in the ways described above the semantics provides for all the different types of readings for an expression denoting a property of events. With internally quantified gerunds instead, the semantics will have to derive very similar readings for propositional phrases. It will have to have duplicate systems for adverbial quantification, existential closure, definite reference for unbound gerunds, and aspectual predicates.

If one accepts having a situation based-theory of gerunds alongside a Davidsonian theory, gerunds without internal quantification will be treated like ordinary definite and indefinite NP's. Indefinite NP's, which are of type <e,t>, have adverbially quantified and existential interpretations, as seen in (31)-(32), so the adverbial quantification and VP-adjunction rules for properties given above can be used for them too.

- (31) Cats always eat mice.  
 (32) Those mice fled from cats.

Definite NP's will use the S-adjunction rule. In contrast, internally quantified gerunds will require their own unique set of rules. Dividing the treatment of gerunds into two distinct

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<sup>4</sup>One might suggest that the *always* can introduce a new event variable, referring to events in which something always happens ("alwaysings"). This would effectively give a variant of the situation-based theory.

systems in this way is quite unsatisfying, and there are other problems as well. Verbs which combine with gerunds directly, by functional application--that is, the nonspecific gerund-complement verbs like *avoid* and the aspectual verbs like *stop*--will all have to have two separate meanings. They must combine with either an expression of type  $\langle e, t \rangle$  or one of type  $t$ . This problem becomes particularly acute when the verb's meaning is decomposed into more primitive semantic relations, as has been done with *stop* above. The application of the gerund to an event variable in the decomposed meaning of *stop*--"G( $e$ )"--will not be transferrable to the internally quantified gerunds. The only way to fully capture the parallelism between the two groups of gerunds is to provide them with the same kind of semantics values.

Another possibility might appear to be to continue letting the Davidsonian event argument of the gerund's verb in (29) provide the event reference for the gerund as a whole, and treat *always* as quantifying over something else. However, this is clearly unworkable. Consider a hypothesis that treats this *always* as quantifying over time intervals. (29) will get a meaning something like (33).

- (33) For some particular event  $e$ ,
  - for every interval  $i$  such that  $e$  is an event of
  - Jack eating something during  $i$ ,  $e$  is an
  - event of Jack eating some beans during  $i$ ,
  - and Jack liked  $e$ .

This claims that Jack liked some particular event (which, whenever it's an eating event, it's an bean-eating event), and not--as it should--that he liked the bean-eating habit.

### **III.2. The Situation-Based Theory**

We have seen that a Davidsonian approach to the semantics for gerunds results in an irreducibly mixed theory. The internally quantified gerunds will have to receive a non-Davidsonian treatment anyway. In this section we will examine a non-Davidsonian alternative based on a situation-semantics like that proposed by Kratzer (1989) and applied to nominalizations by Zucchi (1989). (Some other recent advocates of situation theories are Barwise and Perry (1983) and Landman (1986).)

Within the situation-based theory, the set of possible denotations for expressions of type  $t$  will be the power set of the set of possible situations. The situations form a mereological summation structure; any situation which is not part of another situation can be called a world. No situation can be part of more

than one world. Lastly, it will be necessary to refer to situations by expressions of type  $e$  as well, so I will assume that the set of situations is a subset of the set of individuals.

The following revised lexicon will allow us to spell out the situation-based view in a bit more detail:

**run** translates as **run**, which is of type  $\langle e, t \rangle$   
**eat** translates as **eat**, which is of type  $\langle e, \langle e, t \rangle \rangle$   
**like** translates as **like**, which is of type  $\langle e, \langle e, t \rangle \rangle$   
**-ing** translates as **-ing**, which is of type  $\langle t, t \rangle$   
**some** translates as **some**, which is of type  $\langle\langle e, t \rangle \langle\langle e, t \rangle, t \rangle \rangle$   
**beans** translates as **beans**, which is of type  $\langle e, t \rangle$   
 $PRO_l$  translates as  $\lambda P[P(x_l)]$ , which is of type  $\langle\langle e, t \rangle, t \rangle$   
**Jack** translates as  $\lambda P[P(j)]$ , which is of type  $\langle\langle e, t \rangle, t \rangle$   
 $t_l$  translates as  $x_l$ , which is of type  $e$

The verbs have one less argument than on the Davidsonian theory, and **-ing** is correspondingly of a lower type.

Example of meaning:

**run** denotes that function  $f$  such that, for any individual  $\alpha$ ,  
 $f(\alpha)$ =the set of all possible situations which are runnings by  
 $\alpha$  or a counterpart of  $\alpha$ .

### Functional Application

with  $[C A B]$ ,  
**A** of type  $\langle b, c \rangle$ ,  
**B** of type  $b$ ,  
**C** is of type  $c$ ,  
**C=A(B)**.

### Quantifying In

with  $[C A_l B]$   
**A** of type  $\langle\langle e, t \rangle, t \rangle$   
**B** of type  $t$   
**C** is of type  $t$   
**C= A(\lambda x\_l[B])**

Given the meaning for **run** above, the untensed proposition denoted by *Janet run* will not be true of any situations larger than the minimal ones of Janet running. Situations which contain as a proper part a running by Janet are not themselves

necessarily runnings by Janet. For example, the worlds in which Janet runs are not runnings by Janet. I will rely on tense to change the denotation of tenseless clauses so that they are true of situations which properly include the situations which satisfy the untensed clause (that is, it will make them persistent).

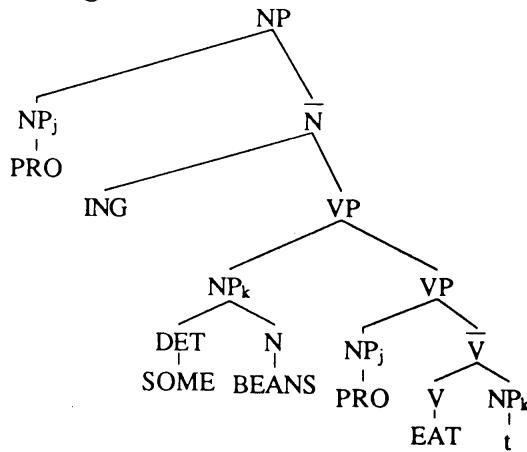
**PRES** is of type  $\langle t, t \rangle$ . It denotes that function  $f$  such that

for any proposition  $p$ ,  $f(p) = \{s : \text{for some } s' \in p, s' < s \text{ and the time of } s = \text{the present time}\}$

As Zucchi discusses, there are elements which take *that* clauses as arguments but not gerunds, such as *be true/false*, *believe*, and *want*. Since gerunds and *that* clauses denote different propositions, this can be accounted for on a propositional theory of gerunds without introducing new elements for gerunds to denote, as Zucchi does.

We are now ready to look again at (22). The translation it is assigned is (34):

(22) eating some beans



(34)  $\text{ing}(\text{some}(\text{beans})(\lambda x_k[\text{eat}(x_k)(x_j)]))$

(34) denotes the set of situations which are eatings of some beans by the reference of  $x_j$ . Returning to (24), we get the LF (35).

(24) Jack always likes eating some beans.

(35)  $[\text{always}_1 [\text{NP}_1 \text{ PRO eating some beans}] [\text{s Jack likes e}_1]]$

Now **always** has two type  $t$  arguments, so the following rule will do:

**Adverbial Quantification** (this can be generalized)with  $[C \text{ always}_i A_i B]$ , $A$  of type  $t$ , $B$  of type  $t$  $C$  is of type  $t$ , $C = \text{always}_i(A[x_i])(B)$ 

With  $A$  the gerund's translation and  $B$  the rest of the sentence's, (35) is translated as (36).

$$(36) \quad \text{always}_i(\text{ing}(\text{some}(\text{beans})(\lambda x_k[\text{eat}(x_k)(j)])))[x_1] \\ (\text{like}(j)(x_1))$$

In the Adverbial Quantification rule we have a novel combination operation, shown by the square brackets, which uses a proposition to restrict an individual variable. Here we are taking advantage of the fact that situations are individuals as well as the stuff from which propositions are made. The semantics of  $A[x_i]$  is given by:

$$[\Phi[x_i]]g = \{s : g(x_i) \in [\Phi]g\}$$

If the individual assigned to  $x_i$  is a situation in the proposition denoted by  $\Phi$ ,  $\Phi[x_i]$  will denote the set of all situations; otherwise it will denote the empty set. As can be seen in (36),  $x_i$  appears in the translation of  $B$  in the Adverbial Quantification rule as well, because the gerund left a trace with index  $i$  when it underwent QR. Thus the gerund functions to bring reference to situations into an NP (here, semantically type e) position. It leaves a variable there, and restricts that variable to situations of Jack eating some beans.

The meaning of *always* is given by:

$$[\text{always}_i(\alpha)(\beta)]g =$$

$\{s : \text{for all } g' \text{ differing from } g, \text{ if at all, only in what it assigns to } x_i, \text{ if } s \in [\alpha]g' \text{ and } g'(x_i) < w_s, \text{ then } s \in [\beta]g'\}$   
 $(w_s \text{ is the world of } s.)$

When  $\alpha$ , the first argument of *always*, is a gerund, this denotes the set of situations  $s$  such that, for every  $b$  which is in the proposition denoted by  $\alpha$  and a part of the world of  $s$ ,  $\beta$  is true in  $s$  when  $b$  is assigned to  $x_i$ . This meaning is reminiscent of Berman's (1987); however, it is quite different because the situations are treated as ordinary individuals and assigned as the

values of variables. (24) denotes the set of situations in which Jack likes every one of his bean-eatings in the world of that situation.

With a specific gerund, as in (37), we need to use a combination rule like that in given below.

- (37) Jack liked eating some beans.

**Conjunction with Event Anaphora (Adjunction to S or VP)**

with  $[C A_1 B]$

**A** of type t

**B** of type t

**C** is of type t

**C**= $(A[x_1] \ \& \ B)$

Some general rule along these lines will be independently needed for discourses like (38).

- (38) Richard ate an apple. He enjoyed it.

(it=eating the apple)

(37) is now translated as (39),

- (39)  $(\text{ing}(\text{some}(\text{beans})(\lambda x_k[\text{eat}(x_k(j)))))[x_1] \ \& \ \text{like}(j)(x_1)$

If b is the individual denoted by  $x_i$ , this denotes the set of situations in which b is an eating of some beans by Jack and Jack likes b.

Given the assumption that the subject argument is saturated within the VP, VP's as well as S's will be of type t. The above conjunction rule will therefore feed existential closure as well.

I believe that within this system the incorporation of internally quantified gerunds goes smoothly. Looking again at (29),

- (29) Jack liked always eating some BEANS.

Rooth (1985) shows how to associate *eating some BEANS* with two interpretations, one expressing its presupposition and the other its ordinary meaning. Straightforward modifications of his ideas allow the ordinary interpretation to be the set of all situations which are bean-eatings by Jack and the secondary interpretation to be the set of all situations which are something-eatings by Jack. The secondary interpretation will be the first argument of *always*, and the ordinary interpretation will be its second argument. The semantics for this focus-sensitive *always* can be given as:

**[always<sub>P</sub> ( $\alpha$ )( $\beta$ )]g =**

{s : P(s) and for all s' such that s'  $\in$  [ $\alpha$ ]g and s' < s,  
 $s' \in [\beta]g\}.$

In our example,  $\alpha$  is the denotation of *Jack eats something* and  $\beta$  is the denotation of *Jack eats beans*. The gerund in (29) will denote the set of "P" situations such that whenever Jack eats something in that situation, he eats beans in it. P is meant to supply a contextual division of the eating situations into groups. With an example like (40)

(40) Every winter we ate nothing but beans. I always liked always eating beans.

P will be something like the set of situations s such that s is the sum of all my eating situations for a past winter.

The goal of this section has been to show how reference to generic events and ordinary events can be unified within a situation-based semantics. The basis of the analysis is to identify events with situations, the entities that make up propositions. Another beneficial consequence of this view should be noted: Vendler (1967) shows that in many cases gerunds seem paraphrasable by *that*- clauses. He concludes from this that they are fact- (or proposition-) denoting--for example (41).

(41a) Bill denied leaving.

(41b) Bill denied that he left.

At first it is difficult to see how to make this conclusion compatible with cases where sentences involving gerunds seem to involve quantification over events, such as (4). Having seen that the two ideas are compatible, however, it turns out that Vendler is exactly right about gerunds, like the complements of aspectual predicates, *deny* or *avoid*, that are interpreted in place. These elements select for a proposition and the gerund directly provides one.<sup>5</sup>

Another potentially fruitful area to investigate is the possibility that the situation-based theory allows an explanation for why in general gerunds do not have existential interpretations when in subject position. Given the categorization of gerund meanings of §II, gerunds have all of the

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<sup>5</sup>Since the gerund and the finite clause denote different, though related, propositions, the synonymy of these examples will also depend on the meaning of *deny*.

readings of ordinary definite and indefinite NP's combined, except for this one. First note that it seems that sentential subjects are presupposed, as in (42a).

- (42a) That he came didn't bother me.
- (42b) His/him coming didn't bother me.
- (42c) Unicorns didn't bother me.

(42b) shows that subject gerunds are similar, and contrast with the indefinite NP in (42c). Koster (1978) has argued that sentential subjects are always topics. While his claim that no clauses appear in subject position at S-structure, but rather are in a Topic position, has been the subject of debate (Delahunty (1983)), this does not affect the idea that subject gerunds are presupposed. If, instead of saying that the syntactic class of subject clauses must be topics, we extend this claim to all propositional entities, the situation-based theory will entail that subject gerunds are topics as well. Topics, being presupposed material, are incompatible with an indefinite meaning. Instead, when a gerund introduces a situation variable it will have to be assigned a value that is familiar or under discussion. On a familiarity theory of definiteness (e.g. Heim (1982), Kamp (1981)), this is to say that the gerund is definite. If this idea works out, it provides a further advantage over the Davidsonian theory. It requires further work, however, because of the variety of differences between *that-* clauses and gerunds.

#### **IV. Conclusion**

In conclusion, it seems that gerunds are best considered to be propositional entities. This conclusion is not at odds with the fact that gerunds seem to denote properties of events. What is perhaps the simplest way of letting gerunds denote properties of events--by incorporating a special Davidsonian argument and otherwise treating a gerund like an ordinary noun--has difficulty giving a unified treatment of both internally quantified and simple gerunds. Instead, if the notion of proposition is reconstructed in situational terms, gerunds can be propositional expressions that have event-like entities in their denotations.

#### **References**

Bach, E. (1977). *The Structure of Histories*. Manuscript, University of Massachusetts at Amherst.

Barwise, J. and J. Perry. (1983). *Situations and Attitudes*. Cambridge, MA: MIT Press.

- Bennett, J. (1988). *Events and Their Names*. Indianapolis and Cambridge: Hackett Publishing Co.
- Bennett, M. (1974). *Some Extensions of a Montague Fragment of English*. University of California at Los Angeles PhD dissertation.
- Berman, S. (1987). Situation Based Semantics for Adverbs of Quantification. *The Proceedings of WCCFL 6*.
- Berman, S. (1989). An Analysis of Quantificational Variability in Indirect Questions. *The Proceedings of WCCFL 8*.
- Chierchia, G. (1984). *Topics in the Syntax and Semantics of Infinitives and Gerunds*. University of Massachusetts PhD dissertation, GLSA, Amherst.
- Delahunty, G. (1983). But Sentential Subjects Do Exist. *Linguistic Analysis* 12: 379-398.
- Diesing, M. (1990). *The Syntactic Roots of Semantic Partition*, University of Massachusetts PhD dissertation, GLSA, Amherst.
- Dowty, D. (1979) *Word Meaning and Montague Grammar*. Dordrecht: Reidel.
- Heim, I. (1982). *The Semantics of Definite and Indefinite Noun Phrases*. University of Massachusetts PhD dissertation, GLSA, Amherst.
- Kamp, H. (1981). A Theory of Truth and Semantic Interpretation. In J. Groenendijk et al., eds., *Formal Methods in the Study of Language*. Amsterdam: Mathematical Centre.
- Kitagawa, Y. (1986). *Subject in Japanese & English*, University of Massachusetts PhD dissertation, GLSA, Amherst.
- Koster, J. (1978). Why Subject Sentences Don't Exist. In S.J. Keyser, ed., *Recent Transformational Studies in European Languages*. Linguistic Inquiry Monograph 3, Cambridge MA: MIT Press: 53-64.
- Kratzer, A. (1989). An Investigation of the Lumps of Thought. *Linguistics and Philosophy* 12: 607-653.

- Landman, F. (1986). *Towards a Theory of Information: The Status of Partial Objects in Semantics*. Groningen-Amsterdam Studies in Semantics 6. Dordrecht: Foris.
- Landman, F. (1990). The Progressive. Manuscript, Cornell University.
- Lewis, D. (1975). Adverbs of Quantification. In E. Keenan, ed. *Formal Semantics of Natural Lanugage*. Cambridge, England: Cambridge University Press: 3-15.
- Montague, R. (1960). On the Nature of Certain Philosophical Entities, *The Monist* 53: 159-94.
- Parsons, T. (1990). *Events in the Semantics of English: A Study in Subatomic Semantics*. Cambridge MA: MIT Press.
- Partee, B. (1987). Noun Phrase Interpretation and type-Shifting Principles. In J. Groenendijk, D. de Jongh, and M. Stokof, eds., *Studies in Discourse Representation Theory and the Theory of Generalized Quantifiers*, Groningen-Amsterdam Studies in Semantics 8. Dordrecht: Foris: 115-143.
- Portner, P. (1991). Interpreting Gerunds in Complement Positions. To appear in *The Proceedings of WCCFL 10*.
- Rooth, M. (1985) *Association with Focus*, University of Massachusetts PhD dissertation, GLSA, Amherst.
- Sportiche, D. (1988). A Theory of Floated Quantifiers and its Corollaries for Constituent Structure, *Linguistic Inquiry* 20.3: 425-450.
- Vendler, Z. (1967). *Linguistics in Philosophy*. Ithaca, NY: Cornell University Press.
- Vlach, F. (1981). The Semantics of the Progressive, In Tedeschi, P. and A. Zaenen, eds., *Syntax and Semantics 14: Tense and Aspect*, New York: Academic Press: 271-92.
- von Wright, G.H. (1963) *Norm and Action*. Humanities Press.

Zucchi, A. (1989). *The Language of Propositions and Events: Issues in the Syntax and Semantics of Nominalization.* unpublished University of Massachusetts PhD dissertation.

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Distributivity & Reciprocal Distributivity  
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### 1. Introduction and preliminary assumptions

In this paper, I will sketch a theory of distributivity and of its role in the interpretation of reciprocal NPs in English.<sup>1</sup> Thus, we will consider examples like the following, involving overt or covert simple distributivity, (1), and reciprocals, (2):

- (1) Joan and Mary (each) ate a bagel
- (2) Joan and Mary like each other

The central idea is that distributivity arises due to a distributive mode of predication. That is, there are two kinds of predication, the first realized by simple function argument application, as in PTO (Montague 1973), and the second, distributive predication. The account owes its general features both to my earlier work on this subject (Roberts 1987) and to a recent article by Heim, Lasnik & May (1991, hereinafter HLM). In the remainder of this section, I will sketch very briefly the type of theory I will assume for the semantics of plurals and the relationship between syntactic and semantic plurality. In §2, I will lay out the main features of HLM and point out some problems with that account. And in §3, I will present my own proposal and show how it overcomes these problems.

I assume that the domain of individuals in a model has a lattice-theoretic structure of the general type proposed in Link (1983); the count domain is a free, complete, atomic join semi-lattice (see also Landman (1989a)). I adopt Link's terminology regarding the lattice; in particular, I use *i-sum* to refer to a non-atomic element of the lattice, and I will call the elements which join to form an i-sum the *i-parts* of the sum in question (the *i-part* relation is reflexive). I

will write  $a \oplus b$  for the join of the individuals  $a$  and  $b$ , and use  $\Pi$  for the part relation (so:  $(a \oplus b)\Pi(a \oplus b \oplus c)$ ) and  ${}^*\Pi$  for the atomic-part relation (if  $a$  is atomic,  $a^*\Pi(a \oplus b \oplus c)$ , but not  $(a \oplus b)^*\Pi(a \oplus b \oplus c)$ ).

As for the relationship between syntactic and semantic number, following Roberts (1987), a singular CN denotes a set of atomic individuals in the model, whereas a plural CN denotes the complete atomic join semi-lattice generated by the denotation of its singular counterpart. That is:<sup>2</sup>

- [ICN]  $\subseteq$  A (the set of atomic elements in the lattice)
- [ICN<sub>pl</sub>] (= \*CN) is the set of elements in the complete, join semi-lattice generated by [ICN], i.e. [ICN]  $\subseteq$  [ICN<sub>pl</sub>]

Hence, the denotation of a singular CN is a subset of the denotation of its plural counterpart. From this and the fact that Craige has a nose, it follows that (3) is true:

- (3) Craige has noses.

Of course, in any ordinary context where we can imagine uttering (3), it would not be taken as true. But it can be argued that its anomaly follows straightforwardly from a Gricean quantity implicature which would arise almost unavoidably in such a context. Since the singular would be more informative than the plural (because the singular denotation is a subset of the plural), use of the plural implicates that for all the speaker knows, Craige has more than one nose. But given that it is well-known that Craige is a human and that humans can have no more than one nose, no competent speaker would reasonably believe this implicature or give rise to it by using the plural.

I also assume that distributivity involves quantifying over all the i-parts of the range, rather than just over the atomic i-parts. This leads to the interpretation of (1) in (1'), rather than the interpretation suggested by Link, shown in (1''):

- (1')  $\forall x[x\Pi]\oplus m \rightarrow \text{ate-a-bagel}'(x)]$

(1'')  $\forall x[x \in \Pi j \oplus m \rightarrow \text{ate-a-bagel}(x)]$

Most of the time in distributivity, domain restriction operates to restrict the domain of quantification to the atomic i-parts of the range, giving the same effect as we find in (1''). But this is not always the case, as illustrated by the phenomenon of plural quantification (Link 1987). Consider (4) and (5):

- (4) a) No competing candidates like each other.
- b) \*No competing candidate likes one another.
- (5) a) All identical twins look alike.
- b) \*Every identical twin looks alike

On the most accessible readings of (4a) and (5a), quantification ranges not over atomic companies or individual people who twins, but over i-sums (intuitively, "sets") of candidates which compete with each other, and over i-sums (or "pairs") of individuals who were born as a set of identical twins. We would not be inclined to give (5) a reading where we look at all the i-sums in the join semi-lattice generated by the atomic set of twins, but I will assume that, again, domain restriction applies to restrict our attention to just those i-sums in that lattice whose i-parts were born together. Not only does the assumption that distributivity ranges over all i-parts of the range permit us to explain plural quantification, but in conjunction with the hypothesis about the relationship between the denotations of singular and plurals CNs shown above, this permits us to explain the anomaly of (4b) and (5b), i.e. to account for the fact that plural quantification is only possible when the head CN is plural. Of course, even if the head CN is plural, we can pragmatically restrict the range of quantification to only atomic individuals, as in (6):

(6) Most/all female cardinals have a red beak.

I will assume that number agreement is obligatory between antecedent and pronoun or anaphor, reflected in a feature matching requirement.

And finally, I assume that there are two types of anaphora (Partee (1972), Roberts (1984, 1987), HLM): bound variable anaphora and discourse, or coreference anaphora. The former is constrained by restrictions on the scope of the antecedent, usually captured in a formal theory via the requirement that the pronoun be c-commanded or f-commanded by its antecedent at some level of representation or interpretation of a sentence. Hence, bound variable anaphora is strictly intra-sentential. I also assume that it involves syntactic coindexation. Discourse, or coreference, anaphora may, though it need not, be intersentential; I will assume that it doesn't require coindexation. The only restriction is that any operators which have scope over the antecedent have scope over the pronoun as well, a restriction expressed in terms of discourse markers in dynamic theories of interpretation (Kamp (1981), Heim (1982), Groenendijk & Stokhof (1990)).

## 2. The account in Heim, Lasnik & May (1991)

HLM propose a theory of reciprocals and of distributivity more generally which takes as its point of departure the English expression *each other*. They argue that the syntax and semantics of this expression are a function of its morphological complexity. Rather than treating it as a simple anaphor, as in previous work in GB, on their analysis it is an R-expression which contains an anaphor at LF. Their LF for (2) is given in (7), and the semantic interpretation of the various parts of that expression are given in (8):

(7) [[ Joan and Mary]<sub>1</sub> each ]<sub>2</sub> [s e<sub>2</sub> [vp [e<sub>2</sub> other (1)]<sub>3</sub> [vp like e<sub>3</sub>]]]]

- (8) a) other' :  $\lambda x \lambda y \lambda z (z^* \Pi y \& z \neq x)$   
 b) [e<sub>i</sub> other (k)]<sub>h'</sub> :  $\lambda z (z^* \Pi x_k \& z \neq x_i)$   
 c) [e<sub>i</sub> other (k)]<sub>h</sub>  $\zeta'$  :  $\lambda y \forall x_h (x_h^* \Pi x_k \& x_i \neq x_h \rightarrow \zeta'(y))$   
 d) [ $\alpha$  each<sub>i</sub>]  $\phi'$  :  $\forall x_i (x_i^* \Pi \alpha' \rightarrow \phi')$   
 e) (7d)':  $\forall x_2 (x_2^* \Pi j \oplus m \rightarrow \forall x_3 (x_3^* \Pi j \oplus m \& x_2 \neq x_3 \rightarrow \text{like}'(x_2, x_3))$

In (7), *each* has been adjoined to the reciprocal antecedent,<sup>3</sup> the subject NP, giving its index to the result. Then the remainder of the reciprocal is adjoined to VP and the derived subject is adjoined to S (= IP). Crucially, HLM stipulate that the trace of *each* in the reciprocal at LF is an anaphor. In (7) it is bound by the trace of the subject, satisfying Principle A of the binding theory, and the entire reciprocal, an R-expression, is free, satisfying Principle C. In (8a), '*other*' is a three-place relation: '*z* is a part of the range *y* which is other than the contrast *x*'. The contrast and the range arguments are supplied anaphorically; the contrast will be bound by the raised *each*, as we see in the translation of the reciprocal's LF in (8b), while the range will be coreferential with (though not bound by) the original plural subject--in (7), *Joan and Mary*. In (8c), we see the interpretation which results when (8b) is adjoined to the VP,  $\zeta$ ; this introduces universal quantification over atomic i-parts of the range. The derived subject also introduces universal quantification over the range, as we see in (8d), and the resulting interpretation for (7) is given in (8e). The interpretation is basically that all disjoint pairs of members of the group *Joan-join-Mary* like each other, which gives the right truth conditions for this example.

Distributivity more generally is treated with an implicit operator with the same effect as the raised *each* in the reciprocal examples. Consider the LF of (1) in (9), and its interpretation in (10):

$$(9) \quad [[\text{Joan and Mary}]_1 D]_2 [s e_2 \text{ ate a bagel}]$$

$$(10) \text{ a) } [\text{NP}_1 D]_h \varphi : \quad \forall x_h (x_h \cdot \Pi \text{NP}_1 \rightarrow \varphi) \\ \text{ b) } (9)' : \quad \forall x_2 (x_2 \cdot \Pi (j \oplus m) \rightarrow \text{ate}'(x_2, \text{a bagel}))$$

The implicit operator *D* adjoins to the surface subject, giving the result a new index, and introduces into the interpretation universal quantification over atomic i-parts of the group *Joan-join-Mary*. The meaning of (10b) is that each such i-part ate a bagel.

HLM assume that floated quantifiers start out in DS adjoined to an NP subject, which is itself generated in the Specifier of VP. At SS, the NP moves to the Specifier of IP, leaving the floated quantifier behind.

Then at LF, the quantifier moves to adjoin again to the subject, giving its index (presumably not the same as that of the NP) to the derived NP at LF. This is shown in (11), which receives the same interpretation as (9):

- (11) Joan and Mary each ate a bagel.  
 DS: [IP [VP [Joan and Mary each] [V ate a bagel]]]  
 SS: [IP Joan and Mary [VP each ate a bagel]]  
 LF: [IP [[Joan and Mary] each] [VP ate a bagel]]

The HLM analysis offers an account of several earlier puzzles (see Higginbotham (1980)) which show the inadequacy of older accounts of reciprocals that treat them as anaphors. HLM's treatment of one of these puzzles, the Grain Problem, is given in (12) - (14):

- (12) Joan and Mary told each other that they should leave.  
 i) the 'I' reading: Each said "I should leave"  
 ii) the 'you' reading: Each said "You should leave"  
 iii) the 'we' reading Each said "We should leave"  
 (13) i) [J+M<sub>1</sub> each]<sub>2</sub> told [e<sub>2</sub> other (1)]<sub>3</sub> that they<sub>2</sub> should leave.  
 ii) [J+M<sub>1</sub> each]<sub>2</sub> told [e<sub>2</sub> other (1)]<sub>3</sub> that they<sub>3</sub> should leave.  
 iii) [J+M<sub>1</sub> each]<sub>2</sub> told [e<sub>2</sub> other (1)]<sub>3</sub> that they<sub>1</sub> should leave.  
 (14) i)  $\forall x_2[x_2 \cdot \Pi] \oplus m \rightarrow \forall x_3(x_3 \cdot \Pi) \oplus m \text{ & } x_3 \neq x_2 \rightarrow$   
                                             told'[x<sub>2</sub>, x<sub>3</sub>, ( $\square$ leave'(x<sub>2</sub>))]  
 ii)  $\forall x_2[x_2 \cdot \Pi] \oplus m \rightarrow \forall x_3(x_3 \cdot \Pi) \oplus m \text{ & } x_3 \neq x_2 \rightarrow$   
                                             told'[x<sub>2</sub>, x<sub>3</sub>, ( $\square$ leave'(x<sub>3</sub>))]  
 iii)  $\forall x_2[x_2 \cdot \Pi] \oplus m \rightarrow \forall x_3(x_3 \cdot \Pi) \oplus m \text{ & } x_3 \neq x_2 \rightarrow$   
                                             told'[x<sub>2</sub>, x<sub>3</sub>, ( $\square$ leave'(j $\oplus$ m))]

There are three readings of (12), shown in (i) - (iii). These are derived with the corresponding pre-LFs in (13), where the crucial difference is the index of the subordinate subject. The resulting interpretations are shown in (14). In (13iii), the subordinate subject is coindexed with the surface subject, *Joan and Mary*, which doesn't c-command it at LF; hence the anaphora in this case is not bound variable anaphora, but coreference anaphora.

(15) - (17) illustrate HLM's treatment of the Scope Problem:

(15) Joan and Mary think that they like each other.

i) narrow scope: Joan thinks Joan likes Mary and Mary likes Joan;  
Mary thinks Mary likes Joan and Joan likes Mary

ii) wide scope: Joan thinks Joan likes Mary, and Mary thinks Mary  
likes Joan

(16)i) [[Joan and Mary]<sub>1</sub> D]4 think that [they<sub>1</sub> each]<sub>2</sub> like [e<sub>2</sub> other (1)]<sub>3</sub>

ii) [[Joan and Mary]<sub>1</sub> each]<sub>2</sub> think that they<sub>2</sub> like [e<sub>2</sub> other (1)]<sub>3</sub>

(17)i)  $\forall x_4[x_4^{\circ}\Pi j\oplus m \rightarrow \text{think}'(x_4, [\forall x_2(x_2^{\circ}\Pi j\oplus m \rightarrow$

$\forall x_3[x_3^{\circ}\Pi j\oplus m \& x_3 \neq x_2 \rightarrow \text{like}'(x_2, x_3)])])]$

ii)  $\forall x_2[x_2^{\circ}\Pi j\oplus m \rightarrow \text{think}'(x_2, [\forall x_3[x_3^{\circ}\Pi j\oplus m \& x_3 \neq x_2 \rightarrow$   
 $\text{like}'(x_2, x_3)])])]$

There are two readings of (15), the "narrow scope" and "wide scope" shown in (i) and (ii). In the LF for the narrow scope reading, shown in (16i), the surface subjects of the matrix and subordinate clauses are coindexed, and *each<sub>2</sub>* from the reciprocal is adjoined to the subordinate subject. There is another, implicit distributivity over the matrix subject, but this is independent of the reciprocal. For the wide scope reading, the LF in (16ii) has the reciprocal *each<sub>2</sub>* adjoined to the matrix subject; the subordinate subject is coindexed not with the surface subject of the matrix, but with the derived LF subject. But the anaphor trace of *each<sub>2</sub>* is still bound within its Minimal Governing Category, by the subordinate subject, *they<sub>2</sub>*. In such cases, the movement of *each<sub>2</sub>* itself is not restricted by Binding Condition A. Again, the range argument of the reciprocal, the (1) after *other* in (16), is not bound by its antecedent, *Joan and Mary*, but only coreferential with it. The possibility that the distributive operator *each<sub>2</sub>* may take scope outside the Minimal Governing Category of the reciprocal NP also provides an account of how we can derive non-contradictory readings of examples like (18):

(18) Joan and Mary think they will defeat each other.

As in (15), if *each* takes wide scope, Joan thinks she will defeat Mary and Mary thinks she will defeat Joan, without either thinking contradictory thoughts.

HLM can also account for examples with non-subject reciprocal antecedents, examples that prove difficult for accounts such as Bennett's (1974), which treat reciprocals as operators on VP:

- (19) a) I questioned them about each other.
- b) [them<sub>1</sub> each]<sub>2</sub> [I questioned e<sub>2</sub> about [e<sub>2</sub> other (1)]<sub>3</sub>
- c)  $\forall x_2(x^* \Pi x_1 \rightarrow \forall x_3[x_3^* \Pi x_1 \& x_3 \neq x_2 \rightarrow \text{question}'(I, x_2, x_3)])$

They also make correct predictions for examples involving control and multiple reciprocals, which I'll skip over here for lack of space.

This account represents a real advance in our understanding of reciprocals, and of their relationship to distributivity more generally. However, there are some problems with the account which will motivate the alternative I propose. Before discussing these, let me point out a crucial criterion of adequacy for such an account, the ability to handle examples with conjoined VPs where one VP is given a collective interpretation, the other distributive. Examples are given in (20) and (21):

- (20) The men each agreed to help build the raft, and gathered on Thursday to get started.
- (21) Mary and Bill won the lottery together and bought each other presents.

*Gather* and *win the lottery together* are predicates which have no atomic elements in their extensions, as we see by the infelicity of (20')/(21'):

- (20') \*The men each gathered on Thursday to get started.
- (21') \*Mary and Bill each won the lottery together.

This was one of the arguments that Roberts (1987) offered against theories which locate distributivity in the subject of a predication, since in such accounts either one would generally expect either a collective or a distributive interpretation of conjoined VPs, but not mixed readings.<sup>4</sup> HLM's account in effect locates distributivity in the

subject, and so we might suspect that it would have problems with these mixed VP examples. But recall their assumption that subjects are base-generated in the Specifier of VP position. In such an account, sentences with conjoined VPs should have a trace of subject in each VP (I'm not sure how across-the-board movement from DS would merge the DS subjects into one). Hence, if they assume that VP conjunction is interpreted with something like the Derived VP rule of Partee (1973), examples like (20) and (21) may be no problem. However, without DS generation of subject in the Specifier of VP, the conjoined VP examples would pose a significant problem for HLM.

Mats Rooth (p.c. to HLM) points out what I take to be an important problem for the HLM approach. This arises in the distinction between examples like (22) and (23):

- (22) The youngest three of the women each gave a lecture to the others.
- (23) The youngest three of the women gave lectures to each other.

In (22), each of the youngest three women may have given a lecture either to the other two youngest women or to all the other women, young and old; i.e., the range argument of *other* is relatively free. But in (23) there is only one reading, where each of the youngest three women gave a lecture to the other two youngest women; that is, the range argument is not free, but must be the c-commanding NP *the youngest three of the women*. In HLM, the requirement that the reciprocal antecedent to be the coreference anaphora antecedent of the range must be stipulated (p.69). But since coreference anaphora is not taken to be syntactically constrained, this appears ad hoc--there is no principled reason why the range couldn't be coreferential with some other accessible element in discourse. It seems desirable that this property follow from the anaphoric aspect of the reciprocal.

There are three problems which pertain to predictions about the scope of the quantificational element *each*. First, as we see in (24a), the "antecedent" of a reciprocal may be itself quantificational:

- (24) a) No kids spoke to each other.

b)  $\neg \exists x_1 [\text{kid}'(x_1) \& \forall x_2 (x_2 \Pi x_1 \rightarrow \forall x_3 (x_3 \Pi x_1 \& x_3 \neq x_2 \rightarrow \text{ speak}'(x_2, x_3)))]$

HLM note that antecedents may be quantificational, but seem to assume that such examples may all be treated using absorption; this procedure, requiring (so far as I know) that the two operators involved have the same quantificational force, would not be suitable for (24). More importantly, the only reading for such examples is the type illustrated in (24b), where the subject quantifier has wider scope than the universal quantification introduced by *each*. We never get *each* wider than the subject. But HLM seem to predict otherwise: if *each* is adjoined to *no kids*, one would expect that at least the wide-scope universal reading should be available, if not both scopes.<sup>5</sup>

Another problem with scope was noted by Williams (1991), in his comments on HLM. He notes that floated *each* behaves differently from the surface quantifier *each*. The latter tends to take widest scope in cases like (25), but *[(the men) each]* in HLM's LF for (26) cannot:

- (25) Someone or other has said that each of the men likes the other.  
 (26) Someone or other has said that the men like each other.

In response, HLM modify their theory so that "NPs of the form [NP *each*] are not eligible for QR but are obligatorily interpreted *in situ*." However, they point out (p.174,fn.3) a problem for this stipulation in examples like the following:

- (27) Their coaches think they will defeat each other.

(27) has a non-contradictory reading. In order to obtain it, HLM must raise *each* to adjoin to the possessive pronoun *their* within the subject, and the latter must then c-command *they* at LF. But *their* would have to undergo QR in order to c-command *they*, which it cannot under the *in situ* modification.

The third scope problem involves the observation by Dowty & Brody (1984) that the surface position of overt floated *each* may fix its scope relative to other INFL elements, such as negation or modals. Examples include:

- (28) The students all didn't leave.
- (29) The students didn't all leave.
- (30) Joan and Mary could each have eaten pizza.
- (31) Joan and Mary each could have eaten pizza.

The only reading of (28) is one where the universal has wide scope over the negation, so that no students left; but (29) permits the wide-scope negation reading. The modal in (30) may have either an epistemic or root interpretation; some speakers report that the modal in (31) has only the root interpretation. If, as sometimes assumed, epistemic modals are taken to be S modifiers and root modals to be VP modifiers, this would suggest a correlation between surface position of the floated quantifier and its potential scope. But I do not see how HLM could accommodate such observations in an account in which all floated quantifiers are basically NP-modifiers, generated within the NP in the Specifier of VP.

Finally, J.J. Nakayama (p.c.) points out that there are some ad hoc features of HLM's account which are problematic from the point of view of GB theory. For example, if the trace of reciprocal *each* is to be an anaphor, then *each* itself must be an NP, under the usual assumptions of the binding theory. But the NP which results when *each* is adjoined to the reciprocal antecedent is then quite odd, out of line with both X' theory and the theory of movement and adjunction. What kind of movement is this and what would motivate it within GB theory?

### 3. A theory of distributivity as a mode of predication

In the theory I will present here, distributivity generally, and reciprocals in particular, involve a special mode of predication, **distributive predication**, in which the logical subject is an i-sum, each of whose i-parts are said to have the property denoted by the

predicate. The logical subject is not necessarily a syntactic subject and the predicate may be derived by abstraction, rather than a syntactic VP. The domain of the universal quantification involved in distributivity, the  $i$ -parts of the relevant  $i$ -sum, is usually pragmatically restricted, as discussed above. To implement this idea, we introduce a set of indexed features  $\{D_i : i \in N\}$ , members of which are freely assigned to nodes in a syntactic tree. A given feature  $D_i$  identifies subcategories of S, VP, and CN (and has no effect on other categories). This feature makes no difference to the interpretation of the constituents it dominates. However, the resulting subcategories,  $S:D_i$ ,  $VP:D_i$ , and  $CN:D_i$ , may be input to semantic rules of distributive predication (though non-distributive predication may apply to them, as well). Hence, addition of one of these features makes the category in question a potentially distributive predicate. The feature index  $i$  plays an important role in constraining distributive predication where reciprocals are involved, as we will see.

Below are the rule schemas for distributive predication. Since I don't think that the theory of distributivity tells us nothing about which framework for semantic analysis one should use, I have implemented it in a fairly classical version of Montague Grammar, co-numbering the rules with the corresponding non-distributive rules in Montague's PTQ (1973). Similarly, I have chosen to represent the syntax of examples using GB LF's similar to those of HLM for convenience of comparison, though it could be implemented in other theories as well.

### Rule Schemas for Distributive Predication

#### T4D<sub>i</sub> Subject-Verb Predication:

If  $\alpha_i \in PT$ ,  $\delta \in P_{V:D-i}$ , then  $F_4(\alpha, \delta)$  translates into

$$\alpha'(\lambda x_r[\forall x_i(x_i \Pi x_r \rightarrow \delta'(x_i))]).$$

#### T14D<sub>i</sub> Quantifying Into S [QI-S]:

If  $\alpha_i \in PT$ ,  $\phi \in P_{t:D-i}$ , then  $F_{10,i}(\alpha, \phi)$  translates into

$$\alpha'(\lambda x_r[\forall x_i(x_i \Pi x_r \rightarrow \phi')]).$$

T15D<sub>i</sub> Quantifying Into CN [QI-CN]:

If  $\alpha_i \in P_T$ ,  $\delta \in PCN:D_{-1}$ , then  $F_{10,i}(\alpha, \delta)$  translates as

$$\lambda y. \alpha' (\lambda x_r [\forall x_i (x_i \Pi x_r \rightarrow \delta'(y))]).$$

T16D<sub>i</sub> Quantifying Into VP [QI-VP]:

If  $\alpha_i \in P_T$ ,  $\delta \in PVP:D_{-1}$ , then  $F_{10,i}(\alpha, \delta)$  translates as

$$\lambda y. \alpha' (\lambda x_r [\forall x_i (x_i \Pi x_r \rightarrow \delta'(y))]).$$

The variable  $x_r$  in these rules is a distinguished variable; it will play an important role in the account of reciprocals.

As an example of how the rules work, let us consider a case of simple distributivity, example (1) above, whose LF and translation in the present theory are shown in (32):

- (32) [= (1)] LF: Joan and Mary<sub>1</sub> [ $y_{P:D_{-1}}$  ate a bagel]  
 trans:  $\forall x_1 (x_1 \Pi j \oplus m \rightarrow \exists y (\text{bagel}'(y) \wedge \text{ate}'(x, y)))$

The truth conditions for the translation require that each of the i-parts of Joan-join-Mary ate a bagel. Normally, this would be understood to apply only to the atomic i-parts of the i-sum in question.

Floated quantifiers will be generated *in situ* and translated as functions from predicates to distributive predicates:

- (33) each<sub>f</sub> (floated):  $\lambda P \lambda x [\forall y (y \Pi x \rightarrow P(y))]$

Hence, floated quantifiers are, in effect, lexicalized distributive predication. Since they are generated *in situ* as adverbials, and since adverbials are known to appear in various locations in INFL and VP, we can imagine an approach to Dowty & Brodie's observations about the fixed scope of floated quantifiers and other auxiliary elements which correlates surface order with scope in LF, though I won't attempt such an account here. Also, this approach permits a lexical meaning account of the differences in interpretive possibilities that

we find with different floated quantifiers (e.g. *all* vs. *both* vs. *each*; see Dowty (1986)).

With respect to reciprocals, I retain HLM's interpretation of the lexical item *other*, taking three arguments as in (8a) above: 'z is a part of the range distinct from the contrast'. English reciprocals will have the LF and translation in (34):

$$(34) \quad [\text{each other } (x_1)(x_r)]_k': \lambda P[\forall x_k(x_k \amalg x_r \wedge x_k \neq x_1 \rightarrow P(x_k))]$$

The LF involves the three arguments of *other*, the contrast  $x_1$ , the range  $x_r$ , and  $x_k$ . Like HLM, the entire reciprocal is an R-expression. But it differs from HLM's (8e) in several respects: though both the range and contrast are free variables in this translation, as in HLM, in this theory the contrast,  $x_1$ , is the anaphor which will be bound by the reciprocal antecedent, rather than the range as in their account. The range,  $x_r$ , is the same distinguished variable we saw in the rules for distributive predication; given the way those rules work, the range will get semantically bound by the reciprocal antecedent in the course of interpreting the associated distributivity via one of the distributive predication rules. We see this in the treatment of (2) in (35):

$$\begin{aligned} (35)[=(2)] \quad & \text{LF: Joan and Mary}_1 [\text{vp:D}_1 [\text{each other } (x_1)(x_r)]_3 [\text{vp like e}_3]] \\ & \text{VP:D}_1': \lambda y[\forall x_3(x_3 \amalg x_r \wedge x_3 \neq x_1 \rightarrow \text{like}'(y, x_3))] = \delta' \\ (35)': & \lambda P[P(j \oplus m)](\lambda x_r[\forall x_1(x_1 \amalg x_r \rightarrow \delta'(x_1))]) \\ & = \forall x_1(x_1 \amalg j \oplus m \rightarrow \forall x_3(x_3 \amalg j \oplus m \wedge x_3 \neq x_1 \rightarrow \text{like}'(x_1, x_3))) \end{aligned}$$

The translation of the VP,  $\text{VP:D}_1'$ , is the result of non-distributively quantifying *each other* into the VP. We then apply distributive predication, T4D, to the result and the translation of *Joan and Mary* to get (35)'. Coindexation of *Joan and Mary* with the anaphoric contrast argument of *other*,  $x_1$ , satisfies Principle A and causes the latter to be bound by the universal quantification introduced in the course of distributive predication. The same rule abstracts on the range,  $x_r$ , with the result given as argument to the translation of *Joan and Mary*. Hence, *Joan and Mary* obligatorily provide both the range

and the set of contrasts, as desired. This obligatory relationship of the reciprocal antecedent to both the contrast and the range predicts the unambiguous status of examples like (23), overcoming Rooth's problem for HLM.

The use of  $x_r$  is a technical way of implementing the central idea about reciprocals--that they presuppose occurrence in a distributively applied predicate. Since  $x_r$  is only introduced in conjunction with such a presupposition, if the predicate in question is not distributively applied to its subject, then  $x_r$  will remain free, leading to failure of its familiarity presupposition and hence to infelicity in the technical sense of Heim (1982). This general approach is significantly different from that of HLM, since the latter make the associated distributivity an entailment, both syntactically and truth conditionally, of the reciprocal. I will argue that the present account is empirically superior in several respects.

The account handles the Grain Problem and Scope Problem straightforwardly, as illustrated in (36) and (37), respectively:

- (36) [= (12)] SS: Joan and Mary<sub>1</sub> told [each other]<sub>3</sub> they<sub>k</sub> should leave.  
 pre-LF: Joan and Mary<sub>1</sub> [vp.D<sub>-1</sub> told [each other (x<sub>1</sub>)(x<sub>r</sub>)]<sub>3</sub>  
 they<sub>k</sub> should leave]  
 transl'n:  $\forall x_1(x_1 \Pi j \oplus m \rightarrow \forall x_3(x_3 \Pi j \oplus m \wedge x_3 \neq x_1 \rightarrow$   
 $\quad \quad \quad \text{told}'(x_1, x_3, \Box \text{leave}'(x_k))))$   
 k = 1: 'I' reading  
 k = 3 'you' reading  
 k = r 'we' reading

- (37) [= (15)] Joan and Mary<sub>1</sub> think they<sub>1</sub> like [each other (x<sub>1</sub>)(x<sub>r</sub>)]<sub>3</sub>  
 at LF: a) narrow scope reading: D<sub>1</sub> adjoins to embedded VP  
       b) wide scope reading: D<sub>1</sub> adjoins to matrix VP only  
 a'): think'(j  $\oplus m_1, (\lambda P.P(x_1)(\lambda x_r[\forall x_1(x_1 \Pi x_r \rightarrow$   
 $\quad \quad \quad \forall x_3(x_3 \Pi x_r \wedge x_3 \neq x_1 \rightarrow \text{like}'(x_1, x_3))])))$   
 $= [\text{via alphabetic variance on } \forall x_1]$   
 think'(j  $\oplus m_1, \forall x_{10}(x_{10} \Pi x_1 \rightarrow \forall x_3(x_3 \Pi x_1 \wedge x_3 \neq x_{10} \rightarrow \text{like}'(x_{10}, x_3)))$

$$\begin{aligned}
 b'): & \lambda P.P(j \oplus m) (\lambda x_r [\forall x_1 (x_1 \Pi x_r \rightarrow \text{think}'(x_1, \forall x_3 (x_3 \Pi x_r \wedge x_3 \neq x_1 \\
 & \quad \rightarrow \text{like}'(x_1, x_3))))]) \\
 = & \forall x_1 (x_1 \Pi j \oplus m \rightarrow \text{think}'(x_1, \forall x_3 (x_3 \Pi j \oplus m \wedge x_3 \neq x_1 \rightarrow \text{like}'(x_1, x_3)))
 \end{aligned}$$

As in HLM, the narrow scope reading (37a) involves an extra free  $D_1$  on the matrix VP, unrelated to the reciprocal. In the final line of the translation of (a), note the coindexation of  $j \oplus m$  with the two range arguments  $x_1$ . Given this (non-accidental) coindexation, *Joan and Mary* will discourse bind these arguments, under the assumption that co-indexation, though not necessary to discourse binding, will automatically lead to it when none of the elements coindexed is bound by an operator (see Roberts 1987, where this assumption holds).

(38) illustrates how the correct results are obtained for the non-subject antecedent example (cf. (19) above):

$$\begin{aligned}
 (38) & \text{ Al and Steve introduced Joan and Mary}_1 \text{ to each other}_3. \\
 & \text{LF: A\&S}_4 [\text{vpJ\&M}_1 [\text{vp:D}_1 [\text{each other } (x_1)(x_r)]_3 [\text{vp intro } x_1 \text{ to } x_3]]] \\
 & \text{VP:D}_1' \text{ (via quantifying } \text{each other} \text{ into the most embedded VP):} \\
 & \lambda y [\forall x_3 (x_3 \Pi x_r \wedge x_3 \neq x_1 \rightarrow \text{intro}'(y, x_1, x_3))] = \delta \\
 & \text{Quantifying } \text{Joan and Mary} \text{ into } \delta \text{ via T16D:} \\
 & \lambda y [\lambda P.P(j \oplus m) (\lambda x_r [\forall x_1 (x_1 \Pi x_r \rightarrow \delta(y))])] = \\
 & \lambda y [\forall x_1 (x_1 \Pi j \oplus m \rightarrow \forall x_3 (x_3 \Pi j \oplus m \wedge x_3 \neq x_1 \rightarrow \text{intro}'(y, x_1, x_3))] \\
 (38)' & : \forall x_1 (x_1 \Pi j \oplus m \rightarrow \forall x_3 (x_3 \Pi j \oplus m \wedge x_3 \neq x_1 \rightarrow \text{intro}'(a, x_1, x_3))
 \end{aligned}$$

Recall that the distributive predication rules require that the index on the subject match the subcategorization marker. Further, in order to satisfy the familiarity presupposition of the range argument of a reciprocal, the index on the distributive subcategorization must be the same as that of the contrast argument, and hence of the reciprocal antecedent. This mechanism insures that in examples like (38) the reciprocal antecedent must play both roles--binder of the contrast and subject of the distributive predication.<sup>6</sup>

(39) shows the treatment of (39), where the reciprocal antecedent, *no kids*, is quantificational. It falls out of the account that the reciprocal antecedent takes wider scope than both the universal

introduced by *each other* and the universal introduced in the course of distributive predication:

- (39) [= (24)] No kids<sub>1</sub> [VP:D<sub>1</sub>] spoke to [each other (x<sub>1</sub>)(x<sub>r</sub>)]<sub>3</sub>  
 VP:D<sub>1</sub>' (via quantifying *each other* into the most embedded VP):  
 $\lambda y[\forall x_3(x_3 \Pi x_r \wedge x_3 \neq x_1 \rightarrow \text{spoke-to}'(y, x_3))] = \delta$
- (39)': (applying distributive predication, T4D<sub>1</sub>)  
 $\lambda P[\sim \exists x(*\text{kid}'(x) \wedge P(x))] (\lambda x_r [\forall x_1 (x_1 \Pi x_r \rightarrow$   
 $\forall x_3(x_3 \Pi x_r \wedge x_3 \neq x_1 \rightarrow \text{spoke-to}'(x_1, x_3))])]$   
 $= \sim \exists x(*\text{kid}'(x) \wedge \forall x_1 (x_1 \Pi x \rightarrow \forall x_3(x_3 \Pi x \wedge x_3 \neq x_1 \rightarrow$   
 $\text{spoke-to}'(x_1, x_3)])$

For reasons of space, I cannot discuss several types of examples which the theory handles adequately. These include the control examples, those involving multiple reciprocals, and examples motivating T15D, distributively quantifying into CN. The theory also predicts readings where a non-subject reciprocal antecedent has wider scope than the subject.

With respect to Williams' observation about the difference between reciprocal *each* and the determiner, illustrated by (26), in the present theory the reciprocal antecedent/embedded subject in such an example is never itself quantificational. Hence, we would expect that the lack of the wide-scope *each* reading of (25) for (26) is the same type of phenomenon as we observe in (40), where there is no reading where the property of being such that someone has said you are happy is distributively predicated of the group of men. I'm not sure why this reading doesn't arise, but at least the theory seems to pick out the correct parallel examples:

- (40) Someone or other has said that the men are happy.

Finally, one might claim that there is another important difference between the two accounts. HLM claim that theirs is a compositional account of the contribution of *each'* and *other'* to *each other*; on the assumption that *each* is the same post-nominal operator we find in *The boys earned a dollar each*. But other assumptions are possible: if

we assume that '*other*' is (8b) (with  $\Pi$  substituted for ' $\pi$ '), and '*each*' is (41), the same determiner we find in *Each boy earned a dollar*, then by function-argument application, we obtain (42):

- $$(41) \text{ each': } \lambda Q \lambda P [\forall x(Q(x) \rightarrow P(x))]$$
- $$(42) \lambda Q \lambda P [\forall x(Q(x) \rightarrow P(x))] (\lambda z(z \cdot \Pi x_k \& z \neq x_i))$$
- $$= \lambda P [\forall x(x \cdot \Pi x_k \& x \neq x_i \rightarrow P(x))]$$

(42) is very close to the translation of '*each other*' in (34); the only difference is that this compositional derivation does not introduce the distinguished variable  $x_j$ . That is, '*other*' in general does not presuppose distributivity, nor does '*each*', but '*each other*' does. I would argue that (34) captures what is compositional about '*each other*' as well as HLM's (8e), while claiming that the distributivity presupposition of the NP is an idiomatic accretion. There are clearly idiomatic aspects to the interpretation of '*each other*--as HLM acknowledge, its quantificational force often seems to be weaker than the universal operator in (41) (see Langendoen (1978), Roberts (1987, §3.1.3.2)). Also, HLM have to posit an invisible determiner in the reciprocal (see (8c)), so that '*each other*' in effect contributes two universal operators; while I don't object in principle to invisible operators, the use of one in this case makes the result seem less compositional in the sense claimed. And with respect to the possibility of a universal theory of reciprocals, I think the present theory appears to be as promising as HLM's. For example, there is no superficial evidence from reciprocal constructions in languages like Italian (*l'uno...l'altro*) that they involve (synchronously or diachronically) the type of adnominal operator which HLM claim '*each*' to be in '*each other*'. The Italian construction also seems to have a slightly idiomatic flavor, and any distributivity involved might be claimed to arise from an idiomatic presupposition.

In closing, I want to touch all too briefly on a point of considerable interest. This is the question of groups, especially as developed in Landman (1989a, 1989b). And it bears on another concern which might be raised in connection with the present theory: If we admit a second series of predication rules, as I propose, why not expect a third or a

fourth? That is, why are there just two ways of predicing something of a logical subject? Landman points out that there are two ways we can think of a sum--as a whole or in terms of its i-parts, and he builds into his models two distinct sets of individuals corresponding to these two ways of thinking about sums. The resulting theory is quite elegant and interesting, particularly the resulting relationship between distributivity and cumulative reference. But note that in view of the kind of data considered here, which he does not consider, Landman would have to constrain predicates with floated quantifiers or reciprocals to apply only to non-atomic i-sums, not to atomic groups. With floating quantifiers, he might claim that the lexically-introduced i-part relationship,  $\mathcal{I}$ , presupposes that the range argument is non-atomic (HLM make a similar claim for  $\mathcal{W}$ ), an assumption that would filter out group subjects for such predicates. But how would the distributivity associated with reciprocals be introduced? In any case, his theory doesn't provide a ready answer to the issues raised here. This, in conjunction with the problems he encounters with conjoined group and collective VPs, has led me to consider the present alternative. I agree with him that there are two ways of thinking of a sum, but here I have realized this intuition differently, in terms of two different ways of predicing properties of sums. I hope to take this question up in more depth in future work.

#### Notes:

<sup>1</sup>This is a report on research in progress. I'd like to thank Tony Blum, Bob Kasper, Hee-Rahn Chae, Andreas Kathol, Manfred Krifka, Fred Landman, Carl Pollard, and JJ Nakayama for discussions which were important in forming the views expressed here, and Irene Heim and Robert May for very helpful comments following my presentation at SALT.

<sup>2</sup>There are well-known lexical exceptions to this rule. E.g. *scissors* is semantically singular.

<sup>3</sup>Though the reciprocal is an R-expression in HLM, as in the account in §3 below, I will use the term **reciprocal antecedent** to refer to the NP which licenses the reciprocal, giving value to its contrast and range arguments.

<sup>4</sup>Roberts (1987), motivated by conjoined collective and distributive VPs and by non-subject distributive antecedents, claims to be using *D* as an adverbial operator on predicates, sometimes corresponding to VP constituents, but sometimes only derived by abstraction. However, as this is implemented in Chapter 4, the *D* operator in fact operates like an NP quantifier, giving the same effect as HLM's adjunction of *each* to the

antecedent. Hence, it actually encounters problems with conjoined VPs. Though I cannot go into details here, a theory which attempts to use  $D$  along with quantifying in, e.g. with non-subject reciprocal antecedents, runs into non-trivial problems with accidental variable binding in the course of lambda conversion, leaving the range free.

<sup>5</sup>To derive the interpretation in (24b) we must also allow quantification to range over non-atomic elements of the lattice  $*k\text{id}$ , but HLM could change their account to permit this very easily.

<sup>6</sup>Indexing the subcategorization feature is a change from the theory presented at SALT. Irene Heim (p.c.) pointed out to me that if the distributivity is free to apply to any predicate which contains the reciprocal, this predicts wrong truth conditions for examples like (38), since *Joan and Mary* might bind the contrast while the distributive predication took *All and Steve* as subject.

## References:

- Bennett, Michael (1974) *Some Extensions of a Montague Fragment of English*. Ph.D. dissertation, UCLA.
- Dowty, David (1986) "Collective predicates, distributive predicates, and All." In F. Marshall (ed.) *ESCOL 86. Proceedings of the Third Eastern States Conference on Linguistics*, Ohio State University.
- Dowty, David, and Belinda Brodsky (1984) "The semantics of "floated" quantifiers in a transformationless grammar." In Mark Coblenz et al. (eds.), *Proceedings of WCCFL III*. The Stanford Linguistics Association, Stanford University, 75-90.
- Groenendijk, Jeroen, and Martin Stokhof (1990) "Dynamic Montague Grammar". In L. Kálmán et al. (eds.) *Proceedings of the Second Symposium on Logic and Language*, Budapest.
- Heim, Irene (1982) *The Semantics of Definite and Indefinite Noun Phrases*. Ph.D. dissertation, University of Massachusetts, Amherst. Reprinted 1989, Garland Press.
- Heim, Irene, Howard Lasnik, & Robert May (1991) "Reciprocity and plurality". *Linguistic Inquiry* 22:63-101.
- Higginbotham, James (1980) "Reciprocal interpretation". *Journal of Linguistic Research*, IU Linguistics Club, Bloomington, Indiana.
- Kamp, Hans (1981) "A theory of truth and semantic representation. In Jeroen Groenendijk, Theo M.V. Janssen, and Martin Stokhof (eds.) *Formal Methods in the Study of Language, Vol. I*. Mathematische Centrum, Amsterdam. Reprinted in Groenendijk, Janssen, and Stokhof (eds.) (1984) *Truth, Interpretation and Information*. Foris, Dordrecht.

- Landman, Fred (1989a) "Groups I". *Linguistics and Philosophy* 12:559-606.
- Landman, Fred (1989b) "Groups II". *Linguistics and Philosophy* 12:723-744.
- Langendoen, D. Terance (1978) "The logic of reciprocity". *Linguistic Inquiry* 9:177-197.
- Link, Godehard (1983) "The logical analysis of plurals and mass terms: A lattice-theoretical approach." In R. Bauerle et al. (eds.), *Meaning, Use, and Interpretation of Language*. de Gruyter, Berlin.
- Link, Godehard (1987) "Generalized quantifiers and plurals." In Peter Gärdenfors (ed.), *Generalized Quantifiers: Linguistic and Logical Approaches*. Reidel, Dordrecht, 151-180.
- Montague, Richard (1973) "The proper treatment of quantification in ordinary English". In Jaakko Hintikka, Julius Moravcsik, & Patrick Suppes (eds.) *Approaches to Natural Language*. Reidel, Dordrecht  
Reprinted in Richmond Thomason (ed.) (1974) *Formal Philosophy: Selected Papers of Richard Montague*. Yale University Press, New Haven.
- Partee, Barbara H. (1973) "Some transformational extensions of Montague Grammar". *Journal of Philosophical Logic* 2:509-534.
- Partee, Barbara H. (1978) "Bound variables and other anaphors." In D. Waltz (ed.), *Proceedings of TINLAP-2*. University of Illinois.
- Roberts, Craige (1985) "On the assignment of indices and their interpretation in Binding Theory". In S. Berman, et al. (eds.), *The Proceedings of NELS 15*, Graduate Linguistic Student Association, University of Massachusetts, Amherst.
- Roberts, Craige (1987) *Modal Subordination, Anaphora, and Distributivity*. Ph.D. Dissertation, University of Massachusetts, Amherst. Reprinted 1990, Garland Press.
- Williams, Edwin (1991) "Reciprocal Scope". *Linguistic Inquiry* 22:173-192

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## UNIQUENESS AND BIJECTION IN WH CONSTRUCTIONS\*

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### SECTION 1: INTRODUCTION

I want to focus in this paper on the fact that questions with one wh NP of the form "which N" have a uniqueness implication while those with more than one such NP allow for a bijective reading. The relevant examples are given in (1):

- (1)a. Which girl saw John?
- b. Which girl saw which boy?

An appropriate answer to (1a) should name only a single girl while an appropriate answer to (1b) can list pairs of girls and boys, as long as each girl who saw a boy saw a unique boy and each boy who was seen by a girl was seen by a unique girl. The fact that (1a) allows only for a unique reading is generally accepted; the fact that (1b) allows for multiple pairings is also uncontroversial but there is some disagreement whether the pairings have to be bijective. I'll follow Higginbotham and May (1981) in taking (1b) to have a bijective reading. While this distinction between single and multiple wh questions has been previously accounted for, namely by Higginbotham and May, it has not been captured within propositional theories of questions, such as Karttunen (1977), Groenendijk and Stokhof (1984) and Engdahl (1986). In this paper I'll show first that by introducing a simple modification it becomes possible to account for this distinction within a propositional theory of questions, such as

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\* I am indebted to Gennaro Chierchia and Fred Landman for discussion. I would also like to thank the audiences at WCCFL X, where section 5 of this paper was presented, and SALT I for helpful comments. The responsibility for all errors, naturally, is mine.

Karttunen's. I'll then show that the proposed modification has other empirical payoffs as well.

## SECTION 2: BACKGROUND

Let me begin by demonstrating that the phenomenon under discussion remains elusive within standard propositional theories. Karttunen (1977), for example, takes a question to denote the set of propositions which jointly constitute the complete true answer to that question. (1a) and (1b), on his account, denote (2a) and (2b) respectively.

- (2)a.  $\lambda p \exists x [girl'(x) \& ^p \& p = ^saw'(x, j)]$
- b.  $\lambda p \exists x \exists y [girl'(x) \& boy'(y) \& ^p \& p = ^saw'(x, y)]$

Consider (2a) first. In a situation where Mary saw John, this allows the proposition  $^saw'(mary, john)$  and prevents the proposition  $^saw'(bill, john)$  from being in the denotation of the question. However, it will not prevent another proposition  $^saw'(sue, john)$  if this happens to be true in the situation. Thus the uniqueness associated with (1a) is not part of the semantic representation in (2a).

Next consider (2b). Here too the set can include several propositions each linking a girl and a boy such as  $^saw'(sue, bill)$  and  $^saw'(mary, john)$ . And this is a welcome result since (1b) clearly doesn't impose a uniqueness requirement -- "Sue saw Bill and Mary saw John" is an appropriate answer to "Which girl saw which boy?". There is a problem with the representation only if we take (1b) to involve a bijective reading.

Though judgements on this issue tend to be delicate, there clearly is a strong tendency towards a bijective interpretation of multiple wh questions. The issue to settle is whether the bijectivity requirement is strong enough to be included in the semantic representation of such questions. Engdahl (1986) argues against including it in the semantics. On the basis of question-answer exchanges like (3) she takes bijectivity to be an implicature:

- (3)a. Which table ordered which wine?
- b. Table A ordered the Ridge Zinfandel, Table B ordered the Chardonnay and Table C ordered the Rose and the Bordeaux.

According to her, (3a) uttered by a bartender who has

mixed up his order slips can, and should, be answered by an exhaustive list matching up tables and wines. (3b) thus is an appropriate answer to (3a) even though it includes a table which has ordered more than one wine.

While I share the intuition that (3b) is not an inappropriate answer in the context, I do not think that it provides a definitive argument against including bijectivity in the meaning of the multiple question. If a multiple question really did not include bijectivity, a question answer exchange such as (4) would also be acceptable:

- (4)a. Which girl saw which boy?
- b. Sue saw Bill, John and Harry

Clearly, however, (4b) is not an appropriate answer to (4a).

It seems to me that acceptable violations of bijectivity, such as (3), typically involve situations in which most of the pairings respect bijectivity and seem to be amenable to a pragmatic explanation. The questioner in (3a), for example, probably expects each table to have ordered a single wine. Knowing that questions are usually exhaustive requests for information, a cooperative interlocuter may provide an answer which includes pairings which violate bijectivity, implicitly denying the questioner's presupposition. I take bijectivity to be part of the meaning of multiple questions on the basis of the unacceptability of answers like (4b) and assume some pragmatic explanation along the lines just sketched why mixed answers like (3b) are not completely ruled out.

Note, then, that nothing in (2b) prevents the set from containing several propositions each linking a single girl to several boys, as in *'saw'(sue,bill)*, *'saw'(sue,john)*, *'saw'(sue,harry)*. That is, Karttunen's analysis of multiple questions does not rule out answers like (4b) which strongly violate bijectivity.

Within Karttunen's theory of questions a pragmatic account would have to be given for the unique reading of questions like (1a) as well as for the bijective reading of questions like (1b). It is not clear, however, what conversational principles could be used to explain these facts. Perhaps, one could suggest that the use of a singular NP is a pragmatic signal of uniqueness but this would leave unexplained the fact

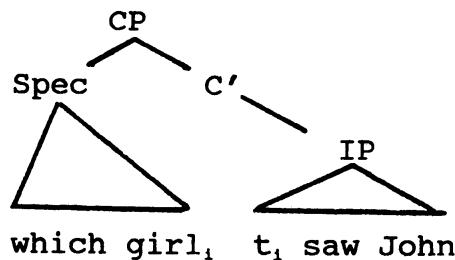
that the same signal is not given in multiple wh structures. Furthermore, the bijective reading of multiple wh questions would still remain elusive.

### SECTION 3: THE PROPOSAL

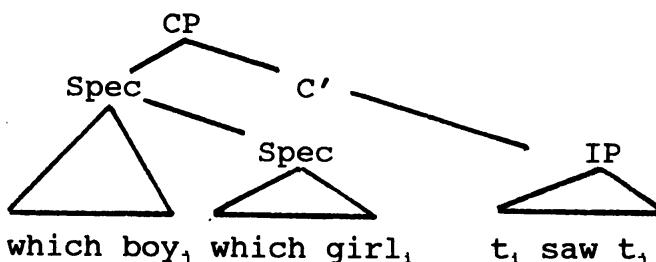
It is possible, however, to incorporate the switch from uniqueness to bijection within a propositional theory of questions without materially affecting the basic insights of that approach, and I'll now outline one way of doing so. Let us follow Karttunen in analyzing questions as sets of propositions but take the question formation rule to include a condition that the existentially quantified variables be unique.

I'll assume a GB style syntactic representation for questions in which a wh NP raises to spec of CP leaving behind a trace. In the case of questions with more than one such NP, the other wh NPs are assumed to raise at LF. The LF representations of (1a-b) which would be an input to interpretation would be as in (5a -b):

(5)a.



(5)b.



The structures in (5) would be interpreted using a question formation rule, such as the one given in (6):

$$(6) \text{ QUES}_n^* [_{\text{cP}}[_{\text{sP}}[\text{ecwh } N^n_1 \dots \text{wh } N^n_n] _{\text{c'}}[\text{IP}]] \Rightarrow \\ \lambda p \exists x_1 \dots \exists x_n [x_1 = x_1(P(x_1) \& \phi) \dots \& \\ \dots x_n = x_n(Q(x_n) \& \phi) \& {}^v p \& p = {}^{\wedge} \phi]$$

P and Q in (6) stand for the predicates denoted by the common nouns inside the wh NPs and  $\phi$  stands for the

open sentence denoted by the IP. I assume that wh traces correspond to individual variables. Thus each wh expression existentially quantifies over an individual variable inside IP, just as in Karttunen. The italicized part in (6) is what is new. What this part does is incorporate the uniqueness associated with the wh expression into the semantic representation. This is done by associating each wh expression with an indexed iota operator which binds the position inside the open sentence denoted by IP, having the same index as itself. Further, there is a condition that only those objects identical to the unique object picked out by the iota be considered in the assignment of values to the existentially quantified variables.

Applied to (5a-b), (6) yields (7a-b) as the translations of the questions in (1):

- (7)a.  $\lambda p \exists x [ [x =_1 y (\text{girl}'(y) \& \text{saw}'(y, j))] \& {}^v p \& p =^{\wedge} \text{saw}'(x, j)]$ .
- b.  $\lambda p \exists x \exists y [ [x =_1 z (\text{girl}'(z) \& \text{saw}'(z, y)) \& y =_1 z (\text{boy}'(z) \& \text{saw}'(x, z))] \& {}^v p \& p =^{\wedge} \text{saw}'(x, y)]$

Let us see if these represent the switch from uniqueness to bijection that we are interested in.

Consider (7a) first. This formula lets into the propositional set all propositions of the form  ${}^{\wedge} \text{saw}'(x, john)$  iff  $x$  is identical to a unique individual who satisfies the predicate  $\text{girl}'$  and is a member of the set of individuals who saw John. It thus allows  ${}^{\wedge} \text{saw}'(mary, john)$ , only if Mary is the unique girl who saw John. In situations where there is no such unique girl, I assume that the iota picks out a dummy object. Since there will be no  $x$  identical to this object the propositional set will be empty.

Let us turn now to multiple wh questions. (1b), for example, translates as (7b). This formula lets into the set any proposition of the form  ${}^{\wedge} \text{saw}'(x, y)$  iff  $x$  and  $y$  are the unique pair that satisfy the predicates in the wh NPs and the relation expressed by the open sentence. It allows for more than one proposition since uniqueness of  $x$  is relativized for a value assignment to  $y$  and vice versa. For example, consider the situations in (8):

- (8)a.  $\text{saw} = \{ \langle \text{mary}, \text{john} \rangle, \langle \text{sue}, \text{bill} \rangle \}$
- b.  $\text{saw} = \{ \langle \text{sue}, \text{john} \rangle, \langle \text{sue}, \text{bill} \rangle \}$
- c.  $\text{saw} = \{ \langle \text{mary}, \text{john} \rangle, \langle \text{sue}, \text{john} \rangle \}$

(6) will allow the propositions  $\wedge \text{saw}'(\text{mary}, \text{john})$  and  $\wedge \text{saw}'(\text{sue}, \text{bill})$  into the set in a situation like (8a) where the relevant relation is bijective. This is because, when  $x$  is assigned the value *mary* and  $y$  the value *john*, uniqueness is maintained and similarly when  $x$  is assigned the value *sue* and  $y$  the value *bill*. Notice that (7b) will not allow the propositions  $\wedge \text{saw}'(\text{sue}, \text{john})$  and  $\wedge \text{saw}'(\text{sue}, \text{bill})$  into the set in a situation like (8b) which is not bijective. This is because when  $x$  is assigned the value *sue* and  $y$  the value *john*, the iota will not be able to pick out a unique boy seen by  $x$  since John and Bill are both seen by Sue. The iota will pick out a dummy object and the propositional set will remain empty since no value assignment to the existentially quantified variable  $y$  can make the second identity statement true.

Similarly, it will not allow the propositions  $\wedge \text{saw}'(\text{sue}, \text{john})$  and  $\wedge \text{saw}'(\text{mary}, \text{john})$  into the set in a situation like (8c). In this case the iota will not pick out a unique girl who sees  $y$  when  $y$  has the value *john*. There will therefore be no value assignment to the existentially quantified variable  $x$  which can make the first identity statement true. Thus, answers to the question will include only those pairs which respect bijectivity.

Note that though (6) allows for multiple pairs it is not restricted to them. It is possible for the set to contain a single proposition identifying one relevant pair of individuals. This is important because multiple wh questions can be answered with a single pair -- this is what Higginbotham and May call the "singular" interpretation of multiple wh questions, as opposed to their "bijective" interpretation and Pope (1976) calls REF-questions. We do not need a separate representation for this in the present account since the question formation rule simply treats this as a subcase of the bijective interpretation.

The schema in (6), we see, successfully captures the switch from uniqueness in single wh questions to bijection in multiple wh questions. Though I have demonstrated how the rule works for questions with two wh NPs only, it is easy to see that it will extend to those with more than two such NPs as well.

So far we have dealt with complex wh expressions like "which *N*" where *N* is syntactically singular. It is easy enough to extend this to the case of plural NPs by adopting a theory of plurals such as Link (to appear) and Landman (1989) and assuming that the iota

is defined on the supremum of the set rather than on absolute uniqueness.

If we simply restrict the interpretation of singular NPs to singular individuals and that of plural NPs to plural individuals we get the desired results. A question like (9a), for example, will also denote a singleton set. Specifically, the set which contains the proposition  $\wedge x$  came where the assignment function gives  $x$  the value of the maximal plural individual who is a girl and saw John.

(9)a. Which girls saw John?

b.  $\lambda p \exists x [ [x =_1 y (\text{girls}'(y) \ \& \ \text{saw}'(y, j))] \ \& \ 'p \ \& \ p = \wedge \text{saw}'(x, j)]$ .

If Mary and Sue saw John, the only proposition in the set will be  $\wedge \text{saw}'(\text{mary+sue}, \text{john})$ .

The evaluation of multiple wh questions with plural NPs follows as expected. This is shown in (10):

(10)a. Which girls saw which boys?

b.  $\lambda p \exists x \exists y [ [x =_1 z (\text{girls}'(z) \ \& \ \text{saw}'(z, y))] \ \& \ [y =_1 z (\text{boys}'(z) \ \& \ \text{saw}'(x, z))] \ \& \ 'p \ \& \ p = \wedge \text{saw}'(x, y)]$

The semantics outlined above also accounts for questions with monomorphemic wh expressions like "who" and "what" which are known not to have uniqueness implications. Take a question like (11), which can be answered with (12a) or (12b), depending on the situation:

(11) Who saw John?

(12)a. Mary  
b. Mary and Bill.

To account for this I make the straightforward assumption that such NPs lack a specification about interpreting them with respect to singular or plural individuals. (11) will then denote (13):

(13)  $\lambda p \exists x [x =_1 y (\text{person-or-persons}'(y) \ \& \ \text{saw}'(y, j)) \ \& \ 'p \ \& \ p = \wedge \text{saw}'(x, j)]$

If this were evaluated in a situation in which two people, Bill and Mary, saw John the iota would pick out the plural individual  $\text{bill+mary}$ . While the proposition  $\wedge \text{saw}'(\text{bill+mary}, \text{john})$  would be in the set, the

propositions  $\wedge \text{saw}'(\text{bill}, \text{john})$  and  $\wedge \text{saw}'(\text{mary}, \text{john})$  would not be. If it were evaluated in a situation in which only one individual, Mary, saw John the iota would pick out the singular individual *mary*. In either case there would be only one proposition in the set. Specifically,  $\wedge \text{saw}'(x, \text{john})$  where *x* would have the value of the maximal individual, singular or plural.

Thus the schema given in (6) captures the switch from uniqueness to bijection in (1a-b) as well the difference between questions with complex wh NPs of the form "which N" such as (1a) and those with monomorphemic wh NPs of the form "who" such as (11).<sup>1</sup>

#### SECTION 4: A COMPARISON WITH OTHER PROPOSALS

The switch from unique to bijective readings in (1a-b), though not so far accounted for in other propositional theories of questions, has been previously accounted for by Higginbotham and May (1981) and May (1989) and I would briefly like to comment on how the three accounts differ.

According to Higginbotham and May (1981) a question like (1a) has an LF of the form (14a), whose meaning can be schematically represented as (14b):

- (14)a. For which girl *x*, *x* saw John
- b. [WH!*x*: *x* a girl] *x* saw john

In their system, too, the semantic value of a wh NP of the form "which N" encodes uniqueness as part of its meaning, represented by the symbol ! on the wh operator.

This analysis extends straightforwardly to multiple wh questions yielding (15a) and (15b) as representations for (1b):

- (15)a. For which girl *x* and which boy *y*, *x* saw *y*

<sup>1</sup> A similar enrichment of other propositional theories such as Groenendijk and Stokhof (1984) is also possible though I will not deal with that here (see Srivastav 1991a). Another relevant construction that do not discuss here is Hindi correlatives which also display a variation between unique and bijective readings depending on the number of wh NPs. Srivastav (1991a and forthcoming) give relevant examples and provide a semantics which is parallel to the one being proposed here for questions.

b. [WH!x: x a girl] [WH!y: y a boy] x saw y

Since the meaning of questions is built up recursively the semantic representation in (15b) requires there to be a unique girl and boy pair in the see relation. That is, it allows for the singular interpretation. In order to get the bijective reading Higginbotham and May propose an optional syntactic operation at LF called *absorption* which combines two or more unary quantifiers, converting (15b) into (15c):

(15)c. [WH!x WH!y: x a girl & y a boy] x saw y

The process of absorption converts the unary quantifiers into a single polyadic quantifier. A semantics for the absorbed polyadic quantifier is then defined which gets the appropriate bijective reading.

Higginbotham and May's account and the one proposed here capture the same range of readings but the two approaches make rather different theoretical assumptions.

Higginbotham and May posit an optional syntactic operation at LF in order to account for the fact that a multiple wh question can be answered by a single pair or by several bijective pairs. In a sense, for them the singular reading of multiple wh questions is basic. The account presented here, on the other hand, treats the bijective reading as fundamental, the singular reading being a special case of it. Intuitively, this seems more satisfactory but as far as empirical predictions go, I do not think that the two accounts can be differentiated.

It is worth pointing out, though, that in the Higginbotham and May account, the bijective reading of multiple wh questions does not build directly on the meanings of the unary quantifiers which are an input to *absorption*. To that extent, then, their semantics is non-compositional. In the semantics proposed here, on the other hand, the bijective reading is compositionally built up out of the uniqueness encoded in each wh NP in the relevant construction. This approach can thus be seen as either doing away with absorption altogether or as treating absorption as a purely interpretive phenomenon involving no syntactic transformation. It is a property of strings of operators in spec that they are interpreted as polyadic quantifiers.

May (1989) develops an account of multiple wh

questions in a somewhat different way from Higginbotham and May (1981). The primary difference is that there is no longer a need for a syntactic operation at LF corresponding to absorption. Instead, a series of wh operators in spec of CP are interpreted as polyadic as well as pair operators since they mutually c-command each other, hence fall in what he calls a  $\Sigma$  sequence. In the case of (1b), for example, there would be a pair wh operator  $\text{which}_1$ , and a binary wh operator  $\langle \text{which}_1, \text{which}_2 \rangle$ . The pair operator is simply the second degree counterpart of the unary wh operator  $\text{which}_1$ . As such, it carries along the uniqueness presuppositions associated with such operators and yields the singular interpretation. The binary operator, on the other hand, does not belong to this class and carries weaker presuppositions comparable to the unary operators corresponding to monomorphemic wh expressions like "who" and "what". It can therefore allow for multiple pairs in the answer. As noted by May himself (footnote 16), however, this does not rule out an answer like (4b). That is, polyadic operators in his system do not incorporate bijectivity which has to be imposed by admitting only assignments where each of the individuals is unique relative to other assignments. Recall that this kind of relative uniqueness is precisely what is built into the rule proposed in section 3 for interpreting wh operators in spec.

The semantics proposed here, then, has a general schema which applies uniformly to questions with complex wh expressions of the form "which N", where N can be singular or plural as well as to those of the form "who" or "what" which may be syntactically singular but which are semantically unspecified with respect to number. It also applies to wh constructions with one or more wh NPs in spec position and yields unique and bijective readings for single and multiple questions respectively. It thus accounts for the range of readings that Higginbotham and May (1981) and May (1989) do, but does so by incorporating the uniqueness associated with wh expressions into the standard propositional theory of questions in a simple and straightforward extension of that theory.<sup>2</sup> The

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<sup>2</sup> Not all multiple wh questions allow for both bijective and singular readings, as noted by Higginbotham and May (1981) and May (1989). When the wh expressions are identical, for example, as in *Which character admires*

proposed innovation thus represents an alternative to those accounts as well as an enrichment of the propositional theory of questions.

#### SECTION 5: EMPIRICAL CONSEQUENCES

While the modification which I have presented is designed to capture uniqueness vs. bijection and should be evaluated on its own merits, I would like to show that it has other empirical advantages as well. In order to do so, I will introduce a problem posed by certain facts of Hindi.

It has been noted that a Hindi wh, though in-situ at S-structure, can only take narrow scope when it occurs inside a finite complement. (16), for example, can only be interpreted as an indirect question:

- (16) raam jaantaa hai merine kyaa khariidaa  
 Ram knows Mary what bought  
 "Ram knows what Mary bought." NOT  
 "What does Ram know Mary bought?"

This is unexpected, given what we know about Chinese wh in-situ. The Chinese counterpart of (16) is ambiguous between a direct and an indirect question reading. As argued by Huang (1982), the verb *know* can take a plus or a minus wh complement, leaving the embedded *what* free to move at LF to the lower or the higher spec, yielding the two readings.

Clearly, finite clauses in Hindi are different from Chinese in that they are scope islands for wh interpretation. In Srivastav (1989) and (1991a) I have shown that Hindi finite clauses are syntactic adjuncts and that extraction is ruled out as a subjacency violation. Davison (1984) and Mahajan (1987 and 1990) provide alternative explanations but for the purposes

which character in *Gone with the Wind?* only the singular interpretation is available. As far as I can tell, none of the analyses, including the one proposed here, can derive this fact. Something more needs to be said in order to prevent absorption in Higginbotham and May (1981), to make unavailable the binary operator in May (1989) and to force there to be only a single assignment of values which makes the formula true in the semantics proposed here. On this count, then, all three theories are comparable. For a discussion of other cases where both readings are not available, see Srivastav (1991a).

of this discussion it is not important to choose between the various accounts. We need only accept it as a descriptive fact that movement of Hindi *kyaa* "what" to the higher spec is ruled out in sentences like (16), the only well-formed LF for it being (17a):

- (17) a. [cp [ip ... [cp what, [ip...t,...]]]]]  
       b. \*[cp what, [ip...[cp t',[ip...t,...]]]]]

(18) provides further illustration of the fact that Hindi wh's cannot escape out of finite complements:

- (18) raam jaantaa hai meri ne kahāā kyaa khariidaa  
       Ram knows Mary where what bought  
       "Ram knows where Mary bought what." NOT  
       "For which x, Ram knows where Mary bought x?"

Consider, however, a Hindi question like (19), a counterpart of the well known English example:

- (19) kaun jaantaa hai merine kahāā kyaa khariidaa  
       who knows Mary where what bought  
       "Who knows where Mary bought what ?"

This can be answered with an individual answer or with the pair list answer, just as its English counterpart would be. Now, the standard explanation for pair list answers, deriving from Baker (1970), is that the embedded wh "what" raises to matrix spec and the answer yields a pairing of "who" and "what". Under this view, the pair list answer to (19) would have to derive from an LF like (20), where the lower wh moves up into matrix spec:

- (20) [cp what, who,  
           [<sub>ip</sub>...<sub>t<sub>1</sub></sub>...[cp where<sub>k</sub>[<sub>ip</sub>...<sub>t<sub>k</sub></sub>...]]]]]

But we know, of course, from (16) and (18) that this is not possible in Hindi. It would be completely ad hoc to posit movement out of the finite complement in (19) while preventing such movement in (16) and (18). The pair list answer, clearly, has to be accounted for without scope interaction of the kind standardly assumed.

Let us see if an alternative account, which does not involve extraction of embedded wh, can be developed. Let us take (21) as the only well formed LF of the Hindi question in (19), and (22) as its

translation, using for the moment Karttunen's original theory:

- $$(21) [\text{cp} \text{ who}_i[\text{ip} \dots t_i \dots [ \text{cp} \text{ what, where}_k[\text{ip} \dots t_j \dots t_k \dots] ]]]$$
- $$(22) \lambda p \exists x [^p \& p = ^{\text{know}}(x, \lambda p \exists y \exists z [^p \& p = ^{\text{bought}}(\text{mary}, y, \text{at } z)])]$$

Now, an answer to this question can only provide values for *kaun* "who", following the standard assumption that an answer only provides values for those wh's which have matrix scope. We know that a wh expression like "who" allows for one or more individuals to be specified in the answer. Suppose, I answer (19) with *John and Bill*, I am giving an individual answer which uses a plural term to identify the matrix subject. If we take the indirect question in (19) to denote a set of propositions we can say that the group of individuals picked out by the plural term *John and Bill* stands in a particular relation to a set of propositions. The answer can be said to have the form:  $R(X, Q)$ , where  $R = \text{know}'$ ;  $X = \text{the set of individuals who know } Q$  and  $Q = \text{the set of true propositions denoted by the indirect question}$ .

In a situation in which Mary bought a book at Borealis and a pen at Hills, and John and Bill know where she bought what, an answer to (22) would have the form:  $\text{know}'(\text{John and Bill}, \cdot)$  where  $\cdot = \{p_1, p_2\}$ ,  $p_1 = ^{\text{mary bought the book at Borealis}}$ ;  $p_2 = ^{\text{mary bought the pen at Hills}}$ .

Note that there is a conventional implicature that if I answer (19) with *John and Bill*, I imply that they each know the two propositions in the denotation of the complement. Though the answer does not specify whether the *know* relation distributes down to the members of the two groups, it conventionally implicates it.

But what if the situation is such that this implicature does not hold? What if John and Bill jointly know the two propositions but neither of them know both? Well, that is precisely the situation where the pair list answer will be used: *John knows where Mary bought the book and Bill knows where she bought the pen*. We can say, that when an individual answer involves groups, the distributive reading is conventionally implicated. The pair list answer cancels the implicature that there is a distributive reading by making explicit that the individuals jointly know the set of propositions. The pair list answer, we

can say, involves a cumulative interpretation of the relation between the two groups.

This distinction between distributive and cumulative readings is based on Scha (1981). Briefly, Scha suggests that sentences which relate two plural NPs, that is, group denoting terms, are ambiguous between, collective, distributive and cumulative readings. Consider (23), for example:

- (23) Two boys solved three problems.

This has a collective reading which says that the two boys collaborated in solving three problems; a distributive reading which says that two boys solved three problems each as well as a cumulative reading which says that, working independently, they solved a total of three problems. The point I am making is that this distinction also applies to the answer which derives from the LF in (21), since both arguments of the verb can denote groups.

Treating pair list answers in terms of the distinctions made by Scha rather than in terms of scope interaction makes a strong prediction. Take a question like (24), which is like (19) in that it is a direct question with an indirect question complement:

- (24) *kaun laRkaa jaantaa hai merine kaun kitaab*  
           which boy     knows       Mary     which book  
           khariidii  
           bought  
           "Which boy knows which book Mary bought ?"

Unlike (19), however, (24) does not allow for a pair list answer. This is a problem for standard accounts of pair list answers. Remember that we are dealing here with a wh in-situ whose extraction is somehow restricted when it is inside a finite complement. Presumably, there would have to be some way of overriding the fact that Hindi finite clauses are scope islands in order to account for the pair list reading of (19). But in that case, it should also be possible to extract *kaun kitaab* "which book" out of the finite complement in (24) and move it to matrix spec. If there is scope interaction between "which boy" and "which book" at the matrix clause level, however, we should be able to get a pair list answer, which we do not.

Under the account of pair list answers I have

proposed, the absence of the pair list reading for (24) is actually predicted. The difference between (24) and (19) is that the two arguments of *know* in (24) cannot refer to groups. The wh in the matrix clause is "which boy" and presupposes that there is only one relevant boy. Further, the indirect question can only contain one proposition, namely the one which identifies the unique book Mary bought. Since the semantic answer to (24) does not relate plural objects, no ambiguity between distributive and cumulative readings is possible. Put another way, if the semantic answer picks out John, for example, as the individual who knows the proposition *Mary bought War and Peace*, there is no meaningful sense in which we can talk about the distributive-cumulative distinction. Since pair list answers, under the proposed account, is a way of canceling the implicature that the relation between the matrix subject and the indirect question object is distributive by making the cumulative reading explicit, it is predicted that a pair list answer to (24) will not be available. Thus the contrast between (19) and (24) argues strongly in favor of the account based on plurality that I just sketched over the standard account of the phenomenon.

If we look a little more closely at the arguments just presented, we will see that the contrast between (19) and (24) is explained more clearly if we use, not the original Karttunen theory of questions, but the modified version I have presented in section 3. Let us see why.

The explanation for the absence of pair list answers hinges crucially on the fact that the arguments of *know* in (24) are singular terms. In Karttunen's theory we saw that this was not part of the semantics and the matrix subject could easily be associated with several boys, and the indirect question with several propositions linking Mary with books bought by her. The uniqueness of single wh questions, in that account, is not part of the semantic representation. Thus, we would have to ensure that the cumulative-distributive distinction that pair-list answers express be made sensitive to the pragmatic restrictions imposing uniqueness. In the modified version of the theory, the semantics itself ensures that the two arguments of *know* be singular, accounting straightforwardly for the absence of the pair list answer.

However, the problem with the original theory is not simply that the explanation for the absence of the

pair list reading in (24) is somewhat complicated. There are cases where it simply makes the wrong prediction. Consider a question like (25), which differs minimally from (24):

- (25) *kaun jaantaa hai merine kyaa khariidaa*  
           who knows       Mary   what bought  
           "Who knows what Mary bought?"

The difference with (24) is that the two terms need no longer refer uniquely. Under Karttunen's theory, this would mean that there would be no pragmatic restriction on the semantic representation which could freely pick out plural objects. That is, the matrix wh subject could be associated with several individuals; and the indirect question could contain several propositions, each linking Mary with some object she bought. Thus, in an account of pair list answers which uses plurality of objects, the prediction would be that a question like (25) should allow for a pair list answer. This, however, is not the case. (25), like (24) and unlike (19), cannot be answered with a pair list.

This is where the proposed modification yields the right results. In the modified account, although (25) has *kyaa* "what" in place of *kaun kitaab* "which book", the indirect question would still denote a set with only one member even if Mary bought two books. It would contain the single proposition *^mary bought emma + ivanhoe*, where *emma + ivanhoe* refers to the plural object that Mary bought. Thus the semantic answer would relate an individual with a singleton propositional set. Since pair list answers express cumulative readings, and cumulative readings are only possible when both terms are plural, it is correctly predicted that a pair list answer to (25) is not possible.

The fact that pair list answers are available with multiple embedded questions and unavailable when the embedded question has only one wh expression seems to be a general phenomenon. This is the case in languages as diverse as English, Hindi, Bulgarian, Russian, Chinese and Japanese.<sup>3</sup> Under the non-movement account

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<sup>3</sup> See Srivastav (1991b) for a fuller discussion of the cross-linguistic application of this idea as well as for an explanation for the possibility of pair list answers to questions like *Who knows where Mary bought*

combined with the modified semantics of section 3 this is not surprising. Indirect questions with more than one wh expression, but not those with just one, can denote sets which may contain more than one proposition. That is, questions with "who" in the matrix and a multiple wh complement can represent a relation between plural objects and may therefore have a cumulative reading; questions with single wh complements necessarily represent a relation with a singleton propositional set in object position so that a cumulative reading is ruled out.

#### **SECTION 5: SOME LOOSE ENDS**

In this section I want to address two problems that remain open in the approach to pair list answers being taken here. In each case, I will outline the problem for the proposed as well as for the standard account. It is predicted on the present account that pair list answers in embedded contexts will only be available when both terms are plural. This was demonstrated by (24) and (25). Now consider (26):

- (26)a. Which boy knows where Mary bought what?
- b. Which boy knows where Mary bought which book?

Under our account these questions represent a relation between the singular individual picked out by *which boy* and a possibly plural subject, the set of propositions denoted by the indirect question. The prediction is that a pair list answer should not be possible since cumulative readings require both terms to be plural. While the prediction is borne out for (26a), it is not so clear that it holds for (26b). Intuitions may vary but it seems that at least for some people (26b) allows for the pair list answer. This is also true for their Hindi counterparts.

The possibility of a pair list answer to (26b), at first glance, seems to favor the standard approach where the wh in-situ is moved at LF to matrix spec. But this does not quite explain why the same is not true for (26a) since scope interaction between *which boy* and *what* should allow for multiple answers. Though there may be a tendency for all wh expressions to be

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*these books?*, noted by Kuno and Robinson (1972) to be problematic for the standard movement-based account.

either complex or monomorphemic, this is not a strict requirement. (27a), for example, uttered in a context where children and activities are being discussed can readily be answered with (27b):

- (27)a. Which kid did what?
- b. John cleared up the mess in the living room  
and Liz took care of the dishes.

Further, it is not clear how Hindi examples like (26b) would be handled since extraction is not possible in the language. Thus the paradigm in (26) is problematic for the standard account as well as for the present one.

The second problem has to do with the fact that pair list answers typically supply values for the matrix wh and that wh in the embedded clause which remains in-situ.<sup>4</sup> Pair list answers to (28a), for example, would pick out people and objects, while answers to (28b) would pick out people and stores:

- (28)a. Who knows where Mary bought what?
- b. Who knows which book Mary bought in which store?

The problem for the present account is obvious. Since the values of the embedded wh is simply a way of identifying the proposition known by each atomic individual picked out by the matrix wh, there is no reason why one rather than the other should be chosen.

Again, at first glance, (28) seems to be amenable to an explanation in terms of the movement account. The trace of the wh in-situ is lexically governed and can therefore move to matrix spec at LF without violating the ECP. Note, however, that the trace of the fronted wh in (28b) is also lexically governed so that there is no reason why this wh could not move at LF to matrix spec, thereby allowing for answers listing people and books. This is ruled out by stipulating that LF movement cannot originate in operator positions (Chomsky 1986). This, however, cannot be maintained universally.

Consider the Bulgarian example in (29). Both embedded wh expressions are in operator positions and yet the question can be answered with a pair list, on

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<sup>4</sup> See Srivastav (1991a), however, for some counterexamples.

par with the English example:

- (29) *koj znae katvo kade e kupila Maria*  
 who knows what where has bought Maria  
 "Who knows where Maria bought what?"

In order to derive the pair list answer, the movement account must allow *kakvo* "what" to move from an operator position at LF. But note that in doing so the explanation why the pair list answer to (28b) does not name people and books is lost.

It is clear that more work needs to be done in order to explain the facts in (26)-(29). What I hope to have shown, however, is that they do not a priori argue against the present account since they are also problematic for standard accounts of the phenomenon.

#### SECTION 6: CONCLUSION

To sum up, I have argued that the uniqueness and bijection associated with single and multiple wh questions such as (1a) and (1b) should be incorporated into the semantic representation of questions. I have presented a modification of Karttunen's theory that accomplishes this by providing a single rule which applies uniformly to single and multiple wh questions having wh NPs of the form "which N" as well as of the form "who". I have also argued that pair list answers do not involve scope interaction between a matrix wh and a wh extracted from the embedded clause and developed instead an account of pair list answers based on the plurality of the arguments involved. I have shown that, combined with the modified semantics of section 3, this accounts for the uniform pattern in the availability of pair list answers found across fairly divergent languages.

#### REFERENCES

- Baker, C.L. (1970) "Notes on the Description of English Questions: The Role of an Abstract Question Morpheme," *Foundations of Language* 6.
- Chomsky, N. (1986) *Barriers*, MIT Press: Cambridge MA.
- Davison, A. (1984) "Syntactic Constraints on Wh in-situ: Wh Questions in Hindi-Urdu", Paper presented at LSA.
- Groenendijk, J. and M. Stokhof. (1984) *Studies in the Semantics of Questions and the Pragmatics of Answers*.

- Higginbotham, J., and R. May (1981) "Questions, Quantifiers and Crossing", *The Linguistic Review* 1, pp.41-80.
- Huang, C.-T. J. (1982) *Logical Relations in Chinese and the Theory of Grammar*, Ph.D. thesis, MIT.
- Karttunen, L. (1977) "Syntax and Semantics of Questions", *Linguistics and Philosophy* 1, 3-44.
- Kuno, S. and J. Robinson, (1972) "Multiple Wh Questions", *Linguistic Inquiry* 3, 463-487.
- Landman, F. (1989) "Groups I and II", *Linguistics and Philosophy* 12.
- Link, G. (to appear) "Plural", in Wunderlich and von Stechow (eds) *Handbook of Semantics*.
- Mahajan, A.K. (1987) "Notes on Wh Questions in Hindi" Paper presented at SALA, Cornell and Syracuse Universities.
- Mahajan, A.K. (1990) *The A/A-bar Distinction and the Theory of Movement*, Ph.D. dissertation, MIT.
- May, R. (1989) "Interpreting Logical Form", *Linguistics and Philosophy* 12.
- Pope, E. (1976) *Questions and Answers in English*, Mouton, The Hague.
- Nishigauchi, T. (1986) *Quantification in Syntax*, Ph.D. dissertation, University of Massachusetts: Amherst.
- Rudin, C. (1988) "On Multiple Questions and Multiple WH Fronting", *Natural Language and Linguistic Theory* 6.
- Scha, R. (1981) "Distributive, Collective, and Cumulative Quantification", reprinted in Groenendijk, Janssen and Stokhof (eds) (1983) *Truth, Interpretation, Information*, GRASS 2, Foris, Dordrecht.
- Srivastav, V. (1989) "Hindi Wh and Pleonastic Operators", in *Proceedings of NELS* 20.
- Srivastav, V. (1991a) *WH Dependencies in Hindi and the Theory of Grammar*, Ph.D. thesis, Cornell University.
- Srivastav, V. (1991b) "Pair List Answers Without Movement", in *Proceedings of WCCFL* X.
- Srivastav, V. (forthcoming) "The Syntax and Semantics of Correlatives", in *NLLT*.

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