ANAPHORA AND QUANTIFICATION IN SITUATION SEMANTICS

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CSLI was founded early in 1983 by researchers from Stanford University, SRI International, and Xerox PARC to further research and development of integrated theories of language, information, and computation. CSLI headquarters and the publication offices are located at the Stanford site.

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Menlo Park, CA 94025

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3333 Coyote Hill Road
Palo Alto, CA 94304

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Center for the Study of Language and Information
Leland Stanford Junior University

Printed in the United States

Library of Congress Cataloging-in-Publication Data
Gawron, Jean Mark
Anaphora and quantification in situation semantics / Jean Mark Gawron and Stanley Peters.
p. cm. -- (CSLI lecture notes ; no. 19)
Includes bibliographical references.
ISBN 0-937073-49-0
P325.G38 1990
401'.43—dc20 90-1583
CIP
To Jennifer Walter and Kathleen Much
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Acknowledgments

The authors have benefited from numerous interactions with members of the STASS group at CSLI, but particularly Jon Barwise, Judith Crow, John Nerbonne, John Perry, Carl Pollard, and Mats Rooth. Special thanks are in order for extensive comments on early versions of this work from Judith Crow, Mary Dalrymple, Elisabet Engdahl, Jonathan Ginzburg, Hans Kamp, John Nerbonne, Pat Hayes, Carl Pollard, Fred Popowich, and two anonymous referees, as well as to Dikran Karagueuzian for help in all phases of the creation of this text. The alphabetically first author would like to thank CSLI for support both moral and nonmoral as a postdoctoral fellow during the period that generated this research.
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Introduction

THIS BOOK IS an investigation into the semantics of quantification and anaphora with third person singular pronouns. Our goal will be to determine what consequences an adequate semantic account of both phenomena has for our general theories of quantification and anaphoric relations. We will defend the claim that the distinctions that need to be made at the level of content are too rich for a theory that attempts to capture quantificational and anaphoric ambiguities in syntactic representations through such devices as NP-indexing and tree geometry.

1.1 The Problem

Most of the example sentences in this book will contain examples of either anaphora or quantification, illustrated in (1) and (2).

(1) Mary loves someone who loves her.
(2) John can solve any problem about anaphora.

One reason for studying phenomena like those in (1) and (2) together is that they interact, as in (3).

(3) Every boy drove his car.

There is a readily accessible interpretation of (3) which means something like, every boy was a car-driver; on this interpretation, the pronoun varies with the quantifier. Linguists and logicians sometimes say it is bound by the quantifier.

In linguistics, interacting phenomena still merit separate study; often, even what appears to be a single phenomenon can illuminatingly be described as the interaction of two distinct processes. A
more compelling reason for studying anaphora and quantification together is that both phenomena involve ambiguities which in most and perhaps all languages are not signalled by any formal syntactic devices; rather they somehow fall out from the way particular contents for these sentences can be articulated in different circumstances of utterance.

Like (1) and (3), sentence (4) can be used in either of two ways.

(4) John left in his car.

When the content is that John left in a car belonging to some other person, the pronoun is used deictically. When the content is that John left in his own car, it is used anaphorically. Which type of use the pronoun will have depends on the particular circumstances of this sentence’s utterance.

The intuition that grammarians have had about anaphoric uses, evident in the “carrying back” which is the etymology of the term, is that the pronoun does not stand on its own, but leads back to a previous word. When there is more than one NP in the linguistic context to which a pronoun may lead back, then the sentence is anaphorically ambiguous. Therefore much linguistic work has focused on determining the nature and limits of the anaphoric relation between a pronoun and its antecedent.

Similarly, (5) has two readings.

(5) Most critics reviewed at least two plays.

On one reading most of critics have property of having reviewed some number of plays greater than two. On the other, there are at least two plays which have drawn the attention of most of the critics. As with (4), which readings a particular utterance has depends on facts about the particular circumstances of that utterance.

Linguists confronted with ambiguity have resorted to one of two strategies, either to deny that the ambiguity is an ambiguity (it is only a vagueness), or to explain the ambiguity as either lexical or syntactic. There is in this impulse something right and something wrong. What is right is the desire to explain; systematic ambiguity

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1The term anaphora originates in rhetoric and designates the figure of repetition, the strategy of repeating “the same word or phrase in several successive clauses,” presumably to cymbal-crashing effect. The quote is from the OED definition (this rhetorical sense is the only one given there).

CHAPTER 1
THE PROBLEM

should have some reflex in the structure of the language, some reflection in the rules which competent speakers command. What is wrong, on our view, is just theoretical error. Two possible sources of ambiguity is too few.

Since the work of Cooper (1975) a third possible kind of ambiguity has been recognized, which one might call semantic ambiguity. At first sight, this phrase may seem unfortunate, since it has a look of pleonasm; yet the idea behind it is crystal clear. The grammar of a speaker of a language consists not only of a lexicon and a syntax, but also of a set of semantic rules. For certain structures, these rules may be non-deterministic; that is, they may combine the pieces in more than one way; when they do, the result is semantic ambiguity.

We regard Cooper's work as seminal; the central impulse is one that guides our own work as well. Syntax is an autonomous level of linguistic structure. Properties with a purely semantic motivation do not belong there, any more than those with a purely phonological motivation do.

What is interesting about semantic ambiguity in Cooper's sense however, is that the phenomena that inspire it are of a limited sort; basically they include the subjects of this book, anaphora and scopal phenomena. The question one might ask is why? Why aren't semantic rules indeterminate in lots of other ways? Why aren't there two ways to combine a subject with a Verb Phrase, say, because there are two different roles to fill?

Our answer to this question is that scopal and anaphoric ambiguities stem from different ways of embedding a sentence utterance into its context; our goal is to take Cooper's idea of semantic ambiguity and flesh it out in a larger independently necessary theory of how interpretations depend not just on structure but on context. Thus, we try to explain Cooper's semantic ambiguity in terms of what we call circumstantial ambiguity. In doing this, we will, with Cooper, deny that there needs to be any syntactic reflex of scopal ambiguity; we will do the same for syntactic representations of anaphoric ambiguity such as NP-indexing.

In the next section we present some preliminary considerations arguing against a syntax-based account of anaphoric relations. We focus on questions concerning anaphora because the bulk of this book concerns anaphoric ambiguity. The reader should bear in mind, however, that our program treats quantification in an analogous way,
and that circumstantial ambiguity is introduced via the treatment of scope relations given in Chapter 3. In Section 1.3, we say a bit more about what a circumstance-based account of anaphoric relations is, and discuss its relation to Situation Semantics. In Section 1.4, we discuss the possible trade-offs between the theory of context and the theory of syntax, and try to characterize the sorts of facts our theory of context should account for. In Section 1.5, we outline the plan for the rest of this book.

1.2 Anaphoric Ambiguities and Syntax

The non-syntactic approach to anaphoric ambiguity just outlined faces the following preliminary hurdle: isn’t the range of contents for sentences with pronouns exactly to be predicted from the range of possible antecedents? If so, then one can quite plausibly reduce anaphoric relations to syntactic relations; while anaphoric relations may not be directly marked (say, by an “antecedent” marker on a pronoun’s antecedent), there is still an abstract syntactic relation that one can appeal to: the pronoun-antecedent relation. Adequate syntactic representations may directly exploit this relation. This is indeed the view that has been prevalent in generative linguistics for some time; it was first canonized in the Pronominalization Transformation of Lees and Klima (1963); it survived in the interpretative approach embodied in proposals like the Empty-Structures Hypothesis of Wasow (1972); and it remains enshrined in a much-improved version in the current Government-Binding Account of Chomsky (1981).

Our chief concern is semantics; we begin by noting that a single syntactic relation between anaphor and antecedent will not suffice to capture the semantic possibilities. This is shown by well-known examples like (6).

(6) John left in his car, and so did Bill.

In contrast with (5), (6) can be used in three different ways. Besides the deictic use of the pronoun, there are two anaphoric uses. One of these gives the so-called strict-identity reading, on which John and Bill both leave in the same car, John’s. The other gives the so-called sloppy-identity reading, on which each leaves in his own car. Note that on both readings, the pronoun *his* has as its antecedent the NP *John*. Thus, anaphoric ambiguities are not simply resolved by resolving pronoun-antecedents.
An adequate analysis of anaphora must provide an alternative account that allows two distinct anaphoric contents for (6). Moreover, that account must extend naturally to allow for degrees of sloppiness in identity on anaphoric uses of the pronoun, since (7c) is four ways ambiguous.

(7)  a. Alice revised her paper.
     b. Alice revised her paper before Betty did.
     c. Alice revised her paper before Betty did, and so did Carol.

The four readings of (7c) are: (i) the deictic reading; Alice, Betty, and Carol revise some fourth woman’s paper; (ii) the strict anaphoric reading: all three women revise Alice’s paper; (iii) the completely sloppy reading: everyone revises their own papers; (iv) a “partially” sloppy reading, on which Alice and Carol share the property of revising their own paper before Betty revises it.

As we observed before, the ambiguity in (7b) is one step ahead of a simple pronoun-antecedent relation; the pronoun her has only one possible antecedent; yet the sentence has two anaphoric readings. Things get worse in (7c) the pronoun still has only one candidate antecedent; the sentence now has three anaphoric readings. Our first complaint against a syntactic account of anaphoric relations, then, is this: more distinctions need to be made in the theory of content than can be accounted for simply by reference to the overt relation between pronoun and antecedent. If the theory of content is adequate, then, it already makes enough distinctions to account for anaphoric relations and any syntactic representation of those relations is otiose.

Partisans of a syntactic account might still try a semantic ambiguity theory for anaphora: trees indexed to capture the single anaphoric relation in (7b) and (7c) might still be correlated with two interpretations in (7b) and three in (7c); this would be like Cooper’s theory of quantificational ambiguity in that it would non-deterministically assign more than one interpretation to a given syntactic representation. The only question is: why do the three anaphoric interpretations merit a single syntactic representation? We started out on our theory of anaphora confident that our semantic intuitions tell us when anaphoric relations need to be distinguished, and that a syntactic representation could adequately capture those intuitions; now when our semantic intuitions tell us a further distinction needs to be made, why isn’t it also made in the syntax?
There are several responses to this difficulty. One is simply to bite the bullet and search for different syntactic representations for the different anaphoric readings of (7b) and (7c). This is in effect the strategy of Partee (1972); the danger of this course is to stray towards a syntax motivated entirely by semantic considerations, laying oneself open to the kind of criticism justly leveled against the work of Montague (1970) and his followers. A second possible response is to claim that there are two sorts of anaphora; and that only one of these needs to be syntactically represented. This is the kind of theory proposed in Reinhart (1983) and revised in Roberts (1987). The challenges to this kind of theory are, first, to find some motivated distinction between the two kinds of anaphora; and second, to deal with the fact that the number of anaphoric readings for examples like (7) is potentially unbounded. When there are three anaphoric readings, are there three kinds of anaphora? We discuss such theories, which we call division-of-labor theories, in Section 4.1.

The third, and in some ways the most interesting, response is to deny that there is any ambiguity involving pronominal anaphora in (7); in each case, there is only one possible anaphoric relation for the pronoun to stand in. The ambiguities arise because of indeterminacies involved in the interpretation of elliptical VP’s. A key claim made by such an account is that (7a) is not ambiguous. We defend the claim that it is in Section 5.2.

We will not attempt to counter all these moves here. Our main goal is to point out a theoretical problem and to locate the responses to it as an important branching point among anaphoric theories. We deal with strict and sloppy ambiguities extensively in Chapters 4 and 5. The account presented there rejects all three of the above alternatives and chooses a course in which anaphoric relations have no syntactic representation.

A second kind of complaint against a syntactic account of anaphoric relations is of a somewhat different kind: there are constraints on anaphoric possibilities which fall out quite naturally from a theory of content, but which remain somewhat arbitrary stipulations in a syntactic theory. Of course, there are well-known syntactic constraints

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2We discuss this kind of account in Section 7.2, when we consider a proposal informally made by Hans Kamp for dealing with such cases (though not in the service of a syntactic account of anaphora).
on anaphoric relations as well. While (8) is two-ways ambiguous, (9) is unambiguous; only a deictic use of the pronoun is allowed.

(8) Every ballerina is standing on her toes.
(9) She is standing on every ballerina’s toes.

But what is often forgotten is that there are semantic constraints which are quite independent of syntactic facts.

Consider the following generalization: pronouns anaphorically related to a quantifier must fall within the scope of that quantifier. One might try to capture this "generalization" with a theory like that of Reinhart (1983), in which all "bound variable" antecedents must C-command pronouns they are anaphorically related to; one could then assume an abstract level of syntactic representation at which anaphoric relations were resolved, and identify a quantifier’s scope with what it C-commands at that level. However, if pronouns bound by quantifiers are interpreted as something like variables in logic, the same generalization is a theorem of just about any logic with bound variables, from first-order logic on; it is in fact difficult to imagine a theory of interpretation for a logic with bound variables which does not validate this claim.

A more interesting example is provided by cases like (10):

(10) Mary corrected her mother’s mistake before I did.

As one might expect given (9), (10) shows an ambiguity between a strict and a sloppy anaphoric interpretation. However, (11) shows the analogous ambiguity only if she is interpreted deictically.

(11) Mary corrected her mother’s mistake before she did.

If she is used anaphorically with her mother as antecedent, no sloppy-identity interpretation is possible for the pronoun her; that is, there is no interpretation on which Mary’s mother corrects Mary’s grandmother’s mistake. A central task for an adequate theory of the range of anaphoric contents of pronouns, then, is that it must naturally show how different anaphoric possibilities can interact, sometimes with the result that the total array of anaphoric contents is reduced.

Another example of a similar sort: while (12) permits he to be anaphoric to her partner and also permits her to be anaphoric to every ballerina, it does not allow both of these anaphoric relations to hold simultaneously.
(12) If every ballerina is too heavy for her partner, he will be displeased.

By contrast two simultaneous anaphoric relations can hold in (13), which appears structurally identical to (12).

(13) If a ballerina is too heavy for her partner, he will be displeased.

These facts are somewhat puzzling and we will need to fill in a fair amount of background before we can shed some light on them. The point here is that we consider a semantic approach the most promising line of attack. Of course, the constraints exhibited in (10)–(13) might be described with a sufficiently abstract notion of syntactic structure. For example, Haik (1984) proposes a double-indexing scheme to capture facts like those in (12). To this sort of move the only adequate reply is a more natural semantic account.

In Chapters 4 and 5, we present a theory of semantic content which correctly predicts the range of readings in (7) and in which the semantic restrictions on anaphora shown in (9) and (12) necessarily follow. That theory also provides an account of VP-ellipsis and its interaction with quantifier scope. It also provides an account of the "scope" of non-quantificational NP's like the following:

(14) a. Every student corrected the paper he had criticized.
    b. Lois hadn't yet met the author of a book about anaphora.
    c. Karen didn't see it.
    d. Irene didn't find a car with its fender undamaged.

In (14a), if the pronoun he is interpreted as anaphoric to the quantifier every student, then the NP the paper he had criticized must be interpreted non-referentially. In (14b), if a book about anaphora is interpreted as falling under the scope of negation, the NP the author of a paper about anaphora must be interpreted that way too; again, a definite receives a non-referential interpretation when an NP contained in it receives a non-referential interpretation. In (14c), there is no non-referential interpretation possible for an isolated pronoun under the scope of negation; the sentence can't be used to say there doesn't exist an inanimate that Karen saw. In contrast, (14d) shows that a non-referential interpretation of a pronoun is possible precisely when it has an antecedent with a non-referential interpretation.

(14a) and (14b) follow directly from what we call the Absorption Principle, which is introduced in Section 4.3. The constraints
on anaphoric relations illustrated in (11) and (12) follow from the same principle. (14c) and (14d) follow from the Absorption Principle once we unify our analysis of pronouns with our analysis of definites. Many of the facts predicted by the Absorption Principle could be predicted by an analogous syntactic principle; the account of Haik (1984) seems to be fairly close to being just that. We show in Section 4.3, however, that the Absorption Principle follows from our theory of content; it is in fact a theorem of the Situation Theory on which our theory of content is founded.

To sum up, we raise two objections to a syntactic account of anaphoric relations: first, the theory of anaphoric contents requires more distinctions than can be made via a syntactic relation between a pronoun and its antecedent; second, there are constraints on possible anaphoric relations which might be statable as syntactic constraints, but fall out as theorems of our theory of content. Neither of these considerations preclude a syntactic account, but the burden now falls on proponents of such an account to show that syntactic representations of anaphoric relations are not otiose, particularly in light of the fact that syntactic constraints on anaphoric relations (like those exhibited in (8) and (9)) can still be stated quite easily in a theory which represents them non-syntactically, as we show in Section 6.3.

1.3 Anaphora, Circumstances, and Situation Semantics

From our perspective three questions about anaphora are central: (A) Given that sentences containing pronouns are ambiguous, what contribution can a pronoun make to the content of an utterance containing it? (B) What facts determine that a particular pronoun utterance makes the contribution to content that it does? (C) What general constraints are there on how pronoun utterances contribute to content?

Much linguistic research on anaphora has assumed that the answer to (B) is that syntactic structure determines a pronoun’s contribution to content, and concentrated on syntactic constraints as an answer to (C). Question (A) has often taken a back seat.

Along with work like Kamp (1981) and Heim (1982), this book focuses on (A). Our answer for (A) has two components: (i) an account of what content information (such as person, number, gender)
a particular pronoun form encodes; (ii) an account of how the pronoun’s content contributes to sentence content in different ways to produce different sentence contents. Our answer to (B) will propose that the crucial information concerns not the utterance’s syntactic structure, but rather its circumstances, the context of utterance in which the sentence is made.

Accounting for the semantics of sentences with pronouns entails having some theory of content independent of pronouns; the particular theory of content we adopt incorporates many of the central assumptions of Situation Semantics, an approach to meaning outlined in Barwise and Perry (1983). Several features will be important: first, we believe that the Relational Theory of Meaning argued for by Barwise and Perry provides an excellent foundation for studying the dependency of interpretation on context: we adopt in its essentials their account of meaning as a relation between contexts and described situations. We also follow Barwise and Perry in interpreting a context of an utterance as a situation (what we call its circumstances). Our notion of circumstance extends in some ways the notion of a discourse situation in Barwise and Perry (1983). In particular, circumstances differ from discourse-situations in including a determination of both the anaphoric and scope relations of an utterance. Thus, on our account, anaphoric and scope relations are context-determined in a way very like the way the reference of a first-person pronoun is.

In brief, we replace Cooper’s non-deterministic semantic ambiguity with a new sort, “circumstantial” ambiguity, in which particular readings due to scopal or anaphoric ambiguities are correlated with facts about the circumstances.

An independent motivation for turning to Situation Semantics concerns its foundation in an ambitious mathematical account of information, Situation Theory, described in some detail in Devlin (in preparation).

To assume Situation Theory is to assume a rich array of conceptual apparatus. Many of the particulars of the theory are motivated by considerations independent of the issues discussed in this book. This is a characteristic problem for work in semantics; the conceptual framework for semantic interpretation is inevitably far richer than is necessary for the treatment of a single phenomenon or type of phenomenon. We try to deal with this problem in part by presenting
a very brief introduction to Situation Theory in Chapter 2, stressing what is important for our purposes. But readers interested in the details, and in the broader considerations which define the scope of the program, are urged to consult Devlin's book.

There is, however, one outstanding feature of Situation Theory which bears mention here, because it is crucial to our semantics for NP's and the account of anaphora built on it; this is the idea of a restricted parameter.

Restricted parameters are in some ways analogous to sorted variables; they can only take values meeting the associated restrictive condition. An essential core of the meaning of the pronoun she can be captured with a parameter restricted to individuals having the property of being female; whether anaphoric or deictic, uses of she can then range only over females. The notion of a restricted parameter thus provides just what is needed to capture the agreement properties of pronouns in English, which has so-called semantic agreement.

Situation theory provides a powerful mechanism for formulating and imposing restrictive conditions on parameters, where satisfaction of the conditions can be relative to a situation. For instance, the condition that forms part of the meaning of I is that the parameter's value is the individual uttering the pronoun. Moreover, the correct formulation of the Absorption Principle, the solution to the puzzle posed by the missing readings for (11) and (12), depends crucially on analyzing Noun Phrases, including pronouns, by means of restricted parameters.

1.4 Circumstances and Logical Form

What belongs in the circumstances? Minimally, facts about who is speaking when and where and what is being uttered. Facts about who is saying what, for example, would enter into determining the interpretation of the pronouns I and we on a particular occasion of use; facts about where and when would fix the interpretation of here and now. We would add, following the spirit of Barwise and Perry (1983), facts determining the reference of any Noun Phrase. Spatial and temporal discourse-dependencies introduce a number of further phenomena, many of them only beginning to be studied. Is there any general characterization of what belongs in the circumstances, even a negative one?
In this study we make the following assumption: the circumstances contribute to the interpretation whatever is not determined by linguistic structure alone. Consider the example of the reference of a proper name. The linguistic form of the word *John* does not determine what individuals it can refer to (though it constrains them); therefore the particular individual referred to on an occasion of use, must be determined by the circumstances.

This example is innocuous enough, but the definition it is illustrating is not. That definition begs an important question.

The question can be characterized as follows. Everyone who believes that there are interpretations (of sentences, of proper names, whatever) needs some theory of context, at the very least to get pronouns and proper names and indexicals to refer to the right sorts of things. But one might claim that linguistic structure plus context is not enough to arrive at interpretation and that something additional is required. We will call theories that require that something extra Logical Form Theories, and we will call the extra thing Logical Form.

Now in order to have this characterization make sense, we have to fix some notion of linguistic structure; what is intended is some sense of structure that clings fairly close to the surface forms. It is tempting to characterize it as distributionally motivated structure, but it is probably better to try for an ostensive definition here. Surfacey structure is what is advocated by surfacey syntactic theories, and in the last decade those have been primarily the theories without movement rules, theories like Lexical Functional Grammar (Bresnan 1982), GPSG (Gazdar, Klein, Pullum, and Sag 1985), and HPSG (Pollard and Sag 1987). Surfacey structure tends to be promoted by theories with one level of syntactic structure, which is perforce a surface level, which accounts for the actual order of the words spoken. In the list just given, Lexical Functional Grammar is exceptional in having two levels of syntactic structure, but they do not differ in abstractness; that is, one is not an underlying structure of the other. They are simultaneous descriptions of the same surface string, rather in the way that a phonological and a syntactic description are simultaneous; this is guaranteed by the Principle of Direct Syntactic encoding in LFG.

Given that sense of structure, it is quite clear, from a casual glance at current linguistic theory, that there are Logical Form
theories. That is, there are theories that make the implicit claim that surfacey structure plus context is not sufficient to yield interpretation. One such theory is that of Montague (1970), which characterizes differences in scope-relations through differences in syntactic derivation trees. Another relatively clear example would be the frameworks outlined in Heim (1982) and May (1985), where movement rules adjoining Quantifiers to Sentences are used to fix scope relations.

We have defined Circumstances specifically so as to exclude any recourse to Logical Form. Obviously to argue against Logical Form in all its incarnations would be a formidable task; the main goal of this book is to shift some of the burden that has been placed on logical form over to the theory of context by means of a plausibility demonstration: we demonstrate the possibility of a Logical-Form-free Theory by pointing to an example of one.

A subsidiary objective, discussed in Section 1.2, is to mount an argument specifically directed against syntactic theories of anaphoric relations; our definition of Logical Form makes any such account a Logical Form theory of anaphora. This is because anaphoric relations are not directly encoded in linguistic structure; they must be represented by some additional syntactic device such as NP-indexing.

Given our concern with anaphora and scope, there are two features of Logical Form that particularly concern us:

- Indexing of syntactic nodes to indicate anaphoric relations.
- Abstract structure to indicate scope relations.

We turn now to a brief sketch of the plan of the book.

### 1.5 An Outline of the Book

The basic plan of the book is the following: in Chapter 2, we sketch our general theory of meaning and semantic interpretation. The chief novelty here is that the compositional semantics given uses the apparatus of Situation Theory and the Relational Theory of Meaning. In Chapter 3, we give a fragment of a semantics for NP's. The chief novelty here is the use of circumstances and the Relational Theory of Meaning to account for scope ambiguity.

In Chapter 4 and 5, we turn to anaphora and to some problems raised by the differing contents of sentences with very similar anaphoric relations; these problems center around the strict and
sloppy readings of sentences like (6). We deal specifically with cases involving VP-ellipsis, and sketch how our account of NP-semantics covers both examples with quantified and unquantified antecedents (Secs. 4.1 and 4.2).

In Chapter 6, we turn to the theory of circumstances; we present a circumstance-based account of anaphoric ambiguities which parallels the circumstance-based account of scope given in Chapter 3. Strict and sloppy ambiguities have often been taken as evidence for a distinction between two kinds of anaphora. We argue here against this conclusion, based on the fact that a uniform circumstance-based account is possible: basically, all anaphoric pronouns cross-reference an argument-place linked to their antecedent. The only formal distinction between pronoun uses in our account is the distinction between anaphoric and deictic uses. We conclude the chapter with a brief presentation of a Binding Theory which shows how syntactic constraints on anaphoric relations may still be stated in our circumstance-based account.

In Chapter 7, we evaluate the work here with respect to other theories. Section 7.1 discusses the relation with Montague's account; Section 7.2 discusses the relation with the frameworks of Kamp and Heim; and Section 7.3 discusses the question of whether C-command need be a part of the account of Quantifier-binding, and we discuss the compatibility of the work here with that of a pragmatic account of binding conditions like Reinhart's.
In this chapter, we present the elements of the theory of situations and present an account of semantic interpretation.

2.1 Situation Theory

In this section we discuss the elements of Situation Theory as given in Devlin (in preparation). This lays the groundwork for the theory of semantic interpretation to be presented in the next section.

Situation Theory is an attempt at constructing a mathematical framework for the study of information; its goals include providing a set of tools fine-grained enough to account for all differences in informational content and accounting for the partiality of information. Carrying forward this ambitious program has required a large body of apparatus, much of it calling for more motivation and detailed discussion than can be provided here. What follows is the briefest of introductions to the theory. Much of what is presented here is covered in more detail in Devlin (in preparation); discussion of issues concerning the modeling of Situation Theory has been omitted entirely, but the reader interested in an example of the sort of model presupposed by this chapter is urged to consult Westerstahl (1990).

Many of the issues central to this monograph can be and have been addressed using a more conventional set theoretic underpinning for semantic interpretation. One of the goals of this monograph, then, is simply to provide a feasibility demonstration, a case study showing that the tools of situation theory are appropriate for the analysis.
of natural language semantics. A more ambitious goal is to show that the use of Situation Theory can actually shed new light on old problems. This we hope to have accomplished in two ways, first by presenting an account of semantic interpretation in which situatedness (or context) plays a central role, and which makes crucial use of situations; second, by pointing to empirical consequences that follow from Situation Theory, in particular to the Absorption Principle of Section 4.3, which is tied to the particular view of parametric objects adopted by situation theory.

2.1.1 States-of-Affairs

We begin with situations.

Situations are limited parts of the world containing individuals and other objects, having properties and standing in relations. Relations exist in the world, for instance, the relation of reading, which can be found in the situation a reader of this book occupies at reading time. Every relation has certain argument roles, one for each of the objects it relates, and certain assignments of objects to argument roles are appropriate. The conditions which determine what objects are appropriate for a given role in a given assignment are called appropriateness conditions. When appropriate objects are assigned, one gets what John Perry calls an issue, the issue of whether or not the relation holds among those objects. We'll consider two ways of resolving this issue: affirmatively or negatively. Each way corresponds to what's now called a state-of-affairs, although that term was used differently in some earlier work on situation theory. So for instance, if you take the relation of hearing, which has, let's say, three argument roles, a hearer, a thing heard, and a time when this occurs, and if you assign, say, Ronald Reagan to the hearer role, and Trubetskoy to the thing-heard role, and Washington, D.C. at the dawn of March 1, 2 Million B.C., to the Location role, then, since that’s an appropriate assignment of objects, we get an issue, whether or not the relation holds among those objects. If we resolve the issue affirmatively we get one state-of-affairs, and if we resolve it negatively we get another.\(^1\) Whenever appropriate objects are assigned to argument-roles and an issue thus arises, one of these two states-of-affairs corresponds to a fact in the world. In this case, it’s the second one.

\(^1\)Devlin refers to what we call states-of-affairs as infons.

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Now, a factive state-of-affairs holds not just in the world as a whole but in a limited part of the world too, in a situation. We call the relation that holds between states-of-affairs and the limited parts of the world they manifest themselves in the *supports* relation. Its argument-roles are appropriately filled by a situation and a state-of-affairs. For instance, an utterance of (15):

(15) John didn’t laugh.

with reference to a person j and a time t, describes a situation s as being of the type which supports the state-of-affairs in which the *laughing* relation does not hold between j and t.

### 2.1.2 Parametric States-of-Affairs

Parametric states-of-affairs are states-of-affairs in which certain elements haven’t been fixed.

They are like states-of-affairs in that a relation has had appropriate objects assigned to fill some argument-roles and a polarity has been determined, but some argument-roles of the relation may not have been filled. Instead they have been parameterized. Each way of filling these roles with appropriate objects will yield an ordinary state-of-affairs, but the parameterized argument roles get labels attached as a means of taking hold of the roles—either to fill them or, as we will see, to relate them to other roles in other parameterized states-of-affairs. For instance:

(16) \( \langle \text{LAUGHING}, x, y; 0 \rangle \)

is a parameterized state-of-affairs with the role of laughter labelled with the parameter \( x \) and the role of location labelled with the parameter \( y \).

Each way of appropriately filling some or all of the parameterized roles in a parametric object is called an anchor; for example, we might anchor the location parameter \( y \) above to a spatio-temporal location \( l_{hn} \), which we might take as the time (and place) of the writing of the first draft of this paper. We will distinguish individuals that actually fill roles from parameterizations of those roles by designating individuals with boldface symbols.

An anchor that fills all the parameterized roles in a parametric state-of-affairs yields an unparameterized state-of-affairs. For instance, anchoring \( y \) to \( l_{hn} \), and \( x \) to Julius Caesar in (16) would yield the state-of-affairs of Julius Caesar not laughing at the time
Parametric states-of-affairs like the one in (16) may be used to build up larger parametric states-of-affairs containing them as parametric constituents. For example the parameterized state-of-affairs in (16) may fill any argument-role for which an ordinary state-of-affairs is appropriate:

\[(17) \quad \langle\langle x, y; 0; 1\rangle, s, \langle{\text{LAUGHING}}, x, y; 0\rangle; 1\rangle\]

The state-of-affairs (soa) in (17) is a parameterized state-of-affairs (psoa) having as parameters \(s\) and all parameters of the parameterized state-of-affairs in (16), in this case just \(x\) and \(y\). We will also use parametric states-of-affairs to help get at the descriptive content of sentences. For instance, an utterance of (15), with reference to a person \(j\) named John and to a time \(t\) earlier than the time of utterance describing a situation \(s\), will assert that \(s\) supports the state-of-affairs that results from anchoring \(x\) to \(j\), and \(y\) to \(t\), in the parametric state-of-affairs in (16). A central role of parameters in our account of meaning will therefore be to act as hooks which the circumstances anchor to individuals to yield an interpretation. That is, parameters will play a role in our account of reference. But as we shall see, we shall also need parameters on occasions when they are not anchored.

It should be clear from these brief remarks that there is a close relationship between what we call parameters and what logicians and computer scientists call variables. Why not just call \(x\) and \(y\) variables? The intended distinction is this: a variable is an object in a logical language; a parameter is an object in a mathematical model. Basically, parameters model variables. It may seem peculiar to talk about models of variables, since variables seem irredeemably language-like and models are supposed to be entirely in the world. But the reason for the interest in variable-like objects in Situation Theory is really quite simple: Situation Theory seeks to provide a mathematical model of information-flow. Variable-like entities play a role in various kinds of information-transfer systems: computational, cognitive, mathematical, and linguistic. Accordingly, parameters play a central if somewhat special role in Situation Theory. For a clear example of a model of Situation Theory including parameters, see Westerståhl (1990).
This having been said, it should be pointed out that the distinction between variables and parameters will not play a major role in this monograph. The interpretations we offer for sentences will never include parametric objects. Parametric states-of-affairs will only play a role in stating the conditions which are used to give us interpretations. That role is central to our account of anaphora and quantification, but it is one that could be explicated in terms of interpretations being relative to a variable assignment function (which is the analogue in the world of variables to what we call an anchoring of parameters). This still leaves some interesting questions about what the status of the variable-like entities is in the first place, questions which have had particular force in the study of anaphora (addressed in works like Karttunen 1976, Kamp 1981, and Heim 1982), but the distinction between parameters and variables does not shed much light on these questions. The reader is encouraged, wherever helpful, to resort to intuitions about variables to understand points about parameters, to link anchoring with assignments and absorption (to be discussed Section 2.1.5) with abstraction.

2.1.3 Unsaturated States-of-Affairs

Parametric states-of-affairs should not be confused with unsaturated states-of-affairs. Situation theory allows states-of-affairs in which not all the argument-roles of a relation have been filled. An unsaturated soa is a genuine state-of-affairs which may be a fact independently of any anchor.

In (18), there are two basic states-of-affairs using the relation eat in which the eaten role is unfilled, while the eater role is filled with an individual a (rather than labelled with a parameter a).

(18)  
   a. ⟨EATING, eater:a; 1⟩
   b. ⟨EATING, eater:a; 0⟩

The question is, when are such such unsaturated soa's factive? The assumption of Situation Theory is that the soa in (18a) is a fact just in case there really is some b such that a is eating b. In a positive soa, role omission amounts to existential quantification. The negative soa in (18b) is factive just in case there is no b such that a is eating b. So there, role omission amounts to the negation of existential quantification.

A related question is the role of appropriateness conditions in unsaturated states-of-affairs. We have just committed ourselves to the
view that unfilled roles are "existentially quantified" out in positive states-of-affairs. The question is, are such roles "quantified out" subject to the appropriateness conditions on the roles or not? That is, suppose the correct appropriateness restriction for EATING is that the EATEN role should be filled only by concrete objects, not abstract objects like sincerity or Situation Theory. Then do we take:

(19) \langle\langle EATING, eater:a; 1 \rangle\rangle 

to be factual iff there exists a physical object x such a is eating x, or do we take it to be factual iff there exists any x such that a is eating x. Given the way we have defined states-of-affairs via issues about appropriate arguments, the stronger alternative seems more natural, and we will adopt it in what follows. Thus, the factivity of

(18a) will entail not just the existence of some eaten thing, but the existence of an object that is appropriate for the eaten role that is eaten. In the dual we will take:

(20) \langle\langle EATING, eatena; 0 \rangle\rangle 

to be factual iff there does not exist an entity x appropriate for the eaten role such that a eats x. Under our assumption about the EATING relation, to establish that (20) is factual, it suffices to establish that a has not eaten any physical objects.

2.1.4 Restricted Parameters

We return now to our analysis of (15). We used the parameterized state-of-affairs in (17) as a sort of frame with which to talk about what situations could be described by (15). Yet there are aspects of what (15) can be used to describe that are missing from (17). For example, how can we capture the fact that x must be anchored only to an individual named John?

In order to build this restriction into the analysis, we need to refine our understanding of parameters, and allow that some parameters have built-in restrictions on what they can be anchored to. We restrict or condition the parameters x and y as follows:

(21) \langle\langle =, s, \langle\langle LAUGHING, x\langle\langle NAMED, x, "John"; 1 \rangle\rangle, \\
y\langle\langle PRECEDES, y, t_u; 1 \rangle\rangle; 1 \rangle; 1 \rangle \rangle 

Here we use the parameterized state-of-affairs \langle\langle NAMED, x, "John"; 1 \rangle\rangle to restrict x; with this condition attached, x can be anchored only to an object j such that the state-of-affairs \langle\langle NAMED, j, "John"; 1 \rangle\rangle is a fact. Thus we analyze how the proper noun John functions.
as a parameter anchorable to individuals bearing the name—a parameter whose value we will allow to be fixed variously in different circumstances of utterance.

An important point about restrictions is that they are restrictions on anchorings. This means that a well-defined anchor for a parameter \( x \) must anchor all the parameters in any restrictions on \( x \) (and any restrictions on \( those \) parameters, and so on). For example, an anchor on \( y \) in (21) must be an anchor for \( l \) as well. This conception of a parameter restriction will play a crucial role in our semantics for referential NP’s, whose content will be a restricted parameter.

From this point on, we’ll often omit ‘;1’ for convenience in writing out the (parametric) states-of-affairs that figure in the Situation-Theoretic analysis of language.

The semantics of restricted parameters will play a central role in our analysis of referential NP’s and pronouns.

### 2.1.5 Types

Properties like that of being a prime number greater than 2 have important relationships to other properties, like being a prime number, and being greater than 2. Parametric states-of-affairs (psoa’s) can help us bring out these relationships:

\[
\left[ x \mid \langle \text{PRIME-NUMBER}, x \rangle \land \langle \text{GREATER-THAN}, x, 2 \rangle \right]
\]

We’ve used a psoa with parameter \( x \) to bring out the fact that we are interested in objects that simultaneously fill the sole role of the PRIME-NUMBER property, and bear the GREATER-THAN relation to 2. But the property itself doesn’t have a parameter. Instead it has an argument-role. We will talk about the relationship between the property and the psoa’s it is formed from by saying that the parameter \( x \) is absorbed by type-abstraction. Absorption for parameters is just the analogue of lambda-binding for variables.

Properties are genuine relations; together with an assignment, they make up an issue, which, given a resolution, is a state-of-affairs that is either factual or not factual.

Like the other sorts of objects we have been talking about, types too can have parameters:

\[
\left[ x \mid \langle \text{PRIME-NUMBER}, x \rangle \land \langle \text{GREATER-THAN}, x, y \rangle \right]
\]

Unlike (22), (23) is not a property that could used to form an issue and a state-of-affairs that would be either factive or not factive. It is
instead a *parametric property*. Each way of appropriately anchoring $y$ gives us a property.

In semantics, types are important for a number of reasons. The contents of common-nouns are types, e.g., "prime number," and so are the contents of Nominal Phrases that consist of common-heads and their modifiers, e.g., "prime number greater than two." Though we glossed over this fact above, the contents of the verb phrases like "didn’t laugh" are also types like the following.

(24) $[x | \langle\text{LAUGHING}, x, y\langle\text{PRECEDES}, y, l_u\rangle; 0\rangle]$

Here $y$ and $l_u$ are parameters for the reference time and the time of utterance respectively, to be anchored by the circumstances of an utterance. Thus the contents of the sentence directly involves this one-argument type, and indirectly the two-argument relation LAUGHING. We will argue in Section 2.2 that the content of a VP really needs to be a relation one of whose roles is for the location. We would write that:

(25) $[x, y | \langle\text{LAUGHING}, x, y\langle\text{PRECEDES}, y, l_u\rangle; 0\rangle]$

We assume that relations come with no particular order imposed on their roles. Thus, (25) denotes exactly the same relation as the following:

(26) $[y, x | \langle\text{LAUGHING}, x, y\langle\text{PRECEDES}, y, l_u\rangle; 0\rangle]$

This is as good a place as any to caution readers about the distinction between the language of Situation Theory (whose elements are described with words like expression, formula, term, and variable) and the objects of Situation Theory (described with words like individual, state-of-affairs, type, and parameter). (25) and (26) are two different expressions in the language of situation theory that denote the same type. In general, there are many such expressions for any Situation Theoretic object. In the model for a parametric situation theory given in Westerståhl (1990), for example:

$[z, w | \langle\text{LAUGHING}, z, w\langle\text{PRECEDES}, w, l_u\rangle; 0\rangle]$ is still a third expression that picks out exactly the same type as (25) and (26).

It is essentially the need for keeping clear about the distinction between the language and its denotata that motivates terms such as *anchoring* and *absorption*, two notions associated with parameters, paralleling *assignment* and *abstraction*, two notions associated with
variables. The closest thing in the linguistic domain corresponding to the notion of a parameter is a free variable. The expressions in (24), (25) and (26) all lack free variables; similarly, the object denoted by them has no parameters.

In a linguistic lexicon, verbs will be associated with particular relations; they will also pick out a particular way of filling the argument roles of a relation; one role will be associated with the Subject, another with Object, and so on. In order to do this we need some way of getting hold of particular roles of relations. One way of doing this, of course, is to have ordered roles. We could then just say that for a particular verb the subject function is associated with the first argument role, the object with the second, and so on. Instead we will cut out the middle man of this transaction and use grammatical function names to directly index roles of relations. In general, we allow relations to be associated with particular indexings of their roles, and we index the role picked out by the Subject with \textit{subj}, the role picked out by the Object with \textit{obj} and the role picked out by Tense with \textit{tns}. So the indexed relation picked out by a past tense verb like \textit{laughed} would be:

(27) \[
[x_{\textit{subj}}, y_{\textit{tns}} \mid \langle \text{LAUGHING, } x, y\langle \text{PRECEDES, } y, i_u\rangle; 0\rangle]
\]

Note that

(28) \[
[x_{\textit{tns}}, y_{\textit{subj}} \mid \langle \text{LAUGHING, } x, y\langle \text{PRECEDES, } y, i_u\rangle; 0\rangle]
\]

isn't a different relation; it's just the same relation under a different indexing, one that our lexicon doesn't use.

When we want to feed one of the roles of an indexed relation an argument, we'll make use of the indexing as follows:

(29) \[
\langle [x_{\textit{subj}}, y_{\textit{tns}} \mid \langle \text{LAUGHING, } x, y\langle \text{PRECEDES, } y, i_u\rangle; 0\rangle], \\
\textit{subj} : j \rangle
\]

The above parameterized state-of-affairs labels the role indexed \textit{subj} with the parameter \textit{j}.

2.1.6 Propositions

Following Devlin (in preparation), we distinguish:

(30) \( s \models \langle \text{LAUGHING, a, 1; 0}\rangle \)

from

(31) \( \langle \text{LAUGHING, a, 1; 0}\rangle \)

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(31) is the state-of-affairs that holds when a is laughing at 1. (30) is the claim or proposition that a situation s supports that state-of-affairs. We assume that propositions are always about some part of the world, whereas states-of-affairs in general are not. States-of-affairs can be either facts or not facts. A non-factual state-of-affairs bears no particular relation to any situations; a factual state-of-affairs is supported by any number of situations. Propositions are either true or false. We will assume that propositions are the interpretations of utterances of declarative sentences.

We write

\[(s : [s_{sit} | s = \langle \text{LAUGHING}, a, l; 0 \rangle])\]

to denote the proposition that a situation s has the property of supporting a's laughing at l. In general the colon signals the claim that the object designated by the expression on the left hand side of the colon is of the type designated by the expression on the right hand side. When the type is a one-role type as in (32), we will use the colon notation without specifying which of the type's roles is being filled.

We claimed above that propositions were asserted of parts of the world, and in (30), the particular part of the world associated with the proposition was a situation. We also allow for propositions asserted of the world at large (which may or may not be a situation, depending on what version of Situation Theory one adopts).\(^2\) Mathematical propositions seem the clearest examples of such claims. In writing down expressions for such propositions, we will follow common practice and omit any reference to the world-at-large, but it should be born in mind that propositions are still things asserted of parts of the world:

\[(3 : \text{PRIME-NUMBER})\]

Here the relation used in the assertion is the arithmetic property \text{PRIME-NUMBER}. We will also have occasion to use mathematical relations like \text{EQUALS} and Situation-Theoretic relations between situations in such world-at-large propositions. Since the colon notation becomes cumbersome with relations, we will adopt the usual infix notation for such claims. We write

\(^2\)This is sort of proposition Barwise and Etchemendy (1987) call Russellian, whereas the situated sort of proposition exemplified in (30) is what they call Austinian.
to designate the claim that \( s_0 \geq s_1 \), that is, that it contains all the facts of \( s_1 \), and we write:

\[ (s_0 = s_1) \]

to designate the claim that \( s_0 \) equals \( s_1 \).

Propositions, like other Situation-Theoretic objects, have their parametric counterparts. Parametric propositions are called conditions, and conditions will play an important part in our account of semantic interpretation.

Finally, we allow conditions to restrict parameters. So alongside

\[ x \langle \text{LAUGHING}, x, 1; 0 \rangle \]

we also have:

\[ x \models \langle \text{LAUGHING}, x, 1; 0 \rangle \]

We also allow conditions to form types. So alongside

\[ [x | \langle \text{LAUGHING}, x, 1; 0 \rangle] \]

we also have:

\[ [x | s \models \langle \text{LAUGHING}, x, 1; 0 \rangle] \]

### 2.2 Meaning, Circumstances, and Semantic Rules

Theories of meaning often begin with claims about the meanings of sentences. A simple account of sentence meaning says something like: the meaning of a sentence is the proposition it expresses. The trouble with this view is that very few (if any) sentences express anything like what most philosophers would agree to call a proposition. A sentence like *I'm hungry* may express an infinite number of propositions depending on who says it, and when. There is some question whether any sentence determines a proposition on its own, independent of any occasion of utterance, but even if there are such sentences, we might well question a theory of sentence-meaning that was limited to a few "eternal" sentences.

A more promising approach to meaning would seek to capture the insight perhaps most clearly expressed in Kaplan (1971): a meaning specifies the relation between contexts of utterance of some sentence type with the proposition expressed in those contexts. On this view,
it becomes clear that before we can say what a meaning is, we need to be able to say what a context is.

Kaplan was not, of course, the first to notice the importance of context in determining the proposition expressed by a sentence on an occasion of utterance. Interest in this subject goes back at least to Bar-Hillel (1952), who defines an area of study called “pragmatics” (a term used in a somewhat more extended sense nowadays) devoted to the context-sensitive properties of sentences. Bar-Hillel pointed out that sentences containing context-sensitive words like I, which he called indexicals, posed special problems for the evaluation of truth, and located pragmatics as the domain in which such problems were addressed. Within a possible-worlds framework, Montague (1974) proposed a theory that added to the world and times indices at which propositions are evaluated indices for speaker, addressee, and so on. Meanings become functions from pragmatic indices to intensions (where intensions are functions from worlds and times to truth values). In effect each new parameter of contextual variation entailed a new dimension of meaning variation.

There are a number of recurring problems with the idea of pragmatic indices. For one thing, context-sensitivity is a far more pervasive property of sentences than early pragmatics researchers had realized. Cresswell (1973), for example, discusses the determiner use of this, which can occur any number of times in a sentence, related with any number of common nouns. Measures of proximity may vary with the nouns used: this country is located differently from this college (which may be an institution distributed through widely scattered buildings), which is still a different matter from this century. How many indices will be necessary? A related problem might be called the coherence of context: if context indices contain a coordinate for speaker and a coordinate for location, then the speaker must actually be speaking at that location (at least, since the advent of answering machines, at encoding time). Issues like these lead one to the gradual conviction that contexts are not tuples, but richly structured objects of some sort.

A central innovation of Barwise and Perry (1983) is to replace pragmatic indices with Discourse Situations.

The Discourse Situation includes the speech situation itself, including speaker, addressee, and local environs. This does all the work of speaker, addressee, and location indices, and attributes the
coherent relations holding among speaker, addressee and location to the coherence of situations themselves, which consist of individuals in particular relations. Besides facts about speakers and addressees, their temporal-spatial locations, a discourse situation may also support facts about the relations of discourse-participants to other contextually relevant situations. Thus, Barwise and Perry also introduce the idea of a Resource-Situation in the analysis of NP's. This is a contextually available situation which provides entities for reference and quantification in particular relations. Thus the dog is taken to invoke a particular resource situation in which some entity is the unique dog. Each NP can invoke its own unique resource situation: this provides an obvious strategy for addressing Cresswell's puzzles with the Determiner-use of this. We have incorporated the Situations and Attitudes treatment of Resource-Situations into the semantics for NP's given in Chapter 3.

Our general picture, then, is this: a context is not a single situation but at the very least a constellation of situations; determining exactly which constellation requires at least looking at the particular sentence, and in general looking at its discourse.

We are now ready to say what a meaning is. Roughly, a meaning will be a relation between discourse-situations and the contents expressed in those situations. In Barwise and Perry (1983), meaning was a relation between discourse-situations, described situations, and connections (which were functions providing referential "connections" of various sorts, such as connecting a referential NP to its referent). But the work done by connections can all be easily fit into a slightly enriched discourse-situation. Thus, meanings for us will be a relation between discourse-situations and described objects (which include other kinds of things besides situations). We will also follow Barwise and Perry (and much of the "formal semantic" tradition) in assigning meaning to syntactic structures.\(^3\)

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\(^3\)One could imagine pursuing a more radical version of the relational theory in which the relation decomposed into phonological, syntactic, morphological, contextual and semantic relata; this would be a Relational Theory of Language which would differ considerably from the "pipeline" view of linguistic structure currently in vogue. There are some obvious motivations for pursuing this direction, such as the desire to interpret semantic aspects of intonation without recourse to ad hoc syntactic encodings. This, however, complicates the picture considerably, and is properly the subject of another monograph.

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In order to specify the meaning of a sentence, then, we need some way of specifying a relation. We will specify meaning relations through what we call a *relation description*. Essentially, a relation description will just be a set of conditions which the relata have to satisfy; any objects simultaneously satisfying the conditions on the relata will stand in the relation. We might, for example specify the relation holding between numbers that add up to 5 as follows:

\[
\text{ARG}_1[\text{ADDS-TO-FIVE}]\text{ARG}_2 \iff (5 = \text{ARG}_1 + \text{ARG}_2)
\]

This describes a relation ADDS-TO-FIVE which holds between two numbers, \text{ARG}_1 and \text{ARG}_2, just in case they add up to 5. Formally,

\[
(5 = \text{ARG}_1 + \text{ARG}_2)
\]

is just a condition with parameters \text{ARG}_1 and \text{ARG}_2. The numbers 2 and 3 stand in this relation, as do 3 and 2, and 6 and \(-1\).

When the relation a relation-description specifies is a meaning, we’ll call it a *meaning-description*. What semantic rules do is spell out meaning-descriptions.

For example, the meaning-description for (15) will look roughly like this:

\[
\text{C}[[\text{"John didn’t laugh"}]\text{DO}] \iff \\
(C \models \langle \text{REFREL, "John", } x, t_C \rangle) \\
(C \models \langle \text{REFREL, PAST, } y, t_C \rangle) \\
(C \models \langle \text{ASSERTED, "John didn’t laugh", DO} \rangle) \\
(C \models \langle \text{ABOUT, "John didn’t laugh", } s_C \rangle) \\
\text{DO} = (s_C : [s \mid s \models \langle \text{LAUGHING,} \\
\quad x(\langle \text{NAMED, } x, \text{"John"} \rangle, \\
\quad y(\langle \text{PRECEDES, } y, t_C \rangle; 0) \rangle])
\]

Here the relata of the meaning relation are picked out with the parameters C and DO, standing for circumstances and described-object respectively. The term *Circumstances* was introduced in Chapter 1; circumstances correspond to the Discourse-situations of Barwise and Perry (1983), but will include various kinds of states-of-affairs not found in discourse-situations.

What (33) says is that circumstances appropriate to utterance of the sentence “John didn’t laugh” type must support four different states-of-affairs; two of those involve what the speaker refers to, an individual named John, and a past spatiotemporal location. We used
the relation-name REFREL rather than REFERRING because we chose a relation that lacked an argument-role for the referrer. An utterance and an individual stand in the REFREL relation just in case someone is referring to that individual with that utterance. Analogous remarks could be made about the choice of ASSERTED relation over the ASSERTING relation; the former is just the latter without the asserter role. The fourth state-of-affairs that needs to be supported guarantees that the situation the sentential proposition is asserted of is indeed the one the sentence utterance is about. We call this the described situation. Again, the ABOUT relation between sentences and described-situations is like the REFREL relation, in that it connects a particular utterance to a particular individual in the world. Sentence utterances, then, are connected with two unique objects, the propositions they express (through the ASSERTED relation), and the part of the world they are asserted of (through the the ABOUT relation). As we noted in Section 2.1.6 propositions are always asserted of parts of the world.

(33) also specifies which proposition the sentence can be used to assert. The assertion must be that a situation, $s_C$ is of a certain-situation-type, the type of situation which supports the fact that the individual referred to by “John” didn’t laugh at the location referred to by the past tense.

Besides the two parameters used for the meaning relata, $C$ and $DO$, there are a number of other parameters in (33). In order for the conditions of the meaning-description to be satisfied for any discourse-situation and any described object, those other parameters must be existentially instantiated. We discuss this in more detail in Chapter 3; for now, we note that if a circumstance and a proposition are to stand in the meaning relation for “John didn’t laugh,” then that entails the existence of a person named John (corresponding to the parameter $x$), an utterance time (corresponding to $t_u$), a time earlier than the utterance time (corresponding to $y$), and a situation ($s_C$) which the proposition is about.

The meaning-description in (33) also contains parameters restricted so as to be anchorable only to particular kinds of English utterances, namely “John didn’t laugh” and “John.” In our official theory of meaning, we assign meaning-descriptions not to expressions, but to syntactic structures. We will view syntactic representations as parameters anchorable to utterances with the indicated structure.

Section 2.2
We now turn to the task of linking up this conception of sentence meaning with a compositional semantics for English. Theories about the nature of context naturally interact with theories about how meanings are put together. On a view on which meaning is a relation between contexts and interpretations, the two theories bear a particularly close relation. The theory of compositionality has to show how the meaning relations of parts constrain the meaning relations of wholes.

We will illustrate our theory of circumstances by giving a compositional semantics for a Lexical Functional Grammar for a small fragment of English. In that fragment, semantic combination rules are given for each node of the context-free analysis of a sentence. In other words, "meanings" are given for each node in terms of the meanings of its daughters.

One cautionary remark should be made immediately. Saying there is a meaning relation for each node of a syntactic analysis, does not commit us to the idea that there is an interpretation at each node. First, the meaning relation assigned to a particular node might be vacuous for its interpretation role; perhaps this is the right treatment for the particle *to* that prefixes English infinitive phrases. Second, and more importantly, the "interpretation" assigned to a particular node in particular circumstances may not be an interpretation at all. It may in some way or other be quantified over. In such cases, the meaning relations we assign for that node will still relate real circumstances to ordinary described objects; it's just that no particular described object will play a role in interpretations in which quantification has taken place. As an example, suppose we treat the meaning relation of an NP like *a dog* as a relation between circumstances in which that NP is uttered and real dogs described on that occasion. It may happen that, on some particular occasion, that NP is existentially quantified away in the interpretation of the sentence-utterance in which it occurs. Its meaning relation will still be the same pairings of circumstances with dogs; it will just turn out that, on that occasion of use, none of those dogs is a constituent of the final interpretation of the sentence. What are we to call the interpretation of the NP on that occasion? It may be convenient to

---

4 For an introduction to the theory of Lexical Functional Grammar, see Bresnan (1982).
call it a parametric interpretation; it seems clearer to say there is no interpretation at all.

Given that the Montagovian idea of assigning interpretations uniformly to each node is going to be abandoned, it may be useful to make a slight digression and discuss interpretations.

Within Montague Grammar (Montague 1970, among others), one of the most fruitful theoretical questions that could be asked was, “What type denotation does such and such a linguistic type have?” Call this the denotation question. The denotation question drove a lot of useful research and got people thinking fairly carefully about how meanings should be put together.

In our framework, the basic account of compositionality is one that combines meanings rather than interpretations, so there is something to drive the machinery for every constituent, even when interpretations can not be had, or can only be had with some embarrassment. The denotation question thus becomes replaced with the meaning question, “What type meaning does such and such a constituent have?” The crucial requirement is that the meanings that are there can sensibly be combined with larger meanings. This we propose to show by means of the fragment.

All this is not to say that questions of interpretation can be ignored altogether. For one thing, we do propose that declarative sentences have propositions as their denotations. This satisfies various theoretical needs. The sort of proposition we use directly contains what we called the described situation as a constituent. Although it enters in in a somewhat different way, that described situation can serve many of the same ends as the described situations of Barwise and Perry (1983) did, answering the same needs that originally helped motivate the inclusion of situations in situation semantics. Beyond that, a proposition is the sort of thing that can be either true or false, so there is now a natural way to talk about both truth conditions and descriptive content in the theory.

Sometimes, interpretations are motivated simply because we have fairly clear intuitions that certain sorts of linguistic constituents have them, even if we sometimes disagree about what those interpretations are. Here the only clear cases, and only sometimes at that, are sentences and referential NP's. An important correlate of such intuitions about interpretation is the possibility of entering into particular anaphoric relations: linguistic forms enter into anaphoric
relations with each other, and at times what is shared between such forms corresponds to our intuitions about what their interpretations are.

This, at least, seems to be what's behind describing two anaphorically related referential NP's as *co-referential*. Along with a number of people before us, we think such talk is basically a confusion. Although it sometimes look as if what's shared between anaphorically related forms is their interpretation, it always turns out on closer inspection that that's not what's shared. Two referential NP's can be anaphorically related even when neither has an interpretation, that is, even when neither has a referent. We return to this point in Chapter 4. To designate the semantic object that's shared between anaphorically related constituents, we have reserved the term *content*. Our attitude towards contents is much the same as our attitude towards interpretations; we produce them as needed. In the case of content, however, the criteria for need are a bit clearer. Whenever we have anaphoric relations we need contents.

In this book we deal with two sorts of anaphora, anaphora between NP's and anaphora between VP's. The contents of referential NP's, on our account, will be restricted parameters, and the contents of VP's will be possibly parametric properties (or more generally relations, as we shall see). In both cases, we will see an abundance of examples in which anaphoric relations exist, but nothing that could comfortably be called an interpretation exists.

It is when we turn to the case of Generalized Quantifiers that the need for separating content from interpretation becomes really striking. Generalized Quantifiers do enter into anaphoric relations with other NP's, but those other NP's are never Generalized Quantifiers. There appear to be no pro-Generalized-Quantifiers in Natural language; that is, there does not exist an anaphoric form PRO such that *Every man walked* or PRO *talked* can mean *Every man walked* or *every man talked*. Rather generalized Quantifiers always enter into anaphoric relations with referential NP's, typically pronouns, but not necessarily as we shall see in 4.3.8. Our criterion for contents tells us that the content of a Generalized Quantifier should thus be a restricted parameter, because this is what it can share with another NP, but that something about its semantics (presumably its quantificational force) prevents it from entering into an anaphoric relation with another Generalized Quantifier.

Chapter 2
The now classic proposal of Montague (1970) is that the interpretations of Generalized Quantifiers are properties of properties. Now Montague’s proposal runs afoul of certain cases of anaphora (sometimes called donkey anaphora) discussed in Chapter 3, but it goes a long way towards accounting for what a Generalized Quantifier contributes to the interpretation of a sentence as a whole. That is, Montague has a satisfying account of how you take what the Generalized Quantifier contributes and what the rest of a sentence contributes and combine them into the interpretation of the sentence.

So there are really three conceptually distinct uses to which interpretations have been put: (i) they act as the denotation of a form on an occasion of use, which we may, sometimes, have intuitions about; (ii) they are what a form shares semantically with other forms in anaphoric relations; (iii) they are what the form contributes semantically to the sentence as a whole. Now we’ve argued that (i) and (ii) can’t be the same because there are cases where forms without denotations enter into anaphoric relations. We’ve also just seen that, in the case of Generalized Quantifiers, (ii) and (iii) can’t be the same. One can make a similar case for VP’s. What a finite VP contributes to the sentence must include its tense and polarity, but these are never shared in VP-ellipsis. It may also be that (i) and (iii) need to stay apart, if there are linguistic forms that simply can’t be given sensible denotations, but contribute something semantically. This would be the case, for example, if there isn’t a good theory of the denotation of Generalized Quantifiers that can handle donkey anaphora.

The bottom line is that whenever we use the term interpretation, we have to be careful which of the three functions we are attending to. Now this book is about a theory of anaphora that interacts correctly with a theory of meaning, particularly compositional meaning; the functions with which we are most directly concerned are (ii) and (iii). When we are concerned with function (ii) we will use the term content. When we are concerned with function (iii) we will use the term “what is semantically contributed.”

The right way to describe our meaning relation is to say that it is a relation between circumstances and what is semantically contributed. And there are two important differences between the semantic contribution and denotation: first, what is semantically contributed on an occasion of use may have no unique value, as in the
case of a pronoun bound by a Generalized Quantifier; second, we will make no commitment to packaging what is semantically contributed into a single piece. Thus, for example, there will be no one single semantic object that can be thought of as the denotation of a Generalized Quantifier. The -arity of the meaning relation will vary depending on how many pieces something contributes semantically.

We now illustrate these ideas with a provisional version of the Sentence rule. The meaning relation for finite-VP Sentences will be a two-place relation between Circumstances and what we will call a Described Object. The Described Object will be a State-of-Affairs.

Thus, as a first approximation of the Sentence rule, we would have:

\[
S \rightarrow \text{NP VP} \\
(↑\text{SUBJ})↓ ▲ ▲ (↓\text{TNS}) = \text{c } + \\
\]

\[
c[S]\text{DO iff } \quad (C \geq C^{\text{NP}} \land C^{\text{VP}}) \\
(\text{DO} = \langle\text{DO}^{\text{NP}}, \text{DO}^{\text{VP}}\rangle) \\
\text{subj : DO}^{\text{NP}} \\
\text{tns : RT}^{\text{VP}} C^{\text{VP}} = \langle\text{REFRELV,VP,RT}^{\text{VF}}\rangle)
\]

We will modify this rule in the next chapter, and again in the fragment in the appendix, but even in this provisional form it embodies a number of firm commitments. First, the rule says that a linguistic form with a certain phrase structure and a certain functional structure can be associated with a meaning. That meaning is a two-place relation between the circumstances of the S, C, the described-object of the S, DO. One condition is placed on the circumstances; they must contain the circumstances of both the subject and the Verb Phrase. This will be a general condition on the circumstances of sub-utterances. This is how the sort of reference facts we saw in (32) become part of the circumstances of a sentence. We will deal with NP rules and circumstantial reference facts in the next chapter.

Of further interest here is that fact that the Verb Phrase is not a property, but a relation, one argument of which is the subject, while the other is the tense. This treatment will be revised in the Appendix, but the basic idea that VP contents can be relations will be important throughout this book. Note that the tense argument supplied is restricted to be the one chosen by the VP’s Circumstances.
through the REFREL relation. The REFREL relation is the relation used for reference, which we shall hear more about in Chapter 3.

Note that what is contributed to interpretation in the above rule is only a state-of-affairs. We said that the interpretation of a declarative sentence will be the proposition asserted, but we don't know that a finite-VP sentence will be used for assertion; it may be embedded under an attitude verb, or presupposed in a relative clause. The next rule is for actually asserted sentences.

(35) \[ \text{ASTN} \rightarrow S \]
\[ C[\text{ASTN}]_{DO} \text{ iff} \]
\[ (C \succeq C^S) \]
\[ (C \models \langle \text{ABOUT, ASTN, } s \rangle) \]
\[ (C \models \langle \text{ASSERTED, ASTN, DO} \rangle) \]
\[ (DO = (s : [s \models DO^S])) \]

This ASTN (for Assertion) rule takes finite-S's and constructs a situation-type from the S's Described Object (a state-of-affairs); the Assertion's own circumstances then supply a described-situation (s above) and a proposition is constructed by predicating the type of the described situation. The ABOUT and ASSERTED relations are, respectively, the relation holding between an assertion and the situation it is asserted of, and the relation between an assertion and the proposition it expresses.

Note that the utterance of the finite-S and the utterance of the Assertion would seem to be the same utterance. Thus, the same utterance is entering into two different meaning relations and will have two distinct circumstances and two distinct Described-Objects. This is less peculiar if we recall that any meaning relation is born in virtue of a linguistic analysis, that is, in virtue of the utterance having the structure licensed by the syntactic portion of the rule. Thus a sentence-utterance may have one pair of circumstances and a described object in virtue of being a finite-VP Sentence, and another in virtue of being an Assertion. The one property of the above treatment that may be open to criticism is that we seem to be treating Assertions as a syntactic category. It might be better to give such rules a different status, calling them rules of use, perhaps (something of the same sort seems to be suggested in Gazdar, et al. 1985). For simplicity, we have chosen the more uniform account.

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We next present a provisional VP rule, to give a little of the flavor of how circumstances from one constituent may affect another.

\[(36)\quad \text{VP} \rightarrow V \quad \text{NP} \]
\[\uparrow = \downarrow \quad (\uparrow \text{OBJ}) = \downarrow \]
\[ (\downarrow \text{TNS}) = _c + \]

\[c[\text{VP}]_{\text{DO}} \text{ iff} \]
\[ (C \geq C^V \land C^{\text{NP}}) \]
\[ (C \models \langle \text{REFREL}, \text{VP}, \text{RT}_{\text{VP}}^{C^V} \models \langle \text{REFREL}, V, \text{RT}_{\text{VP}} \rangle \rangle) \]
\[ (\text{DO} = [x_{\text{subj}}, y_{\text{tns}} | \langle \langle \text{DO}^V, x_{\text{subj}} : x, y_{\text{tns}} : y \rangle \rangle] \]

The VP meaning is a two-place relation among the circumstances of the VP, \(C\), and the described object of the VP, \(DO\). The described object is also a two-place relation between the subject role and the tense role. The main motivation for this is that tense seems not to be shared in cases of VP-ellipsis. An elliptical VP may have a distinct tense from its antecedent. Thus in the present set of provisional rules, we defer evaluation of tense until the sentence level. In order to handle non-referential tense correctly, we will revise this rule in the fragment in the Appendix.

The circumstances of the VP are required to supply the REFREL relation for the tense reference. That reference-relation holds between the VP-utterance (throughout, we use the category-name as a way of designating the utterance of the category), and the reference-time that the verb's circumstances assign to the verb-utterance. This condition on the circumstances tells us that both the circumstances of the verb and the Verb Phrase have a reference-time, and it is the same for both. Note that the sentence utterance does not enter into a reference-relation with a temporal location. The assumption is that only verbal categories have a temporal reference time.

We next present an example of a verb rule for the past-tense transitive verb \textit{revised}:

\[(37)\quad V \rightarrow \text{revised} \]
\[\uparrow = \downarrow \]
\[ (\downarrow \text{TNS}) = + \]
C[V]DO iff
\[
\begin{align*}
(C &\models \langle \text{REFREL}, V, \text{RT} \rangle) \\
(C &\models \langle \text{BEING-UTTERED}, V, l \rangle) \\
(\text{DO} = [x_{\text{subj}}, y_{\text{obj}}, z_{\text{tns}} | \langle \text{REVISING}, \text{reviser} : x, \text{revised} : y, \text{loc} : z_{\langle \text{PRECEDES}, x, l \rangle} \rangle])
\end{align*}
\]

Note that the Verb rule for revised does not directly place the requirement of pastness on the reference time; rather it is an appropriateness restriction on the tense argument-role. Currently the rules make tense referential so this makes little difference, but when we make tense referentiality optional in the revised rules of the Appendix, the pastness requirement of past tense will still hold. This seems correct. Even when we are quantifying over times in a whenever clause, we must still be quantifying over past times for a past tense verb.

In the case of Assertions, Sentences, Referential NP's, Verbs, and (provisionally) VP's, we can package what is contributed into a single piece, called the the Described Object. In general, however, the -arity of the meaning relations will vary, depending on how many pieces are contributed to the interpretation of the sentence. We will see in the next chapter that the meaning of Generalized Quantifier is a four-place relation among a Circumstances, a described object (the parameter which is the content), a described type (the restricting property of the quantifier), and a Quantificational force (the Determiner relation). Our revised VP rule in the Appendix will be a three-place relation. All the Meaning relations for major categories will have at least a Circumstances and a Described Object role, and what we call the content, when there is one, will always be the the Described Object. Note that not every constituent will have a content because not every constituent can enter into anaphoric relations.

In these provisional rules the relation between the content and the circumstances is quite simple; in effect, all that has happened is that a parameter has been fixed, or that circumstances have been collected. When we turn to to matters of scope in the next chapter, we will propose that the relationship can become somewhat more complicated. Our proposal for dealing with anaphoric relations will

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complicate the circumstances still further. The driving principle here is the one we enunciated about the circumstances in Chapter 1: the circumstances contain all that is necessary in addition to the linguistic structure to fix an interpretation.
The Semantics of Noun Phrases

IN THIS CHAPTER, we present our semantics for Noun Phrases. Following Kamp (1981), Heim (1982), and Barwise and Perry (1983), we assume that Noun-Phrases can be separated into Generalized Quantifiers and what we call Referential NP’s (none of the works cited uses that term in that sense). Referential NP’s are expressions which have the potential on some occasions of use of referring.¹ In contrast, Generalized Quantifiers do not. Referential NP’s do not necessarily end up referring, because they may be quantified away or be anaphoric. As we shall see below, there are both similarities and differences in the semantics of the two kinds of NP’s. Both kinds will be associated with what we call a Described-Object which ranges over individuals. Generalized Quantifiers, however, will differ in that they are also associated with a Quantification-Force, a relation between properties which causes parameters to be absorbed.

In Section 3.1 we discuss Referential Noun Phrases; in Section 3.2 we combine the rules for sentences and Verb Phrases with those for Referential NP’s and work through the analysis of a simple sentence to illustrate the workings of our semantic rules. In Section 3.3 we discuss Generalized Quantifiers. In Sections 3.4 and 3.5 we illustrate

¹There is a little glitch in this characterization because actually some things we call Referential NP’s may not have that potential. Some people would say the pronoun I never refers, and it is probably true that reflexives never refer in our sense, because they are always anaphoric. It might be better to say that Referential NP’s are those that never quantify, or those that are not Generalized Quantifiers.
our extended theory of context by presenting a circumstantial account of scope. In Section 3.6 we summarize our account of NP’s and discuss possible constraints on circumstances. In Section 3.7 we review the role parametric objects play in our semantics.

3.1 Referential Noun Phrases

For all referential NP’s the content and what is semantically contributed will be the same. Thus we can informally characterize the semantics of referential NP’s by specifying their contents and what they contribute to the circumstances. We give rules for referential NP’s at the end of this section.

We begin with the case of Proper Names. A typical rule introducing a proper name is:

(38) NP → John

\[ c[NP]_D \text{iff} \]
\[ (C \models \langle \text{REFREL}, \text{NP, DO} \rangle \langle \text{NAMED, DO, "John"} \rangle) \]

What this essentially claims is that Proper Names are obligatorily referring. So, in a sense, are first and second person pronouns, although the individuals they denote are quite constrained: second-person singular pronouns:

(39) NP → I

\[ c[NP]_D \text{iff} \]
\[ (C \models \langle \text{UTTERING, DO, NP} \rangle) \]

NP → You

\[ c[NP]_D \text{iff} \]
\[ (C \models \langle \text{ADDRESSED-WITH, DO, NP} \rangle) \]

Thus, on typical occasions of utterance, first- and second- person pronouns would exhibit the following sorts of circumstance-content pairings:

(40) **Expression:** \[_{NP} I \]
**Circumstances:** \(\langle \text{UTTERING, DO, "I"} \rangle\)
**Content:** DO

**Expression:** \[_{NP} you \]
**Circumstances:** \(\langle \text{ADDRESSED-WITH, DO, "you"} \rangle\)
**Content:** DO

Chapter 3
Here we sidestep the question of whether these pronouns actually do refer, and assign them circumstance-conditions that capture their respective constraints: \( I \) denotes its utterer and \( you \) its addressee.

The contents of third person singular pronouns would have the following sort of relation to their circumstances, when the pronouns are used deictically:

\[
\begin{align*}
\text{Expression: } & [NP \text{ he }] \\
\text{Circumstances: } & \langle \text{REFREL, "he"}, x \rangle \\
\text{Content: } & x_{\langle \text{MALE}, x \rangle}
\end{align*}
\]

\[
\begin{align*}
\text{Expression: } & [NP \text{ she }] \\
\text{Circumstances: } & \langle \text{REFREL, "she"}, x \rangle \\
\text{Content: } & x_{\langle \text{FEMALE}, x \rangle}
\end{align*}
\]

Thus we treat deictic pronoun uses simply as referring uses of referential NP's. We defer until Chapter 4 the discussion of anaphoric uses.

The rule for combining referential Determiners with Common Nouns follows:

\[
\begin{align*}
\text{(42) } & \text{NP} \rightarrow \text{REFDET } \text{CN} \\
& (\uparrow \text{SPEC}) = \downarrow \quad \uparrow = \downarrow \\
& C[NP]_{DO} \text{ iff } \\
& (C \models \langle \text{REFREL}, \text{NP}, DO \rangle) \\
& (C \models \langle \text{EXPLOITS}, \text{NP}, s \rangle) \\
& (s_{RR_{\text{RefDet}, s, DO^{CN}}} \models \langle \text{DO}^{CN}, DO \rangle)
\end{align*}
\]

Rule (42) introduces a new relation for the circumstances, the relation EXPLOITS. EXPLOITS is the relation holding between an NP utterance and a situation when the NP-utterance exploits that situation as its resource-situation. Following Barwise and Perry (1983), we give all NP's, including Generalized Quantifiers, resource-situations. Note that a deictic use of "she" has to be anchored in the Circumstances through a REFREL fact, but an ordinary use of "a blackboard" doesn't. The default effect of not having a REFREL fact in the circumstances is that an NP will get an existential quantification reading (we'll show how in Section 3.4).

The relations REFREL and EXPLOITS both hold between an utterance and an object and are both relations through which the object can become a constituent of the utterance's interpretation.

Section 3.1
Another such relation that we have seen is ABOUT, which is the relation holding between an assertion and its described situation. Other examples are the UTTERING relation (which we have called BEING-UTTERED when the speaker was omitted), which introduces utterance-times and speakers for indexicals like tense and the first person pronoun and the closely related is the ADDRESSED-WITH relation for the second-person pronoun. One thing a theory of circumstances ought to do is determine how many circumstantial relations there are which makes objects constituents of interpretations. We might call these anchoring relations because they introduce parameters in meaning-descriptions which are anchored to particular objects to give interpretations for particular utterances. Thus far, then, we have relations for speech-situation participants, referents, resourcesituations, and described-situations. For the phenomena dealt with in this book, these are all the anchoring relations we need, but they are certainly not all we would need in a full dress theory of context.\footnote{Deixis with this and \emph{that} and deictic zero forms appear to require other \lq\lq referential\rq\rq or anchoring circumstantial relations; spatial orientation prepositions like \emph{across} and \emph{behind} would seem to require still others. \lq\lq Differing personal pronoun systems in other languages would seem to call for more circumstantial relations as well, for example, in the case of so-called fourth-person or obviative pronouns, and in the case of first person exclusive forms.}

As we shall see when we turn to scope and anaphoric ambiguities, there are also circumstance-relations which are not anchoring relations.

Note that the described object in (42) depends on both the \textsc{do} (the described object of the Common Noun), and the \textsc{rr} (the resource-restriction) of the Determiner). This latter dependency allows us to capture the difference between definites and indefinites.

A typical indefinite like \emph{a blackboard} will introduce the following conditions into meaning-descriptions:

\begin{enumerate}
\item \textbf{Expression:} \textit{[NP a blackboard]}
\item \textbf{Circumstances:} \langle \textsc{refrel}, \textit{a blackboard}, \textsc{do} \rangle
\item \textbf{Content:} \langle \textsc{exploits}, \textit{a blackboard}, \textit{s} \rangle
\end{enumerate}

Here, the resource situation is restricted so that it must be in the \textsc{true} relation with the property \emph{blackboard}. We take \textsc{true} to just be the vacuous relation that holds between any two arguments.
That is, indefinites place no special restrictions on their resource-situations.

In contrast, definite noun phrases such as "the blackboard" work as follows:

(44) Expression: [NP the blackboard]
Circumstances: ⟨REFREL, "the blackboard", DO⟩
        ⟨EXPLOITS, "the blackboard", s⟩
Content: \( x(s(\text{UNIQUE}, s, \text{blackboard})) \models (\text{BLACKBOARD}, x) \)

Here, the resource situation is restricted so that it must be in the UNIQUE relation with the property blackboard. The force of that restriction is that the resource situation contains only a single exemplar of the property BLACKBOARD. This small distinction between definites and indefinites will eventually play a crucial role in our analysis when we turn to the various conditions under which definites and indefinites may have non-referential readings (in Secs. 3.3 and 4.3).

We next present the rule for two determiners:

(45) RefDet → The
     [RefDet]RR iff RR = UNIQUE
     RefDet → A
     [RefDet]RR iff RR = TRUE

These Determiner rules are the first we have encountered which place no condition on their circumstances, and so we have unary meaning relations with no Circumstance role. The claim, then, is that what these words contribute to the interpretation is invariant across utterances. Note that rather than a described object, these rules introduce an RR (for Resource-Restricion). This is simply because it seems wrong to call the UNIQUE relation what is described by the word the; it doesn't describe anything; rather what it semantically contributes to a Noun-Phrase utterance is a relation restricting the resource-situation's relation to the Common-Noun property.

We conclude this section with a pair of Common Noun rules.

(46) CN → blackboard
     [CN]DO iff DO = BLACKBOARD
     CN → paper
     [CN]DO iff DO = PAPER

Section 3.2
3.2 Meaning, Parameter-Picking, and Role-Covering

In this section we illustrate the interpretation of our semantic rule formalism by working our way through the analysis of the sentence,

(47) John revised the paper.

We begin with a straightforward definition of when a circumstance and described objects can stand in the meaning relation defined by a set of conditions. Although this definition alone does not guarantee it, our fragment is written so that the extensions thus determined will never be parametric. The most important consequence of this fact is that interpretations of utterances are never parametric.

The Meaning Relation

A circumstance $c$ and semantic contributions $d^1 \ldots d^n$ stand in a meaning relation $c[\alpha]_{d^1 \ldots d^n}$ with meaning-description $C_1(c, d^1 \ldots d^n) \ldots C_m(c, d^1 \ldots d^n)$ if and only if there is an anchoring $f$ such that $f(c) = c$, $f(d^1) = d^1$, $\ldots$, $f(d^n) = d^n$ and $C_1[f]$ and $\ldots C_m[f]$.

The proposition $C[f]$ ($C$ a condition, $f$ a total anchor for all the parameters in $C$) is the result of replacing the parameters in $C$ with their values under $f$. What this definition says, then, is that $c$, $d^1 \ldots d^n$ enter into the meaning relation if and only if there is some way of anchoring the parameters $c, d^1 \ldots d^n$ to $c, d^1 \ldots d^n$ that makes the relation's conditions true.

Thus, once we can construct a set of conditions that count as the meaning-description of a sentence to hold, we are home free; and meaning-descriptions, of course, come from our rules. However, we need to be a little careful about how we get from rule conditions to the conditions to be used in finding the extension of the meaning relation.

We begin simply by collecting and relabelling the conditions accompanying the one syntactic analysis of (47) admitted by the following rules:

(48) ASTN

a. $(C^{\text{ASTN}} \geq C^s)$

b. $(C^{\text{ASTN}} \models (\{\text{ABOUT}, \text{ASTN}, s\}))$

c. $(C^{\text{ASTN}} \models (\{\text{ASSERTED}, \text{ASTN}, \text{DO}^{\text{ASTN}}\}))$

d. $(\text{DO}^{\text{ASTN}} = (s : [s | \{\models, s, \text{DO}^s\}])))$
Here all we have done is to take the conditions given by each of the rules used in the syntactic analysis and append them together, modulo some relabelling of parameters. Two sorts of relabelling
went on. First, we relabelled utterance parameters to avoid placing conditions on distinct utterances with the same parameter. Thus, since there are two NP's, we have used NP1 and NP2 instead of the designator NP used in both the rules. We also relabelled other elements of the rules; for example, the rule for Referential NP's and the VP-rule both made use of the parameter $x$ as written, and had we left things that way, we would have some object revising itself, with the proviso that it was named John and was a paper. In general, then, in spelling out a set of conditions licensed by our rules we have observed the convention that parameters used in the meaning-description are unique, *ceteris paribus*.

There are two outstanding cases where *ceteres* are not *pares*.

First, when the same parameter is used twice in the same rule, we obviously mean: use the same parameter in these two places. A case in point is the two uses of the parameter $x$ in the VP-rule. Second, the parameter DO$^{NP1}$ was used in two places, as replacement for the reference in the Sentence rule to DO$^{NP}$, and as a replacement for the DO in the proper noun rule, used for admitting the subject *John*. That's simply a convention of how the rules are interpreted: DO$^{NP}$ is to be bound to the described object of the particular NP dominated by a particular S in a particular utterance analyzed by the sentence rule. Neither of these two kinds of co-parameterization seems particularly problematic, and both have their correlates in other kinds of syntactically driven rules in very different frameworks.

Now (48) is just the unstructured set of all the conditions from all the rules for the tree admitting (47). What we are really interested in is finding the necessary and sufficient conditions for circumstances and described objects to stand in the meaning relation for the *assertion*, not for every constituent in it. We get at those as follows: the Assertion rule spells out a ground set of conditions that must be met (48a)-(48d), but these conditions contain parameters which are further conditioned by the rules admitting other parts of the tree. So the basic idea is: *we view those other conditions as restrictions on the parameters in (48a)-(48d)*.

For example, the Sentence rule is responsible for (48e):

$$ (C^S \geq C^{NP} \land C^{VP}) $$

We can incorporate this into (48a) as a restriction on $C^S$:

$$(49) \quad C^{ASTN} \geq C^S(C^S \geq C^{NP} \land C^{VP})$$

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The other parameter in (48a)-(48d) which is restricted by other conditions in the tree is DO^S; (48d) is:

\[(DO^{ASTN} = \{s : [s \mid (|=, s, DO^S]\})]\]

We take DO^S to be restricted by (48f):

(50) \[(DO^S = \langle DO^{VP},
    subj : DO^{NP_1}
    tns : RT^{VP} \langle|=, C^{VP}, \langle REFREL, VP, RT^{VP}\rangle \rangle\))\]

We have now spelled out (49a) and (50d) in greater detail as (48) and (49). The remaining two conditions on the Assertion, (48b) and (48c),

\[(51) (CASTN \models \langle ABOUT, ASTN, s\rangle)
    (CASTN \models \langle ASSERTED, ASTN, DO^{ASTN}\rangle),\]

contain no parameters restricted by conditions elsewhere in the tree. But (49) and (50) now do, namely C^{NP}, C^{VP}, DO^{NP}, and DO^{VP}. The next step is to continue spelling things out, computing augmented versions of conditions (49) and (50). (49) places the restriction

\[(52) C^S \geq C^{NP} \land C^{VP}\]

on C^S. Augmented with conditions (48g) and (48h), and (48i), (52) becomes:

\[(53) (C^S \geq C^{NP_1}\langle REFREL,NP_1,DO^{NP_1}\rangle
    \land C^{VP}(C^{VP} \geq C^V \land C^{NP}) \land (C^{VP} \models \langle REFREL,VP,RT^{VP}\rangle)\)]

where RT^{VP} is restricted with

\[\langle|=, RT^{V}, \langle REFREL, V, RT^{V}\rangle \rangle\]

Similarly, DO^{VP} in (50) is restricted with condition (48j):

\[(54) (DO^{VP} = [x_{subj}, y_{tns} \mid \langle DO^{V}, subj : x
    obj : DO^{NP_2}
    tns : y \rangle \})]\n
We thus compute a meaning-description for the ASSERTION by descending "top down" through the conditions as defined by the tree, restricting the Assertion conditions further with the conditions imposed by its daughters, and its daughters' daughters, and so on. In each case "restricting further" means placing an added restriction on one of the ASSERTION condition's parameters. We do this until we bottom out at the conditions at the bottom node. At that point we are guaranteed that we have used all the constraints imposed
by the rules on this meaning-description. Of course, the use of a
top-down tree descent here is really just an expository convenience;
there is no order to constraint satisfaction. A bottom-up construc-
tion would have worked just as well, as we long we continued to
place the conditions on daughters as restrictions on the conditions
for their mothers.

A final point: in discussing our theory of anaphora we will of-
ten make reference to a form's content. The content of a form is
the parameter (or parametric object) in a form's meaning conditions
whose anchoring in some particular circumstances yields the form's
Described Object. Thus, given some anchor f which anchors DO_{NP1}
in the above conditions to a, a will be the described object, but
DO_{NP1} will be the content. Note that the content does not enter
into the extension of the meaning relation. Only the Described Ob-
ject a does (assuming a meets the condition of being named John).
Particular contents are determined by condition sets. Particular De-
scribed Objects are determined by particular utterances. Contents,
then, are not part of the meaning relation; they are only used to help
us define it.

Before concluding our discussion of this example, it will be helpful
to preview some of the terminology for Chapter 4. The role indexed
subj for the Verb in (54) bears an interesting relation to the role
indexed subj for the Verb-Phrase. The Verb-Phrase role is the role
obtained from absorbing the parameter that labels the Verb role.

In these cases we will say that the first role is a projection of the
second. Here the role indexed subj for the Verb Phrase is a projection
of the role indexed subj for the Verb. Note that roles do not need
to have the same indexing in order for one to be a projection of
the other. One might for example define the content of the reflexive
intransitive verb wash in terms of the transitive verb's content as in
(55).

In this case the role indexed subj for the WASH^{T} relation is a
projection of role washer of the lexical WASH relation and the role
indexed subj for the WASH^{R} relation is a projection of the roles
labelled subj and obj of the WASH^{T} relation.

A final piece of terminology that will be of help to us is the notion
of covering a role. The Sentence-rule tells us that the Described-
Object of the Sentence is the state of affairs formed by labelling
the role indexed subj for the Described-Object of the Verb-Phrase

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(55) \( \text{WASH}^T = [x_{\text{subj}}, y_{\text{obj}}, z_{\text{tns}} | \langle \text{WASH},
\text{washer} : x,
\text{washed} : y,
\text{loc} : z \rangle] \)

\( \text{WASH}^R = [x_{\text{subj}}, y_{\text{tns}} | \langle \text{WASH}^T,
\text{subj} : x,
\text{obj} : x,
\text{ins} : y \rangle] \)

utterance with the Described-Object of the NP-utterance. In general, any rule introducing an NP will associate it with some indexed role which, in the rule conditions, the NP's content parameter labels. That is the role the NP covers. In the case of the Sentence-rule we will say the NP covers the role indexed \( \text{subj} \) for the VP. Combining two new terms, we can say that the subject NP covers a projection of the role labelled \( \text{subj} \) for the Verb. Both covering and role-projection will play an important role when we discuss cases of anaphora with sloppy readings.

3.3 Quantified Noun Phrases

We turn now to Quantified Noun Phrases such as \textit{every boy}, \textit{no book} and \textit{most students in the class}. We basically utilize the Generalized Quantifier analysis of Barwise and Cooper (1981) and Barwise and Cooper (in preparation). Each of these Noun Phrases has a determiner \textit{every}, \textit{no}, or \textit{most}, and a common noun phrase. The determiner contents are two-place relations, \textit{EVERY}, \textit{NO}, and \textit{MOST} respectively, and the common noun contents are types. Both roles of the Determiner relations are appropriately filled by properties.

It will be useful to give an example of what we targeting onto, before discussing what GQ Noun-Phrases semantically contribute to a sentence, and before presenting the rules for Generalized Quantifiers. We propose that the meaning-description for the sentence \textit{Every boy was looking at the frog} render the content as:

(56) \( \langle \text{EVERY},
[x | \langle \text{BOY}_s, x \rangle],
[x | \langle \text{LOOKING-AT}, x, \exists \langle \text{FROG}_s, y \rangle, z \langle \text{PRECEDES}, z, l_w \rangle \rangle] \rangle \)

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This content is a state-of-affairs consisting of a Determiner relation with two types as its arguments.\(^3\)

This example introduces two abbreviations for resource-situations which will be useful:

(57) \( s \models \langle \text{BOY}, x \rangle \)

is rendered as

(58) \( \langle \text{BOY}_s, x \rangle \)

And:

(59) \( y \langle \text{HAS-UNIQUE}, s', \text{frog} \rangle \models \langle \text{FROG}, y \rangle \)

is rendered as:

(60) \( \forall y \langle \text{FROG}, y \rangle \)

This is the unique \( y \) that is a frog in \( s' \). The symbol "\( \iota \)" is of course intended to suggest an analogy to Russell's iota-operator.

We turn now to the question of the compositional semantics of Generalized Quantifiers. What the Generalized Quantifier Noun-Phrase semantically contributes to a sentence content like (56) only determines the domain of quantification. We might write that contribution:

(61) \( \langle \text{EVERY}, [x \mid s \models \langle \text{BOY}, x \rangle], \ldots \rangle \)

But the expression in (61) really has no interpretation as a situation theoretic object. We do not want to interpret it to be an unsaturated state of affairs because we do not want the interpretation of \textit{Every boy} to be the state-of-affairs that holds when there exists a property that every boy has.

Another possible content is the following:

(62) **Expression:** "Every boy"

\[ \text{Content: } [P \mid \langle \langle \text{EVERY}, [x \mid s \models \langle \langle \text{BOY}, x \rangle], P \rangle \rangle] \]

This is essentially the analysis of Montague (1970). But Montague's treatment runs afoul of what has come in the literature to be called donkey anaphora. These medieval examples were first brought to modern attention in Geach (1962); his most famous example is:

(63) Every farmer who owns a donkey beats it.

\(^3\)Although Determiner contents are relations, and have roles like the other relations of Situation Theory, we will, for readability display Quantified contents as if the determiners were ordered relations, with the quantificational domain argument first, and the scope argument second.

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Here the problem is that there seems to be no way to give the "existential quantifier" introduced by the NP *a donkey* wide enough scope to bind the pronoun. If one scopes it outside the universal quantifier altogether, the result is a reading on which there is one donkey such that every farmer who owns it beats it, clearly not the most salient reading, if it is available at all.

The solution to this problem (arrived at independently in Kamp 1981 and Heim 1982) is what really institutionalized the distinction between Referential NP's and Generalized Quantifiers: referential NP's like the indefinite *a donkey* in (63) do not introduce any quantificational force of their own. Rather, they are interpreted as free variables which may or may not be captured by appropriate operators; they take on the quantificational nature of any quantifier they fall in the scope of; correspondingly a determiner like *every* must allow what Heim calls non-selective quantification; it must have the ability not just to bind the *farmer* variable but an indeterminate number of other free variables as well.

Having preserved the distinction between Generalized Quantifiers and Referential NP's in our work, there is no reason why we can't follow Kamp and Heim and countenance non-selective quantification for determiners like EVERY . But if we do, then Montague's analysis, treating an NP Quantifier as a property of properties, is closed to us. No parametric property that was an argument of (62) could coherently have any of its parameters bound by the Determiner EVERY.4

The conclusion we reach, then, is that there is no single situation theoretic object which can be the descriptive contribution of a Generalized Quantifier. Rather, we will needs several such objects. We propose to break the contribution of a Quantifier into three pieces. The first is the Determiner relation or *Quantificational force*. The second is the Determiner's domain of Quantification, or what we

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4It might be helpful here to remember an analogous case of semantically illicit binding, the case of a lambda-conversion in which a variable becomes "accidentally" bound. Thus, correctly applied lambda-conversions preserve logical equivalence, but:

\[ \lambda x \exists y [\text{love}(x, y)](y) \]

and

\[ \exists y [\text{love}(y, y)] \]

are not logically equivalent. Combining a Montagovian semantics for NP's with non-selective quantification seems to require just this sort of illicit binding.

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will call the *Ascribed Type*. The third is the parameter the Quantifier binds, or the *Described Object*. There are two useful functions this described object performs: first it captures the way in which Generalized Quantifiers are like Referential NP’s; they are syntactically associated with particular roles, the roles they cover, and their described-objects (parameters) label those roles. We will see below that the same rules which accounted for the association of Referential NP’s with their syntactically determined roles, also account for the association of Generalized Quantifiers with their syntactically determined roles. Second, the described objects of both Referential NP’s and Quantifiers are their contents, that part of what is semantically contributed that enters into anaphoric relations.

This view leads to the following NP rule for GQ’s:

(64)  \[ \text{QUANTDET} \rightarrow \text{EVERY} \]
\[ [\text{QUANTDET}]_{\text{DO}} \text{ if and only if } \text{DO} = \text{EVER} \]

(65)  \[ \text{QUANTDET} \rightarrow \text{MOST} \]
\[ [\text{QUANTDET}]_{\text{DO}} \text{ if and only if } \text{DO} = \text{MOST} \]

NP \rightarrow \text{QUANTDET} \quad \text{CN}
\[ (\uparrow \text{Spec}) = \downarrow \quad \downarrow = \uparrow \]
\[ C[NP]_{\text{DO}, \text{AT}, \text{QF}} \text{ iff} \]
\[ (C \models \langle \text{EXPLOITS, NP, s} \rangle) \]
\[ \text{AT} = \{ x \mid s \models \langle \text{DO}^\text{CN}, x \rangle \} \]
\[ (\text{QF} = \text{DO}^\text{QUANTDET}) \]

The interesting thing about this rule is that it puts no conditions on the described object; what it is does not matter since it will invariably be quantified away by the time we are dealing with sentence contents. Given this rule, a Generalized Quantifier utterance can be analyzed as follows:

(65)  **Expression:** [NP, Every boy ]

**Circumstances:** \( \langle \text{EXPLOITS, “every boy”, s} \rangle \)

**Content:** \( v_0 \)

**Quantificational Force:** EVERY

**Ascribed-Type:** \[ x \mid s \models \langle \text{BOY}, x \rangle \]
in the VP’s Described Object with the NP’s Described Object. Take a meaning-description for *Every boy* as in (65). What the sentence rule in Chapter 2 would give as the Described-Object of *Every boy walked* is:

(66) **Expression:** \[ s \left[ NP \text{ Every boy} \right] \left[ VP \text{ walked} \right] \]

**Circumstances:**  
\[
\langle \text{EXPLOITS, “every boy”,} s \rangle \\
\langle \text{REFREL, “walked”,} l \rangle 
\]

**Content:**  
\[
\langle \left[ x_{\text{subj}}, y_{\text{tns}} \mid \langle \text{WALK,} x, y \rangle \right], \text{subj:} v_0, \text{tns:} l \rangle 
\]

Now this won’t do as the content of the sentence, because there is no reference to the ascribed type and quantificational force of the quantifier. But notice that there’s something right about it: it has gotten the Quantifier content associated with the right role. So to deal with Generalized Quantifiers, we need to revise the S-rule (and the VP-rule, for analogous reasons), but we need to preserve what’s right about both of them. In the next two sections we discuss how we deal with quantifier scope by enriching our theory of circumstances.

### 3.4 Scope and Circumstances I: Referential NP’s

There are well-known types of ambiguity which the semantic apparatus introduced thus far will not handle. The most celebrated is the kind of Quantifier-scope ambiguity exhibited by a sentence like:

(67) Two critics like every movie.

Thus far the rules presented will not assign a quantifier any kind of scope at all, let alone two different possible scopes, but the real problem is not writing the rule that assigns scope; it is fitting the indeterminacy of the results in with our account of meaning.

One way to go is to associate different NP scopings with different syntactic structures. We have avoided that path for reasons discussed in Chapter 1. The alternative we sketched there was to correlate different NP scopings with differences in context, in a way analogous to the way the reference of an indexical pronoun like *I* is correlated with facts about the circumstance. This introduces *circumstantial ambiguity* into the grammar.

There is already a very simple motivation for dealing with scope in the circumstances; we deal with reference facts in the circumstances, and scope and the possibility of referring interact. A sentence like *Every girl liked the book she read* requires that the NP *the book she read* be understood non-referentially, if *she* is anaphoric to the Quantifier.

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The same NP can be referential in other circumstances. But being Quantified away and being referential are mutually exclusive. The treatment of scope we give below handles this interaction naturally.

Beyond the appeal to naturalness, there is simply the goal of a more satisfactory theory of context. One of the motivations for shifting our account of context from the indices of the Montague-Kaplan approach into situations is that constraints on situations can be used to capture facts about the coherency of contextual facts. For example, the here and now of discourse must be of the here-and-now that goes with I; this is what makes I’m not here now sound contradictory (at least before the advent of answering machines). The interrelation of scope and reference seems to be an analogous example of the coherence of context.

In this section, we propose an analysis of scope in many respects inspired by that of Cooper (1975). It is an analysis in the same spirit because it eschews any syntactic ambiguity in accounting for scope ambiguity. It differs in attempting to correlate scope ambiguities directly with features of context.

Let’s consider a very simple sort of “scope” example first. A verb phrase like “did not eat a biscuit” can have very different contents in different circumstances. Ignoring tense, the VP contents can be

\[(x_{subj} \mid \langle\text{EATING, } x, y(s)\rangle \langle\text{BISCUIT, } y)\rangle; 0)\]

with a parameter \(y\) for a biscuit; this reading, difficult for most speakers, is the one on which the indefinite takes wide-scope; there is one particular biscuit that wasn’t eaten. In other circumstances the content can be:

\[(z_{subj} \mid \langle[x_{subj}, y] \langle\text{EATING, } x, y(s)\rangle \langle\text{BISCUIT, } y)\rangle\rangle,\]

\[subj : z; 0)\]

here there is no parameter for a biscuit. As we noted in Section 2.2, forming a psoa by providing just one argument to a two-argument relation, without parameterizing the other argument role, has the effect of quantifying it away. Thus, this second content corresponds to the reading of the VP on which the indefinite Noun Phrase falls inside the scope of negation. For readability we introduce the abbreviation:

\[\{x, y_1 \ldots y_i | \sigma \}, z\} =_{df} \exists y_1 \ldots y_i \langle[x | \sigma], z\rangle\]

Thus an equivalent rendering of (69) is:

\[(z | \langle[x | \exists y \langle\text{EATING, } x, y(s)\rangle \langle\text{BISCUIT, } y)\rangle\rangle, z; 0)\]
We now sketch a treatment of NP scope on which the difference between the two VP contents (70) and (68) correlates with differences in circumstances. First we introduce a rule of VP negation:

(71) \[
\begin{align*}
\text{VP}_0 \rightarrow \text{NOT} \quad \text{VP}_1 \\
(\uparrow \text{NEG}) &= \uparrow \downarrow \\
c[\text{VP}_0]_{\text{DO}} \text{ iff } \\
(C \geq C^{\text{VP}_1}) \\
(\text{DO} = [x_{\text{subj}}, y_{\text{tns}} | (\text{DO}^{\text{VP}_1}, \text{subj}:x, \text{tns}:y; 0)])
\end{align*}
\]

What the content part of this rule does is to wrap a negation around a VP content and project the subj and tns roles into a new VP content. \(\text{VP}_0\) will be associated with the relation \(x\) and \(y\) have when they are not in the \(\text{VP}_1\) relation.

Now given the rules we have thus far, the only reading we can get is the one on which the biscuit is referential. One reason is that rule (9) in Section 3.1 makes all referential NP’s refer. Reference is part of the if and only if conditions in the rule:

(72) \[
\begin{align*}
\text{NP} \rightarrow \text{REFDET} \quad \text{CN} \\
(\uparrow \text{Spec}) &= \downarrow \downarrow \\
c[\text{NP}]_{\text{DO}} \text{ iff } \\
(C \models \langle \text{REFREL}, \text{NP}, x \rangle) \\
(C \models \langle \text{EXPLOITS}, \text{NP}, s \rangle) \\
(s_{\langle \text{RR}^{\text{RefDet}}, s, \text{DO}^{\text{CN}} \rangle} \models \langle \text{DO}^{\text{CN}}, \text{DO} \rangle)
\end{align*}
\]

What we want is to allow the possibility of reference but not to require it. That is, instead of (72), we should have:

(73) \[
\begin{align*}
\text{NP} \rightarrow \text{REFDET} \quad \text{CN} \\
(\uparrow \text{Spec}) &= \downarrow \downarrow \\
c[\text{NP}]_{\text{DO}} \text{ iff } \\
(C \models \langle \text{EXPLOITS}, \text{NP}, s \rangle) \\
(s_{\langle \text{RR}^{\text{RefDet}}, s, \text{DO}^{\text{CN}} \rangle} \models \langle \text{DO}^{\text{CN}}, \text{DO} \rangle)
\end{align*}
\]

And we must now somehow allow ourselves the option of including in the circumstances:

\(C \models \langle \text{REFREL}, \text{NP}, x \rangle\)

The idea of licensing options in meaning-descriptions puts a new wrinkle in our semantic theory: a single syntactic structure can now license more than one meaning-description. Structures which license more than such meaning-description will be called circumstantially
ambiguous. As we will see shortly, the grammar will countenance many such structures.

Our strategy is the following: the circumstance-conditions in a meaning-description will be responsible for dictating where NP-subutterances have reached their "maximal" scope; they will do so through facts of the form:

\[(74) \langle \text{SCOPES-OVER, } \alpha, \beta \rangle\]

where \(\beta\) is some utterance over which NP-utterance \(\alpha\) takes scope. Note that until now we have only seen circumstances supporting anchoring relations, relations between utterances and constituents of interpretations; SCOPES-OVER is not an anchoring relation, but a relation between utterances.

Of course, merely including such a fact in the circumstances is insufficient. The idea is that such a fact has consequences for the content of an utterance. We will express these consequences by means of a function called Closure. Closure is a function which takes a state-of-affairs \(\sigma\) and an utterance \(\beta\) and returns a state-of-affairs \(\sigma'\) in which all the parameters of \(\sigma\) have been absorbed when \(\beta\)'s circumstances say they must be.

We now give a version of Closure which deals with the Absorption of Referential NP's; in the next section we extend it to handle Generalized Quantifiers. The provisional definition of Closure is as follows:

\[(75) \text{Closure}(A, \sigma) = \exists \text{DO}^a_1 \ldots \exists \text{DO}^a_i \sigma\]

where \(a_1 \ldots a_n\) is the longest sequence of NP sub-utterances of \(A\) such that \((C^A \vdash \langle \text{SCOPES-OVER, } a_i, a_{i+1} \rangle)\) and \((C^A \vdash \langle \text{SCOPES-OVER, } a_n, A \rangle)\).

Note that SCOPES-OVER is a functional relation; each NP has at most one utterance that it scopes over; the most narrowly scoping NP scopes over \(\beta\); the other NP's scoped by the circumstances of \(\beta\) all take scope over other NP's.

To hook Closure up to our rules, we need to make some revisions. For example, to handle the reading of *John didn't eat a biscuit* on which the indefinite takes narrow scope, we need to revise the VP-rule given in Chapter 2:
The only change in the rule is the appearance of the function Cl in the the condition on the described object.

The difference between the two VP contents for *did not eat a biscuit* will now correlate with whether or not the innermost VP circumstances contain the fact:

\(\langle\langle\text{SCOPES-OVER, "a biscuit", "eat a biscuit"}\rangle\rangle\)

If they do contain the fact, Closure will "existentially quantify away" the VP parameter in building that VP content, and we will get a non-referential reading, in fact just the content in (70). To allow more than one possible scoping for an NP, SCOPES-OVER facts will have to be introduced by optional conditions, just as REFREL facts are.

Thus far, we have introduced two new devices into our rule system: first, optional circumstantial conditions through which a single structure can be associated with more than one meaning-description; second, functions which are sensitive to circumstantial facts.

One question that remains is: how do SCOPES-OVER facts (or any optionally instantiated facts) get into the circumstances so that a circumstantially-sensitive function like Closure can "use" them? We propose the following instantiation principle:

**Circumstance Principle for NP's**

For every NP \(NP_i\) in structure \(S\) there is exactly one circumstantial fact either of the form \(\langle\langle\text{SCOPES-OVER, }NP_i, \beta\rangle\rangle\) (for some utterance \(\beta\) in \(S\)) or of the form \(\langle\langle\text{REFREL, }NP_i, DO^{NP_i}\rangle\rangle\).

The reader can now think of the operation of our rules as follows: we first instantiate a syntactic structure for an expression licensed by the syntactic part of the rules. We then begin building meaning-descriptions. As a first step, we use the Circumstance Principle to

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come up with a large number of partial meaning-descriptions. We then flesh each of those meaning-descriptions out exactly as we did in Section 3.2, with the difference that now our rules introduce a function sensitive to the type of circumstances of an utterance.

It is not necessary, however, to give such a procedural interpretation to the rules. One can also think of the semantic part of a grammar rule as stating a minimal constraint which all meaning-descriptions for that structure must meet. The Circumstance Principle then states a further constraint which meaning-descriptions for any structure must meet.

On this scheme, most of our NP rules become simpler because they no longer need to introduce any REFREL facts. Presumably the proper name rules still will introduce an obligatory REFREL fact because proper names are obligatorily referring.

What we have said thus far is too permissive. For one thing, our rules taken together with the Circumstance Principle allow any NP to be referring, and of course not every NP can be. Generalized Quantifiers cannot be; reflexives cannot be;\(^5\) Also we have not yet formally stated the constraint that the SCOPES-OVER relation is functional; no NP can scope over more than one utterance. These all amount to different constraints on well-formed meaning-descriptions. They might be built into the Circumstance Principle, or they might be stated independently. The important point here is that we need certain general constraints on meaning-descriptions and their relations to structures. We will have occasion to explore another such constraint when we propose a Binding Theory in Section 6.3.\(^6\)

We can organize these constraints in a hierarchy of generality. In one form or another, the Circumstance Principle and the Binding Theory are very general constraints on the relation of structure to meaning. Constraints like the requirement that a Generalized Quantifier not refer are particular to a certain type of NP; when we deal with anaphora, the fact that all pronouns (or possibly all definites) are allowed to be anaphoric will be a fact about pronouns (or possibly about definites). The grammar thus must be understood to

\(^5\)Since personal pronouns like I and you cannot "take scope," the Circumstance principle as stated makes the claim that they refer. Nothing very much hangs on this, but it does make the statement of the Principle simpler if they do.

\(^6\)It will ultimately be the principles of our Binding Theory that will keep reflexives from being referential.
consist of particular constraints on particular structures and lexical items, and constraints of varying degrees of generality that interact with those. In the Fragment in the Appendix we focus on those that affect quantification and anaphora.

We turn now to a very different question concerning the referential status of definite NP's. On our account, definite NP parameters will be absorbable too, in theory, but the absorption will have no descriptive effect. Consider a content for the VP *did not eat the biscuit* on which the definite parameter has been absorbed (ignoring tense):

\[(77) \quad T = [x \mid \langle [x_{subj}, y \mid \langle [EATING, x, y(\theta = \langle BISCUIT, y \rangle)]], x; 0 \rangle \rangle \]

where \( \theta = \langle \langle \text{UNIQUE}, s, \text{biscuit} \rangle \rangle \)

The interesting part of the content above is the internal type, a two-place relation with two roles we shall call \([x]\) and \([y]\):

\[(78) \quad T' = [x_{subj}, y \mid \langle [EATING, x, y(s, r = \langle BISCUIT, y \rangle)] \rangle \]

where \( r = \langle \langle \text{UNIQUE}, s, \text{biscuit} \rangle \rangle \)

Here a parameter \( y \) with restrictions on it has been absorbed. Since the restriction was parametric, the result is that the whole type is parametric. Two questions arise: How do we interpret restrictions on absorbed parameters? And how do we interpret them in unsaturated states-of-affairs? The answer to the second question will depend on the first.

A natural answer is that restrictions on absorbed parameters turn into appropriateness conditions on the corresponding role. Thus, in the above example, suppose that, in the restriction on the \( y \) parameter, the parameter \( s \) is anchored to some specific resource-situation \( r \) in the circumstances. Then the appropriateness condition on the role \([y]\) (formed from abstracting on \( y \)) would be that \( r \) support the fact that the role-filler is a biscuit. Thus, the only appropriate fillers for this role would be—not only biscuits—but biscuits in \( r \). Non-biscuits, or biscuits only recognized in other situations, need not apply, because no assignment assigning them to the \([y]\) role will yield a state-of-affairs. This may seem like a peculiar "appropriateness" condition for a relation to have, but it is useful to keep in mind that the stock of relations offered by Situation Theory is supposed to be the foundation for a general theory of relations, not just those likely to be lexicalized in a natural language. This is crucial even
for the limited purposes of our semantic account, of course, because many of the relations we will need, in accounting for VP-contents, for example, are not likely to be lexicalizable.

In Section 2.1.3, we adopted the view that the "existential quantification" in unsaturated states-of-affairs would be restricted existential quantification, that is, quantification only over appropriate fillers of the role. Thus, in an unsaturated state-of-affairs in which the \( y \) role was unfilled, the quantification would be only over biscuits in \( s \). In the case of a negative existential state of affairs, say:

\[
(79) \quad \sigma = \langle \{ x, y \mid \langle \text{EATING, } x, y(\epsilon s) = \langle \text{BISCUIT, } y \rangle \} \rangle, a; 0 \rangle
\]

\( \sigma \) is a fact iff there does not exist some biscuit \( x \) in \( s \) such that \( a \) is eating \( x \). We can now return to the type \( T \) in (77) as a content for *John did not eat the biscuit*. That type is parametric in \( s \), so that the circumstances must somehow anchor \( s \) in order for the sentence to describe a situation. But the parameter \( s \) has a restriction on it, which requires that \( s \) be a situation that has a unique biscuit in it. So the circumstances must be able to supply such a situation, if the type is to be able to fulfill any descriptive function. Given such an \( s \), then \( T \) is the property of being an \( x \) such that there does not exist a biscuit \( y \) in \( s \) such that \( x \) eats \( y \). Of course there is a biscuit in \( s \), in fact a unique biscuit, because that's how we had to choose \( s \), so, descriptively \( T \) is just the property of not eating that biscuit.

Thus we can capture an important difference between Definites and Indefinites not by placing any restrictions on when their parameters can be absorbed, but by placing an appropriate condition on the resource-situation of definites. We will see in 4.3 that this analysis extends rather naturally to the cases where definites are non-referential, cases like *every girl liked the book she read*.

We have now extended the theory of circumstances so that circumstances deal not only with matters of reference, but also with matters of scope. In the next section we will extend this treatment to the scoping of Generalized Quantifiers.

### 3.5 Scope and Generalized Quantifiers

To extend our treatment of the "scope" of referential NP's to Generalized Quantifiers we need some way for the circumstances to specify where a GQ will take its scope. We will do so by extending our interpretation of the SCOPES-OVER relation. We still take SCOPES-OVER
to be a relation that holds between an NP utterance and and some other utterance when the NP has reached its maximal scope.

(80) \[ \langle \text{SCOPES-OVER}, \alpha, \beta \rangle \]

As before, we take (80) to mean that \( \alpha \) immediately scopes over \( \beta \). Thus in the case of a single node \( \gamma \), at which two or more GQ's, \( \alpha \) and \( \beta \), need to be quantified in, with \( \beta \) the narrower scoping, \( \beta \), will be in the SCOPES-OVER relation to \( \gamma \), and \( \alpha \) will be in the SCOPES-OVER relation to \( \beta \).

We now present a modified definition of closure, and a modified S rule that incorporates it (the modified VP rule of last section will stand as is):

(81) \[
\text{Closure}(A, \sigma) = \text{df} \quad \exists \text{DO}^{\alpha_1} \ldots \exists \text{DO}^{\alpha_{i-1}} \langle \text{QF}^{\alpha_i}, \text{AT}^{\alpha_{i+1}},
\left[ \text{DO}^{\alpha_i} | \exists \text{DO}^{\alpha_{i+1}} \ldots \text{DO}^{\alpha_{i+j}} \langle \ldots \langle \text{QF}^{\alpha_n}, \text{AT}^{\alpha_n},
\left[ \text{DO}^{\alpha_n} | \exists \text{DO}^{\alpha_{n+1}} \ldots \text{DO}^{\alpha_{n+j_n}} \sigma \rangle \ldots \rangle \rangle \rangle \right] \ldots \rangle \rangle \]
\]

where \( \alpha_1 \ldots \alpha_{n+j_n} \) is the longest sequence of NP sub-utterances of \( A \) such that \( (C^A \models \langle \text{SCOPES-OVER}, \alpha_i, \alpha_{i+1} \rangle) \) and \( (C^A \models \langle \text{SCOPES-OVER}, \alpha_{n+j_n}, A \rangle) \).

(82) \[
S \to \text{NP} \quad \text{VP}
\]
\[
(\uparrow \text{SUBJ}) = \downarrow \quad \uparrow = \downarrow
\]
\[
(\downarrow \text{TNS}) = c +
\]
\[
c[S]_{\text{DO}} \text{ iff } \quad (C \geq C^{\text{NP}} \land C^{\text{VP}})
\]
\[
(DO = \text{Cl}(S, \langle \text{DO}^{\text{NP}}, \text{subj : DO}^{\text{NP}}, \text{tns : RT}^{\text{VP}}, C^{\text{VP}} \models \langle \text{REFREL}, \text{VP}, \text{RT}^{\text{VP}} \rangle \rangle))
\]

As with the VP rule, the only change to the version of Chapter 2 is that we have added the Closure operation.

We now work through some alternative meaning-descriptions of the sentence:

(83) Two critics liked every movie.

one on which the circumstances license a wide-scope reading for the Verb Phrase quantifier, another which forces it to have a narrow-scope reading.

We begin by considering circumstances on which the Quantifier \textit{Every movie} gets wide scope over the subject quantifier \textit{Two critics}.
Given the above definition of closure, wide-scoping of the VP internal quantifier will occur when the circumstances of an utterance of (83) support the facts:

(84) 〈SCOPES-OVER, “Two critics”,
      “Two critics like every movie”〉
      〈SCOPES-OVER, “Every movie”, “Two critics”〉

Suppose, then that the analysis of “every movie” is:

(85) Syntax: \[_{NP} \text{every movie} \]
Circumstances: 〈EXPLOITS, “every movie”, s〉
Content: \(v_0\)
Quantificational Force: EVERY
Ascribed-Type: \([x \mid s \models \langle MOVIE, x \rangle]\)

Under the circumstances in (84), our revised VP rule gives us:

(86) Syntax: \[_{VP} \text{likes}_{NP} \text{every movie}\]
Circumstances: 〈REFREL, “likes”, I〉
      ∧ 〈EXPLOITS, “every movie”, s〉
Content: \([x_{\text{subj}}, z_{\text{ins}} \mid \langle \text{LIKING}, x, v_0, z_{\rho} \rangle]\)
where \(\rho = \langle \text{OVERLAPS}, z, I_v \rangle\)

That is, nothing interesting about scoping was contained in the circumstances of the VP, so no quantificational business was transacted. The resulting VP-content is parametric. We return to this point later.

Suppose the utterance of “two critics” is as follows:

(87) Syntax: \[_{NP} \text{Two critics} \]
Circumstances: 〈EXPLOITS, “two critics”, s’〉
Content: \(v_1\)
Quantificational Force: TWO
Ascribed-Type: \([x \mid s' \models \langle \text{CRITIC}, x \rangle]\)

We now build up the result of our revised sentence rule in (82) in steps. Using the VP-content in (86), we first form the state-of-affairs argument to the closure operation in (81). Rule (82) tells us to take the described object of the subject NP and use it to label the subject role of the VP’s described object. From (87), we see the Described Object is \(v_1\):
According to (84), "two critics" takes scope here; so Closure requires us to quantify in "Two critics", absorbing the parameter $v_1$:

\[(89) \langle \text{TWO}, \text{CRITIC}_{s'}, [v_1 | \langle \{x_{subj}, z_{tns} | \langle \text{LIKING}, x, v_0, z_\rho \rangle \}, subj : v_1, tns : \text{RT}^V] \rangle \]

Finally, we scope in "Every movie", absorbing the $v_0$ parameter:

\[(90) \langle \text{EVERY}, \text{MOVIE}_{s}, [v_0 | \langle \text{TWO}, \text{CRITIC}_{s'}, [v_1 | \langle \{x_{subj}, z_{tns} | \langle \text{LIKING}, x, v_0, z_\rho \rangle \}, subj : v_1, tns : \text{RT}^V] \rangle \rangle \]

(90) is the final result of closure for rule (82).

There are two distinct sorts of circumstances that would yield the opposite scoping, in which TWO outscoped EVERY; on one sort, "Every movie" would be scoped in at the VP node, on the other, at the S-node, but still with narrower scope than "two critics." We deal first with the case where both Quantifiers are scoped in at the S-node.

The circumstances in that case would be:

\[(91) \langle \text{SCOPES-OVER}, \text{"Every movie"}, \text{"Two critics like every movie"} \rangle \]

\[
\langle \text{SCOPES-OVER}, \text{"Two critics"}, \text{"Every movie"} \rangle
\]

Suppose that the analysis of "every movie" and "two critics" is as before. Then the VP-content will be as before.

And the closure version of the Sentence-rule would give us:

\[(92) \langle \text{TWO}, \text{CRITIC}_{s'}, [v_1 | \langle \text{EVERY}, \text{MOVIE}_{s}, [v_0 | \langle \{x_{subj}, z_{tns} | \langle \text{LIKING}, x, v_0, z_\rho \rangle \}, subj : v_1, tns : \text{RT}^V] \rangle \rangle \]

Finally there are the circumstances in which the Quantifier is scoped in at the VP. Those are:

Section 3.5
In this circumstance-type, the VP-content differs, under our new closure version of the VP-rule:

\[(94) \quad [x_{subj}, z_{tns} | \langle \langle \text{EVERY, MOVIE}_s, \quad [v_0 | \langle \langle \text{LIKING}, x, v_0, z_\rho \rangle \rangle] \rangle] \]

And the content of the Sentence, before closure:

\[(95) \quad \langle \langle [x_{subj}, z_{tns} | \langle \langle \text{EVERY, MOVIE}_s, \quad [v_0 | \langle \langle \text{LIKING}, x, v_0, z_\rho \rangle \rangle] \rangle], \quad \text{subj : } v_1, \text{tns : 1} \rangle \rangle \]

And after closure:

\[(96) \quad \langle \langle \text{TWO, CRITIC}_s, \quad [v_1 | \langle \langle [x_{subj}, z_{tns} | \quad \langle \langle \text{EVERY, MOVIE}_s, \quad [v_0 | \langle \langle \text{LIKING}, x, v_0, z_\rho \rangle \rangle] \rangle], \quad \text{subj : } v_1, \text{tns : 1} \rangle \rangle \rangle \]

The details of our account, and the interim stages that the compositional semantics requires, all follow the lines of Cooper (1974) in the development of what has come to be called Cooper Storage. As we noted in Chapter 1, Cooper’s motivation for his storage device is like ours: he was seeking an account of scope ambiguities that would be independent of syntactic structure.

One complaint one might voice about this account goes as follows: the VP *like every movie* contains the Generalized Quantifier *every movie* but the content proposed in (86) has no EVERY relation, and nothing about movies. If the content of a VP doesn’t include all the semantic material in the VP, why call it a content at all? Why even include such a semantic object in a linguistic analysis? The answer to this question will be dealt with in detail in Section 4.2, but we can briefly indicate here the nature of the relevant evidence, which was discussed in Sag (1976) and involves VP-ellipsis:

\[(97) \quad \text{John read every book before Mary did.} \]

Sag notes that sentences like (97) have two readings. On one reading John reads through the totality of books before Mary reads through the totality; on the second, John reads each book before Mary reads it. On this second, or wide-scope reading, what is being shared
by the elliptical VP and its antecedent is something like the type 
\[ x \mid \langle \text{READS}, x, y \rangle \], where \( y \) is bound by the wide-scoping quantifier. As will be the case throughout this work, anaphora considerations motivate an appeal to parametric contents. Here, VP-anaphora motivates parametric VP-contents.

Note also that the other reading of (97) shows why we must allow Quantifiers to take VP-wide scope, as in (94). On the totality reading, John and Mary share the property of reading every book, and it is that property that John attains before Mary.

3.6 Constraints on Circumstance and Scope

We have now completed sketching an account of the semantics of NP's in which Circumstances play a central role. No longer do they simply provide anchorings for parameters. Now they also dictate when parameters can be absorbed in fairly complicated ways. To recap the guiding principle that motivates this treatment: our view is that circumstances must supply all the information necessary to get from linguistic structure to interpretation; and our view of structure is a surface-ist one.

There are four important features of our treatment of scope and Generalized Quantifiers that bear mention. (i) Quantified NP occurrences cover roles with parameters just as referential NP occurrences do, and are associated with those roles in exactly the way referential NP's are, via their syntactic properties. (ii) Scoping is an independent process controlled not by syntactic properties but by properties of the circumstances. (iii) As a result, the contents of constituents containing Quantified NP's may be parameterized, when those NP's are scoped wide by the circumstances. (iv) There are general constraints relating meaning-descriptions and structure, among them the Parameterization Principle and the Circumstance Principle.

Feature (i) is motivated just by general considerations of economy. Natural languages seem to treat all NP's alike; therefore, it is

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7 The problem being addressed here is a general one for syntax/semantic frameworks. One must capture the semantic difference between referential NP's and Quantified NP's, and yet not lose their essential similarity as role-covering NP's. A solution clearly in the same spirit as the one offered here, which has in some respects inspired it, is that proposed in HPSG. See Pollard and Sag (1987).
reassuring to find some unifying semantic property despite the necessary distinction between referential NP's and Generalized Quantifiers. Feature (ii) naturally captures the fact that sentences with NP's are scopally ambiguous: these ambiguities are not resolved by differences in linguistic form but through different ways of embedding forms in circumstances. Feature (iii) will be an important part of our discussion of anaphoric phenomena in the next two chapters. We will return to feature (iv) in Chapter 6, when we present our circumstantial theory of anaphora, along with a Binding Theory.

3.7 Parametric Objects

As we noted in Section 2.2, our meanings will be relations between circumstances and what is semantically contributed, where what is semantically contributed is gotten at through parametric objects. The relevant sense of "gotten at" here was discussed in Section 3.2, when we showed how meaning-descriptions are used to determine the extension of the meaning relation. We also pointed out that that extension is not itself parametric.

Now parametric objects have a way of raising qualms. The general drift is something like this: the idea of a situation is good, and even the idea that its structure can be articulated in terms of states-of-affairs; similarly perhaps for the idea that states-of-affairs could be cross-classified in terms of regularities called relations, individuals, locations, and polarities; and perhaps even propositions are a good idea. But what on earth or in Plato's heaven is a parameter, and what is a parametric object?

These qualms deserve some sympathy. It really won't do to swallow and throw back one's head and just get tough about being a realist. Something different is going on in the case of parameters. But parametric objects do seem to be a handy tool in building a general mathematical theory of information; the question of why they are appears to be a deep and interesting one; they have proven useful in Situation Theory in giving accounts of such varied phenomena as inference, propositional attitudes, and anaphora. For relevant discussion, see Israel & Perry (1989).

Certainly the use to which Kamp (1981) puts discourse representations is quite akin to our use of parametric conditions here. Similar remarks could be made about the Files of Heim (1982). The main
difference of our approach is in trying to integrate something like a Discourse-Representation with a theory of context.

There would be no need for parametric objects if there were a well-defined notion of a completed discourse, and we could talk only about completed discourses. Presumably the interpretation of a completed discourse would be a large proposition or a set of smaller propositions. It is only when we try to talk about the interpretations of pieces of discourse and the interpretation of one piece needs to co-vary with the interpretation of other pieces, that parameterization suddenly appears. Essentially, the theory of linguistic anaphora takes such co-variations in linguistic contents to be its subject matter.

This much said, the following points should be made about our use of parametric objects.

- The Meaning Relations given by our rules are not parametric. A parametric relation would be one whose extension wasn't determinate until some parameters were fixed. Our Meaning relations are determinate relations. Fixing an anchor on the condition set of an utterance analysis doesn't fix the meaning relation's extension; it fixes a single tuple in its extension. The relation's extension is the set of tuples for which there exists such an anchor.

- None of the members of the tuples in the extensions of our meaning relations are themselves parametric, neither the circumstances nor what is semantically contributed.

- When we present our Circumstantial account of anaphora in Chapter 6, the circumstances won't make reference to particular parameters, but to the fact that the roles contributed by two sub-utterances need to be co-parameterized. That is, what will be expressed is a fact about co-variation, not a fact about a particular parameter.

- As we have said, parameters capture co-variation. We also think they capture dependency. This happens when one parameter occurs in a restriction on another. We discuss the empirical consequences of this sort of dependency in Section 4.3, when we introduce the Absorption Principle.

In sum, parameters provide a tool for capturing a number of the features of the relationship between the circumstances and what is
semantically contributed. In future chapters we will try to show how the detour through parametric objects en route to interpretation yields a number of fruitful insights in the domain of anaphoric relations. Then in Chapter 6 we will try to connect those insights with our theory of circumstances. Our main goal is to state as clearly as possible what needs to be accounted for. If parameters can serve that end, they have more than justified their use.
Anaphora and Quantification

The focus of our investigation will be on how anaphoric relations affect interpretations. Our account of anaphoric relations will be that they are nothing more than constraints on possible interpretation imposed by a particular context. We will begin by examining some well-known facts about the contents of sentences with anaphoric pronouns.

A central problem in accounting for the semantic nature of the anaphoric relation has been the question of whether there are, in fact, two kinds of anaphora, one necessarily involving a bound variable (or absorbed parameter, in our terms), referred to in Partee (1972) as Bound Variable Anaphora, the other not involving a bound variable (or at least not necessarily, as we shall see below). This second type of anaphora has been referred to as Referential anaphora (for example, in Reinhart 1983), or co-specificational anaphora (Sells 1986), or Discourse anaphora (Roberts 1987). For reasons outlined below, we will call these two classes of uses role-linking and co-parametric uses.

There is no question that an observational distinction can be drawn between two classes of anaphoric uses, as the examples reviewed in Section 4.1 will show. The question for the theorist interested in a discourse account of pronouns is: does this distinction need to be reflected in the theory? That is, do there need to be two different kinds of antecedency conditions for pronouns? We will argue in Chapter 6 that this question can be answered in the negative.

This has important consequences for what we called division-of-labor theories in Chapter 1; division-of-labor theories are those that
divide the work of accounting for anaphoric relations between Logical Form (in the sense defined in Chapter 1) and context. But if there is no motivated division of anaphora into two kinds then the attractiveness of a division-of-labor theory is greatly diminished.

In Section 4.2, we turn specifically to the class of Generalized Quantifiers. Two basic questions are addressed. First, how do Quantifiers establish anaphoric relations? In this respect our theory will be much like everyone's: Under certain conditions a Quantifier can capture a pronoun parameter, binding (or as we call it) absorbing it. A question that immediately arises: if there are two kinds of anaphora, one of which "binds" the pronoun, are Quantifier antecedents limited to that type? We will argue that a plausible cut through the data and a plausible account of NP semantics does not commit one to that view. But we will defer detailed discussion of that topic until Chapter 5, after we have laid out some of the basics of our account of quantificational anaphora. Thus, the main purpose of Section 4.2 is as an outline of our basic approach to quantificational anaphora and a review of the data that must be accounted for, particularly data involving the interaction of VP-ellipsis with Quantifier scope.

Finally, in Section 4.3 we turn to a very different part of the problem, in some ways independent of the rest. This has to do with the "scope" of referential NP's containing bound pronouns. The problem becomes urgent because in such cases referential NP's have "scope" properties that would be exactly predicted if they were treated as Quantifiers. Thus, it is important for any account that maintains a distinction between two kinds of NP to show that this quantifier-like behavior of referential NP's can be handled in a principled fashion. To that end we propose a principle on parameters in general, not just referential parameters, which we call the Absorption Principle. The principle is argued to be motivated not just by linguistic considerations, but by deeper principles of Situation Theory.

A further consequence of the Absorption Principle discussed in Section 4.3 is that it enables us to predict facts about the referentiality and "scope" of pronouns. For example, in contrast to indefinite NP's, non-anaphoric pronouns cannot be quantified away under the scope of negation; *John didn't see it* has no reading that claims that there was no inanimate thing that John saw. However, pronouns with antecedents may be quantified away under negation *when those*
antecedents are. So there is a non-referential reading for the pronoun its available in John couldn't find a car with its headlight intact. With a minor revision of our analysis, the Absorption Principle predicts just these facts.

4.1 Co-Parametric and Role-Linking Uses of Pronouns

4.1.1 Two Types of Referential Dependence

The goal of this section is to identify and describe in the terms of this framework two types of uses of pronouns that went undiscussed in Chapter 3, where our general analysis of referential expressions was laid out. Both use-types are anaphoric, in the sense that in both cases the pronoun can be thought of as "referentially dependent" on another NP, and the distinction between them will largely correspond to a well-known distinction between two types of anaphora. What we will call the co-parametric use corresponds roughly to what in the literature has been called the "referential" (Reinhart's term) or "co-specificational" (Peter Sells's term) use; and what we will call the role-linking use will correspond in many cases to what has been called the bound-variable use.

For some time, researchers in logic and language (Quine (1953) is a relatively early example) have remarked on the close connection between some uses of pronouns and bound variables in logical languages. The analogy is exhibited in (98):

\( (98) \quad \forall x[(x \text{ is a New Zealander}) \rightarrow (x \text{ loves } x\text{'s mother})] \)

Here the variable \( x \) is bound; it does not designate anything, but rather its value ranges over the set of objects we are quantifying over.

In terms of the treatment of Quantified NP's presented in the last section, this sentence would have a content:\(^1\)

\( (99) \quad \langle \langle \text{EVERY}, \[
\begin{array}{l}
[ y \mid s \models \langle \langle \text{NZ}, y \rangle \rangle ], \\
[ y \mid \langle \langle \text{LOVE}, y, z_{\langle \langle \text{MOTHER-OF}, z_{\langle \langle \text{MALE}, y \rangle \rangle} \rangle} \rangle ] \rangle 
\end{array}
\rangle \rangle \)

\(^1\)Actually, as we saw in Section 3.5, what we get after scoping is a little more complicated, but we abstract away from those complications here. There is also a complication involving what, in Section 4.3, we will call the Absorption Principle.
The bound-ness of the logical variable \( x \) in (98) here corresponds to the type-absorption of the parameter \( y \) in (99).

Note that the pronoun parameter here is restricted, as it was for deictic pronouns in Chapter 2. Since we will be seeing a lot of such parameters in what follows let us adopt the convention that a parameter like:

\[
\text{x}_{\langle \text{MALE}, x \rangle}
\]

can be abbreviated as:

\[
x_{\text{MALE}}
\]

In contrast to cases like (98), deictic pronoun uses make it clear that some pronoun uses are much closer to the way free variables are used in logical languages.

(100) He arrived.

\[ \text{[a arrived]} \]

Here the interpretation of the pronoun is a specific contextually-assigned referent, just as the interpretation of the logical sentence depends on the assignment given the variable. In terms of the scheme presented in the last section, omitting the described situation, the content of (100) would be, roughly,

\[
\langle \text{ARRIVE, x}_{\text{MALE}} \rangle
\]

Thus, there seem to be at least two semantically distinct sorts of pronoun uses. This difference becomes problematic when we consider the sorts of examples that have often concerned linguists, that is, cases of simple anaphora, where the pronoun is referentially connected to some other overtly expressed NP:

(101) John loves his mother.

One might now ask: is (101) more like (99) or (100)? That is, glossing over some details,\(^2\) is it best represented as (102a) or (102b)?

(102) a. \[
\{ [y] \mid \langle \text{LOVE}, y, z \langle \text{MOTHER-OF}, x, y_{\text{MALE}} \rangle \rangle, \quad w_{\langle \text{NAMED}, \text{subj}:w, \text{"John"} \rangle} \}
\]

b. \[
\{ [y] \mid \langle \text{LOVE}, y, z \langle \text{MOTHER-OF}, x, w_{\text{MALE}} \rangle \rangle, \quad w_{\langle \text{NAMED}, \text{subj}:w, \text{"John"} \rangle} \}
\]

In (102a), the parameter corresponding to the pronoun, \( y_{\text{MALE}} \), is type-absorbed, just as it was in (99). In (102b), it is not, and the

\(^2\)In particular, tense and those that will arise in connection with what we call the Absorption Principle in Section 4.3.
circumstances will be responsible for anchoring it, just as in (100). It so happens, however, that the pronoun parameter is the same as the parameter utilized by the Noun Phrase John, so that both Noun Phrases will necessarily end up referring to the same individual.

In classical Transformational Grammar, something like the view (102b) was favored: the actual vehicle was the Pronominalization Transformation, which simply substituted the pronoun for an underlying copy of the Noun-Phrase John. The pronoun was a sort of parameter whose appropriate valuation was determined by its syntactic source. It was Barbara Partee who first noted that neither (102a) nor (102b) might be satisfactory, or rather, that both might be, because of ambiguities like those in (103) (see Partee 1972):

(103) Only John expected that he would lose.

This sentence has one reading, traditionally called the strict reading, on which only John has the property of being an x that expects John to lose. This is the reading we might expect on the Transformational "substitutional" account of the anaphoric relation, as evidenced by the fact that it can be paraphrased with "Only John expects John to lose."³

There is, however, another reading, christened the Sloppy reading in Ross (1967), on which only John has the property of being someone who expects their own loss. It is this second reading which Partee calls the "bound-variable" reading.

The two readings differ on which property only John is claimed to have. In our sense, then, they can be distinguished by the VP contents:

(104) I. Strict

VP-content:

\[
[x_{subj} | [\langle \text{EXPECT}, x, \langle y | \langle \text{LOSE}, y \rangle \rangle, subj : w_{\text{MALE}} \rangle ]]
\]

Sentence-content:

\[
\langle \text{ONLY}, w_{\langle \text{NAMED}, w, \text{"John"} \rangle},
\langle x_{subj} | [\langle \text{EXPECT}, x, \langle y | \langle \text{LOSE}, y \rangle \rangle, subj : w_{\text{MALE}} \rangle ] \rangle \rangle
\]

³Partee (1972) suggests that rather than look at the transformational account as co-parameterization, it is more appropriately seen as a "lazy" pronoun account, in the sense of Geach (1962). In any case, we will not pursue the analogy here.
II. Sloppy

VP-content:

\[ [x \mid \langle\text{EXPECT}, x, \langle[y \mid \langle\text{LOSE}, y\rangle], \text{subj} : x_{\text{MALE}}\rangle\rangle]\]

Sentence-content:

\[ \langle\text{ONLY}, w\langle\text{NAMED}, w, \text{"John"}\rangle, [x \mid \langle\text{EXPECT}, x, \langle[y \mid \langle\text{LOSE}, y\rangle], x_{\text{MALE}}\rangle\rangle\rangle \rangle \]

Recall the convention that parameters like

\[ w\langle\text{NAMED}, w, \text{"John"}\rangle \]

and

\[ x\langle\text{MALE}, x\rangle \]

can be abbreviated \( w_{\text{JOHN}} \) and \( x_{\text{MALE}} \), respectively.\(^4\) On reading I above the VP-content thus roughly becomes the property of being an \( x \) that expects John to lose, while II becomes the property of being an \( x \) that expects \( x \) to lose.

A second sort of phenomenon that Partee looked at involved other examples of a sort first discussed in Ross (1967). Consider:

(105) John expected that he would lose and Bill did too.

We are interested in two readings of (105) differing in what Bill expects: On Ross’s strict reading, Bill, too, expects that John will win; on the other, sloppy reading, he expects himself to win. In the relevant readings of (105) two kinds of anaphora are at stake simultaneously, the relation of \emph{he} to its antecedent \emph{John}, and the relation of the null or elliptical VP following \emph{did} to its antecedent \emph{expected that he would win}. Let us make the following assumption about VP-anaphora:

**Elliptical VP Hypothesis**

The described object of an elliptical VP is the described object of some other VP in the discourse.

In both the readings we are examining the “other VP” is \emph{expected that \emph{he} would win}. The Elliptical VP Hypothesis is assumed in one form another by most of those who have worked on VP anaphora, from Partee (1972) to Sag (1976) to Bach & Partee (1980). The

\(^4\)On the proposed semantics, ONLY is assumed to be appropriate only with referential NP’s. This would explain the unacceptability of “Only every boy. If the proposed generalization is correct, it offers us another test for distinguishing referential NP’s and Generalized Quantifiers.

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crucial point here is that if we adopt it, we are forced to account for the ambiguity of (105) by assuming that the antecedent VP expected that he would lose is ambiguous.

Consider again the two VP contents in I and II proposed for that VP; what different properties would be attributed to Bill if we took each as the content of the elliptical VP? With the VP content in I, the property of being an $x$ that expects John to lose would hold of Bill; with property II, the property of being an $x$ that expects $x$ to lose would hold of Bill. This contrast exactly captures the distinction between the strict and sloppy readings. It is this semantic fact that led Partee to the conclusion that one and the same linguistic contrast was responsible for the ambiguities of (103) and (105), and that that contrast could be explained in terms of two contrasting syntactic sources for pronouns.

Although we will not correlate the ambiguities in (103) and (105) with any syntactic distinction, we will endorse the core of Partee's intuition: in order to account for the ambiguity of such sentences, we need to posit two distinct contents for the VP's. The possibility for such contrasting contents will exist generally for VP's containing pronouns. In some cases—cases like (101)—those two distinct VP contents will contribute to building distinct but co-extensive situation-types for the sentence-content. In other words, the two VP-contents will contribute to truth-conditionally indistinguishable readings of the sentence. In other cases—cases like (103) and (105), where the VP-contents are arguments of a higher relation, or are exploited in VP-anaphora, the contrast between them will have truth-conditional consequences.

A central question we will be concerned with is whether such contrasting VP-contents need to be talked about in terms of two contrasting types of anaphora—two types which require different antecedency conditions on pronouns.

Because the observational distinction we draw here between two kinds of pronoun uses will not always correspond to the theoretical distinctions researchers like Partee have drawn, we propose a terminological amendment: corresponding roughly to Partee's "bound-variable" anaphora we will have role-linking pronoun uses; other anaphoric pronoun uses will be called co-parametric.

Using the notion of an NP covering a role and one role being a projection of another (both introduced in Section 3.2), we can
distinguish between the two classes of cases Partee identifies by looking at two sentence contents:

(106) I. \( \langle \{ y_{\text{subj}} \mid \{ \text{LOVE}, y, z_{\langle \text{MOTHER-OF}, z_{\text{subj}:w_{\text{MALE}}} \rangle} \}, w_{\text{JOHN}} \rangle \) 

II. \( \langle \{ y_{\text{subj}} \mid \{ \text{LOVE}, y, z_{\langle \text{MOTHER-OF}, z_{\text{subj}:w_{\text{MALE}}} \rangle} \}, w_{\text{JOHN}} \rangle \) 

In both cases the NP that utilizes the parameter \( w \) covers the role indexed \( \text{subj} \) for the VP content. This is determined by the semantics of the Sentence rule. In what we are calling the co-parametric case I, the subject parameter and the pronoun parameter are the same parameter \( w \). In the role-linking cases, however, the subject NP does not utilize the same parameter as the pronoun. Rather, it covers a projection of the role the pronoun covers. We thus propose to give role-linking anaphora the following characterization:

**Role-Linking Anaphora**

In role-linking anaphora the antecedent covers a projection of the role the pronoun covers.

This definition already makes some strong commitments, because it makes use of the notion of *covering* (introduced in Section 3.2). Grammatically speaking, the subject NP is minding its own business. It only covers the role it was meant to cover in virtue of its syntactic position; and presumably there is only one such role. This characterization of role-linking thus gives some of the effect of the C-command restriction discussed in Reinhart (1983).\(^5\) Consider, for example, (107), taken from Reinhart (1983):

(107) That people hate him disturbs Felix but doesn’t disturb Max.

For Reinhart, (107) may not involve Bound Anaphora because *Felix* doesn’t C-command the pronoun *him*. Our conception of role-linking will not admit role-linking either. Why not?

The key intuition behind most semantic treatments of the sloppy identity cases is that distinct NP’s may be the antecedent for a single pronoun because some form of ellipsis (like VP ellipsis) allows them, in our terms, “to share a role”. In the case of (105), John and Bill share the role of being “expecters of their own loss.” One might say the same of (107) and Felix and Max: they share the role of

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\(^5\)The idea of replacing C-command with a property defined in terms of how constituents meanings are interpreted goes back to Bach & Partee (1980).
being an x such that that people hate x disturbs x. But if we are going to interpret “cover” as we did in Section 3.2, then this can’t be the role either object NP covers in (107). For one thing, that role belongs to a property that contains the subject content, and the subject is outside the VP. In the kind of semantics we gave in Chapters 2 and 3, it would be impossible for a rule to require an NP parameter to label some role belonging to a relation that included semantic contributions from outside the constituent that immediately contained the NP. So an object NP, which is inside the VP, can’t cover a role belonging to a relation which includes material contributed by the subject. This is just a consequence of stating on our semantic rules on a context-free skeleton. Thus, our current characterization of role-linking will not extend to cover all cases of what has been called “sloppy identity.”

No one has come close to giving a complete, unified account of all sloppy anaphora facts. The way we have defined role-linking proposes what we believe is a useful cut through the data and allows us to confront the problem of a unified account of antecedency. The relevant test of the whole theory is whether it allows for both a plausible account of antecedency and an account of some of the constraints that do exist on sloppy interpretations.

The term role-linking is intended to highlight the fact that accounting for the semantic properties of these pronoun-uses will crucially involve reference to roles. As an example of what “crucially” means here, consider the following sentence:

(108) Every student revised his paper before the teacher did.

We will present a detailed discussion of this sentence in Section 5.1; for now, all that is important is that there are two distinct role-linking analyses consistent with the indicated anaphoric relations. These analyses correspond to two distinct readings of the sentence, which might again be called “strict” and “sloppy” readings. On the

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6 The negation here shows exactly why “sharing a role” can’t be reduced to “having the same property.” The sentence doesn’t assert that Felix and Max have the same property. It asserts that Felix has it and Max doesn’t.

7 We will consider some limited roads around this restriction in Section 7.3.1, when we return to the problem posed by cases like (107).

8 We are greatly indebted to Mats Rooth for initially bringing this example to our attention.

9 There is also a co-parametric analysis discussed in Section 5.3

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strict reading, each student revises that student's paper before the teacher revises that student's paper. On the sloppy reading, each student revises that student's paper before the teacher revises the teacher's paper. Capturing the distinction between these two role-linking readings will involve specifying two different roles that can absorb the parameter the pronoun his utilizes. These two role-linking possibilities will correspond to two different contents for the maximal VP. Schematically, those are:

(109) **Strict:**

\[
[ x | [ y | y \text{ revises } x's \text{ paper } ](x) \text{ BEFORE } [ y | y \text{ revises } x's \text{ paper } ](t) ]
\]

**Sloppy:**

\[
[ x | [ y | y \text{ revises } y's \text{ paper } ](x) \text{ BEFORE } [ y | y \text{ revises } y's \text{ paper } ](t) ]
\]

Here the strict property should be read as the property of being an x that has the property of being a y that revises x's paper before t has that property. The sloppy property is the property of being an x that has the property of being a y that revises y's paper before t has that property. Our account of such ambiguities will be to correlate them with different circumstances that dictate different co-variations among role-values. Once it is fixed which roles must co-vary, the antecedent of a pronoun is predictable. It is in this sense that antecedent/anaphor relationship is secondary in role-linking: it follows from a relation between roles.\(^\text{10}\)

What the two readings of an example like (109) show is that no bare relation between two NP's is sufficient to capture the semantic nature of role-linking; whether that relation is represented by syntactic co-indexing or some other theoretical device, something more will be required to distinguish among different role-linking readings. In proposing a circumstantial account whereby the circumstances determine what roles will co-vary, we have offered a mechanism that is sufficient to make the necessary number of content distinctions. But that mechanism is also sufficient to describe anaphoric relations in general; any further appeal to some NP-to-NP relation like syntactic co-indexing would be redundant. We return to this point in Chapter 10.

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\(^{10}\) Technically, it follows from a relation on what we call role-aspects, to be introduced in Section 5.1.

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5, and discuss some important efforts to couple a syntax co-indexing account with "something more" in Chapter 7.

This basic observation about role-linking is only a refinement of the observation that pronouns can often act like bound variables—a commonplace in the literature for quite some time. When Quine (1953) observed examples like (98), he was pointing out what at that time was a largely anecdotal relationship between natural and formal languages. A more systematic discussion of that relationship can be found in Geach (1962). The direct precursor of Partee's analysis is the treatment in Montague (1970), which captures the bound-variable behavior of pronouns with a single binding device, lambda-abstraction. There is an obvious connection between the sort of type we give as the VP content for a sloppy reading of expects that he will lose, and the property Montague or Partee would represent in Intensional Logic as a lambda-expression:

\[
\lambda x [\langle \text{EXPECT}, x, \lambda y [\langle \text{LOSE}, y \rangle, x_{\text{MALE}}] \rangle]
\]

4.1.2 Binding and Reference

We turn now to an important question whose answer will help motivate our rejection of any theoretical distinction between two kinds of anaphora: is role-linking (or bound-variable anaphora) the only sort of bound anaphora; otherwise put, can co-parametric anaphora be non-referential?

The answer is that it must be; at least, if there are two sorts of anaphora, and one sort is going to explain strict readings, then that sort must give rise to non-referential readings as well. This has already been noted in the literature, especially in Sells (1986). Sells cites examples like the following:

(111) Every time a movie becomes a hit, the director thinks he's a genius, and the star does too.

The key point here is that the elliptical VP has both a strict and sloppy interpretation, yet neither forces the pronoun to have a referential interpretation. Thus, it follows that if the difference in strict and sloppy readings is going to be accounted for by a difference between two kinds of anaphora, then "co-parametric NP's" need not be referential. This is the chief reason Sells favors the term co-specificational over Reinhart's term, co-referential anaphora.

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Examples like (111) abound, but two more examples may help make this point clearer. Consider:

(112) a. The officers hadn't stationed a man with a weapon in the one spot where it could safely be fired.

b. Every woman who leaves her husband eventually gives him a second chance.

The relevant pronoun in (112a) is it, which is clearly non-referential, and yet anaphorically related to an NP a weapon, which does not C-command it. Rather than assimilating this to a class of exceptions to the C-command condition, we would suggest that this is not role-linking (or bound-variable) anaphora at all, but simply co-parametric anaphora. The antecedent and the pronoun share the same parameter, which is then absorbed by a single negation. A mechanism for the absorption of such indefinite parameters was discussed in Chapter 2. Example (112b) is similar; her husband does not C-command him, yet an anaphoric relation is possible even in the absence of a referential understanding for the NP's. Again, we would propose a co-parametric analysis in which the parameter shared by the two NP's is simply captured by the Quantifier. We discuss examples of Quantifiers capturing Referential NP parameters in Section 4.3.

In Section 4.1.1 we defined co-parametric anaphora as anaphora in which the antecedent uses the same parameter as the pronoun. On that characterization, there is nothing to prevent the parameters involved in co-parametric anaphora from being absorbed together by some operator in the correct semantic environment. This greatly expands the class of cases which can be called co-parametric. As we will see when we turn to our formulation of quantification, even quantificational NP's can be co-parametric antecedents.

These facts can all be looked at as prima facie motivation for our use of parametric contents as a way of capturing co-variation between parts of an interpretation; indeed, they are all of the sort which pose no problem of principle for theories (like ours and Discourse Representation Theory) that assume such co-variation. The account of the "anaphoric" relation can be given at the level of parametric contents; those contents may or may not be referential, depending on surrounding discourse circumstances. Nowhere in the account of anaphora does the notion reference play any role. What we want
to suggest here is that a basic motivation for distinguishing between two kinds of anaphora disappears once that distinction is cut loose from referential and non-referential anaphora. Otherwise put: linguists had good reason to think there were two kinds of anaphora before they had fully appreciated the consequences of examples like those above. It is an interesting hypothesis to suppose that certain pronouns are simply referential (we need those anyway for deixis), while others are bound, and that other facts correlate with this distinction (like strict and sloppy readings). Call this Reinhart's hypothesis. Once Reinhart's hypothesis is shown to be false by examples like those above, then most of the interest in having two kinds of anaphora disappears. Furthermore, we also need some device to capture the co-variations of content that do occur, and parametric conditions provide such a device. What we will argue in Section 6.2 is that once we have that device, the need for two kinds of anaphora disappears completely.

Sentences like (112) are problematic for the particular pragmatic formulation of the anaphora split given in Reinhart (1983), but they need not be a challenge for her whole approach. In particular, the pragmatic principle "Use Bound Variable Anaphora," can still be stated, as long as it is correctly understood. We will return to this point in Chapter 7, where we discuss the general question of pragmatic approaches to binding facts.

4.2 Quantification, VP-ellipsis, and Scope

In Section 4.1 we drew an operational distinction between two kinds of anaphora—largely on the basis of examples involving referential NP antecedents. We turn now to the question of anaphora with Quantified NP antecedents. Although examples involving Quantified antecedents (like (94) above) first made the case for the similarity of pronouns and bound variables, we will eventually see that Quantified NP antecedents can in fact be involved in both kinds of anaphora as we have defined them.

Before turning to the account of quantified NP's and dependent pronouns, we will need to lay out some more details of our proposed treatment of quantifiers. Section 4.2.1 will deal with Quantified NP's and scope, Section 4.2.2 with anaphora and scope, and Section 4.2.3 with some interactions between quantifier scope and VP-ellipsis. We
defer discussion of whether Quantifiers can be the antecedents of co-parametric pronouns until Chapter 5.

4.2.1 Scope

Consider two readings of (113):

(113) At least two critics reviewed every performance.

**Narrow scope:**
There are at least two critics \( x \) such that \( x \) reviewed every performance.

**Wide scope:**
For every performance \( y \) there are at least two critics who reviewed \( y \).

Given the account of Quantified NP's in Chapter 3, the following is roughly the content of the wide-scope reading (we shall see why it is only roughly the content in Section 4.3):

(114) \( \langle \text{EVERY,} \langle y \mid \langle \text{PERFORMANCE}_y, y \rangle \rangle, \langle v_0 \mid \langle \text{TWO-OR-MORE,} \langle x \mid \langle \text{CRITIC}_x, x \rangle \rangle, \langle x \mid \langle z \mid \langle \text{REVIEW}, z, v_0 \rangle, x \rangle \rangle \rangle \rangle \rangle \)

In previous examples, it was easy to pick out the VP content from the entire content presented; it was just the major relation of that state-of-affairs. For example, for a co-parametric use of the pronoun *his*, the content for *John loves his mother* is roughly:

(115) \( \langle [x \mid \langle \text{LOVE}, x, y\langle \text{MOTHER-OF}, y,j_{\text{MALE}} \rangle \rangle], j_{\text{JOHN}} \rangle \)

The type

(116) \( [x \mid \langle \text{LOVE}, x, y\langle \text{MOTHER-OF}, y,j_{\text{MALE}} \rangle \rangle] \)

is the VP-content; so a semantic constituent of the sentence content corresponds exactly to a syntactic constituent. But no semantic constituent in (114) corresponds so obviously to the syntactic VP constituent in (113).

In the account of Quantifier scope presented in Section 3.5, however, we proposed that

(117) \( [z \mid \langle \text{REVIEW}, z, v_0 \rangle] \)

was actually the VP content, despite the fact that this content is (a), parametric, and (b), does not contain all the material semantically contributed by the NP "every performance."

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Since \( z \) is absorbed in (117), here, \( v_0 \) is the sole parameter; note that it is also the only element of this content that has to do with the NP *Every performance*; relative to (114), \( v_0 \) is the parameter utilized by the Quantified NP. If VP-contents like (117) can be motivated as part of a semantic analysis, then we will have more motivation for a framework which employs parametric objects.

The relevant evidence was first discussed in Sag (1976) and Williams (1977). Example (118) is modeled on one of Sag’s, again with two readings:

(118) Judith Crist reviewed every movie before Vince Canby did.

**Narrow Scope:**

JC reviewed all the movies before VC reviewed all the movies.

**Wide Scope:**

For every movie \( x \), JC reviewed \( x \) before VC reviewed \( x \).

We concentrate on the Wide-Scope reading. The content is roughly:

\[
(119) \langle \text{EVERY}, \left[ x \mid s \models \langle \langle \text{PLAY}, x \rangle \rangle, y \mid \langle \langle \text{BEFORE}, l_1 \langle \langle \text{REVIEW}, x, y, l \rangle \rangle, j, l_1 \rangle \rangle, l_2 \langle \langle \text{REVIEW}, x, y, l \rangle \rangle, v, l_2 \rangle \rangle \rangle
\]

BEFORE here has been rendered as a relation between locations, where the two locations compared are those of the main clause verb and the subordinate clause verb. Note that the shared VP content is a relation, not a property this time. Actually, the VP-contents shared in ellipsis will in general have to be relations between space-time locations and bearers of the role covered by the subject; this is because elliptical VP’s and their antecedents don’t have to agree on tense (we will elaborate on this point in Section 5.1).

The important thing about (119) is that what is shared by the elliptical VP and its antecedent HAS to be parametric. On this reading, we don’t want to pick up the property of reviewing every play (as we do on the narrow-scope scope reading). For every play, we want to get at the property of reading that play; it’s THAT property that’s going to enter into an anaphoric relation with an elliptical VP. So it’s that property we want to call the content of the antecedent VP.

More striking support for the need for Sag-Williams style interpretations comes from the phenomenon of “antecedent-contained VP..."
deletion," first noted in Bouton (1970). Consider a pair of sentences like those in (120), discussed in Sag (1976, Sec. 1.3):

(120) a. John wants to read at least one book Betsy wants him to.
    b. John wants to read at least one book Betsy wants him to read.

Sentence (120b) has two readings: first, a de re reading on which at least one book that Betsy wants John to read is such that John wants to read it (not necessarily because Betsy wants him to); second, there is a de dicto reading on which John sets out to read at least one book at Betsy's behest. The second reading is appropriate for the situation in which John sets out to obey the command: "Read at least one book Betsy wants you to read," which he may do even if there are no such books. Note, however, that only the de re reading is possible for (120a). Now consider the two possible situations which our account of VP content allows us, as given in:

(121) John wants to \([\text{VP}_0 \text{ read } \text{NP}_0 \text{ at least one book Betsy wants him to}]\)

Either the content of NP0 is in the content of the VP0 (narrow-scope or de dicto reading), or it is not (wide-scope or de re reading). If it is in the content of VP0, then it must also be in the content of any VP anaphoric to VP0. But in this case NP0 already contains a VP anaphoric to VP0; so if the content of NP0 were included in the content of VP0, the content of VP0 would have to contain itself. Assuming that our theory of linguistically permissible semantic objects rules out such peculiar constructs, it will also rule out the de dicto content of (120a).11

There are thus various sorts of examples involving VP-ellipsis that motivate the idea of parameterized-VP as proposed by Sag and Williams. The important point about such parameterized VP's is that they provide further support, through a different anaphoric process, for the sort of parametric contents to which we have committed ourselves. One might claim that VP's have no content and still have some hope of dealing with the semantics of examples like (120) (the DRS accounts described in Chapter 7 might be looked

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11There is extensive discussion of circular propositions in Barwise and Etchemendy (1987). Though there is evidence for circular propositions there is no evidence yet for circular quantified propositions, nor any clear idea of what claim they would make if there were any.
at that way), but there is no obvious way to relate the semantics contributed by the elliptical VP to the semantics contributed by its antecedent without using parametric contents. The DRS accounts in Chapter 8 essentially involve copying clause contents and leaving out the conditions contributed by the subject, but because the copying must occur inside the scope of a quantifier, those contents are crucially parametric.

Again, the motivation for parametric objects involves anaphora, this time VP-anaphora, but the conclusion is the same as was forced on us by the existence of strict non-referential readings: parametric contents crucially enter into the account of certain anaphoric facts.

4.2.2 Pronouns and Scope

The null hypothesis suggested by examples like (113) is that a quantifier can bind any appropriate pronoun in its scope. This follows on the standard assumptions built into a number of frameworks, including that of Montague (1970), Kamp (1981), Heim (1982), Roberts (1987), and Government Binding Theory, in so far as the notion of semantic scope can be identified with scope in Logical Form. An example like (122) suggests the converse, also built into the above frameworks; a quantifier can bind only pronouns in its scope.

(122) a. John read every book before Bill read it.
   b. John read every book before Bill did.

Sentence (122b) is ambiguous in a way analogous to the ambiguity in (120): either John read each book individually before Bill read that book, or else he read the sum total of the books before Bill read the sum total of the books. The second reading can be paraphrased “John read every book before Bill read every book.” On the first—or wide-scope—reading, every scopes over before. Note that only this wide-scope reading is possible in (122a) with the indicated anaphoric relations. This is easily explained if we assume every book must have wider scope than before in order to bind the pronoun—that is, if quantifiers can only bind pronouns within their scope.

Further support for this view comes from examining contexts that preclude the possibility of wide-scoping readings. Consider (123):

(123) If every senator wins, then John will be pleased.

This sentence has no reading on which every outscopes if, that is, no reading which might be paraphrased If any senator wins, John will be
pleased. As a number of people have noted, it seems to be a property of if-then clauses, for whatever reason, that many quantifiers cannot scope out of them.

Given this observation, consider:

(124) *If every incumbent wins, then he’ll be surprised.

This sentence appears to be unacceptable with the indicated anaphoric relations. Again, this phenomenon would be explained under the assumption that quantifiers can bind only pronouns in their scope. A natural extension of this generalization would be Claim A:

A: A Quantifier can only bind parameters within its scope.

As noted in Chapter 1, analogues of this claim involving variables are theorems of just about any semantics of a formal language with bound variables. As we shall see in the next section, A makes some strong claims outside the domain of anaphora with pronouns, claims about the interaction of scope and VP-ellipsis.

4.2.3 The Analogy between Pronouns and Quantifier Parameters

The following example is used to make points first discussed in Sag (1976) and Williams (1976):

(125) If at least two critics reviewed every performance, then Clive Barnes did.

The relevant claim about this sentence is that it lacks the reading:

If, for every performance \( x \), at least two critics reviewed \( x \), then Clive Barnes reviewed \( x \).

That is, even though the first clause is (125) is ambiguous as to scope (see (112)), that ambiguity disappears in the context of (125). Only the narrow-scope reading of Every performance is possible:

This observation in fact follows from Claim A made in the last section, taken together with our observations about scope in if-then clauses. There are three possibilities for scoping every performance that we need to consider, which we will informally represent as positions in (126):

(126) \( \Delta_1 \) If \( \Delta_2 \) at least two critics [\( _{VP_0} \text{reviewed} \Delta_3 \ y \)], then CB did \( VP_0 \).

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Here we take \( y \) as the parameter covered by *every performance*. The \( \Delta_i \)'s represent possible scopes. Scoping *Every performance* in situ (position 3) gives us the reading that is in fact possible. Scoping to position 2 is impossible, because that gives us a parameterized VP content. But that parameterized VP-content, VP\(_0\), must be reused as the content of the elliptical VP, and when it is used there, the parameter \( y \) occurs outside the scope of its binding quantifier. This is precluded by Claim A. The only place the Quantifier could scope to and still bind both occurrences of the \( y \) parameter is outside the *if-then* clause altogether. But as we saw before, *Every* does not appear able to scope outside of *if-then* clauses.

### 4.2.4 Crossed-Scope Readings and Hirschbuhler's Examples

Sag (1976) and Williams (1976) also discuss examples like the following:

(127) If at least two critics attended every performance, then some director did.

The prediction that Sag's system makes is that sentences of this sort lack the reading:

If, for every performance \( x \), at least two critics \( y \) attended \( x \), then for every performance \( x \), some director \( z \) did.

Sag calls these inaccessible readings *crossed-scope* readings. Without some radically different idea of how Quantifier scoping works,\(^{12}\) our system makes exactly the same prediction as Sag's. The idea is that once a Quantifier takes wide scope out of a VP, the VP-content is parametric; any elliptical VP that uses that VP-content should fall within the scope of the Quantifier, but in (127) the elliptical VP is necessarily outside the scope of the Quantifier.

As it turns out, some later observations have made the status of Sag's prediction somewhat problematic. (128) is a variant of an example given in Hirschbuhler (1982):

(128) If an American flag hangs outside every American Embassy, then a Canadian flag does too.

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\(^{12}\)Essentially, to allow the forbidden reading of (127), we would have to allow a Quantifier to quantify in more than one; obviously, without some restrictions, this course would lead to havoc; for example, it would allow a reading of *Every student revised his paper* which meant *Every student revised every student's paper.*
Crossed-scope readings do appear possible for (128). That is, (128) has a reading paraphrasable as If, for every American Embassy $x$, an American flag $y$ hangs outside $x$, then for every American Embassy $x$ a Canadian flag $z$ hangs outside $x$, too. It would appear semantically as if the only way of binding both occurrences of the parameter $x$ is to have the Quantifier scope outside the if-then clause altogether, but the sentence does not have any such wide-scope reading. It cannot mean: For any American Embassy $x$, if an American flag hangs outside $x$, then a Canadian flag hangs outside $x$, too.

Whatever is going in (128), it is not entirely clear that it is an example of a parameter occurring outside the scope of its binding Quantifier. Consider the status of the referential NP an American flag. On the problematic reading, it occurs inside the scope of the Quantifier every American Embassy. In our terms, the NP parameter ought to be absorbed inside the scope of the Quantifier, and thus, it ought not to be available for anaphora outside that scope. But it appears that it is available for anaphora in the consequent clause:

(129) If an American flag hangs outside every American embassy, then a Canadian flag hangs beside it.

Moreover, it appears much more difficult to obtain a pronoun anaphoric with the Quantified NP:

(130) If an American flag hangs in front of every American embassy, then a Canadian flag hangs behind it (the embassy).

Sentence (130) suggests what we were already in fact assuming, that the scope of the quantifier includes only the antecedent clause. (129) suggests that the parameter for an American flag is not absorbed within that scope. But in that case, it is not clear that we have a crossed-scope reading at all here, and thus not clear that we have a parameterized VP content occurring in both halves of the conditional.

What are the alternatives? The alternatives are not very appealing, but they may be forced on us by this array of facts: we must conclude that an indefinite NP can somehow be dependent on a quantifier without being in its scope. One way this might occur is by some sort of relaxation of the usual reference function of an indefinite NP in a generic context like that in (130). Thus, instead of denoting an actual American flag, it might denote some function that returns
American flags, a sort of choice (or Skolem) function: give me a domain object and I'll give you back a corresponding American flag. We must now imagine that, by a kind of metonymy, generic statements about flags actually have such choice functions as constituents in their interpretations. When the subject of a sentence denotes such a choice function, the VP must correspondingly denote a property of such functions. Given this bit of non-compositional freedom, we open up the following route for treating (130); let our choice function for American flags be written:

\[(131) \ f(\langle \text{INVOLVES}, \{x,y\}, \langle \text{EQUAL}, f(x), y \rangle, \langle \text{AMERICAN-FLAG}, y \rangle \rangle) \]

This is a function which is restricted to obey a constraint. The constraint relation INVOLVES is introduced in Barwise and Perry (1983); basically one situation involves another when the following holds: if the first is a fact, then so is the second. The relation INVOLVES has a new sort of argument, a set of parameters, This is because INVOLVES has the unusual property of being able to absorb parameters; the set of parameters tells us which of the parameters in the constraint's arguments are actually absorbed. In this case, \(x\) and \(y\) are absorbed, so we have a parametric constraint, the only parameter of which is \(f\). Thus, the restriction on \(f\) is that it can only be anchored to some function \(f\) which, when substituted into the parametric constraint, makes it factual. The constraint says that for every \(x\) and \(y\) such that \(f(x)\) equals \(y\), \(y\) is an American flag. So what the restriction says is that \(f\) can be anchored only to functions that have only American flags in their range.

So much for the NP An American Flag. Complementing this unusual view of the interpretation of the NP, we will also have an unusual view of the interpretation of the VP should be:

\[(132) \ [f \mid \langle \text{EVERY}, \ y \mid s \models \langle \text{AMERICAN-EMBASSY}, y \rangle \rangle, \ y \mid s' \models \langle \text{HANGS-OUTSIDE}, f(y), y \rangle \rangle] \]

This is the property of being a choice function which, for every embassy \(y\), takes one to an \(f(y)\) that hangs outside \(y\). What the sentence as whole says, then, that one such choice-function is one that outputs American flags. The VP content given has no parameters, and thus is free to be re-used where it will, in or outside the scope of other quantifiers. Claim A is no longer at issue.

Section 4.2
Thus, for the price of a promissory note charged to our theory of reference, we may have an account of the Embassy-example. Such a proposal raises numerous interesting issues and difficulties but it is not our aim here to explore them fully. Our point was simply to suggest the form of an account that might handle the peculiarities of such cases without abandoning Claim A. It is perhaps worthwhile tarrying to point out that the same account would extend to account for some mysteriously bound pronouns we will turn to in Section 7.3.2. Consider a variant of the antecedent clause of the Embassy example:

(133) The flag of its country hangs outside every American Embassy.

Here, the effect of binding the pronoun with its quantifier can be simulated by rendering the VP with the same VP content as before, and by rendering the subject with the following choice function:

(134) \[ f\langle \text{INVOLVES},\{x,y\},\langle \text{EQUAL},F(x),y\rangle,\langle \text{FLAG-OF},y,x\langle \text{COUNTRY-OF},z,x\rangle \rangle \rangle \]

This is the choice function that takes one from a country to its flag. Given this interpretation, one could maintain that the binding of the pronoun by the universal quantifier was only apparent. Therefore, one could continue to defend either the claim that Quantifiers must C-command the pronouns they bind (see, for example, Reinhart (1983) again), or the claim we defend in Section 7.3.2, that they must occur to the left of them.

In sum, these phenomena still pose a significant problem for anybody's account, but there appears to be some promise of an account that preserves Sag's crossed-scope prediction. We thus continue to pursue the development of a theory that incorporates something like Claim A.

### 4.3 The Absorption Principle

The goal of this section is to explore the consequences of a Principle of Situation Theory called the Absorption Principle for our semantics of NP's. We begin by presenting the linguistic motivations for the Absorption Principle, all of which can be viewed as ways in which Referential NP's behave like Quantifiers. We then show how the Absorption Principle follows from some natural assumptions of Situation Theory, in particular, assumptions about the nature of type-abstraction and restricted parameters.

**Chapter 4**
The Absorption Principle is best introduced by returning to a puzzle referred to in Chapter 1. In (135), both strict and sloppy anaphoric interpretations are possible. However, (135) shows the analogous ambiguity only if she is interpreted deictically.

(135) Mary corrected her mother's mistake before I did.

(136) Mary corrected her mother's mistake before she did.

If she is used anaphorically with her mother as antecedent, no sloppy-identity interpretation is possible for the pronoun her, having Mary as antecedent. The sentence cannot mean: Mary corrected Mary's mother's mistake before Mary's mother corrected Mary's grandmother's mistake. When the sloppy interpretation is fixed, then, something constrains the anaphoric possibilities of the NP her mother. The question is what? Our answer crucially involves the Absorption Principle; we will show that the Principle requires that the parameter corresponding to the NP her mother be absorbed in the content of the first VP on the sloppy reading; it is therefore unavailable for anaphoric relations with anything outside the VP.

In this section we first try to argue for the Absorption of the relevant class of NP parameters; then we state the Absorption Principle and explore its consequences; as we shall see, it predicts a number of facts about referential NP's containing pronouns, as well as facts about the absorption of both definite and indefinite NP parameters, including pronouns.

### 4.3.1 Absorption

We begin with our analysis of (137). The content shown appears appropriate for a role-linking use of the pronoun his.

(137) John washed his car and Bill did too.

\[
\langle \langle x_{subj} | \langle \langle \text{WASH}, x, y \langle \text{CAR}, s, y \rangle \rangle \wedge \langle \langle \text{OWN}, s, y, x_{male} \rangle \rangle \rangle, \\
\text{subj} : j\text{JOHN} \rangle \\
\wedge \langle \langle x_{subj} | \langle \langle \text{WASH}, x, y \langle \text{CAR}, s, y \rangle \rangle \wedge \langle \langle \text{OWN}, s, y, x_{male} \rangle \rangle \rangle, \\
\text{subj} : b\text{BILL} \rangle
\]

The question we need to address is whether the content given in (137) is the right one.\(^{13}\) Note that the content shared by the VP washed his car and the elliptical VP is parametric. That means that

\[^{13}\text{For now, we will treat possessives as indefinites and defer discussion of the interaction of the Absorption Principle with definites until Section 4.3.7.}\]
when \( y \) gets anchored in some set of circumstances, it will be the same \( y \) that Bill and John are related to. And though joint tenancy is certainly possible for cars, it just isn’t correct that on the sloppy reading this sentence requires Bill and John to own the same car.

What we want is a content that allows that but doesn’t require it. That is we want (138), which ignores tense:

(138) John washed his car and Bill did too.

\[
\begin{align*}
\langle [x_{subj}, y | \{\langle \text{WASH}, x, y\langle \text{CAR}_s, y \rangle \langle \text{OWN}_s, y, x_{\text{MALE}} \rangle \} ] , \\
\quad \text{subj : } j_{\text{JOHN}} \rangle \\
\wedge \langle [x_{subj}, y | \{\langle \text{WASH}, x, y\langle \text{CAR}_s, y \rangle \langle \text{OWN}_s, y, x_{\text{MALE}} \rangle \} ] , \\
\quad \text{subj : } b_{\text{BILL}} \rangle 
\end{align*}
\]

The content of the both clauses of (138) involves a relation that holds between \( x \) and \( y \) when \( x \) washes \( y \), a car that \( x \) owns. When the content of the first clause is anchored by some anchor \( f \), the resulting state-of-affairs is a state of affairs in which \( f(j) \) fills the subj role of that relation. Since \( [y] \) is a role of this relation but is unfilled it is in effect existentially quantified over (see Section 2.2, on unsaturated states-of-affairs).

The Absorption Principle is a principle of Situation Theory which rules out (137) entirely as a possible content for the sentence. One might ask: do we really want a principle ruling out (137)? How do we know that (137) and (138) aren’t both bonafide sloppy readings? As we noted, the sentence can certainly be true in the case of joint tenancy; so what prevents us from counting (137) as a reading?

We might try appealing to classical ambiguity tests of the sort discussed in Zwicky and Sadock (1974). Consider:

(139) John washed his car after Bill did, and Frank did too.

If the sentence really has two sloppy readings, then crossed readings of the two clauses, one requiring joint tenancy and the other not requiring it, ought to be impossible. Speakers seem to agree that they are possible. Unfortunately, this doesn’t settle the issue, because this is precisely the kind of situation for which Zwicky and Sadock point out the fallibility of classic ambiguity tests. The reading in (137) entails the reading in (138); therefore what looks like “crossed” readings can be explained just by using the content in (138). That doesn’t mean there isn’t a reading captured by (137). Thus, standard ambiguity tests are of no help.
Hence what becomes important is the overall explanatory adequacy of a theory that blocks (137). We know we can get by without it; the question is, do we need to? In the rest of this section we try to state the Absorption Principle precisely, and then point to a number of other consequences that follow from it.

### 4.3.2 Statement of the Absorption Principle

We begin by noting a very general restriction on parametric relations. We'll say that a parameter $y$ depends on $x$ if $x$ is a parameter of a restriction on $y$. In (139), then, $y$ depends on $x$. Then, what we'll call the Absorption Principle says:

**Absorption Principle**

If $x$ is a parameter of some object $o$, then every parameter that $x$ depends on is a parameter of $o$.

What the Absorption Principle does is rule out any properties that look like this:

\[ [x \mid \langle\ldots y\langle\ldots x\ldots\rangle\ldots\rangle] \]

The claim of the Absorption Principle, then, is that these types do not exist. The reason has to do with the nature of restricted parameters.

As we noted in 2.1.4, when we introduced restricted parameters, restrictions are restrictions on anchoring. Any anchor for a parameter must anchor all the parameters in its restriction; this is because a restriction must be satisfied before an anchoring can count as a bonafide anchoring, and only a non-parametric condition can be satisfied. But consider some type $T$ of the sort ruled out by the Absorption Principle, $[x \mid \langle\ldots y\langle\ldots x\ldots\rangle\ldots\rangle]$, where $y$ is a parameter of $T$ and $y$ depends on $x$, but $x$ is not a parameter of $T$. Given our initial assumptions about restrictions, there is no sensible interpretation for an anchor for the single parameter of $T$, and thus for $T$ as a parametric object.\(^{14}\) With this in mind, we turn to the question of how the the VP-content in (138) is to come about.

The grammar-rules of Chapter 2 and 3 tell us that the content of a VP is a type formed by absorbing the parameter labelling the subject role and the tense role. We might think of the VP-rule as giving us an underspecified relation:

\(^{14}\)For readers interested in further discussion, we motivate the Absorption Principle further in the Appendix.
In Circumstances where $x$ is a parameter in some restriction on another parameter—as it is in (140)—the Absorption Principle tells us to absorb that other parameter—$y$ in this case. So what we get is:

(141) \[
[|x \text{subj}, z \text{tns}, y| \langle \langle \text{WASH}, x, y \langle \langle \text{CAR}, y \rangle \rangle \rangle \land \langle \langle \text{OWN}, y, y \text{Male} \rangle \rangle, z \rangle]
\]

The result (141) satisfies the requirements of the VP-rule by absorbing the minimal set of parameters which both satisfy the rule and give a type allowed by the Absorption Principle. This VP-content is not a property of washers of their own cars, but a relation between car owners and the cars they wash. In Chapter 2, we adopted a view of VP-contents which made them two-place relations with one role indexed subject and the other indexed tense; it will follow from the Absorption Principle that there won’t be any particular -arity shared by all VP-contents; VP-contents can in principle be relations of any -arity, depending on how many parameters are absorbed by the Absorption Principle. Note, however, that the grammar and lexicon will always fix a particular number of roles that are indexed, since only the grammar rules and lexical entries can index roles. In the rules of Chapter 2, VP-contents always have two indexed roles. Given our rule formalism, only indexed roles can be labelled by parameters that are anchored or quantified away. Thus, the unindexed roles of a VP introduced by the Absorption Principle are inaccessible; they cannot be given arguments. In effect, they function as if they were Existentially Quantified away.

The general picture, then, is this. The schematic output in (140) corresponds to a unique type with the role corresponding to $x$ indexed subj, and the role corresponding to $z$ indexed tns, and with any parameter that depends on either $x$ or $z$ also absorbed. This type necessarily satisfies the Absorption Principle.

By way of contrast, consider a co-parametric analysis of the VP in (141), given in (142).

(142) John washed his car and Bill did too.

\[
\langle [x \text{subj}, z \text{tns}] | \langle \langle \text{WASH}, x, y \langle \langle \text{CAR}, y \rangle \rangle \rangle \land \langle \langle \text{OWN}, y, y \text{Male} \rangle \rangle, z \rangle \rangle
\]

\[
\land \langle [x \text{subj}, z \text{tns}] | \langle \langle \text{WASH}, x, y \langle \langle \text{CAR}, y \rangle \rangle \rangle \land \langle \langle \text{OWN}, y, y \text{Male} \rangle \rangle, z \rangle \rangle
\]

\[
[x : j \text{JOHN}, \quad [x : b \text{BILL}]
\]
This time when the subject parameter is absorbed in the VP rule, it does not occur as a parameter of any restriction, so the Absorption Principle is not invoked. Consequently, the same $y$ parameter is shared by both VP-contents, and it is the same car that John and Bill wash. This is just what we want for the strict reading of the elliptical VP.

In the next sections, we turn to a number of consequences of the Absorption Principle.

4.3.3 Referential Dependence

To begin with, we need some terminology. In general the effects of the Absorption Principle will concern Noun Phrases related the way *John* and *his car* are in (137). These two Noun Phrases aren't in an anaphoric relation, but they are in a relation of referential dependence, since the referent of *his car*—on the intended use—depends on the referent of *John*. In such cases, we'll say that the NP *his car* depends on NP *John*, paralleling the way the car parameter $y$ depends on the subject parameter $x$.

In fact, there appears to be a general relation of *referential dependence* between NP's—of which the anaphor/antecedent relation is only a special case.\(^{15}\)

Consider the relations exemplified by the italicized NP's in (143), beginning with two examples we have seen before:

(143) a. *John* loves *his mother.*
   b. *Every New Zealander* loves *his mother.*
   c. *This teacher* is better than *the other teacher.*
   d. *Every teacher* uses *a different method.*

In each of the sentences in (143), the second italicized NP can be thought of as in some way *referentially dependent* on the first, though

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\(^{15}\)Reference to a general dependency relation among NP's is made in Barwise (1987), who would speak of the italicized NP's in (143a)–(143d) as being in an antecedent/dependent relation. For an interesting discussion that has inspired some of the points made in this one, see Roberts (1987). Roberts also makes use of a general "dependence" relation among NP's. But for her, this relation is all that can be established on the basis of co-indexing in syntactic trees. Thus, our notion of dependency will differ in two important respects: first, we make no use of such syntactic decorations as indexing, and no accompanying distinction between "discourse" antecedents and syntactic antecedents. Second, our notion of "dependency" is probably somewhat more general than Roberts's, since she would probably not include the relation among the italicized NP's in (143a).
the dependency relationship in question is nothing like co-reference. (143a) and (143b) show the kind of referential dependence which will be governed by the Absorption Principle. (143c) and (143d) show other kinds that will not be a concern in this book. To single out the case of referential dependence for pronouns, we will say the pronoun is anaphorically dependent on its antecedent. Both role-linking and co-parametric pronouns are anaphorically dependent on some other NP. To single out cases like (143a) and (143b), where a referential NP, NP₁, is dependent on another NP, NP₂, in virtue of something about its restriction, rather than something about the parameter it utilizes, we will speak of NP₁ being indirectly dependent on NP₂.

Note that the intuition of referential dependence includes anaphora; in (143a), both his and his mother are referentially dependent on John, though in different ways. Thus far, however, in presenting sentence contents we have not provided a uniform treatment of referential dependence. Indirect dependence has been represented by parametric dependence; the parameter for his mother depends on the parameter for John in (143a). Direct dependence has, in the case of co-parametric anaphora, been represented as parametric equality; the parameter for his equals the parameter for John. In fact, it is quite easy to collapse the two phenomena, and treat all referential dependence as parametric dependence. Suppose we represent anaphoric dependency as follows:

(144) A student revised his paper.

\[\{[x | \langle\text{REVISE}, x, y\langle\text{PAPER-OF}_{s}, u_{g}, y\rangle\rangle]\}, t_{s}\models\langle\text{STUDENT}, t\rangle\]\n
where
\[\theta = \langle\text{MALE}, u\rangle \land \langle\text{=}, u, t\rangle\]

Here instead of using the same parameter \(t\) for the student and for the pronoun his, we have used two different parameters \(t\) and \(u\) and placed the restriction on \(u\) that it be equal to \(t\). This content would replace the co-parametric analysis of A student revised his paper.

\[\text{Along the same lines, some American Indian languages have what are called switch-reference markers, which can mark disjointness of reference between NP's in the same discourse. For an example discussed in current theoretical idioms, see the discussion of Pomo in O'Connor (1986). Again, the relation is one of referential dependence, but hardly one of co-reference.}\]
Note that now, anaphoric dependence is reflected at the level of content by parametric dependence. The parameter \( u \) depends on \( t \).\(^{17}\)

An important point to note is that it is the Absorption Principle that makes (144) a practical treatment. Because of the Absorption Principle, a pronoun parameter dependent on some other NP parameter must be absorbed whenever that NP parameter is. Without it, it would be something of a mystery, on the above account, why pronouns always have the same scope as their antecedents.

In constructing a semantic fragment using a context-free skeleton, it is actually somewhat easier to work with the above treatment of anaphora than with the treatment that uses parametric identity to represent anaphora. The reason is that making an NP anaphoric means placing an extra condition on it; whereas on the other route it means contriving to pick the right parameter in the first place. But this is a minor point. Empirically, given what we have looked at thus far, there seems to be no difference between the two accounts of anaphoric dependency. In Section 4.3.8, when we turn to the question of unifying pronouns and definites, we will see that representing anaphoric dependency as parametric dependency makes some interesting predictions.

4.3.4 The Absorption Principle and Referential NP's

A first general consequence of the Absorption Principle can be stated as follows: Suppose a pronoun utilizing parameter \( x \) occurs inside a referential NP utilizing parameter \( y \). Then if \( x \) is absorbed in role-linking, so is \( y \). Informally, whenever a pronoun inside a referential NP is used "sloppily" that NP must be used sloppily too. When it is used non-sloppily, the Absorption Principle won't apply.

Example (145) serves to illustrate the contrast.

(145) Alice recommended a book she hated before Mary did.

Again there are sloppy and strict readings, it can be a book Alice hated that Alice recommends, or a book that Mary herself hated. The claim enforced by the Absorption Principle is that this sentence can't be used to assert that there is a certain book \( y \), such that Alice

\(^{17}\)Within Situation Semantics, the idea for this treatment of anaphora is due to unpublished fragments by Israel and Perry. The Discourse Representation Theory approach outlined in Kamp (1982) also captures anaphoric relations through equality conditions on discourse-markers, which are analogous to our parameters.
recommended and hated $y$, and Mary recommended and hated $y$.

(146) gives the content allowed by the Absorption Principle.

(146) | (BEFORE,
\begin{align*}
  l_1 \langle [x, l, y][\langle \text{RECOMMEND}, x, y, \rho(x, y), l \rangle], a_{\text{ALICE}}, l_1 \rangle \\
  l_2 \langle [x, l, y][\langle \text{RECOMMEND}, x, y, \rho(x, y), l \rangle], a_{\text{MARY}}, l_2 \rangle
\end{align*}
\)

where \(\rho(x, y) = \langle \text{BOOK}_s, y \rangle \land \langle \text{HATE}_s, x, y \rangle\)

Since the prediction is that sloppiness of the pronoun entails sloppiness of the enclosing NP, a conflict arises in the case of a grammatical device that makes the enclosing NP refer. Either the referring reading of the NP must disappear or the sloppy reading of the VP must disappear. A natural case to look at is that of definite NP’s.

(147) Alice liked the paper about anaphora that she read, and Mary did too.

Sentence (147) has both a strict and sloppy reading. The crucial point is that, on the sloppy reading, the NP the paper about anaphora that she hated can no longer be used to refer, even though it is definite. It must be allowed to pick out different papers for Alice and Mary.

Note also that syntactic choices that don’t encode restrictions on parameters need not trigger invocation of the Absorption Principle. Consider:

(148) Alice recommended the paper about anaphora though she hated it, and Mary did too.

In contrast with (147), this sentence appears to allow the reading on which there is a certain paper Alice and Mary hated and Alice and Mary recommended.

One way of looking at the Absorption Principle is that it states a property of referential NP’s that is also a property of Quantifiers. Some referentially dependent NP’s are Quantifiers, as (149) shows:

(149) No linguist likes every paper about anaphora she reads.

On the reading in which she is anaphorically related to No linguist, every paper about anaphora she reads can no longer be understood as taking wide scope. This follows on just about everyone’s theory of quantifiers, because the semantic nature of quantifiers precludes

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the possibility of a quantifier $Q_2$ in the scope of another quantifier $Q_1$ binding $z$ in the restriction of $Q_1$.

(150) Ruled out: $Q_2$ binds $z$ in $\langle (Q_1, [x \ldots z \ldots]), [x \ldots Q_2 \ldots] \rangle$

This is really just a special case of claim A discussed in Section 4.2.2: Quantifiers do not bind pronouns outside their scope. Suppose every paper about anaphora she reads in (149) takes wide scope; then it would be playing the part of $Q_1$ and $Q_2$ would be no linguist; thus no linguist would correctly be predicted to be unable to bind the pronoun. An immediate consequence of (150), or really of Claim A, is that no analogue of the Absorption Principle is needed for Generalized Quantifiers. To put it another way, if all our referential NP’s were treated as Quantifiers, the predictions of the Absorption Principle would automatically follow.

Treating the contents of Referential NP’s as restricted parameters captures this quantifier-like property of Referential NP’s. Putting it in the language of those who use variables, our restricted variables are defined so that no variable can be “free” in a formula without its restricting variables also being free; those restricting variables can thus never be bound “too soon.” Thus we capture an essential similarity of Generalized Quantifiers and Referential NP’s while presenting an account that still captures their differences, such as those exhibited by donkey-anaphora.

4.3.5 Bach-Peters Cases

We noted in Section 4.3.1 that anaphora with NP’s indirectly dependent because of role-linking was impossible outside the scope of where the Absorption Principle had applied. This was what explained the impossibility of anaphora in Mary corrected her mother’s mistake before she did. The Absorption Principle will also exclude any anaphoric connections between pronouns inside the Subject and any NP indirectly dependent on the Subject because of role-linking.

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18 A related point is this: if a pronoun inside a VP Quantifier is to be anaphorically related to the subject by role-linking, the Quantifier can at most take VP scope. This can be seen in the following contrast:

(i) Mary read every book before Ann did.
(ii) Mary read every book she bought before Ann did.

Sentence (i) is ambiguous between a reading on which every book takes wide scope, and one on which it takes narrow scope. In (ii), with the role-linking reading, only narrow scoping of the Quantifier is possible.
This is precisely the sort of situation that crops up in connection with what have come to be called Bach-Peters sentences.

(151) The pilot who shot at it hit the MIG that chased him.

Here there are crossing co-reference possibilities. The pronoun *him* can be understood as anaphorically linked to the subject *the pilot who shot at it* and the pronoun *it* as anaphorically dependent on *the MIG that chased him*.

Before we turn to cases involving role-linking, it might be useful to point out here that sentences like (151) provide yet another motivation for distinguishing referential NP's from Generalized Quantifiers. Consider a treatment of (151) in which both NP's were treated as Generalized Quantifiers. Then (150), discussed in Section 4.3.3, would incorrectly rule out the possibility of a Bach-Peters reading. First consider the scoping on which *the pilot who shot at it* has wider scope than *the MIG that chased him*. On that scoping, the pronoun *it* cannot be bound to *the MIG that chased him* because it falls outside its scope. This is just the situation discussed in Section 4.3.3; here, *the MIG that chased him* would play the role of Quantifier$_2$ in (150). But (150) seems an inevitable consequence of any standard semantics for Generalized-Quantifiers. On the other hand, if both NP's are treated as referential, then there are no scopes to worry about, and the problem disappears. The accompanying prediction is that Bach-Peters sentences are impossible for genuine Quantifiers. And that appears to be correct:

(152) Every pilot who shot at it hit every MIG that chased him.

This sentence appears to have no reading on which *every MIG that chased him* binds *it*. The lack of such a reading, then, can be predicted purely on semantic grounds.\(^\text{19}\)

So these sentences, originally devised as a criticism of a classic generative account of anaphora, serve here to reaffirm the distinction between referential NP's and Generalized Quantifiers. As we shall see, they also provide another context in which to test the predictions

\(^{19}\text{Of course there are other explanations for why the intended reading of (152) is impossible, for example that Quantifiers must precede the pronouns they bind (see Section 7.3.2), or that Quantifiers must C-command the pronouns they bind. But one can claim some priority for the semantic incoherence explanation, since presumably everyone's semantic theory needs a semantics for Generalized Quantifiers.}\)
of the Absorption Principle, which might be thought of as calling that distinction into question.

What the Absorption Principle predicts is that Bach-Peters understanding of sentences like (151) is impossible when role-linking has applied. If role-linking applies to the *him* parameter, then the MIG parameter must be absorbed; it will thereby be unavailable for an anaphoric linkage with the pronoun *it* inside the subject. We can test for this, as usual, with VP-ellipsis.

(153) The pilot who first sighted it downed the MIG that chased him, and so did his squadron mate.

As expected, this sentence, on the Bach-Peters understanding of the pronouns, appears strange. It does not appear to have a sloppy reading, and is pragmatically bizarre on the strict reading.

### 4.3.6 Quantified NP’s and the Absorption Principle

We turn now to issues involving Quantified NP’s and their interaction with the Absorption Principle.\(^{20}\)

To begin with, we will note the following:

Referential NP’s that are indirectly dependent on Quantified NP’s will always have their parameters absorbed via the Absorption Principle.

We will illustrate this through an example involving a pronoun, although in the next section we will have occasion to look at some examples of indirect dependence that do not involve pronouns:

(154) *Every student* revised *his* paper.

The VP content for (154) is given in (155).\(^{21}\)

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\(^{20}\) Examples like those discussed in this section are also discussed in Haïk (1984) and Epstein (1987); and indeed the Skolemization approach followed by Epstein is quite closely related to the approach taken here; both authors, however, assume that the phenomena in question are limited to cases involving quantification.

\(^{21}\) We will argue in Chapter 5 that Quantified NP’s can be co-parametric antecedents; thus, there are really two cases to deal with here, corresponding to a role-linking and a co-parametric use of the pronoun. Relative to the issues being discussed here, however, these cases will not exhibit important differences. Thus, in the following examples we will focus on Quantifiers as role-linking antecedents. We discuss the case of co-parametric anaphora with quantifiers in detail in Sections 5.1 and 5.3. In Section 5.1 we show that co-parametric quantified antecedents will also absorb the parameters of NP’s indirectly dependent on them because of the Absorption Principle.
Since $y$, the parameter utilized by his paper depends on the pronoun parameter $x$, the Absorption Principle applies. Ignoring tense, (156) gives the final sentence content:

(156) $\langle\langle$EVERY, STUDENT$_s$, $\langle v_0 \mid \langle\langle x_{subj}, y \mid \langle\langle$REVISE, $x$, $y$PAPER$_s,y\rangle\rangle$AUTHOR-OF$_s,y,x_{MALE}\rangle\rangle\rangle$, subj : $v_0$ $\rangle\rangle$}

In forming the property that gives us the scope argument of the Quantifier, only the $subj$ role is labelled. As with the referential cases, the effect on the $[y]$ role is to existentially quantify it away. This means that the pronoun parameter $y$ is unavailable for anaphora outside the scope of the Quantifier.

As far as the Absorption Principle goes, then, the facts for Quantified antecedents will be quite analogous to those we saw for referential NP's containing role-linking pronouns. Consider (157):

(157) John, Every student $\{ -$resented a teacher who flunked him.$-$

We consider only readings on which the Subject is anaphorically related to him. For the Quantified subject, the entire NP a teacher who flunked him must be understood as falling within the scope of Every. There may in fact be a single teacher who flunked all the relevant students, but the sentence can’t be understood as making that claim.

Note that just requiring a pronoun to occur within the scope of any quantifier that binds it does not make the necessary prediction here, as we can see by looking at version of (156) that does not obey the Absorption principle:

(158) $\langle\langle$EVERY, STUDENT$_s$, $\langle v_0 \mid \langle\langle x_{subj} \mid \langle\langle$REVISE, $x$, $y$PAPER$_s,y\rangle\rangle$AUTHOR-OF$_s,y,x_{MALE}\rangle\rangle\rangle$, subj : $v_0$ $\rangle\rangle$}

If we hadn’t absorbed $y$, the pronoun parameter $x_{MALE}$ would still occur within the scope of its quantifier. Without the Absorption
Principle, nothing would stop the parameter \( y \) from being a parameter of this whole content, and ultimately having to be anchored by the circumstances.\(^{22}\)

As we have seen, the Absorption Principle binds dependent parameters within the scope of Quantified NP's. This treatment predicts that NP's dependent on a quantifier should have the same anaphoric possibilities as the Quantifier. More precisely, given Claim A of Section 4.2, it requires that they can find their anaphoric partners only within the scope of that Quantifier. Thus, whenever a Quantified NP occurs in a scope-limiting environment that restricts the occurrence of pronouns anaphoric to it, that environment should also restrict the occurrence of pronouns anaphoric to indirect dependents of the Quantifier. To illustrate, as we saw in Section 4.2.3, it is generally difficult for Quantifiers to scope across \textit{if-then} clauses. This accounts for the infelicity of:

\[(159) \text{ If every student rewrote his paper twice then we should thank him.}\]

on the reading on which \textit{his} is anaphoric to \textit{every student}. Given the Absorption Principle, we can also accounts for the infelicity of:

\[(160) \text{ If every student rewrote \textit{his paper} twice then \textit{it} should be published.}\]

on the reading on which \textit{his} is anaphoric to \textit{every student} and \textit{it} is anaphoric to \textit{his paper}.\(^{23}\)

\subsection*{4.3.7 Indirect Dependency without Pronouns}

The Absorption Principle says nothing about pronouns. It's stated in terms of the notion of one parameter depending on another. In that light, consider the following minimal pair:

\[(161) \begin{align*}
\text{a. John hasn't yet met the author.} \\
\text{b. John hasn't yet met the author of a paper about anaphora.}
\end{align*}\]

As in Section 4.3.3, we consider a case where the tendency of definite NP's to be referential conflicts with the Absorption Principle. \((161a)\)

\(^{22}\)Note that ascribing the uniqueness of the paper \( y \) relative to \( x \) to presuppositions induced by the definiteness of the NP \textit{his paper} might work for examples such as \((154)\) but will not extend to the absorption of the teacher-parameter in \((157)\).

\(^{23}\)This sentence is exactly analogous to the example \((12)\) of Chapter 1: \textit{If every ballerina is too heavy for her partner, he will be displeased.}

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has only a referential reading, but (b) allows a non-referential reading. The reason appears to be the difficulty of giving indefinites like a paper about anaphora referential readings in negative polarity environments. Once we grant that the indefinite parameter in (b) must be absorbed, the definite parameter must also be absorbed (as well as its resource-situation parameter). In the following treatment, we simply represent NOT-YET as an operator on states-of-affairs. Any treatment in which the two NP-parameters were absorbed by or in the scope of an operator (or series of operators) within the VP would make the same point:

\[(162) \quad \langle \langle x \mid \langle \langle \text{NOT-YET}, \langle \langle x_{\text{subj}}, y, z, s \mid \langle \langle \text{MEET}, x, y_\rho \rangle \rangle, x \rangle \rangle \rangle, j_{\text{JOHN}} \rangle \]

where
\[
\rho = (s, r = \langle \langle \text{AUTHOR-OF}, y, z \rangle \rangle)
\]
\[
r = \langle \langle \text{UNIQUE}, s, w \mid \langle \langle \text{AUTHOR-OF}, w, z_\sigma \rangle \rangle \rangle
\]
\[
\sigma = \langle \langle \text{PAPER}_{s'}, z \rangle \rangle \land \langle \langle \text{ABOUT}_{s'}, z, \text{anaphora} \rangle \rangle
\]

The crucial difference between the content of the definite NP the author of a paper about anaphora and other definite NP examples we have looked at is that the definiteness property, the property of being an author of a paper about anaphora, is parametric in \(z\), the paper parameter; the property for which the definite’s resource situation is required to provide a unique exemplar is thus parametric (see condition \(r\) above). As a result, there are multiple absorptions triggered by the Absorption Principle. \(y\), the definite NP parameter, has restriction \(\rho\), which contains \(z\), so \(y\) is dependent on \(z\), the indefinite NP parameter. The resource-situation-parameter for \(y, s\), has restriction \(r\), which also contains \(z\), so \(s\), too, is dependent on \(z\). Thus, when \(z\) is absorbed, so are \(y\) and \(s\), via the Absorption Principle. The absorption of \(s\) is crucial here. As we saw in Chapter 2, absorbing a definite NP parameter does not ordinarily give a non-referential reading, because the resource-situation must still be anchored, and that resource-situation is constrained to contain a unique exemplar of the NP-property. Once the resource-situation is absorbed, however, then we have a relation that requires a unique exemplar for each filler of the resource-situation role. The above content requires that John have the property of being an \(x\) such that it is not yet the case that there exists \(y, z, s\), such that \(x\) meets \(y\),

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where \( y \) is the unique author of \( z \) in \( s \), and where \( z \) is a paper about anaphora.

A more complex example involves the absorption of a definite NP which does not contain any pronouns:

(163) Every class expects the teacher to change her schedule.

Here, a very natural interpretation is that, for each class, there is a teacher—the teacher of that class—whom the students expect to change her schedule. Such examples of "narrow-scoping" definites have been noted before; what seems to license them is a salient relation between the definite NP and the quantifier under whose scope it falls. The more salient the relation, the better the quantification. Thus, relational nouns (mother, owner, mayor and king) seem particularly amenable to heading definites that are quantified away; non-relational nouns, even if they can be immediately understood as bearing some salient relation to the quantifier, are perhaps less amenable to covert quantification:

(164) Every American car blows the engine within five years of purchase.

This suggests that a very natural content for (163) might be (165):

(165) \( \langle \text{EVERY}, \langle [x | \langle \text{CLASS}, x \rangle \rangle, \langle [v_0 | \langle [x_{\text{subj}}, y, z, s | \langle \text{EXPECT}, x, y_\rho, \langle \text{CHANGE}, y, z_\tau \rangle \rangle \rangle, \text{subj : } v_0 \rangle \rangle \rangle \rangle \)

where
\[
\begin{align*}
\rho &= \langle s_\sigma | \langle \text{TEACHER-OF}, y, x \rangle \rangle \\
\sigma &= \langle \text{UNIQUE}, s, [w | \langle \text{TEACHER-OF}, w, x \rangle \rangle \rangle \\
\tau &= \langle \text{SCHEDULE}_{s'}, z \rangle \land \langle \text{OWNS}_{s'}, y, z \rangle
\end{align*}
\]

In (165), an extra argument-position of the noun has been parameterized and role-linked with the subject parameter of expect. \( y \), the teacher parameter, depends on \( x \), so when \( x \) is absorbed, \( y \) must be, too, by the Absorption Principle.

This example illustrates the transitivity of the Absorption Principle. \( y \) is absorbed by the Absorption Principle, and \( z \), the schedule parameter, and \( s \), the resource-situation parameter, both depend on
y, so both must be absorbed. It is the absorption of s that allows the teacher to vary with each class.  

The prediction is that z, too, should be sealed off from anaphoric relations with anything outside the scope of Every. This seems to be borne out by (166):

(166) If every class expects the teacher to change her schedule, then it will never get settled.

Although it is possible to read it as anaphorically related to schedule, the resulting interpretation no longer makes the Noun Phrase the teacher dependent on every class. There must be a single teacher under the gun from every class.

Note that the transitivity of the Absorption Principle is crucial: the dependency between an absorbed definite and a quantifier does not have to be direct, but may be mediated through another NP. The following example is from Kempson (in preparation); it seems to be analyzable as very similar to (166):

(167) Every KGB Agent gets into a yellow cab to question the driver.

Here, the indefinite a yellow cab is most naturally interpreted as falling within the scope of the quantifier Every KGB agent; but the NP the driver is semantically dependent on it; when the yellow-cab parameter is absorbed, the driver parameter will have to be absorbed as well, by the absorption principle. It is interesting that examples of this sort have prompted calls for a pragmatic treatment. Kempson argues for a pragmatic account of narrow-scoping definites, and so does Heim (1982), via what she calls accommodation.

---

24Note that the absorption of the resource-situation also points out the need for another revision of the NP rules of Chapter 2. There, each NP was obligatorily associated with a particular resource-situation, through a circumstantial condition using the relation EXPLOITS. This is inconsistent with 'having the resource-situation absorbed in examples like (165). The solution is to treat conditions containing EXPLOITS facts similarly to those containing REFREL facts. They are optional conditions whose occurrence is subject to general constraints on meaning descriptions. This is the treatment given in the fragment in the appendix.

Chapter 4
4.3.8 Pronouns, Definiteness, and the Absorption Principle

Heim (1982) proposes an analysis of definites which makes a striking claim: definiteness just is anaphoricity. Definite NP's can "hark back" to previous NP's just as anaphoric pronouns do:

(168) A cat walked in. The cat was gray.

The definite NP in the discourse in (168) can easily be replaced with a pronoun. Heim's idea then is that definites enjoy the same rights and privileges as pronouns; they can, in our terms, be either deictic or anaphoric, though Heim draws no such line. Definiteness, or anaphoricity, means requiring an appropriate discourse-referent be already available in the discourse. How it was introduced, linguistically or otherwise, is not important here.

Suppose we explore Heim's basic idea by trying to assimilate our analysis of pronouns to our analysis of definites. Then the content for *He walks* would be:

(169) \( \langle \text{WALK}, x, \langle \text{UNIQUE, s, MALE} \rangle \rangle = \langle \text{MALE, } x \rangle \rangle \)

Here, UNIQUE is the two-place relation introduced in Chapter 2 in the analysis of definites, the relation that holds between a situation and a property when there is a unique individual in the situation with that property. Thus, we would analyze the deictic pronoun *he* as something like *the male* where a suitably restricted resource situation tells us which one.

An immediate pay-off of such an analysis is that it explains certain common properties of pronouns and definites. We noted in Section 4.2 that our analysis of definites predicted that they would receive referential readings even under the scope of negation. The above analysis of pronouns would subsume them to definites, and thus achieve the same result for pronouns, predicting that there is no reading of *John didn't see it* paraphrasable as 'John didn't see some inanimate'.

But this proposal raises an immediate problem in that it is a bit too much of a good thing. The problem now is how to ever give a pronoun a non-referential reading in some non ad hoc fashion. The most obvious cases where we need to are cases where a pronoun is anaphorically related to a Quantifier: *Every student revised his paper*. The referentiality of definites follows from the properties of their resource-situations; as long as the circumstances have to supply

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an actual resource situation with a unique exemplar of the definite-property, then the definite NP will receive a referential reading. We can always give a definite a non-referential reading by absorbing its resource-situation, but thus far we have introduced no circumstantial control mechanisms for absorbing resource-situations. They have been absorbed only when the Absorption Principle required it (as in Section 4.3.7). If we provide such a mechanism for cases like *Every student revised his paper*, why isn’t it also available in cases like *John didn’t see it*?

It might look as if, on the framework adopted here, subsuming pronouns to definites wasn’t a good idea. But further examination of the properties of definites shows that the problem has nothing to do with collapsing pronouns and definites; the problem is that our analysis of definites is incomplete:

(170) *Every little leaguer’s* father thinks the boy is a star.

Here, the definite NP the boy can be understood as anaphorically related to the Quantifier. So we have the same problem here as we had with *Every student revised his paper*. The problem arises because of the fact which is the central insight of Heim (1982): definites can be anaphoric. And if so, there can be no objection to collapsing the analysis of definites and pronouns: if there is some non-ad hoc way to absorb the resource-situation parameter in one case, then it can be extended to the other.

We now consider a refinement of our analysis which solves this problem. The basic idea is to exploit the Absorption Principle in a somewhat different way to guarantee the absorption of “anaphoric” definites. Suppose, then, that we represent anaphoric dependency as follows:

(171) A student revised his paper.

\[
\langle \langle x \mid \langle \text{REVISE}, x, y \langle \text{PAPER-OF}, u, \theta, y \rangle \rangle \rangle, \\
\quad t_{\theta'} = \langle \text{STUDENT}, t \rangle \rangle
\]

where

\[
\theta = (s_{\mu, \nu} \models \langle \text{MALE}, u \rangle) \\
\mu = (s \models \langle =, u, t \rangle) \\
\nu = \langle \text{UNIQUE}, s, [u \mid \langle \text{MALE}, u \rangle] \rangle
\]

This content would replace the co-parametric analysis of *A student revised his paper*. The only difference between a deictic analysis
and this co-parametric analysis is that on the deictic analysis the condition \( \mu \) would be absent. Thus, for a pronoun parameter to be anaphoric is simply for its resource-situation to have an extra equality condition placed on it. This analysis is just a special case of treating anaphoric dependence as parametric dependence, as discussed in Section 4.3.3. The basic virtue is that it makes the pronoun parameter subject to the Absorption Principle; whenever the antecedent parameter is absorbed, so is the pronoun parameter, and so, crucially, is its resource-situation parameter. This can be illustrated via the corresponding role-linking analysis corresponding to (171). The role-linking analysis sets the parameter \( u \) equal to \( x \), the parameter labelling the lexical subject role of \( \text{REVISE} \), with corresponding alterations of the absorption properties of the whole VP:

\[
(172) \quad \langle \{x, u, s, y \mid \langle \text{REVISE}, x, y\{\text{PAPER-OF}_{x'}, u_{x'}, y\}\rangle \}, \\
\qquad r_{s'}=\langle \text{STUDENT}, t \rangle \rangle
\]

where

\[
\begin{align*}
\theta &= (s_{\mu, u} \models \langle \text{MALE}, u \rangle) \\
\mu &= (s \models \langle =, u, x \rangle) \\
\nu &= \langle \text{UNIQUE}, s, \{u \mid \langle \text{MALE}, u \rangle \} \rangle
\end{align*}
\]

Now, when the \( x \) parameter is absorbed, so the \( u \) and \( s' \) parameters are absorbed too, because they depend on \( x \), and so is the \( y \) parameter, since it depends on both \( s' \) and \( u \). The basic predictions of how the Absorption Principle will interact with sloppy readings, discussed in Sections 4.3.1, 4.3.4, 4.3.5, 4.3.6 and 4.3.7, remain unchanged in this revised analysis.

This is the analysis adopted in the fragment in the Appendix. To illustrate its working, we present a rule admitting the pronoun \( \text{he} \):

\[
(173) \quad \text{NP} \to \text{he} \\
\uparrow=\downarrow
\]

\[
\mathbb{C}[\text{NP}]_{\text{DO, RES}} \iff
\begin{align*}
(s\langle \text{UNIQUE}, s, P \rangle \models \langle P, x \rangle) \\
(P = \{x \mid \langle \text{MALE}, x \rangle \})
\end{align*}
\]

This rule is unlike the other referential NP rules of Chapter 3 in that the meaning relation is a three-place relation, with a new argument for the resource-situation. An NP \( \text{NP}_i \) is anaphoric whenever \( \text{RES}^{\text{NP}_i} \)
is restricted with a condition of the form:

\[(s \models \lla (=, \text{RESNP}_1, x)\rra)\]

We turn to the question of how those restrictions are introduced into meaning-descriptions in Section 6.2. The treatment will be analogous to our treatment of scope; anaphoric contents will be licensed by certain kinds of circumstantial facts.

To motivate this refinement, we illustrate how it accounts for the following sorts of sentences:

(174) a. John didn't see it.

   b. John didn't see a student who had lost his card.

The key point is that the pronoun in (174a) has only a referential understanding: it cannot be interpreted as having been absorbed within the scope of negation. This is parallel to the case with definites; \emph{John didn't see the card} has only a referential reading for the definite.

The obligatory referentiality of the pronoun in (174a) contrasts with the possibility of a non-referential reading of \emph{his} in (174b). The possibility of a non-referential reading correlates with two things: first, understanding the pronoun as anaphorically related to \emph{a student}; second, understanding a \emph{student} non-referentially. The generalization, roughly, seems to be: the pronoun parameter can be given a non-referential interpretation only if it is anaphoric, and then, only if its antecedent can be.

We now try to show how analyzing anaphoric dependence as parametric dependence predicts these correlations:

(175) a. John didn't see it.

\[
\lla [[x_{\text{subj}} | \lla [x, y | \lla \text{SEE}, x, y\theta \rra], x; 0]] \rra,
\]

where

\[\theta = (s_\rho \models \lla \text{INANIMATE}, u\rra)\]

\[\rho = \lla \text{UNIQUE}, s, [u | \lla \text{INANIMATE}, u\rra] \rra\]

b. John didn't see a student who had lost his card.

\[
\lla [[x_{\text{subj}} | \lla [w_{\text{subj}}, y, u, s', z, s' | \lla \text{SEE}, w, y\kappa \rra], \text{subj} : x; 0]] \rra
\]

where

\[\kappa = (s \models \lla \text{STUDENT}, y \rra \land \lla \text{LOSE}, y, z_v \rra)\]
\[ \nu = (s' \models \langle \text{OWNS, } u \theta, z \rangle \land \langle \text{CARD, } z \rangle) \]
\[ \tau = \langle \text{UNIQUE, } s', [w | \langle \text{OWNS, } u \theta, z \rangle \land \langle \text{CARD, } z \rangle] \rangle \]

and
\[ \theta = (s''_{\rho, \omega} \models \langle \text{MALE, } u \rangle) \]
\[ \rho = \langle \text{UNIQUE, } s'', [u | \langle \text{MALE, } u \rangle] \rangle \]
\[ \mu = (s'' \models \langle =, u, y \rangle) \]

The account of referentiality of (175a) is entirely parallel to the account of the referentiality of ordinary definites sketched in Section 3.4: the key point is that the resource-situation isn't absorbed: the property John has, then, is the property of being an \( x \) such that there is no \( y \), \( u \), \( s' \), \( z \), and \( s'' \) such that \( x \) sees \( y \), \( u \), \( y \), and \( s'' \) such that \( x \) sees \( y \) a student drawn from \( s \) where \( y \) has lost \( z \), the unique card owned by \( u \) in \( s' \), where \( u \) is the unique inanimate in \( s'' \) that equals \( y \).

In contrast, (175b) is just an ordinary case of what we have till now called co-parametric anaphora. In this case, the key content-constituent is the internal type of the VP, which is a relation of six argument-roles. One of these, the \([w]\) role, is just a projection of the lexical subject role of see; another, \([y]\), is the projection of the role the indefinite NP a student who had lost his card covers. The absorption of \( y \) is dictated by the particular circumstances of utterance; in other circumstances \( y \) may not be absorbed, and the indefinite NP would have a referential reading. However, once \( y \) is absorbed, then the absorption of the other four parameters, \( u \), \( s'' \), \( z \), and \( s' \) follows. \( u \) and \( s'' \) are absorbed because both depend on \( y \) (see restrictions \( \theta \) and \( \rho \), respectively). But now \( z \) and \( s' \) are absorbed, because both depend on \( u \) (see restrictions \( \nu \) and \( \tau \), respectively). Because their resource-situations are absorbed, the definite parameters \( u \) and \( z \) can now both be given non-referential readings. Once the remaining parameters of the whole content, \( s \) and \( j \), are anchored to some real John and some resource-situation \( s \) for students, John will have the property of being an \( x \) that there is no \( y \), \( u \), \( s' \), \( z \), and \( s'' \) such that \( x \) sees \( y \) a student drawn from \( s \) where \( y \) has lost \( z \), the unique card owned by \( u \) in \( s' \), where \( u \) is the unique inanimate in \( s'' \) that equals \( y \).

We see, then, that because anaphoricity is analyzed as parametric dependence, the Absorption Principle guarantees that the anaphoric NP’s parameter (together with its resource-situation parameter) is absorbed whenever its antecedent’s parameter is. This, of course, will also apply in the case of quantified antecedents, as in (176).
Every student revised his paper.

\[ (\forall v_0. ((\forall \text{STUDENT}_s, [v_0] \forall (x_{\text{subj}}, y, u, s') (\forall \text{REVISE, subj : x}, y (\text{PAPER}_s, y)^{\text{\&}} (\text{AUTHOR-OF}_s, y, u_p))]) \]

where

\[
\rho = (s'_{r, u} = (\forall \text{MALE, } u)) \\
\tau = (\forall \text{UNIQUE, } s', [u | (\forall \text{MALE, } u)]) \\
\mu = (s = (\forall =, u, x))
\]

Here, we have rendered a role-linking analysis of the pronoun, and abstracted away from the details of what happens to the paper parameter \( y \). The key point is that \( u \) and \( s' \), the pronoun parameter and its resource-situation parameter, are dependent on \( x \), the reviser parameter, so that when \( x \) is absorbed both \( u \) and \( s' \) are as well. Thus the descriptive import of (176) is that for every student \( v_0 \), there is an \( s' \) and a \( u \) such that \( u \) is the unique entity equal to \( v_0 \) in \( s' \), and such that \( v_0 \) revises \( u \)'s paper.

Note that the essentials here do not depend on the choice of a role-linking versus a co-parametric analysis; if the pronoun parameter had been set equal to \( v_0 \) rather than \( x \), it and its resource-situation would still have to have been absorbed when \( v_0 \) was, and the net effect would have been the same. Nor does the analysis depend on any difference between pronouns and definites. The account of the example discussed in Section 6.1, *Every little leaguer's father thinks the boy is a star* is essentially the same.

In sum, unifying our analysis of definites with our analysis of pronouns captures the similarity of the absorption properties of definites and pronouns; basically both are absorbed whenever an NP they referentially depend on is absorbed. Here we take referential dependence to include, as in Section 4.3.3, anaphoric relatedness.

Most of the issues we discuss related to pronouns, are orthogonal to their behavior as definites; therefore, for readability, we will represent pronouns as if they were indefinites in what follows. However, in the fragment in the appendix they are treated as definites, and when we present our formal sketch of the circumstantial account of anaphora.
in Section 6.2, we give an alternative version that takes definiteness into account.

4.3.9 Summing up the Absorption Principle

To sum up: The Absorption Principle is motivated by the requirements placed on parametric objects by Situation Theory. The Absorption Principle, together with the situation theoretic account of omissible arguments, and our treatment of role linking, makes a number of predictions about the scopes and anaphoric possibilities of referential NP's dependent on both referential NP's and Quantifiers:

(a) It predicts the sloppy or non-referential interpretation of indirectly dependent NP's, NP's dependent because of the role-linking of a pronoun they contain, whether of referential or quantificational antecedents.

(b) It predicts the impossibility of anaphora with these NP's from positions outside the scope of the role-linking. A special case of this prediction is the impossibility of role-linking in Bach-Peters sentences.

(c) It allows for a very natural treatment of the behavior of definites with relational noun heads under the scope of quantifiers, whether the noun's complements are overtly present or not.

(d) It allows us to unify the analysis of pronouns and definites, and capture the similarities of their scoping properties.
Role-linking and Co-parameterization Sharpened

In this chapter we try to tighten our argument against a Logical Form approach to anaphoric relations. In Sections 5.1 and 5.2, we examine in detail a pair of examples that argue that anaphoric relations can't be captured by means of relations between NP's. In Section 5.3 we consider whether anaphora with Quantifiers can be limited to role-linking as we have defined it, and we argue that it cannot.

5.1 Three Contents and Quantification

In this section we propose to take a more detailed look at the semantics of a pair of crucial examples—both to illustrate the semantics of role-linking in detail and its interaction with quantification and VP ellipsis—and to illustrate the need for role-linking.

Consider example (177):

(177) Every boy ate before Mary did.

We will assume the structure for the VP's of such examples is:

(178) \([_{VP} [_{VP \text{ ate}}] [_{ADV} \text{ before Mary did}]]\)

We assume that the content of the minimal VP in (178) is:

(179) \([_{x_{\text{subj}}, y_{\text{loc}}} | \{\langle \text{EATING}, x, y_{\langle \text{PRECEDES}, y, l_{w} \rangle} \rangle \}]\)

Note that we continue the practice, begun in Chapter 2, of not interpreting tense at the VP level. Our chief motivation for this is...
that, in VP-ellipsis, Verb Phrases need not not share their tense: Mary ate but Bob will not. Thus, the VP-content, what is shared between anaphorically related VP's, cannot include tense.\(^1\)

Next we consider ate before Mary did. The fragment in the appendix includes a rule for combining adverbial phrases with VP’s to produce larger VP’s. What it outputs can, for our purposes here, be rendered:\(^2\)

\[(180) \ [z_{subj}, l_{loc} | \langle\langle \text{BEFORE}, l^{\langle\langle [x_{subj}, y_{loc} | E], z, l] \rangle, l^{\langle\langle [x_{subj}, y_{loc} | E], w_{MARY}, l'] \rangle} \rangle, v_0 \rangle] \]

As usual, the rules prescribing a content (180) will interact with the Absorption Principle. (180) requires that the Subject-parameter \(z\) be absorbed. But absorbing that parameter triggers an invocation of the Absorption Principle. Since \(l\) depends on \(z\), \(l\) must also be absorbed. This turns out to be crucial in getting the correct interpretation for a sentence like (177). To interpret the Quantified subject in (177), we need to take the relation in (180), and construct the property in (181):

\[(181) \ [v_{subj} | \langle [z_{subj}, l_{loc} | \langle\langle \text{BEFORE}, l^{\langle\langle [x, y | E], z, l] \rangle, l^{\langle\langle [x, y | E], w_{MARY}, l'] \rangle} \rangle, v_0 \rangle] \]

(181) is the property that we will, in effect, predicate of each boy. It’s the fact that \(l\) has been absorbed which let’s the time of eating vary with the boy. Different boys can eat at different times, but, if the sentence is true, all of those times precede the time when Mary ate. The content for (177) is:

\(^1\)For a discussion of some very different motivations for a “higher” interpretation of tense, see Nerbonne (1983). One problem for the treatment of tense sketched in Chapter 2 is that by obligatorily recording a verb’s reference time in the circumstances, it makes the claim that tense is always referential, a claim clearly falsified by temporal modifiers like every Friday. We modify our treatment of tense in the appendix to allow for this possibility. A remaining problem, not dealt with in the appendix, is that VP’s sometimes need to have their tenses interpreted at VP-level and not at sentence level, as when VP’s of differing tense are conjoined.

\(^2\)The difficulty with (180) is that it gets the descriptive content of (177) wrong. (180) has BEFORE as its main VP relation, but the main relation of (177) should be EATING; the time of that eating should be restricted to be before the time of Mary’s eating. Nevertheless, the representation in (180) is considerably more readable than what the rules of the fragment in the Appendix give, and the difference is not germane to the discussion here.

Chapter 5
We now turn to an example we previewed in Chapter 3:

(183) Every student revised his paper before the teacher did.

We begin as before with the minimal VP. (184) shows a simple role-linking content for the VP revised his paper. As with (3), what we want it is a relation one of whose roles is a location-role. Again, however, the Absorption Principle intervenes to make what would have been an n-place relation an (n + 1)-place relation:

(184) \[ x_{subj}, y, z_{loc} \rightarrow \langle \text{REVISING}, r_0 : x, \r_1 : y\langle \text{PAPER-BY}, r_2 \cdot y, r_3 : x_{MALE}\rangle, \r_4 : z\langle \text{PRECEDES}, z, \_u\rangle \rangle \]

Here, since \( y \) depends on \( x \), it must be absorbed when \( x \) is. Since we will need to start distinguishing readings soon, we will annotate the fact that that the \( r_3 \) role has been parameterized with the \( r_0 \) role by associating the content in (184) with a fact stating just that:

(185) \langle \text{COVARIES-WITH, "his", \{"revised", subj}\} \rangle

We take COVARIES-WITH to be a relation between an anaphoric NP utterance and what it is anaphoric to.\(^3\) In Chapter 4, we roughly characterized "what an NP is anaphoric to" as a role, but of course what is at issue here can't be an unchanging relation-role, but must be something that varies across utterances. We have thus represented the second argument of the COVARIES-WITH relation as a pair of an utterance and some relation-index. The utterance must be the sort that has a relation as its content, and the index must be one assigned by the grammar to that relation for that utterance.\(^4\)

\(^3\)In a language with zero-anaphora, we would have to recast COVARIES-WITH as a relation between two roles, the first of his which would be the role the pronoun covers.

\(^4\)Recall that we assumed in Chapter 2 that lexical items were assigned indexed relations as their content in the lexicon. This is crucial in (185). We assume that the reviser role of the verb revised is indexed subj in the lexicon. Note also that the only index our examples have made use of is subj. Finally, in a language with null-anaphora, COVARIES-WITH could not be a relation between an utterance and a role-aspect; it would have to be a relation between two role-aspects, indicating that two relation roles were co-parameterized.

Section 5.1
Like other circumstantial facts concerning NP's, conditions containing COVARES-WITH will be introduced into circumstances by way of a revised version of the Circumstance Principle for NP's, which we first saw in Section 3.4. The effect of such a condition will be to guarantee the corresponding co-parameterization of roles. We present the the revised Circumstance Principle in Section 6.2. Here we will show the circumstantial facts correlated with particular anaphoric relations for concreteness, but we will focus on issues of content.

Another possibility for the content of the VP *revised his paper*, is that the pronoun utilizes some other parameter—*w*—distinct from the parameter that labels the lexical subject role. The resulting content is:

\[(186) \ [x_{subj}, z_{loc} | \langle\text{REVISING}, r_0 : x, \ r_1 : y\langle\text{PAPER-BY}, r_2 : y, r_3 : \text{wMALE}\rangle, \ r_4 : w\langle\text{PRECEDES}, z, l_w\rangle\rangle] \]

Here there is no invocation of the Absorption Principle; also, if this content is used in a context in which *w* does not occur, there is no possibility of a COVARES-WITH fact parallel to (185). No special circumstantial facts need hold.

We will now take a closer look at how these two VP contents enter into the interpretation of a larger verb phrase, *revised his paper before the teacher did*. We limit our attention to circumstances in which *did* is anaphoric to *revised his paper*.

Let us abbreviate the first VP content, the three-place relation in (184), as \( R_{<3>}, \) to remind ourselves that it is a three-place relation. Then, in the case where *did* is anaphoric to a VP with that content, the content for the VP *revised his paper before the teacher did* is:

\[(187) \ [w_{subj}, l_{loc} | \langle\text{BEFORE}, l\langle R_{<3>}, w, l\rangle, \ l'\langle R_{<3>}, \text{lTEACHER}, l'\rangle\rangle] \]

Now if every student in turn fills the \([w]\) role of this relation, then every student will have the property of revising his paper at some time \(l\) before the time \(l'\) at which the teacher revises the teacher's paper. This is what we called the sloppy reading in Section 3.1.

Now consider the VP content in (186), the one in which the parameter utilized by the pronoun was *w*. Let us abbreviate that content:
This reminds us that we are dealing with a two-place relation. If we use \( w \) and \( l \) for the parameters absorbed by the maximal VP (as in (187)), we have:

\[
(188) \quad [w_{\text{subj}}, l_{\text{loc}}, y, l' \mid \langle \text{BEFORE}, l_{\text{prev}}[x, z | R_w], w, l \rangle, \\
\quad \quad \quad \quad l'_{\text{prev}}[x, z | R_w], l_{\text{TEACHER}}, l' \rangle]
\]

Several things have happened. First, the parameter \( w \), in the VP content \([x, z | R_w]\), now occurs in two places. We record that fact, as before, with the circumstantial fact:

\[
(189) \quad \langle \text{COVARIATES-WITH, "his", ["revised his paper", subj]} \rangle
\]

Second, as we noted before, the Absorption Principle does not apply in specifying the content for \([x, z | R_w]\). But it does apply now in specifying the content for the maximal VP, (188). Three parameters depend on \( w \), which is absorbed by grammatical rule, the two location parameters, \( l \) and \( l' \), and \( y \), the paper parameter in (186). All must be absorbed with \( w \) because of the Absorption Principle. The maximal VP-content (188) thus becomes a four-place relation.

If every student fills the \([w]\) role of this new VP content, every student \( w \) will have the property of revising his own paper, \( y \), at some time before the time at which the teacher revises \( y \). Note that \( l \) and \( l' \) have also been correctly absorbed: the time \( l' \) at which the teacher revises a paper \( y \) will vary with each student \( w \). For the sentence to be true, each such \( l' \) must be after the \( l \) determined by a particular student \( w \).

This second reading is what, in Section 3.1, we called the strict reading. By the definitions we gave there, both these contents involve role-linking antecedents. In neither case does the Subject antecedent share a parameter with the pronoun it is anaphorically linked to. In both cases the Subject covers a role which is semantically linked to the role the pronoun covers. We can see this most easily by looking at the contrast between the two readings captured by our bookkeeping.

\[
(190) \quad \text{Strict: } \langle \text{COVARIATES-WITH, "his", ["revised his paper", subj]} \rangle
\]

\[
\text{Sloppy: } \langle \text{COVARIATES-WITH, "his", ["revised", subj]} \rangle
\]

Here the role indexed \( \text{poss} \) is the role that the possessive pronoun covers, and the \( \text{subj} \) role of "revised" is the lexical \( \text{reviser} \) role, while the \( \text{subj} \) role of "revised his paper" is the role labelled \( \text{subj} \) in (186).
In both cases, the role indexed *poss* is made co-parametric with a role which has the role indexed *subj* for "revised his paper before Mary did" as a projection. This example shows that distinguishing among role-linking readings is just as important as observing that role-linking has occurred. It is not sufficient for such examples to specify which kind of anaphora has occurred.

Another point this example brings out is that role-linking does not entail a sloppy reading; both the strict and sloppy readings above involve role-linking. The key point about role-linking is not that it engenders sloppy readings, but that it involves absorbing a pronoun parameter into a relation-role that is either covered by an NP or absorbed by a role that gets covered by an NP. This point can perhaps be made more clearly with the example discussed in the next section, which has a referential subject/antecedent.

(183) also can be used with a deictic pronoun. Here, *did* may still be anaphoric to *revised*—but *his* just utilizes some arbitrary parameter, *p*, and the VP content is \([x, z | R_p]\). If *p* occurs nowhere else in this context, this will just turn out to be a deictic use of *his*, and there will be no anaphoric connection with the Subject.

There is, however, a third possible analysis of the VP *revised his paper before the teacher did* which would still link the pronoun anaphorically with the Quantified subject. This is what we will call the co-parametric use of the pronoun with a quantified antecedent. As always, we will reserve the term co-parametric anaphora for the cases where the antecedent-parameter and the pronoun parameter are the same. There is no reason why this can’t happen when the antecedent is a Quantifier; it just happens that in that case, the antecedent parameter is immediately bound by the quantifier. As we noted in Section 3.1, there is no reason why parameters involved in co-parametric anaphora can’t be absorbed.

To see how this works, let us minimally alter the examples we’ve been looking at. Suppose the Quantified Subject utilizes the parameter *v₀*, and the VP content is:

\[
\text{(191) } [w_{subj}, l_{loc} | \langle \langle \text{BEFORE}, l'_{\langle \langle [x, z | R_{v₀}], w, l]\rangle} ,
\langle [x, z | R_{v₀}], l'_{\langle \langle T_{TEACHER}, l'\rangle}\rangle \rangle]
\]

The chief difference between this VP content and the two role-linking contents discussed above is that there hasn’t been any absorption of
NP parameters via the Absorption Principle, because $v_0$ is still a parameter of the VP content. Call the above relation $[w_{subj}, l_{loc} | S_{v_0}]$. The rules for combining a Subject Quantifier with a VP will effectively give us:

(192) $\langle\hbox{EVERY,}
\langle\hbox{STUDENT,}
[v_0 \ldots | \langle[w_{subj}, l_{loc} | S_{v_0}], v_0\rangle\rangle\rangle$

There is a problem here for the rules given in Chapter 3. The problem occurs where the dots above occur. What happens when the Absorption Principle applies while we are trying to form a scope property in the Closure Operation of Section 3.5? This is exactly the case of (191). $v_0$ has a parameter that depends on it, namely $y$, the paper parameter, as we can see by expanding $R_0$:

$$[x_{subj}, z_{loc} | \langle\hbox{REVISING,} r_0 : x, r_1 : y \langle\hbox{PAPER-BY,} r_2 : y, r_3 : v_0 \hbox{MALE}\rangle, r_4 : z \langle\hbox{PRECEDES,} z, l_o\rangle\rangle]\]

$R'$ also depends on $v_0$, as we can see in (191). Given this dependency, what Closure actually gives is:

$$\langle\hbox{EVERY,}
\langle\hbox{STUDENT,}
[v_0, y, l' | \langle[w_{subj}, l_{loc} | S_{v_0}], v_0\rangle\rangle\rangle\rangle$

But this isn't semantically coherent because EVERY expects two properties as its arguments; given a three-place relation as its scope argument, it isn't clear which role is actually the one being quantified over. We redefine Closure to take this possibility into account in the Appendix. The solution is to take:

$$[v_0, y, l' | \langle[w_{subj}, l_{loc} | S_{v_0}], v_0\rangle]\]$$

and project the $[v_0]$ role one more time to get

$$[v_0 | \langle[v_{0\text{scope}}, y, l' | \langle[w_{subj}, l_{loc} | S_{v_0}], v_0\rangle], \text{scope:} v_0\rangle\rangle]\]

The final result is that every student will have the property of there being a $y$ that is their paper that they revise before the teacher revises $y$. But this is just descriptively equivalent to the reading in (188).

The three distinct anaphoric analyses of (183) raise some questions. First, given that two of them are descriptively equivalent, are
three analyses really necessary? Second, even if they sometimes are, are they necessary in this sentence? This returns us to the question raised in Chapter 3: is co-parametric anaphora for quantified antecedents necessary?

The situation here is rather like the one we had for simple VP's before we looked at the consequences of the strict and sloppy readings that Partee pointed out. There is no reason, on the face of it, to give a simple VP like *washed his car* two different contents—not until you look at the two different ways the VP can behave in VP-ellipsis contexts. Similarly, we can look at more complex contexts to find the necessary motivation for three distinct contents for (183). This we do in the next section. We then return to one of the issues raised in Chapter 1: is there really motivation for positing an ambiguity for sentences like *John revised his paper* on the basis of ambiguities in more complicated sentences like *John revised his paper before Bill did*. In Section 5.3, we return to the specific question of whether Quantified NP antecedents should be allowed to be co-parametric.

5.2 Three VP Contents and a Referential Subject

We turn first to the specific issue raised by the analysis presented in Section 5.1: does the VP *revised his paper before the teacher did* have three anaphoric readings? The necessary motivation for three VP-contents comes from examples like the following:

(193) *John revised his paper before the teacher did, and Bill did too.*

Let us restrict our attention to cases where *his* is anaphoric to *John* and the elliptical VP in the second conjunct is related to the VP *revised his paper before the teacher did*. There are three relevant readings.

1. Everyone—John, the teacher, and Bill—revised their own paper.
2. John and Bill share the property of having revised their papers before the teacher revised their papers. That is, John revised John's paper before the teacher revised John's paper, and Bill revised Bill's paper before the teacher revised Bill's paper.
3. Everyone—John, the teacher, and Bill—revised John's paper.
Now suppose that the NP *John* utilizes the parameter $j$. Then these three readings correspond exactly to the following three contents for the VP *revised his paper before the teacher did*:

\[(194)\] **Reading 1:**
\[
[w, l \mid \langle \text{BEFORE}, l\langle R_{<3>, w}, l \rangle, \\
\text{Circumstances: } \langle \text{COVARIES-WITH,} \\
\text{“his”,} \\
\text{[“revised”, subj]}\rangle]
\]

**Reading 2:**
\[
[w, y, l', l \mid \langle \text{BEFORE}, l\langle\{x, z|R_w \}, w, l \rangle, \\
\text{Circumstances: } \langle \text{COVARIES-WITH,} \\
\text{“his”,} \\
\text{[“revised his paper”, subj]}\rangle]
\]

**Reading 3:**
\[
[w, l \mid \langle \text{BEFORE}, l\langle\{x, z|R_j \}, w, l \rangle, \\
\text{Circumstances: } \langle \text{COVARIES-WITH,} \\
\text{“his”,} \\
\text{[“revised his paper before the teacher did”, subj]}\rangle]
\]

Note that readings 1 and 2 are just contents (187) and (188), which we used in Section 5.1 for the two role-linking analyses of (182). Reading 3 is just content (191) from Section 5.1, with the parameter $j$ substituted for $v_0$; in both cases the pronoun is just co-parametric with the subject. So example (193) gives us the required motivation for our three VP contents for (183). In particular, it gives us a case where the two role-linking readings are truth-conditionally distinct from any available co-parametric analysis.

Our argument parallels the argument for two anaphoric readings of *John revised his paper* on the basis of the ambiguity of *John revised his paper before Bill did*. But one might well question the conclusions in both cases. In both cases, we argue for the ambiguity of a simple sentence on the basis of the ambiguity of a more complex sentence.

**Section 5.2**
In both cases, the simpler sentence is not perceived to have all the readings we attribute to it. Perhaps the more complex sentence introduces something which is sufficient on its own to account for the ambiguity. The elliptical VP's in these examples in fact provide an excellent candidate for this extra something.

This view of the strict/sloppy ambiguities in question has been advanced before. Dahl (1972) defends the position that it is an ambiguity in the interpretation of elliptical VP's that is responsible for strict/sloppy readings, and cites as evidence the following example:

(195) John realizes that he is a fool, but Bill does not, even though his wife does.

Dahl claims this sentence can have the reading *John realizes that John is a fool, but Bill doesn't realize that Bill is a fool, even though his wife realizes that Bill is a fool*. The crucial point is that in the first ellipsis the antecedent VP is being interpreted sloppily, and in the second, strictly. This judgment is problematical for our analysis, as it is for any analysis, such as Sag's, which adopts a version of the Elliptical VP Hypothesis of Section 4.1.1:

**Elliptical VP Hypothesis**

The described object of an elliptical VP is the described object of some other VP in the discourse.

Judgments on Dahl's example, however, are not uniform, and in many other examples, the expected number of readings does not appear:

(196) John revised his paper before Bill did, but after the teacher did.

This simply does not have the reading: *John revised John's paper before Bill revised Bill's paper but after the teacher revised John's paper*. We conclude that the Elliptical VP Hypothesis is empirically well-founded.5

A somewhat different angle on the strict/sloppy ambiguities is to test them with sort of ambiguity test discussed in Zwicky and Sadock (1974). Consider the strict and sloppy readings of:

(197) John revised his paper before the teacher did.

5 In Section 7.2.2, we deal with a specific proposal of Hans Kamp's which also rejects the Elliptical VP-Hypothesis. That proposal runs into the problems noted here as well as some others.

**Chapter 5**
We now ask: is this a genuine ambiguity or are we merely observing different ways the statement could be true? Zwicky and Sadock would turn to sentences like (193) to answer this question. If (193) allows us to "cross" the readings of (197), then we are, all things being equal, dealing with a "vagueness"; otherwise we are dealing with a genuine ambiguity. Speakers seem to agree that crossed readings are impossible. Sentence (193) cannot, for example, be interpreted so as to assign the strict reading to the first conjunct and the sloppy reading to the second. That is, the sentence cannot mean that John revised John's paper before the teacher revised John's paper, and Bill revised Bill's paper before the teacher revised the teacher's.

Taking the ambiguity of (197) as established, then, let us ask further why the test just employed should be a reliable diagnostic for ambiguity, as it seems to be.

(198) These people like flying planes, and so do those people.

In a case like (198), when there are independent linguistic reasons for assuming the ambiguity, speakers seem to agree that crossed readings are impossible,

A natural explanation is provided by the Elliptical VP Hypothesis. If there is only one vague property the first VP in (198) can be used to express, that property is the one that will be expressed on any occasion of utterance, and that property, with its attendant vagueness, will be picked up by any elliptical VP anaphoric to it: Whereas, if the first VP of (198) can express either of two distinct properties, it will express one or the other on any occasion of utterance, and a VP elliptical to it will have to express the same one.

So the Elliptical VP Hypothesis justifies the Zwicky and Sadock ambiguity test. It also clearly requires that the minimal VP of (197) (revised his paper) be ambiguous on its own, for otherwise the elliptical VP in (197) could not pick up different properties from the same antecedent on different occasions. The conclusion that revised his paper is ambiguous is thus a necessary consequence of (a) accepting the results of Zwicky and Sadock test for ambiguity; and (b) justifying those results on the grounds of the Elliptical VP Hypothesis. Anyone who questions this conclusion, can challenge it either by finding an alternative justification for Zwicky and Sadock's ambiguity test or by showing that the test is unreliable.

Section 5.2
To sum up the discussion of Sections 5.1 and 5.2: sentences like (183) and (193) motivate the various contents we have been proposing for sentences involving anaphoric pronoun uses; they show that both role-linking and co-parametric uses are necessary. Ultimately, sentences like (187) and (197) show there is no hope of even stating the facts, let alone generating an analysis of them, by simply appealing to a single uniform relationship of anaphora between an antecedent and a pronoun—or even by appealing to two distinct anaphora relations; the two distinct role-linking readings at issue involve the same pronoun and antecedent. The necessary distinction can only be made by reference to the roles that establish the anaphoric relation.

We can re-state this point as follows: the relation critical to describing anaphoric pronoun uses is not the anaphor/antecedent relation—a relation between NP’s—but rather the COVARIES-WITH relation, a relation between NP’s and roles, or role-aspects. The consequences of this criticism are far-reaching. If correct, it is an objection to any account of anaphora based only on an anaphor/antecedent relation between NP’s—or any encoding of such a relation, such as syntactic indexing of NP’s.

5.3 Co-parameterization and Quantification

In this section we argue that allowing co-parametric anaphora with Quantified NP antecedents is necessary. If correct, this claim is an important motivation underlying our attempt in Chapter 6 to present a uniform account of antecedency conditions.

On a theory like Reinhart’s in which there are two kinds of anaphora, the claim that quantifiers are limited to one of those kinds is advanced as one of the strongest motivations for maintaining a theoretical split in the account of anaphora. If, in our attempt to account for the necessary semantic distinctions, we find that quantification extends to both kinds of anaphora, then we shall lose a large part of the motivation for believing that those two kinds are really two kinds, and we will be more inclined to hunt for a unifying account of antecedency conditions.

The first reason to allow co-parametric anaphora for Quantifiers is simple but quite compelling in its own way. It is the easiest thing to do. In general we will allow any two NP’s to co-parameterize;
thus, it would take a special stipulation to prevent quantifiers from sharing their parameters with other NP's. Of course, our theory may need to be augmented with some binding conditions that restrict co-parameterization (discussed in Section 6.2.4), but a principle ruling out co-parameterization for quantifiers would, as we will see below, need to target some NP-pairs in which neither C-commands the other. This is not a usual feature of Binding Theories as they are conceived in Government-Binding Theory.

That is about all there is to the argument from theoretical convenience: it would take a special stipulation in the system we have sketched to prevent co-parametric anaphora with quantified antecedents. Next, we argue that there are cases of anaphora with quantified antecedents which cannot possibly be role-linking anaphora. So they must be co-parametric. Finally, we try to meet the charge that we have drawn the distinction between two kinds of anaphora in the wrong place by showing that the cases we have called co-parametric have properties that make them interestingly different from the role-linking cases.

We noted in Section 5.1 that (199) has three potential analyses that allowed his to be anaphorically related to Every student:

(199) *Every student* revised his paper before the teacher did.

Two of these analyses are role-linking analyses; one is the sort of co-parametric analysis now in question. Now consider (200), with the indicated anaphoric relation:

(200) *Every student’s* tutor revised his paper before the teacher did.

Either role-linking analysis of the maximal VP in (200) gives us the wrong anaphoric relation. Thus, the only way to connect *Every student* and his here is by co-parametric anaphora.

As we noted in Section 5.1, not doing any role-linking gives us only one content for the VP in (200), schematically:

\[
[x | [y | y revised v₀’s paper](x) \text{ BEFORE } [y | y revised v₀’s paper](t)]
\]

This content is only appropriate for the “strict” reading, the one on which the teacher revises student-papers. This is, in fact, the only reading (200) has. There is no understanding equivalent to the sloppy reading of (200), paraphrasable as: every student’s tutor
revised that student's paper before the teacher revised the teacher's paper.

Thus, the need for co-parametric anaphora for quantifiers arises out of semantic necessity. As we have defined role-linking, there is simply no role-linking analysis available to do the necessary work.

Another important property of (199) is that neither of the anaphorically related NP's C-commands the other. This is not a configuration for which tinkering with the definition of C-command gives promising results, because anaphora is possible in sentences like *His mother loves John, and reflexivization is impossible: *John's mother loves himself.\(^6\)

We now try to show is that the contents of sentences with quantificational anaphora which must be co-parametric have properties which significantly distinguish them from anaphoric contents which may involve role-linking.\(^7\)

To show this, we need to discuss a somewhat mysterious condition governing Quantifier parameters, which we will call the Quantified Parameter Condition (henceforth the QP condition). We do not propose the QP condition as a principle of the grammar;\(^8\) we merely address the question of whether it describes a desirable property of the grammar:

**Quantified Parameter Condition**

A parameter \(x\) which is the Described Object of a Quantified

---

\(^6\)Reinhart (1983) actually does settle on an account which tinkers with the definition of C-command; thus C-command is defined so that a possessive inside a subject NP C-commands all the material in the VP. Following Chomsky (1981), she requires that reflexives be bound within their Minimal Governing Category (MGC), and adds to Chomsky's formulation the requirement that the reflexive and its antecedent share a single MGC node. On this account, the notion of a C-commanding antecedent clearly diverges from our notion of a possible role-linking antecedent. What appears to be unexplained on Reinhart's account is why *His mother loves John is so much more acceptable than He loves that picture of John on the anaphoric interpretations. On this question, see Roberts (1987).

\(^7\)Note that the way things have been set up any sentence which may have a role-linking content may also have a co-parametric content, but not vice versa.

\(^8\)In the fragment in the Appendix, the QP condition is not stated as an independent principle. Having failed to formulate the fragment in some way so as to to make the QP condition a theorem, we have for simplicity dispensed with it. The fragment therefore does not account for the absence of an "arbitrary individual" interpretation for examples like (201).
NP with Determiner content $D$ can neither be anchored by the circumstances nor absorbed by any other operator but $D$.

At first sight the QP condition appears simply to be a stipulation of some semantic bookkeeping that will have to be dealt with in any semantic account of the variable scope of quantifiers; but it also makes some nontrivial predictions. Consider a case of the sort discussed in Section 4.2:

(201) Some critic reviewed every play, but Clive Barnes didn’t.

On a wide-scope analysis of (201), the content of the first VP might be:

$$[x | \langle\langle\text{REVIEW}, x, v_0\rangle\rangle]$$

Without the QP condition, what is to keep this parametric content from being used as the content of the elliptical VP, even though every play does not have scope over the second conjunct? The fate of the parameter $v_0$ would then be open to conjecture. It might be anchored to an arbitrary individual, a result which would leave as a possible content for (201) something roughly with the sense of (202), with the pronoun deictic:

(202) Some critic reviewed every play, but Clive Barnes didn’t review it.

So much for the QP condition on its own. We now turn to its potential interaction with Quantifier anaphora.

Consider the contrast in (203):

(203) a. Every student’s tutor revised his paper and the teacher did too.
   b. Every student’s tutor revised his paper before the teacher did.

Given that the only analysis of possessive Quantified antecedents like those in (203a) and (203b) is the co-parametric one, the VP content for both must be something like:

$$[x | \langle\langle\text{REVISE}, x, y\langle\langle\text{AUTHOR-OF}, v_0, y\rangle\rangle\rangle]$$

where $v_0$ is the parameter covered by the quantified NP. But if this content is shared by the VP in the second conjunct, then either a

---

9This problem was pointed out in the analysis of VP-ellipsis given in Partee & Bach (1981).
quantifier parameter must be anchored by the circumstances, or the quantifier must scope across both clauses. The low acceptability of (a), then, is due to the well-known difficulty of scoping a quantifier across conjoined clauses, exemplified in sentences like (204):

(204) *Every student* finished his paper and the teacher passed *him.*

Note, however, that there is a contrast between cases like (203a) and examples that may involve role-linking. Thus, we have, on the sloppy reading:

(205) *Every student* revised his paper and the teacher did too.

Here, even though the quantifier binds a pronoun in the first VP, there is no difficulty in conjoining a VP elliptical to it. The explanation is that a sloppy reading of (205) requires a role-linking analysis. That is, there is a VP content:

\[
[x, y \mid \langle\text{REVISE}, x, y\langle\text{AUTHOR-OF}, x, y\rangle\rangle]
\]

Note that this VP-content does not contain a quantifier parameter. Thus, even when it occurs outside the scope of the quantifier *Every student,* there is no violation of the QP condition. Note also that, with the indicated anaphoric relation, neither of the sentences in (203) have a "sloppy" interpretation, that is, an interpretation on which the teacher revises his own paper. This is because a role-linking analysis of the first clause would force the antecedent of *his* to be *Every student's tutor,* not *Every student.*

The interaction of co-parametric anaphora and the QP condition makes a similar prediction for sentences like (206):

(206) Every child's parent reviewed his progress, and every teacher did too.

(206) lacks the reading: for every child \(v_0\), \(v_0\)'s parent reviewed \(v_0\)'s progress; for every teacher \(v_0\), \(v_0\) reviewed \(v_0\)'s progress.\(^{10}\) This reading is ruled out by the QP condition. Suppose that the content of the first VP schematically was:

(207) \([x \mid x \text{ reviewed } y[y \text{ is } v_0\text{'s progress}]\]

\(^{10}\)If quantifiers cannot scope across conjuncts, then the following reading is also ruled out: for every child \(x\), \(x\)'s parent reviewed \(x\)'s progress; for every teacher \(y\), \(y\) reviewed \(x\)'s progress.

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Without the QP condition, we could get the nonexistent reading by allowing two distinct Quantifiers to bind $v_0$ by co-parametric anaphora.\footnote{Any such Quantifier would of course also have to absorb $y$, by the Absorption Principle.}

The QP condition is, as its name suggests, only a condition on Quantified Parameters. In contrast, there appears to be no difficulty in having a referential NP parameter absorbed in one sentence content, and still be a parameter of another as a result of VP ellipsis. This, at least, appears to be the moral of the sort of missing antecedent phenomena discussed in Grinder and Postal (1971):

(208) Lynn has never read a book, but Fran has, and it was over a hundred pages long.

We can roughly describe what is going on here as follows: suppose the NP $a$ book utilizes the parameter $x$; then $x$ is a parameter of the content of read a book but not of the content of never read a book. Thus, in cases where the VP never read a book occurs alone, no parameter is available for a pronoun:

(209) ?Lynn has never read a book, and it was over a hundred pages long.

When read a book is used as the antecedent for the elliptical VP in (208), $x$ is made available as a parameter which can be co-parameterized with an available pronoun.

The upshot of these examples is that the QP condition appears to capture a special fact about Quantifier parameters; in quantified contexts, it correctly predicts differing potentials for VP-ellipsis for co-parametric and role-linking VP's. Those differences correlate with whether a VP contains a quantifier parameter or not.

We thus propose to allow co-parametric anaphora for Quantified NP's for three different reasons: (1) that it would be extra work for the grammar to rule it out; (2) that it is semantically necessary to capture some bindings of pronouns by quantifiers; (3) that readings describable only with co-parametric contents have interesting restrictions on them, which can be accounted for by something like the QP condition. As a result, our account of Quantifiers will differ from that of someone like Reinhart. Although we enforce something
like a C-command condition on role-linking, we enforce no such restriction on Quantifier binding. From what we have said so far, Quantifiers may bind any parameter in their scope, regardless of its syntactic position, through the simple mechanism of co-parametric anaphora. On this account, another of the grounds for a distinction between bound-variable and other kinds of anaphora vanishes.

What remains to be addressed is one of the principle claims of Reinhart’s analysis, that there are empirical generalizations to be captured by means of a C-Command Constraint on Quantifier-Binding. We address those claims in Section 7.3.2.
6

Circumstance

Thus far we have reduced our account of anaphoric relations between NP's to an account of anaphoric relations between NP parameters. The question we want to address in this chapter is: how does this account relate to our theory of circumstances? A subsidiary question, raised by our discussion of two kinds of anaphora in Chapter 4, is: can the account of the relationship of circumstances and parameters uniformly handle cases of both role-linking and co-parameterization?

6.1 Towards a Framework for Circumstance

In Section 5.1, we made a proposal about what sort of fact makes the right distinctions among the contents of sentences with anaphoric relations:

(210) \langle COVARIES-WITH, NP, r \rangle

In this chapter we propose a treatment which incorporates such facts in the circumstances and makes the contents of particular utterances depend on them. The important claim of that treatment is that the right place to state facts about anaphoric relations is in the theory of context. This means anaphoric relations are not syntactic relations. They are instead contextually governed relations between parts of a sentence's content. To say that anaphoric relations are contextually governed is to say that the fact that determines which NP in a sentence is the antecedent of a pronoun is like the fact that determines which college is picked out by an utterance of this
college. The accounts of the two things belong in the same place in the grammar.

Beyond this meta-theoretical point, we have argued in Sections 4.1, 5.1, and 5.2 that there are numerous cases where the relation of syntactic co-indexing between two anaphorically related NP's underdetermines the contents of utterances. The simplest case involves the need to distinguish between strict and sloppy readings, between what we have called role-linking and co-parametric contents. One approach to making this distinction falls into the class of what we have called division-of-labor theories: the theory gives a syntax-based account of only the role-linking cases, supplemented with a pragmatic account of the co-parametric cases. The co-parametric cases then fall under the scope of what one might generally call pragmatic accommodation. This is the approach taken in Reinhart (1983) and Roberts (1987). But there are several considerations militating against such an approach. First, a uniform account of antecedency conditions is always going to be prima facie preferable to a split account: the burden is on the proponents of the split to motivate it. We argued in Section 4.1 that a very natural motivation for the split fails to go through: Reinhart's claim that all pragmatically-accommodated anaphora is referential seems not to account for the body of facts in question. We further argued in Section 5.3 that anaphora with quantificational antecedents needs to be of both kinds; if this argument goes through, this takes away another major motivation for the division between kinds of anaphora, to wit, that quantificational anaphora has special properties best accounted for by constraints stated only on syntactic representations. We supplement that argument in Section 7.3 by challenging the assertion that quantificational antecedents need to C-command the pronouns they bind. What remains, then, is the challenge of outlining a unified account, one that can be stated in terms of facts about a single representation, and one that naturally makes the necessary content-distinctions. This challenge we take up in Section 6.2.

Since incorporating the sort of fact given in (210) somewhat expands the usual conception of what goes into a discourse-situation, we have been using the term circumstances. Included in the circumstances will be not just information about location, speakers, addressees, and reference, but also the general conditions relating the contents of the linguistic forms in their discourse. The circumstances

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are a single situation, but there may be a constellation of other situations that provide material for the discourse, for example, the described situation, and the resource situations.

This initial characterization is broad enough so that it might be helpful to distinguish what we do not include in the circumstances: we do not include structural information about linguistic forms, their syntax, morphology, or phonology. Nor do we include the contents those forms have. The circumstances are about those contents. But we have set things up so the circumstances are only indirectly about contents. They never contain bits of content as constituents. Rather they relate utterances to things in the world (deixis, reference) or to other utterances (anaphora).

What the circumstances do contain is facts like the following:\(^1\)

\[
\begin{align*}
&((\text{COVARIATES-WITH}, \text{NP}, r)) \\
&((\text{REFREL}, b, u_1)) \\
&((\text{EXPLOITS}, s, u_1)) \\
&((\text{UTTERING}, a, u_2)) \\
&((\text{ADDRESSED-WITH}, a, u_2)) \\
&((\text{SCOPES-OVER}, u_1, u_2)) \\
&((\text{POSREL}, \text{NP}, P))
\end{align*}
\]

The first fact relates two role-aspects that will be labelled with the same parameter; the second relates an utterance with what it refers to; the third relates a resource situation with the utterance that exploits it; the fourth relates an utterance and its utterer; the fifth an utterance and its addressee; the sixth is a relationship between utterances appealed to in our circumstantial account of scope ambiguities in Sections 3.4 and 3.5. The last contains the POSREL relation, which is the relation linking a possessive NP-utterance to the particular possession relation exploited by that NP in the fragment in the Appendix. This is one approach to the notorious ambiguity of the possession relation.

To say that an account of circumstances belongs in the grammar is to say that different linguistic forms have different circumstantial requirements, that there is such a thing as a circumstantial analysis of an utterance. In the face of words like I this claim seems

\(^1\)The alert reader will note that BEING-UTTERED is missing from this list, but this can just be thought of as UTTERING with only two of its three possible arguments filled.
uncontroversial enough. What is perhaps a more striking feature of our analysis is that a single form may have more than one meaning-description. Thus, in Chapter 3, we first illustrated circumstantial ambiguity through our treatment of scope ambiguities. A single syntactic analysis of a sentence may have an arbitrarily large number of different meaning-descriptions. The introduction of anaphora into our theory of circumstance will increase the possibilities for circumstantial ambiguity still further. To integrate our account of anaphoric content with our account of circumstantial ambiguity is the aim of this chapter.

6.2 One Kind of Anaphora

On the grounds given in the last section, the choice as to whether a pronoun—once anaphoric—is given a role-linking or a co-parametric analysis will be a matter of circumstantial ambiguity. The strict/sloppy ambiguities discussed in Section 4.1 show that the distinction between the two kinds of pronoun uses have direct consequences for content.

What is not so clear is whether this distinction has any systematic consequence for the grammar. An analogy may be helpful here. We may recognize an ambiguity between two senses of the noun bank without granting that ambiguity any systematic status. The two nouns may be phonologically, morphologically, and syntactically identical, and differ only in their contents. The strict/sloppy ambiguities we are dealing with obviously have more status as a regular phenomenon. We propose to recognize that status by casting them as circumstantial ambiguities. But we may still choose to have other parts of the grammar, in particular, our theory of antecedency conditions on pronouns, insensitive to that distinction.

The position we take is that the distinction between role-linking and co-parametric uses of pronouns is just a natural consequence of the anaphoric options the grammar offers.

The reasons for this decision are several:

First: No rule of the grammar makes reference to the distinction between role-linking and co-parametric pronoun uses. For example, the VP-rule makes reference only to type-formation on the subject-role, which, as we have seen, is a phenomenon that interacts with both sorts of pronoun uses.

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Second: Generalized Quantifiers can be the antecedents of both kinds of pronoun uses. As we saw in Section 5.3, this was necessitated by numerous examples in which quantified antecedents could not rolelink to the pronouns they bound. Thus, a natural line with which to draw the boundary between two kinds of anaphora does not, on this analysis, exist.

Third: The absorbing-role in role-linking contents is always one formed by a syntactic rule.

We repeat the definition of role-linking given in Section 4.1.

**Role-Linking Anaphora**

In role-linking anaphora the antecedent covers a projection of the role the pronoun covers.

The role an NP covers is the role assigned to it by semantic rule in virtue of its syntactic position. Thus, in order to be a role-linking antecedent, an NP must either cover the absorbing role directly in virtue of its syntactic position (these are the simple role-linking analyses of *John washed his car*), or some projection of the absorbing role (these are more complex cases, like the sloppy reading of *Every student revised his paper before the teacher did*, which was discussed in Section 5.1).

The distinction between roles formed in virtue of syntactic properties and other roles deserves some discussion. In this book, we admit only three mechanisms for role projection:

(A) A role may be absorbed because the circumstances dictate it (through the Closure operation of Section 3.5). The role then has no further projections.

An example is the treatment of negation sketched in Chapter 3. There one analysis of the VP *didn’t eat a biscuit* was:

\[(212) \quad [x_{subj} \mid \langle[x, y \mid \langle\text{EATING, } x, \\
\text{y}\langle\text{BISCUIT, } y\rangle, \\
\text{z}\langle\text{PRECEDES, } x, t, 0\rangle, 0\rangle], x]\]

Here the \([y]\) role is absorbed with no indexing. Thus, under the definition of role-linking given above, it cannot give rise to role-linking antecedents.

(B) A principle like the Absorption Principle can require that a role be projected. But such roles are unindexed and so they cannot be covered.

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A rule can project a role in virtue of a syntactic configuration. Examples are the VP rule which projects the lexical Subject role of a verb, and the VP-adjunct rule discussed in Section 5.1, which in turn can project that projected role. We will call such roles grammatical projections. Such roles are always indexed.

It would appear, thus, of the three sorts of projected roles, only grammatical projections are indexed and available to be labelled, and, thus, only grammatical projections can give rise to role-linking antecedents. If (A), (B), and (C) are already facts about the grammar, then our definition of role-linking does not need to have any grammatical status. It will follow that the only way to associate a pronoun parameter with another NP parameter by role-projection is to project the pronoun role to a grammatical role which can then be covered. Thus, nothing special needs to be said about role-linking, and if at all possible, nothing ought to be.

There remains the fact that role-linking and co-parametric VP-contents for a VP like washed his car are still two different contents. Following the ideas presented in Section 5.1, we correlate this distinction on contents with distinct facts in the circumstances.

(213) **Strict (Co-parametric):**

**Expression:** John washed his car

**Circumstances:** \((\text{COVARIATES-WITH},
\text{"his"},
<\text{"washed his car"}, subj>)\)

**Content:** 
\[
\left[ x_{\text{subj}} \mid \left( \text{WASH},
\begin{array}{l}
\text{r}_1 : x, \\
\text{r}_2 : y \langle \text{OWNS}, r_3 : \text{MALE}, r_4 : y \rangle \land \langle \text{CAR}, r_5 : y \rangle
\end{array}\right) \right]
\]

\[ [x] : j_{\text{JOHN}} \]

**Sloppy (Role-linking):**

**Expression:** John washed his car

**Circumstances:** \((\text{COVARIATES-WITH},
\text{"his"},
<\text{"washed"}, subj>)\)

**Content:** 
\[
\left[ x_{\text{subj}}, y \mid \left( \text{WASH},
\begin{array}{l}
\text{r}_1 : x, \\
\text{r}_2 : y \langle \text{OWNS}, r_3 : \text{MALE}, r_4 : y \rangle \land \langle \text{CAR}, r_5 : y \rangle
\end{array}\right) \right]
\]

\[ [x] : j_{\text{JOHN}} \]
The remaining question is to guarantee that these contrasts in circumstances are correlated with contrasts in contents. We will accomplish this by revising the Circumstance Principle of Section 3.4. There, we countenanced two possibilities for an NP; it was either referential or scoped. We now add a third possibility, being anaphoric:

**Circumstance Principle**

For every NP \( NP_j \) in structure \( S \) there is exactly one circumstantial fact either of the form \( \langle \text{SCOPES-OVER}, NP_j, \beta \rangle \) (for some expression \( \beta \) in \( S \)), or of the form \( \langle \text{REFREL}, NP_j, DO^{NP_j} \rangle \), or of the form \( \langle \text{COVARIES}, NP_j, (\beta, j) \rangle \) (for some expression \( \beta \) in \( S \)), where (i) \( DO^{NP_j} \) has the restriction \( \langle =, DO^{NP_j}, x \rangle \), and (ii) \( x \) labels index \( j \) for expression \( \beta \).

In Section 4.3.8, we refined our analysis of pronouns and recast them as definites. To allow for that analysis, we replace the clause

\[
\text{where (i) } DO_{NP_j} \text{ has the restriction } \langle =, DO_{NP_j}, x \rangle
\]

with the clause

\[
\text{where (i) } RES_{NP_j} \text{ has the restriction } RES^{NP_j} \models \langle =, DO^{NP_j}, x \rangle.
\]

We have now said that all NP's must be either scoped or referential or anaphoric. But we have not yet restricted what other sorts of things can be one of these three. Is it only NP's? Clearly, the answer is no. For example, tense can be both referential and quantified away. VP's can be anaphoric. One might also argue that some PP's, such as locatives, can be both referential and anaphoric (see Creary, Gawron, and Nerbonne 1989). Just as clearly, not everything can take scope or be referential or anaphoric. Therefore, some constraints limiting the possibilities are in order; we have formulated a few of these in the fragment in the Appendix.

### 6.3 Circumstances, Anaphora, and a Binding Theory

We now turn to syntactic conditions on such anaphoric relations—such as disjointness restrictions on pronouns, for example, the restriction that the pronoun can't C-command its antecedent—or restrictions on anaphors, such as the restriction that the antecedent governs the pronoun if and only if the pronoun is reflexive.

Our basic strategy is to recast the sort of Binding Theory presented in Chomsky (1981) as a set of constraints on the relationship
between structure and meaning-descriptions. What this amounts to is a concrete proposal to replace syntactic indexing.

In the Binding Theory below we take the sort of circumstantial fact we have used to determine anaphoric relations (a fact containing the relation COVARIATES-WITH), and use it to recover the NP's that stand in an anaphoric relation. Once those NP's are gotten hold of, the usual syntactic constraints can be stated using the syntactic C-command relation. The crucial point is that the NP's can be recovered from our circumstantial relation between role-aspects, but the role-aspects can't be recovered from any relation between NP's. This was the moral of sections 5.1 and 5.2, where we looked at sentences with pronouns that had multiple readings: while the syntactic antecedent of the pronouns remained constant, the readings varied depending on how the pronoun parameter linked to other parameters in the content.

We place the following restrictions on the relationship between meaning-descriptions and structure:

**Binding Principles**

Consider a meaning-description \( \mathcal{M} \) licensed by structure \( S \). If a condition of the form \( c \models \langle \text{COVARIATES-WITH}, \text{NP}_1, r \rangle \) occurs in \( \mathcal{M} \), then for any NP NP2 that covers a projection of \( r \),

(a) If NP2 is an independent NP it is not C-commanded by NP1 in S; and

(b) NP1 governs NP2 in S if and only if NP2 is reflexive or reciprocal.

There are three strong motivations arguing in favor of such formulation in preference to one that uses some syntactic device such as co-indexing. First, anaphora conditions are stated directly in terms of relations between the syntax and contents and the syntactic representation is consequently simplified. Second, the need for a statement of the "interpretation" of syntactic co-indexing is removed.\(^2\) Third, constraints such as the Absorption Principle can be stated quite naturally, since they are fundamentally semantic constraints.

One might claim that the results of this book amount to an interpretation for syntactic co-indexing and not to a direct challenge

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\(^2\)Reinhart (1983) points out that there is no reason why the sort of theory she favors needs to include the device of syntactic indexing. A direct interpretive theory can capture the same facts.
to the theoretical concept; but we have tried to argue otherwise. The claim made in Chapter 1 was that a motivated semantics of anaphora cannot be adequately formulated as an interpretation of syntactic indexing: if a semantic account of anaphora is given after syntactic indexing, the indexing plays no theoretically motivated role. Together the Circumstance Principle and the Binding Principles will guarantee the following: any two Noun Phrases are going to either not be anaphorically related or else they will be specifically permitted to be in virtue of a circumstantial fact and their having the right structural relationship.

3A rather natural option open to the sort of system sketched here is to attempt to state binding conditions on the contents themselves without reference to syntactic structures. Although we have not developed that possibility in this work, there may be some cases on which this approach would yield different predictions. For example, the following bindings appear impossible without stress on the second italicized NP, although they are difficult to rule out without recourse to some very abstract syntactic representation:

(i) *The tutor corrected John even before he did.
(ii) *Every student's tutor corrected him before he (himself) did.

A problem for the purely content-oriented approach may be posed by the contrast between (iii) and (iv), where (iv) is an example discussed in Section 4.3.7.

(iii) The teacher asks every class to come to his office hours.
(iv) Every class asks the teacher to change his office hours.

The dependency of the definite the teacher on the quantifier is impossible in (iii). Presumably that dependency is parametric (there is no overt pronoun) and involves circumstances. Thus this would appear to be another argument against trying to encode anaphoric dependency in syntactic indexing (see Haik (1984) for an extended indexing analysis to handle such cases). But the contrast between (iii) and (iv) seems to be related to a difference in the surface forms. However see Section 7.3.2 and the discussion of linear order there.
Other Accounts of Anaphora

7.1 Montague and Referential NP’s

We have already noted the debt our account of absorption in general owes to Montague (1970). The idea of mediating all absorption through types has its roots in Montague’s strategy of mediating binding through lambda-abstraction. What we propose to do in this section is to discuss very briefly the relationship of our general framework to that in Montague (1970), and then specifically to clarify our preference for our version of role-linking to what we will call Montague’s extended role-linking.

To begin with, as explained in Section 2.3, there is a conception of Logical Form which we want to argue can be dispensed with. This goal predisposes us to choose an account of Quantifier Scope modeled on that of Cooper (1975), rather than that of Montague. Montague, because of his commitments to a particular theory of compositionality, reflects differences in scope in syntactic differences. Cooper does not.

The same can be said for Montague’s use of indexed syntactic objects—essentially the “pronouns” he0, he1... For us, parameters are a feature of the analysis of content, and need not be tracked by any difference in the syntactic representation.

We turn now to a difference more pertinent to the topic of anaphora and a way in which our analysis, along with a number of recent analyses, differs from Montague’s original treatment of NP-semantics. Following up on Heim (1982), Kamp (1981), and Barwise and Perry (1983), we recognize a semantic difference between referential NP’s and Quantified NP’s. Montague’s original insight was to
give all NP’s a unified treatment as Quantifiers. For Montague, all NP’s had scope. As far as anaphora goes, the virtue of this treatment is that it provides an explanation both for how Quantifiers can bind pronouns, and for how referential NP’s can be involved in both strict and sloppy readings. This was indeed the main use to which Partee (1975) put it. The problem with Montague’s treatment which later revisions sought to resolve was that it attributed scope to referential NP’s. Semantically this was not a problem in Montague’s system, since it guaranteed logically equivalent derivations for proper names quantified in at different levels, and made reasonable predictions about scope differences with other sorts of referential NP’s. But it raised some serious problems in accounting for some simple facts of anaphora, referred to as donkey anaphora in Chapter 4:

(214) a. *If every incumbent wins, then he’ll be surprised.
     b. If an incumbent wins, then he’ll be surprised.

We have already noted the impossibility of the anaphoric relation indicated in (214a), and proposed to explain it by a scope limitation on Every. Just as important is the contrast with the analogous relation in (214b). (214b) does not entail the existence of any incumbent, yet an anaphoric relation with a pronoun in the consequent clause is still possible. But if anaphoric relations can only be established by quantifying in to the if-then clause as a whole, then (214b) presents a genuine semantic paradox.

Essentially the insight in Kamp (1981) is that indefinites may be given differing quantificational force depending on their quantificational environment. They therefore lack any quantificational force of their own. In committing ourselves to an analysis like his, we have, like Kamp, committed ourselves to not allowing referential NP’s to have scope (in the sense discussed in Section 5.2). We have explained one set of phenomena where referential NP’s appear to have the power to bind pronouns like quantifiers via a very limited kind of role-linking—one which, as it were, scopes the referential NP in place. A role-linking antecedent must cover the absorbing role or a projection of it. Quantified NP’s have greater possibilities for binding pronouns because they can be co-parametric antecedents and still bind the pronouns by taking wide enough scope. Thus there is a contrast in the possibilities of interpreting the pronoun as “bound” in (215a) and (215b):

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(215) a. *John's* mother loves *him*.
   b. *Every man's* mother loves *him*.
   c. *John's* mother loves *him* and *Fred's* mother does too.

(215a) has only a co-parametric analysis. The pronoun parameter, which is also the parameter covered by *John*, must be anchored by the circumstances. (215b), similarly, has only a co-parametric analysis, but the quantifier, when it is scoped, may still bind the pronoun that is co-parametric with it (see Chapter 4). Montague, on the other hand, would have treated both examples exactly alike, by quantifying in. Thus, he would had no difficulty in principle with capturing the sort of sloppy reading that some speakers can attribute to (215c). We argue in Section 7.3.1, however, that sentences like (215c) involved something more than garden variety VP-ellipsis, and merit special treatment.

7.2 Discourse Representation Theory

7.2.1 Roberts's 1987 Account of Strict and Sloppy Identity

The theory outlined in Roberts (1987) is an appealing synthesis of a number of different lines of research into anaphoric phenomena. Employing Kamp's theory of Discourse Representation, Roberts assumes a level of Discourse Representations which intervenes between S-structure and model-theoretic interpretation. Her syntactic framework owes its roots to the the Government Binding framework of Chomsky (1981), but differs from most versions in following Williams (1986) and eschewing a level of LF at which matters of scope and binding are resolved. Her theory of binding incorporates an elaborated version of the theory of Reinhart (1983), maintaining the central feature that there need be no disjoint reference conditions, and that only one sort of binding, C-command binding, need be represented at S-structure.

It is not our purpose here to attempt an overall evaluation of this system. Some aspects of her system are compatible with the work here; some are not. What directly concerns us now is the account in Chapter 2 of the contrast between strict and sloppy readings in VP-ellipsis contexts.

Utilizing (216), discussed in Section 5.2,

(216) Alice revised her paper before Betty did, and Carol did too.
we will show that there is a problem for her account in handling certain extended cases of role-linking. We will diagnose the source of this problem as the lack of binding mechanism analogous to role-linking. Then we will discuss the consequences of this lack for the antecedence condition on pronouns.

To begin with, Roberts adopts something like Reinhart’s two-factor account of anaphora. There are two ways pronouns can find antecedents: they can be C-commanded by co-indexed NP’s in S-structure, or they can find Discourse Antecedents in Discourse Structure. In the first case—which Roberts calls C-command anaphora—the pronoun simply uses the discourse referent of its antecedent. In the second, it uses its own Discourse Marker (DM), but that DM must be licensed by a discourse antecedent. The only available antecedents in the Discourse Representation are those markers tied to entities already salient in the discourse. We show briefly how Roberts accounts for strict and sloppy readings, using the example she discusses:

(217) Alice thinks she has the mumps and Betty does too.

We will begin with the sloppy reading, which is derived from an S-structure analysis in which the pronoun is co-indexed with the Subject:

(218) **Sloppy Reading**

\begin{itemize}
\item[(a)] $x_1$
\item[(b)] Alice($x_1$)
\item[(c)] $x_1$ thinks $x_1$ has the mumps
\item[(e)] Betty($x_2$)
\item[(f)] $x_2$ thinks $x_2$ has the mumps
\end{itemize}

We follow Roberts’s own description (slightly modified):

(a) we introduce a discourse referent in the DM for the subject of the first conjunct,

(b) placing on it the condition that it be Alice in any possible interpretation.

(c) The original clause becomes a condition on $x_1$. Since the pronoun is co-indexed with the Subject, it uses the same Discourse referent.

(d) We introduce a discourse referent for the subject *Betty* of the second conjunct.
(e) Since there is no predicate in the second conjunct, we borrow one from the preceding conjuncting replacing all instances of $x_1$, the discourse referent for the Subject of the first clause, with $x_2$, the discourse referent for the Subject of the second clause.

We have emphasized the step that will most concern us for the cases we discuss here. The strict reading of (217) is derived from a syntactic representation in which the pronoun and the subject are not co-indexed:

(219) **Strict Reading**

(a) $x_1$
(b) Alice($x_1$)
(c) $x_2$
(d) $x_1$ thinks $x_2$ has the mumps.
(e) $x_1 = x_2$.
(g) Betty($x_3$)
(h) $x_3$ thinks $x_2$ has the mumps

This time, we introduce a new discourse referent for the pronoun *she*. Since *she* is a pronoun, we must equate $x_2$ with another accessible discourse antecedent, on this reading $x_1$. This happens in (e). In steps (f) through (h) we proceed as before, but this time the result is different when we replace all instances of $x_1$, with $x_3$.

Given the rules for for model-theoretically interpreting structures like those in (219), this procedure correctly captures the distinction between the strict and sloppy readings of (217). We turn now to applying the same sort of analysis to example (216). We first give the analysis on which the pronoun and the Subject are co-indexed:

(220) **Co-Indexed Analysis**

(a) $x_1$
(b) Alice($x_1$)
(c) $x_2$
(d) $x_1$ revised $x_1$’s paper.
(e) Betty($x_2$)
(f) $x_2$ revised $x_2$’s paper.
(g) $x_1$ revised $x_1$’s paper before $x_2$ revised $x_2$’s paper.
(i) Carol($x_3$).
(j) $x_3$ revised $x_3$’s paper before $x_2$ revised $x_2$’s paper.

On this analysis, the reading derived is the one on which everyone revises their own paper. The pronoun shares its DM with the Subject, so that, when all occurrences of the Subject DM are substituted
for, the result is (f). (g) brings all the pieces of the first conjunct together. The Subject DM is still $x_1$, so that the result of the final ellipsis-substitution is (j).

(221) gives the analysis on which the pronoun and Subject are not co-indexed at S-structure, but the pronoun takes the Subject’s DM as a discourse antecedent:

(221) **Non-Co-Indexed Analysis**

(a) $x_1$
(b) Alice($x_1$)
(c) $x_2$
(d) $x_1$ revised $x_2$’s paper.
(e) $x_1 = x_2$.
(g) Betty($x_3$).
(h) $x_3$ revised $x_2$’s paper.
(i) $x_1$ revised $x_2$’s paper before $x_3$ revised $x_2$’s paper.
(j) $x_4$
(k) Carol($x_4$).
(l) $x_4$ revised $x_2$’s paper before $x_3$ revised $x_2$’s paper.

On this analysis, everyone revises Alice’s paper.

In Section 5.2, we saw that this sentence has yet another reading, one on which there are two paper authors, Alice and Carol. On this reading, Alice revised Alice’s paper before Betty did, and Carol revised Carol’s paper before Betty did.

The algorithm Roberts provides in Chapter 2 makes no provision for obtaining such a reading. Moreover, any revision that could obtain it will not be a trivial one. The problem is that once the pronoun has been assigned a DM in (c), the only way to change the referent assigned in other clauses is by substitution. But using the DM’s in (221), the readings we want for the two conjuncts are:

(a) $x_1$ revised $x_2$’s paper before $x_3$ revised $x_2$’s paper.
(b) $x_4$ revised $x_4$’s paper before $x_3$ revised $x_4$’s paper.

There is no way to get from (a) to (b) by a uniform substitution of $x_4$ for $x_1$. To get to (b), what we want instead of (a) is:

(a’) $x_1$ revised $x_1$’s paper before $x_3$ revised $x_1$’s paper.

But (a’) must have come from connecting (a’”) and (a’’”) with “before”:

(a’”) $x_1$ revised $x_1$’s paper
(a’’”) $x_3$ revised $x_1$’s paper

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There is no way to get to \((a'')\) from \((a'\) by a uniform substitution of \(x_3\) for \(x_1\).

The treatment given in Section 5.2 gets to an analogue of \((a\) via the following sort of analysis of the VP-content:

\[
(222) \quad [x_1 \mid [x_2 \mid x_2 \text{ revised } x_1\text{'s paper}] (x_1) \\
\text{BEFORE } [x_2 \mid x_2 \text{ revised } x_1\text{'s paper}] (x_3)
\]

We can think of type-abstraction as having as its analogue in Robert's system the rule of DM substitution; in particular, the "scope" of the lambda-operator corresponds to the domain over which substitution is defined. The problem in getting the relevant reading for (216) is that we need to think of two substitutions happening on the same condition:

\(x_2 \text{ revised } x_1\text{'s paper}\).

One puts in \(x_1\) for \(x_2\), the other puts in \(x_3\) for \(x_2\). But Robert's algorithm offers us no such abstract substitution template. Such a template would in effect be a VP-content with the bound DM being the one substituted for. And such DM's introduce just the sort of complications for antecedency conditions our NP-parameter Principle was designed to meet.

A further problem involves various facts we discussed in Section 4.3 under the heading of the Absorption Principle. The semantics of (216) will also involve a parameter for the NP the paper. In discussing it, we did not deal with the question of when that parameter is absorbed and when it is not. Complicating Robert's algorithm to handle such indirect absorptions will involve—at the very least—introducing substitutions of pairs of DM's for other pairs in various expressions. Returning, for example, to just the first clause of (216):

\[(223) \text{ Alice revised her paper before Betty did.}\]

Obtaining the sloppy reading involves not just substituting Betty's DM \(x_2\) for Alice's DM \(x_1\), but also some DM for Betty's paper—call it \(y_2\) for the DM for Alice's paper \(y_1\). This is a general problem. For example, it crops up with very simple examples like:

\[(224) \text{ Joan saw a car and Frieda did too.}\]

Something must guarantee it isn't necessarily the same car. This appears to be a problem only for Robert's specific algorithm.\(^1\)

\(^1\)Kamp's proposal for handling these examples (discussed in Section 7.2.2) meets this challenge quite naturally.
The claim made by our analysis is that a very natural way of accounting for the facts is to allow VP's to be binding operators on their own. Ultimately, the theoretical decision comes down to this: if one has interpretation procedures involving substitution, one would like to avoid complicating the substitution protocols so much that they begin to duplicate work ordinarily done by variable binding.

We summarize the results as follows. The analysis given here is compatible in goals and general outlook with work in DRT, but not with certain views of the relationship of parametric contents and syntax, in particular the view advanced by Roberts. The chief source of the problem is the view that facts about strict versus sloppy readings can be accounted for at the level of syntax by co-indexing which then has a direct mapping into discourse-representations. The distinctions that can be made at the level of the syntax are too few to handle the more complicated examples. One needs more hooks for the necessary anaphoric relations; in particular, as we argued in Sections 5.1 and 5.2, one needs to make reference to roles within VP's contained by the maximal VP of a clause.

It should be noted that the particular objections raised here to Roberts's account are not objections to any central ideas of DRT. Klein (1987) proposes an account of VP-ellipsis which essentially renders VP contents as properties, as we do, and is vulnerable to none of the points we raise here. Essentially, Klein's representation of a sloppy reading of *Alice revised her paper* would be:

\[
\begin{array}{c}
\vdots \\
x_1 \\
\end{array}
\]

\[\text{Alice}(x_1)\]

\[
\begin{array}{c}
P: \\
x_2 \text{ revised } x_3 \\
x_2's\text{-paper}(x_3) \\
P(x_1) \\
\end{array}
\]

This can easily be extended to handle the case we discussed here, and render all three readings of (216). It is clear that machinery like this is not *incompatible* with syntactic co-indexing; it is just that, once one considers the case of embedded VP's, it is not at all clear what role the co-indexing will play in determining contents. In Section 7.2.2, we consider an alternative proposal of Kamp's for handling
sentences like (216), one which does not appeal to any distinction made at the level of syntax. In fact, Kamp's proposal has the novel property that it gives the antecedent-clauses of elliptical VP's a single content independent of whether the VP is given a strict or sloppy interpretation.

7.2.2 Kamp's proposal

Kamp (pc) has made an interesting suggestion for handling the data of the last section without recourse to any special binding of VP DM's.

Kamp takes the interesting option of not representing strict versus sloppy ambiguities as an ambiguity in the antecedent clause in VP-ellipsis contexts. That is, there is only a single DR Structure for the antecedent clause. The ambiguity comes in through an equivocation in the copying procedure which lets one clause borrow its conditions from another in VP-ellipsis contexts. That equivocation has specifically to do with how anaphoric pronoun interpretations are copied.\(^2\)

Kamp thus follows Dahl (1972) in rejecting the Elliptical VP Hypothesis defended in Section 5.2:

**Elliptical VP Hypothesis**

The described object of an elliptical VP is the described object of some other VP in the discourse.

As we noted in Section 5.2, there are some problems with rejecting the Elliptical VP Hypothesis; in particular, it becomes unclear why "crossed" strict and sloppy readings are unavailable in contexts with more than one elliptical VP. As we shall see, Kamp's proposal runs into a version of these same problems.

We turn now to a formulation of a clause-copying procedure along the lines of Kamp's suggestion. The rule is this: Follow exactly the

\(^2\)There is a revision of Roberts's method of dealing with non-subject DM's in the antecedent clause. Unless a DM \(x_1\) is anchored to something outside the antecedent clause, the copying procedure always generates a new DM \(x_2\) and uniformly substitutes \(x_2\) for \(x_1\) to generate the conditions of the new clause. Intuitively, anchored simply means referential. This lets Alice and Frieda see different cars in cases like *Alice saw a car and Frieda did too*. The effect of something like the Absorption Principle can then be confined to determining when "anchorings" of a parameter are permitted. We will return to this point below.
steps of generating the antecedent clause conditions, including the steps of generating new DM's where allowed, and substituting new DM's for old wherever appropriate. There are two sorts of exceptions: (1) the conditions contributed by the subject of the previous clause: these must be replaced by the new conditions given by the new subject; (2) any condition giving an anaphoric connection with the antecedent subject DM. Such a condition will contain two DM's flanking an "=" sign; call them \( x_1 \) and \( x_2 \), and suppose \( x_1 \) is the old subject DM. There are two ways of copying such equality conditions, the Strict Option and the Sloppy Option. On the Strict Option, proceed as with any non-subject DM for \( x_2 \), substituting the new DM corresponding to \( x_2 \) for it. In the case of the Subject DM \( x_1 \), however, do not substitute for \( x_1 \); leave it in the condition for the new clause. The Sloppy Option is exactly like the Strict Option, except that we substitute the new subject DM for the old subject DM \( x_1 \).

In the following sample derivations, we use the symbol "\( \downarrow \)" following a DM to signal that it is anchored.

(226) **Strict Option Copying**

(a) \( x_1 \downarrow \)  
(b) Alice(\( x_1 \))  
(d) \( x_1 \) revised \( y_1 \)'s paper.  
(e) \( x_1 = y_1 \).  
Strict Copy begins  
(g) Betty(\( x_2 \)).  
(i) \( x_2 \) revised \( y_2 \)'s paper. (Copy of (d))  
(j) \( x_1 = y_2 \). (Strict Option on (e))

What characterizes this as Strict Option copying is (j): the old subject DM is preserved, giving the Strict reading. Sloppy option copying would differ only in that the last condition would be (j') \( x_2 = y_2 \), because \( x_2 \) will be substituted in for \( x_1 \).

A useful way to think of Kamp's account is to view it as a lazy pronominalization account of strict/sloppy ambiguities. Compare it, for example, to Karttunen's celebrated paycheck example:

(227) The man who gave his paycheck to his wife was wiser than the one who gave it to his mistress.

Here, *it* fails to have the same reference as its antecedent. It is interpreted as if it were simply a repetition of the NP *his paycheck*. One way to deal with such examples is to say that something special
may go on when an antecedent itself contains an anaphoric element; when re-used in a new linguistic context, that anaphoric element may be re-evaluated and find a new antecedent. The reference of his is re-evaluated to be the same as the reference of the one and the paycheck referred to changes accordingly. This is precisely what the equivocation in Kamp’s clause-copying procedure does: it treats any subject-bound pronouns occurring in an antecedent VP as lazy, and allows them to be re-evaluated.

Turning now to example (216) repeated here:

(228) Alice revised her paper before Betty did, and Carol did too.
Kamp’s proposal captures all three of the readings we have discussed. The interesting thing is that it also captures one more, which may or may not be genuine. We discuss possible consequences of this result below; first we present two of Kamp’s four readings (leaving the other two as an exercise to the reader): the reading not available on Roberts’s analysis, and the one not available on our analysis.

(229) **Strict Option in first conjunct, Sloppy in second**

(a) \( x_1 \) (c) \( y_2 \) (f) \( x_2 \) (h) \( y_2 \)
(b) Alice(\( x_1 \))
(d) \( x_1 \) revised \( y_1 \)'s paper.
(e) \( x_1 = y_1 \).
(g) Betty(\( x_2 \)).
(i) \( x_2 \) revised \( y_2 \)'s paper.
(j) \( x_1 = y_2 \). (Strict Option on (e))

**First Conjunct:**

\( x_1 \) revised \( x_1 \)'s paper before \( x_2 \) revised \( x_1 \)'s paper.

(l) Carol(\( x_3 \)).
(n) \( x_3 \) revised \( y_3 \)'s paper. (Copy of (d))
(o) \( x_3 = y_3 \). (Sloppy Option on (e))
(p) Betty(\( x_2 \)). (\( x_2 \) is anchored, so no new DM)
(r) \( x_2 \) revised \( y_4 \)'s paper.
(j) \( x_3 = y_4 \). (Sloppy Option on (j))

**Second Conjunct:**

\( x_3 \) revised \( x_3 \)'s paper before \( x_2 \) revised \( x_3 \)'s paper.

On this reading Alice and Carol share the property of revising their own papers before Betty revises their papers.
Next, we give the reading unavailable on our analysis;

(230) **Sloppy Option in first conjunct, Strict in second**

(a) $x_1 \downarrow$  
(b) Alice($x_1$)  
(c) $y_2$  
(d) $x_1$ revised $y_1$’s paper.  
(e) $x_1 = y_1$.  
(f) $x_2 \downarrow$  
(g) Betty($x_2$).  
(h) $y_2$  
(i) $x_2$ revised $y_2$’s paper.  
(j) $x_2 = y_2$. (Sloppy Option on (e))

**First Conjunct:**

$x_1$ revised $x_1$’s paper before $x_2$ revised $x_2$’s paper.

(l) Carol($x_3$).  
(n) $x_3$ revised $y_3$’s paper. (Copy of (d))  
(o) $x_1 = y_3$. (Strict Option on (e))  
(p) Betty($x_2$).  
(r) $x_2$ revised $y_4$’s paper.  
(s) $x_1 = y_4$. (Simple copy; no subject DM’s)

**Second Conjunct:**

$x_3$ revised $x_1$’s paper before $x_2$ revised $x_2$’s paper.

On this reading Alice revises Alice’s paper before Betty revises Betty’s paper, and Carol revises Alice’s paper before Betty revises Betty’s paper.

The difficulty in getting this reading on our analysis is that it requires giving a sloppy reading to the elliptical VP in the first conjunct, but that commits us to role-linking in the main clause VP of that conjunct (*revised her paper*), which gives:

(231) $[x_1 \mid [x_2 \mid x_2 \text{ revised } x_2\text{'s paper}] (x_1)$  

BEFORE $[x_2 \mid x_2 \text{ revised } x_2\text{'s paper}] (x_3)]$

If we hand this content off to the second conjunct, and apply it to Carol, Carol revises her own paper before Betty revises her own. That is, what we have is just the overall sloppy reading, on which everyone revises their own papers. Thus, role-linking in the first conjunct is just carried over to become role-linking in the second; there is no equivalent to “taking the Strict Option” in the second conjunct. There appears to be no simple revision of our account which would yield such a reading. To put it more strongly, it is difficult to see

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how any account which adopted the Elliptical VP Hypothesis could arrive at Kamp's fourth reading. Thus, this seems to be just the right sort of example to distinguish between two theories that differ in a fundamental way.

When it comes to consulting the facts to see which theory makes the correct prediction, however, some problems arise. Some speakers willing to entertain the question at all are willing to call this reading odd, but a few are also willing to accept it. It is difficult to find informants with secure judgments either way. With semantic judgments of this complexity, it is difficult to find informants, period.

There are a number of simpler examples that test the basic issue, such as Dahl's crossed reading example from Dahl (1972), discussed in Section 5.2, and reproduced here:

(232) John realizes that he is a fool but Bill does not, even though his wife does.

Judgments on these examples, however, are not secure either. And where informants do clearly reject crossed readings, there is always the possibility of another explanation, for example, some poorly understood parallelism constraint.

A few meta-theoretical comments: there is immense appeal to Kamp's idea; first, because it confines the ambiguity to just those cases where it shows up; second, because it attributes the ambiguity to choices made while constructing discourse representations. The implications of letting this sort of ambiguity into the game are rather far-reaching, and they bear some careful thought. In the absence of such an example it would have been easy to claim that every ambiguity attributable to an option in representation-constructing strategy can be reformulated as a difference in content. That does not appear easy to do in this case. Whichever way the data falls, that makes the example interesting.

We have been at pains to point out that Kamp's proposal differs in important ways from ours, Roberts's, and many others. It may be worthwhile pointing out too that there is a way in which it is similar to our approach and differs from that in Roberts: it chooses not to represent any of the ambiguities in question at the syntactic level. Instead it opts for a one-many mapping from a single syntactic structure to different overall contents. Our strategy has been to correlate the different contents with distinct circumstances. The
difference in Kamp is that he has chosen a more non-deterministic account.

A few reservations are in order, though. First, it is not always the case that Kamp's algorithm generates more readings than ours. For Kamp, the option to get a strict or sloppy reading is taken for an entire clause before copying it. For us, the option of role-linking applies to each pronoun independently. This means that in VP's with two pronouns, we will find more readings than Kamp. For example:

(233) Sandra sent her resume to her agent and Anita did too.

For us this has a reading on which Anita sends Anita's resume to Sandra's agent. Kamp's algorithm gives no such reading. Speakers do seem to find such readings accessible.

It seems that a relatively minor revision of Kamp's idea would give these readings. Instead of making the strict/sloppy option an option for the entire clause copy, make it an option for each anaphora condition containing the antecedent subject. This revision gets the desired readings for (233), but it has striking consequences for (229). The revised algorithm will give the sentence six readings.\(^3\) Inspection of the derivations above will show that there are three choice points if strict/sloppy options are allowed for each copy of an anaphora condition. In the cases where one takes the sloppy option first, there is no option by the time one gets to the third copy (j), as shown in derivation (231) above. This still leaves six readings. The two new readings are:

(234) Alice revises Alice's paper before Betty revises Alice's paper, and Carol revises Carol's/Alice's paper before Betty revises Alice's/Carol's paper.

Whether these readings are possible is again difficult to say; our intuitions find them more inaccessible than Kamp's fourth reading.

A second potential objection to Kamp's proposal is that it is not at all clear that it can be naturally extended to handle all kinds of strict/sloppy ambiguity. Consider Partee's example:

(235) Only John expects that he will lose.

There does not appear to be any place where "copying" can go on in the interpretation of this sentence. Therefore the ambiguity will have to be attributable to some option in the interpretation of only.

\(^3\)Oh no!
(essentially, having two only's), or to some ambiguity in where the anaphora conditions (the \( x = y \) statements) take effect. Both are ambiguities in the DRS itself. The first option seems somewhat arbitrary; it also faces the challenge of explaining why Only John expects to lose is not ambiguous. The second option seems more motivated, but only if varying the "scope" of anaphora conditions is a general possibility within the theory. One would then need to ask why such variations do not enter into the interpretation of VP-ellipsis.

A final objection to the sort of account Kamp proposes here involves the facts we have described in Section 4.3 which all revolve around the Absorption Principle. It is a central feature of Kamp's account that he gives the clause that will provide the antecedent for an elliptical VP a uniform analysis, whether the elliptical VP takes the strict or sloppy reading. We, on the other hand, claim that the antecedents of sloppy VP's must involve a role-linking pronoun, and therefore absorption, and that absorption principle effects are thus observable. We thus claim, for example, that in Bach-Peters cases, sloppy readings are not possible:

(236) The pilot who first sighted it downed the MIG that chased him, and so did his Squadron mate.

This is because if the pronoun him is role-linked, the parameter of the NP containing it must be absorbed and is thus unavailable for anaphoric relations outside the VP, in particular with the subject, The pilot who first sighted it. Kamp needs a representation of the first conjunct with the problematic anaphoric relation, but it is difficult to see what non-adhoc device would block sloppy option copying in just that case but not strict option copying. Finally, it is difficult to see how Kamp's account would handle facts captured by the Sag/Williams account of the interaction of VP-ellipsis and Quantifier-scope. What is to keep him from making a copy of a VP-content even when there is a quantifier scoping out of that VP, relabelling and using the Quantifier parameter elsewhere? Thus a sentence like

(237) Some critic reviewed every play, and Bill did too.

could receive an interpretation on which for every play \( x \), some critic reviewed \( x \), and Bill reviewed some arbitrary \( y \). Similar remarks apply for other facts captured by what was called the Quantified Parameter Condition in Section 5.3.
In sum, Kamp’s proposal is interesting and original. It raises a challenge not only to this account but to a number of accounts of its ilk. It also raises some fundamental questions about the treatment of ambiguity. As Kamp himself puts it (pc):

The matter that interests me most in this connection is whether this may be an area where our interpretive strategies aren’t very well determined, varying from case to case and speaker to speaker.

It is just the sort of underdetermination of strategy that Kamp is wondering about that would account for the murkiness of some of the judgments here. The matter must rest on the evaluation of just how systematic the facts we have pointed to are.

7.3 C-Command

7.3.1 Role-Linking and C-Command

In Chapter 6, we opted for a grammatical account of anaphora which made no systematic distinction between two kinds of anaphora, although we succeeded in drawing an operational distinction.

The sort of approach pioneered in Reinhart (1983) provides a strong motivation for at least a pragmatic distinction between two kinds of anaphora. Reinhart proposes to dispense with disjoint reference conditions entirely in the grammar, and to supplement the grammatical account of binding with a pragmatic component. The grammatical account of binding is basically: an antecedent may be co-indexed with a pronoun if it C-commands it. The pragmatic principle that guides a speaker’s anaphoric strategy is basically: Use C-command anaphora whenever possible. Two basic sorts of disjoint reference facts are handled as violations of this pragmatic principle:

(238) a. *He thinks John is smart.
    b. *John likes him.

Both (238a) and (238b) are violations because there are variants that can signal C-command anaphora and communicate the same

---

4 There are a number of pragmatically driven approaches to binding facts in the literature, including Farmer (1984), Farmer and Harnish (1987), and Kempson (1985). The first proposal that the complementarity of reflexives and pronouns be accounted for by a Gricean Principle appears to be that in Dowty (1980). We discuss only Reinhart’s here because it is the best known and the most relevant to our particular proposal.

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thing. The anaphoric linking targeted for in (238a) can be satisfactorily achieved with *John thinks he is smart*. The linking targeted in (238b) can be achieved with *John likes himself* where the reflexive pronoun, because it has a higher binding strength, is a preferred strategy for satisfying the pragmatic principle.

The approach taken here admits a reconstruction of Reinhart's enterprise as follows. Let role-linking contents be a category of content referred to in our theory of pragmatics. Let the pragmatic rule be: use role-linking whenever possible. Now just as Reinhart counsels, disjoint reference conditions can dispensed with in favor of this pragmatic principle. (238a) cannot be a case of role-linking, because that would require that the non-pronominal be bound; (238b) might be, semantically speaking, but A-pronouns (reflexives, for example) can still count as stronger signals of role-linking than B-pronouns (ordinary pronouns).

One bonus of this approach is that the notion of C-command may become theoretically dispensible. If role-linking is limited to cases where the antecedent covers a projection of the pronoun role, it would then follow in many cases that the role-linking antecedent C-commands the pronoun. Whether it always follows will depend on a number of features of the theory as a whole.

As an example, we review some unsettled questions regarding the issue of control. Consider (239), which is modeled on some examples first pointed out by John Ross (cited by Reinhart):

(239) a. Hearing the news that *he* had been elected disturbed *John.*

b. *Hearing the news that John had been elected disturbed him.*

Suppose for concreteness that we defined projection so that the role a controlling NP covers could be a projection of the controlled role; suppose further that the Object of the verb *disturb* was the controller of any subjectless, non-finite clauses in Subject position. Then *John* could be a role-linking antecedent for *he* in (12a), even though it does not C-command it. The impossibility of co-reference in (239b)

---

5 This is a radical proposal. It means the role an NP covers might not be contained in the content of a constituent containing that NP. Essentially we would be saying that John covered the [x] role in

\[ x \mid x^{'}s \text{ hearing the news that } x \text{ had been elected disturbed } x \]

rather than any role in the VP-content. The VP content would then have to be parametric, as in the case of wide-scoping Quantifiers.
would follow from Reinhart's account of disjointness. What would also follow is the possibility of sloppy-readings for cases like (240):

(240) Hearing the news that he had been elected disturbed John, and delighted Fred.

The striking point here is that we are able to account for examples like (239) and (240) without positing any syntactic element which \textit{does} C-command the pronoun; since our commitment is rather to the semantic notion of role-linking, we make our theoretical adjustments there.\textsuperscript{7}

Of course, evaluating such a proposal fully means looking at a much wider range of data than have been considered in this book. A crucial set of issues is the treatment of long-distance dependencies, reflexives, and Cross-over and Weak Crossover facts, about which we will have nothing illuminating to say here. It is worth noting, however, that there does not appear to be any prima facie evidence that pronouns related to their antecedents through long dependencies need have role-linking analyses:

(241) a. Alice washed the car that she had rented more often than Sue did.
   b. Which car that she had rented did Alice wash more than Sue did?
   c. A car that Alice washed more than Sue did would be a rarity.

\textsuperscript{6}Adopting such an account for (240) opens at least the possibility of an account of one of the more puzzling cases pointed out by Ross:

(i) The news that he had been elected disturbed John, and delighted Fred.

The close semantic connection between (240) and (i) suggests that a role-linking analysis of (i) might be parasitic somehow on that of (240). How far one should go towards formalizing this possibility is not clear; but note that, like (b), (ii) is somewhat questionable with the indicated anaphoric relations:

(ii) ?The news that John had been elected disturbed him.

Ross points out similar examples involving the noun \textit{discovery}. Such judgments shade gradually into cases like (iii), where the anaphoric options seem more open.

(iii) a. The picture of John disturbed him.
   b. The picture of him disturbed John.

\textsuperscript{7}It should be noted here that the original inspiration for dispensing with C-command in favor of some semantic property defined in terms of how the semantics is put together comes from Bach & Partee (1980), which develops the idea in a Montagovian framework, and without the aid of Reinhart's "pragmatic" component.

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Although (241a) has both a strict and a sloppy reading, (241b) and (241c) do not. Thus there is no obvious reason to posit a role-linking analysis for (241b). Note, in contrast, that the need for a role-linking analysis reappears in (242):

(242) Which student did Beth think revised her paper before the teacher did?

This result is good news within our general framework, since role-linking to a subject-role has consequences for the VP content. It would be unfortunate if VP-contents varied depending on whether their Subjects had been moved or not.

This still leaves a residue of unexplained cases, whether one begins with C-command, or role-linking. We recall the case cited in Section 7.1:

(243) a. John's mother loves him, and *Harry's mother does too.

b. The news that he had been nominated pleased John and disturbed Harry.

c. A chair he sat on supported Fred and collapsed under Tom.

We are interested in only the sloppy readings of the sentences in (243). All the sentences in (243), if acceptable, raise the specter of "quantifying in" referential NP's. In order to get sloppy reading of (243b), for example, the NP's John and Harry will each have to cover the projected role schematically given in (244):

(244) [x | The news that x had been nominated disturbed x]

Labelling the [x]-role in (244) with an NP parameter would be a violation of NP-closure.

It seems clear that there are a variety of sloppy readings beyond those allowed by our restricted definition of role-linking and an assumption like NP-Closure. What is not clear is just which of these ought to be supplied by some systematic mechanism in the grammar. The judgments in (243) are far from secure, and there is some evidence that examples like those in (243) involve special repetition contexts. In (243c), the unacceptability of the continuation with Harry's father suggests that this is more than a just a garden variety case of VP-ellipsis; some more complicated elliptical phenomenon—involving a repetition of previous material—seems to be involved.
Also, examples like (243c) seem to be favored by conjunction contexts. A sloppy reading analogous to (c) is much less accessible in:

(245) Fred’s mother loves him more than Bill’s mother does.

In light of the unclear status of these examples, we will chose to reject the various possible weakenings of the theory that would give us Montagovian extended role-linking. Besides the general advantage of a stronger theory, it leaves us with one more naturally suited to being coupled with a pragmatic account like Reinhart’s.

Summarizing: much of the enterprise laid out in Reinhart (1983) is compatible with the work here, if our notion of role-linking is taken to replace her notion of bound-variable anaphora. In that sense, there may in fact be two types of anaphora: the preferred kind mentioned in Reinhart’s pragmatic principle or some variant of it, and anything else. Even if we adopted Reinhart’s revision of Binding Theory, this would still not entail marking a division between role-linking and co-parametric anaphora in our theory of content and circumstances.

7.3.2 Quantification and C-Command

When Partee first proposed a distinction between two sorts of anaphora, she had in mind that Quantified NP antecedents would always use the “bound-variable” sort. Since then, a number of researchers, Reinhart included, have proposed that that sort of anaphora be limited to cases where the antecedent C-commands the pronoun. Our account makes no distinction between two kinds of anaphora, and even our operational (or pragmatic) distinction between co-parametric and role-linking uses is drawn so that Quantifiers can exploit both kinds. If it is true that Quantifiers must C-command the pronouns they bind, then this is a serious objection to the approach taken in this paper. It is an objection on two grounds. First, there is an important grammatical phenomenon which splits precisely along the line where the distinction between two kinds of anaphora should be drawn; second, even granted a pragmatic category of role-linking, the environments for role-linking cannot be defined to handle some of the difficult cases.

In this section we argue that C-command is not the right restriction on Quantifier-binding; we also argue, following up on suggestions by a number of researchers, that linear word-order—or rather, that order of a slightly more abstract sort—is the right restriction. In
particular, we argue for an analysis based on processing order in the sense of processing assumed in a dynamic interpretation framework like that of Heim (1982).

We begin with some well-known counterexamples to the C-command claim:

(246) a. Every man’s mother loves him.
   b. The soldiers turned some citizens in each state over to its governor.

Roberts (1987) gives an ingenious "inverse-linking" account of examples like (246a); the details of her account need not concern us here, but the crucial prediction is that NP’s dominated by another NP may bind anything the containing NP C-commands. This correctly predicts a contrast in binding possibilities between examples like (246) and its passive counterpart. Roberts’s account, however, does not extend to examples like (246b). Reinhart accounts for (246a) by adjusting the definition of C-command; but as we noted in Section 5.3, this makes it difficult to account for the contrasting anaphoric possibilities of He loves John’s mother and His mother loves John. Reinhart would appear to have nothing to say about examples like (246b).

Consider as an alternative an account based on left/right precedence which claims that a quantifier must occur to the left of a pronoun it binds. Neither of the sentences in (246) pose a challenge to that claim. Such an account would also account for the following:

(247) a. John talked to every applicant about his application.
   b.*John talked about his application to every applicant.
   c. John sent every application back to its owner.
   d.*John sent its owner back every application.

Whichever definition of C-command is taken, one of sentences (247a) or (247b) would appear to be unaccounted for. (c) and (d) would appear to be problems on any standard definition.

There is a class of examples which are sometimes taken as evidence for a C-command account which might at first blush appear to count against a left/right account:

(248) A woman who knew every artist brought her to the party.

Here, the pronoun is unable to be interpreted as anaphoric with the quantifier. However, the difficulty of an anaphoric interpretation in cases like these can be chalked up to the great difficulty in having

Section 7.3
quantifiers embedded inside relative clauses take wider scope than the head of the relative clause:

(249) A woman who knew every artist brought a painting to the party.

Note that this sentence has no reading that can be paraphrased as: for every artist $x$, there is a woman $y$ who knew $x$ and a painting $z$, such that $x$ brought $z$ to the party. Claim A of Section 4.2 is thus sufficient to account for (248): A quantifier can bind only pronouns in its scope. The relative clause constraint and the subject constraint can be correlated with Island-Constraints on movement. Capturing such constraints will of course be an independent requirement on a theory that incorporates a C-command constraint on Quantifier-binding, because, as (249) shows, such constraints arise in cases without any anaphora.

An implicit claim made by a theory adopting a left-right account of Quantifier binding is that the ability of subject-embedded quantifiers to bind pronouns in VP-position should correlate with their ability to take sentence-wide scope. Consider, for example, (250):

(250) a. A picture of each candidate showed him campaigning.
    b. A picture of each candidate showed a modest white house in the background.
    c. Each candidate’s picture showed him campaigning.
    d. Each candidate’s picture showed a modest white house in the background.

The prediction is that a reading of (a) which allows an anaphoric interpretation should be no worse than the following reading of (b): for every candidate $x$, there is a picture $y$ of $x$ and a modest white house $z$ in the background of $y$, such that $y$ shows $z$. Similarly for (c) and (d). Both these predictions appear correct: Anaphora and sentence-wide scope are difficult in the case of (a) and (b), and perfectly acceptable in the case of (c) and (d). Thus, the left/right theory need say nothing special about possessive quantifiers in its theory of anaphora, either by revising its definition of C-command, or by positing a special movement rule such as Roberts’s inverse-linking rule. The capacity of possessive quantifiers to bind pronouns follows from their scoping properties.

The reasoning is exactly parallel for cases like:
(251) a. Every Democrat declared victory before some Republican
did.
   b. Every Democrat declared victory and some Republican did.
   c. Every incumbent declared victory before his opponent did.
   d. Every incumbent declared victory and his opponent did.

Lest we seem overly optimistic at this point, let us admit that
a strict left/right account of Quantifier-binding quickly runs into
trouble. The difficulty has to do with long-distance dependencies.
First the good news: as one would expect on a strict left-right theory,
leftward movement can improve a Quantifier's anaphoric options:

(252) Which picture of every Englishman does he find flattering?

Now the bad news: leftward movement never reduces a quantifiers
binding options:

(253) Which picture of him does every Englishman find flattering?

Here, if surface left/right order were really the controlling factor, one
would expect an anaphoric interpretation of (253) to be impossible.
But it is not. (253) is, if anything, more acceptable than (252). 8

Examples like (253) show that simple left/right order will be insuf-
ficient to correctly characterize the binding conditions of quantifiers.
Indeed, (252) and (253) taken together show that no antisymmetric
relation 9 between NP's A and B in a surface representation can be
a necessary condition for A's binding B. Surface word order is one
such relation.

But note that surface C-command does no better with the facts in
(253).

Finally, we turn to another class of important sentences that can
be explained on neither account, cases where a Quantifier appears
to neither precede nor C-command a pronoun it binds:

(254) a. A plaque bearing the date of its incorporation can be found
outside every American city. (Sells's example, cited in
   Roberts 1987)
   b. Devotion to his country characterizes every good soldier.

Cases of this sort seem to all share a strongly generic flavor. In
Section 4.2.4, we discussed a proposal for handling these cases which

8 Some speakers experience mild weak-crossover effects with (252). Engdahl
(1980) discusses a number of such cases insightfully.

9 A relation R is antisymmetric if it is never the case that xRy and yRx.
did not involve quantifier-binding at all, but rather interpreted the
generic subjects as selection-functions, and the VP's as properties of
selection functions. If an analysis of that sort can be made to go
through, then a linear-precedence account of Quantifier-binding can
stand.

In sum, there appear to be enough problems with a C-command ac-
count so that linking Quantifier-binding directly up to role-linking,
or to any C-command based sort of anaphora, is unmotivated. A
linear-precedence account, on the other hand, shows some promise,
though it is also not without its problems. A linear-precedence ac-
count also has a strong appeal from the point of view of theoretical
parsimony. There already appears to be some need for reference to
linear order in our account of anaphora with at least some indefinites
(see Wasow 1972), and it would not be surprising—it would even be
desirable—if another sort of NP obeyed the same sorts of constraints.
Appendix: A Fragment

Part One

Discourse Rule

(255) DISCOURSE \rightarrow S_1 \ldots S_n

\[ c[\text{DISCOURSE}]_{DO,SIT} \text{ iff} \]
\[ (C \geq C^{S_1} \land \ldots \land C^{S_n}) \]
\[ (C \models \langle \text{ABOUT, DISCOURSE, SIT} \rangle) \]
\[ (C \models \langle \text{ASSERTED, DISCOURSE, DO} \rangle) \]
\[ (DO = (\text{SIT} : [s | s \models C_1(\text{DISCOURSE}, DO^{S_1} \land \ldots \land DO^{S_n})))) \]

Basic Sentence-Structure Rules

(256) S \rightarrow NP \quad VP

(↑ SUBJ) =↓  ↑=↓

\[ c[S]_{DO,RT} \text{ iff} \]
\[ (C \geq C^{NP} \land C^{VP}) \]
\[ (DO = C_1(S, \langle DO^{VP}, \quad subj : DO^{NP} \quad tns : RT^{VP} \rangle)) \]
\[ (RT = RT^{VP}) \]

(257) VP \rightarrow V \quad NP

↑=↓  (↑ OBJ) =↓
\[ c[VP]_{DO,RT} \text{ iff } \\
(C \geq C^V \land C^{NP}) \\
(\text{DO} = [x_{subj}, y_{tns} \mid C(VP, \langle DO^V, subj : x, obj : DO^{NP}, tns : y \rangle))] \\
(\text{RT} = R^T_V) \]

**Noun-Phrase Rules**

*Referential Noun-Phrase Rules*

(258) \[ NP_0 \rightarrow NP_1 \]
\[ 's \]
\[ \uparrow = \downarrow \]
\[ (\uparrow \text{ CASE}) = \text{POS} \]

\[ c[NP_0]_{DO,RES} \text{ iff } \\
(C \geq C^{NP_1}) \\
(\text{RES} = \text{RES}^{NP_1}) \\
(\text{DO} = \text{DO}^{NP_1}) \]

(259) \[ NP \rightarrow \text{RefDet} \quad \text{NOM} \]
\[ (\uparrow \text{ Spec}) = \downarrow \quad \uparrow = \downarrow \]

\[ c[NP]_{DO,RES} \text{ iff } \\
(\text{RES}_{\langle RR^{\text{RefDet}}, \text{RES}, \text{DO}^{\text{NOM}} \rangle} = \langle \text{DO}^{\text{NOM}}, \text{instance: DO} \rangle) \]

(260) \[ NP_0 \rightarrow NP_1 \]
\[ \text{NOM} \]
\[ (\downarrow \text{ CASE}) = _c \text{POS} \quad \uparrow = \downarrow \]
\[ (\uparrow \text{ Def}) = + \]

\[ c[NP_0]_{DO,RES} \text{ iff } \\
(C \models \langle \langle \text{POSREL}, NP_0, R \rangle \rangle) \\
(\text{RES}_{\langle \text{UNIQUE}, \text{RES}, P \rangle} \models \langle P, \text{instance:DO}^{NP_1} \rangle) \\
(\text{P} = \langle x_{\text{instance}} \mid \langle \langle R, \text{DO}^{NP_1}, x \rangle \rangle \\
\wedge \langle \langle \text{DO}^{\text{NOM}}, \text{instance: x} \rangle \rangle) \]

*Generalized Quantifier Rules*

(261) \[ NP \rightarrow \text{QUANTDet} \quad \text{NOM} \]
\[ (\uparrow \text{ Spec}) = \downarrow \quad \uparrow = \downarrow \]

\[ c[NP]_{DO,AT,QF,RES} \text{ iff } \\
(\text{AT} = \{ x \mid \text{RES} \models \langle \text{DO}^{\text{NOM}}, \text{instance: x} \rangle \}) \\
(\text{QF} = \text{DO}^{\text{QUANTDet}}) \]
Nominal Phrase Rules

(262) NOM₀ → NOM₁ VP
       ↑=↓  (↑ ADJ) =↓
       (↓ FORM) =c PRP

\[c[NOM₀]_{DO} \text{ iff } (C \geq C^{NOM₁} \land C^{VP})\]
\[(DO = \{x_{instance} \mid CI(NOM₀, \langle DO^{VP}, subj:x\rangle \land \langle DO^{NOM₁}, instance:x\rangle)\})\]

(263) NOM → CN
       (↑=↓)
\[c[NOM]_{DO} \text{ iff } (DO = \{x_{instance} \mid \langle DO^{CN}, instance:x\rangle\})\]

Auxiliary VP Rules

(264) VP₀ → VP₁ VP₂
       ↑=↓  (↑ XCOMP) =↓
       (↓ TNS) =c +
       (↓ AUX) =c +
\[c[VP₀]_{DO,RT} \text{ iff } (C \geq C^{VP₁} \land C^{VP₂})\]
\[(DO = \{s_{subj, tns} \mid CI(VP₀, \langle DO^{VP₁}, subj:x, tns:y\rangle)\})\]
\[(RT = RT^{VP₁})\]

(265) VP₀ → NOT VP₁
       ↑=↓
       (↓ TNS) =c –
\[c[VP₀]_{DO,RT} \text{ iff } (C \geq C^{VP₁})\]
\[(DO = \{s_{subj, tns} \mid CI(VP₀, \langle DO^{VP₁}, subj:x, tns:y;0\rangle)\})\]
\[(RT = RT^{VP₁})\]

(266) VP → V
       ↑=↓
       (↓ AUX) =c +
\[
\begin{align*}
c[\text{VP}]_{\text{DO,RT}} \text{ iff} & \quad (C \geq C^V) \\
& \quad (RT = RT^V)
\end{align*}
\]

Other VP Rules

(267) \(\text{VP}_0 \rightarrow \text{VP}_1 \quad \text{AdvP}\)
\[
\uparrow = \downarrow \quad (\uparrow \text{ADJ}) = \downarrow
\]
\[
c[\text{VP}_0]_{\text{DO,RT}} \text{ iff} & \quad (C \geq C^{\text{VP}_1} \land C^{\text{AdvP}}) \\
& \quad (\text{DO} = \quad [s_{\text{subj}}, y_{\text{tns}} | C I (\text{VP}_0, \langle \text{DO}^{\text{VP}_1}, \text{subj} : x, \text{tns} : y, \langle \text{DO}^{\text{AdvP}}, \text{instance} : y \rangle \rangle)])) \\
& \quad (RT = RT^{\text{VP}_1})
\]

(268) \(\text{AdvP} \rightarrow \text{ADV} \quad S\)
\[
\uparrow = \downarrow \quad (\uparrow \text{OBJ}) = \downarrow
\]
\[
c[\text{AdvP}]_{\text{DO}} \text{ iff} & \quad (C \geq C^{S} \land C^{\text{AdvP}}) \\
& \quad (\text{DO} = \quad [x_{\text{instance}} | \langle \text{DO}^{\text{AdvP}}, \text{instance} : x, \text{object} : RT^{S} \text{DO}^{S} \rangle])
\]

Lexicon

(269) \(\text{NP} \rightarrow \text{John}\)
\[
c[\text{NP}]_{\text{DO,RES}} \text{ iff} & \quad (C \models \langle \text{REFREL, NP, DO, RES} = \langle \text{NAMED, DO, "John"} \rangle \rangle)
\]

(270) \(\text{NP} \rightarrow \text{he}\)
\[
(\uparrow \text{Def}) = +
\]
\[
c[\text{NP}]_{\text{DO,RES}} \text{ iff} & \quad (\text{REL} \langle \text{UNIQUE, RES, P} \rangle \models \langle P, \text{DO} \rangle) \\
& \quad (P = [x | \langle \text{MALE, x} \rangle])
\]

(271) \(\text{NP} \rightarrow \text{himself}\)
\[
(\uparrow \text{Def}) = +
\]
\[
(\uparrow \text{Refl}) = +
\]
\[c[NP]_{DO,RES} \iff \text{RES}_{\langle \text{UNIQUE,RES,P} \rangle} = \langle P, DO \rangle \]
\[P = [x \mid \langle \text{MALE}, x \rangle] \]

(272) \(NP \rightarrow she\)
\[\text{(↑ Def) } = + \]
\[c[NP]_{DO,RES} \iff \text{RES}_{\langle \text{UNIQUE,RES,P} \rangle} = \langle P, DO \rangle \]
\[P = [x \mid \langle \text{FEMALE}, x \rangle] \]

(273) \(NP \rightarrow herself\)
\[\text{(↑ Def) } = + \]
\[\text{(↑ Refl) } = + \]
\[c[NP]_{DO,RES} \iff \text{RES}_{\langle \text{UNIQUE,RES,P} \rangle} = \langle P, DO \rangle \]
\[P = [x \mid \langle \text{FEMALE}, x \rangle] \]

(274) \(NP \rightarrow his\)
\[\text{(↑ Def) } = + \]
\[\text{(↑ Case) } = \text{POS} \]
\[c[NP]_{DO,RES} \iff \text{RES}_{\langle \text{UNIQUE,RES,P} \rangle} = \langle P, DO \rangle \]
\[P = [x \mid \langle \text{MALE}, x \rangle] \]

(275) \(NP \rightarrow her\)
\[\text{(↑ Def) } = + \]
\[\text{(↑ Case) } = \text{POS} \]
\[c[NP]_{DO,RES} \iff \text{RES}_{\langle \text{UNIQUE,RES,P} \rangle} = \langle P, DO \rangle \]
\[P = [x \mid \langle \text{FEMALE}, x \rangle] \]

(276) \(CN \rightarrow student\)
\[c[CN]_{DO} \iff \text{DO} = [x_{\text{instance}} \mid \langle \text{STUDENT}, x \rangle] \]

(277) \(CN \rightarrow paper\)
\[c[CN]_{DO} \iff \text{DO} = [x_{\text{instance}} \mid \langle \text{PAPER}, x \rangle] \]

(278) \(V \rightarrow revised\)
\[\text{(↑ TNS) } = + \]
\(c[V]\rightarrow{DO,RT}\) iff
\( (C \models \langle \text{BEING-UTTERED, V, l} \rangle)\)
\( (DO = [x_{\text{subj}}, y_{\text{obj}}, z_{\text{tsn}} | \langle \text{REVISING, reviser : x, revised : y, loc : z} \rangle]) \)

\((279)\ V \rightarrow \text{revising}\)
\( (\uparrow \text{TNS}) = - \)
\( (\uparrow \text{FORM}) = \text{PRP} \)

\(c[V]\rightarrow{DO,RT}\) iff
\( (DO = [x_{\text{subj}}, y_{\text{obj}}, z_{\text{tsn}} | \langle \text{REVISING, reviser : x, revised : y, loc : z} \rangle]) \)

\((280)\ V \rightarrow \text{revise}\)
\( (\uparrow \text{TNS}) = - \)
\( (\uparrow \text{FORM}) = \text{BSE} \)

\(c[V]\rightarrow{DO,RT}\) iff
\( (DO = [x_{\text{subj}}, y_{\text{obj}}, z_{\text{tsn}} | \langle \text{REVISING, reviser : x, revised : y, loc : z} \rangle]) \)

\((281)\ V \rightarrow \text{is}\)
\( (\uparrow \text{TNS}) = + \)
\( (\uparrow \text{XCOMP FORM}) = \text{PRP} \)
\( (\uparrow \text{AUX}) = + \)

\(c[V]\rightarrow{DO,RT}\) iff
\( (C \models \langle \text{BEING-UTTERED, V, l} \rangle)\)
\( (\langle \text{OVERLAPS, RT, l} \rangle)\)

\((282)\ V \rightarrow \text{did}\)
\( (\uparrow \text{TNS}) = + \)
\( (\uparrow \text{XCOMP FORM}) = \text{BSE} \)
\( (\uparrow \text{AUX}) = + \)

\(c[V]\rightarrow{DO,RT}\) iff
\( (C \models \langle \text{BEING-UTTERED, V, l} \rangle)\)
\( (\langle \text{PRECEDES, RT, l} \rangle)\)
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(283) NOT → not

(284) QUANTDET → EVERY

\[ QUANTDET \text{DO} \iff (DO = \text{EVERY}) \]

(285) QUANTDET → MOST

\[ QUANTDET \text{DO} \iff (DO = \text{MOST}) \]

(286) REFDET → The

\[ (\uparrow \text{DEF}) = + \]

\[ REFDET \text{RR} \iff (RR = \text{UNIQUE}) \]

(287) REFDET → A

\[ (\uparrow \text{DEF'}) = - \]

\[ REFDET \text{RR} \iff (RR = \text{TRUE}) \]

(288) ADV → before

\[ \text{ADV\ DO} \iff (DO = [x_{\text{instance}}, y_{\text{object}}] \land \langle \text{BEFORE, instance : x, object : y} \rangle) \]

Part Two

Definition of Closure

The main difference between the version of Closure given here and that in Section 3.5 is that the version here has been extended to allow for Donkey-anaphora, very much in the spirit of the treatment given in DRT. We allow Quantifiers to bind a set of auxiliary parameters, as we allowed the relation INVOLVES to bind an undetermined number of parameters in Section 4.2.3. Thus, one content for the canonical donkey-sentence will be:

(289) \[ \langle \text{EVERY}, \{y\}, \]

\[ [x | s' = \langle \langle \text{FARMER, x} \rangle \land \langle \text{OWNING, x, y} \rangle \]

\[ \land \langle \text{DONKEY, y} \rangle \]

\[ [x | \langle \text{BEATING, x, y} \rangle \}] \]

Let the first parametric property argument of EVERY, \( R \), be called the restrictor-property, and the second, \( S \), the scope-property. The idea is that the above state-of-affairs is a fact if and only if for every anchor \( f \) for \( y \), every bearer of \( R[f] \) has the property \( S[g] \) where \( g \) is some extension of \( f \). Only if \( y \) is anchored to a donkey owned by a
farmer in $s'$ can the restrictor-property have a non-empty extension; and every such farmer must beat $y$.

This treatment obviously leaves a lot of questions about donkey anaphora unanswered, but it is sufficient for the purpose of showing how donkey anaphora can be integrated with our treatment of scope and closure. We now present a revised version of Closure, augmented to allow this new kind of binding. In (290), $n + j^n$ NP's are being quantified in. For each $i$, $j^i$ is the number of referential NP's quantified away by Quantifier $\alpha_i$; the narrowest-scoping generalized Quantifier is $\alpha_n$; and since $\alpha_n$ quantifies away $j^n$ referential NP's, $\alpha_n + j^n$ is the narrowest-scoping NP:

$$(290) \quad \text{Closure}(A, \sigma) = df \exists DO^{\alpha_1} \ldots \exists DO^{\alpha_{n+1}} \langle \langle QF^{\alpha_1}, \{DO^{\alpha_{i+1}} \ldots DO^{\alpha_{n+j^i}}\}, AT^{\alpha_{i+1}}, [DO^{\alpha_1} | \langle \ldots \langle QF^{\alpha_n}, \{DO^{\alpha_{n+j^n}}\}, AT^{\alpha_n}, [DO^{\alpha_n} | \sigma] \rangle \ldots ] \rangle )$$

where $\alpha_1 \ldots \alpha_{n+j^n}$ is the longest sequence of NP sub-utterances of $A$ such that ($C^A \models \langle \langle \text{SCOPES-OVER}, \alpha_i, \alpha_{i+1} \rangle \rangle$) and ($C^A \models \langle \langle \text{SCOPES-OVER}, \alpha_{n+j^n}, A \rangle \rangle$).

This has the effect of quantifying in all the NP’s that the circumstances need to be quantified in in the order in which the circumstances dictate it. Note that this is not the equivalent of emptying Cooper store; thus, the above formulation allows, for example, for a VP which contains two NP’s and quantifies-in one of them at the VP level, allowing the second to be quantified in higher up. That second NP will simply not bear the SCOPES-OVER relation to either the VP or the first NP. It will instead bear it to some utterance containing the VP (or possibly to some third Quantifier scoped in higher up).

**Binding Theory**

Consider a meaning-description $M$ licensed by structure $S$. If a condition of the form ($c \models \langle \langle \text{COVARIATES-WITH}, NP_1, r \rangle \rangle$) occurs in $M$, then for any NP $NP_2$ that covers a projection of $r$,

(a) If $NP_2$ is an independent NP, it is not C-commanded by $NP_1$ in $S$; and

(b) $NP_1$ governs $NP_2$ in $S$ if and only if $NP_2$ is reflexive or reciprocal.
Circumstance-Principle

(1) For every NP $NP_i$ in structure $S$ there is exactly one circumstantial fact either of the form

$$\langle \text{SCOPES-OVER}, NP_i, \beta \rangle$$

(for some expression $\beta$ in $S$)

or of the form

$$\langle \text{REFREL}, NP_i, DO^{NP_i} \rangle.$$ 

or of the form

$$\langle \text{COVARIATES}, NP_i, \langle \beta, j \rangle \rangle$$

(for some expression $\beta$ in $S$ where (i) $RES^{NP_i}$ has the restriction $RES^{NP_i} \models \langle =, DO^{NP_i}, x \rangle$ and (ii) $x$ labels index $j$ for expression $\beta$.)

(2) For every VP $VP_i$ admitted by rule (266) in structure $S$ there is exactly one circumstantial fact of the form

$$\langle \text{COVARIATES}, VP_i, \beta \rangle$$

(for some other VP $\beta$ in $S$ where $DO^{VP_i}$ has the restriction $\langle =, DO^{VP_i}, DO^\beta \rangle$.)

Special Constraints on Meaning-Descriptions

(1) If $\alpha$ occurs in a fact of the form

$$\langle \text{COVARIATES}, \alpha, \beta \rangle,$$

then $\alpha$ is a definite NP (one with the value “+” for the feature $Def$) or a VP analyzeable by Rule (266).

(2) If $\alpha$ occurs in a fact of the form

$$\langle \text{EXPLOITS}, \alpha, s \rangle,$$

then $\alpha$ is an NP and $s$ is $RES^{NP}$.

(3) If $\alpha$ occurs in a fact of the form:

$$\langle \text{REFREL}, \alpha, x \rangle,$$

then $\alpha$ is either a finite verb (one with the value “+” for the feature TNS) and $x$ is $RT^\alpha$ or else $\alpha$ is a referential NP.

(4) For any NP $\alpha$, there is at most one utterance $\beta$ such that

$$\langle \text{SCOPES-OVER}, \alpha, \beta \rangle.$$
Notes on the Absorption Principle.
Our account of the facts discussed in Section 4.3 specifically hinges on the account of referential NP's as restricted parameters. Restricted parameters were introduced under the somewhat unfortunate name roles in the analysis of referential NP's presented in Situations and Attitudes, and were subsequently built into Situation Theory. Our reliance on them to make predictions about scope and anaphoric potential is one of the features that distinguishes our account of anaphora from others, in particular, from the closely related DRS accounts. In DRS accounts like that of Kamp (1981), conditions on Discourse Markers (DM's) are given equal status, whether they come from inside the DM's NP or not.

Parameter restrictions are restrictions on the anchoring possibilities of a parameter. They thus have a very different semantic status from states-of-affairs which are part of the main body of the content. For example:

\[ s \models \langle \text{WALK}, f(x) \rangle \land \langle \text{MALE}, f(x) \rangle, \text{ under some anchoring } f, \]
\[ s \models \langle \text{WALK}, f(x) \rangle \text{ and } s \models \langle \text{MALE}, f(x) \rangle. \]

So the fact of \( x \)'s maleness is a fact of the described situation.

\[ s \models \langle \text{WALK}, f(x_{\text{MALE}}) \rangle \]
\[ s \models \langle \text{WALK}, f(x) \rangle \text{ and } s \models \langle \text{MALE}, f(x) \rangle. \]

It must be a fact that \( x \) is male, but it need not be a fact in \( s \). The upshot of this is restrictions on parameters need not be part of what is described about the described situation. Thus, sentences like She saw him walking need not be understood so that the maleness of the walker is part of what is seen. Similarly, the following sentences will have different minimal visual scenes:

(291) a. She saw a doll that walked talk.
   b. She saw a doll that talked walk.

(291a) will require that the seen situation include at least talking (but not necessarily walking). (291b) will require that it include at least walking (but not necessarily talking).

So the distinction between a restriction on a parameter and being part of the main body of a state-of-affairs is not merely a distinction in the syntax of the notation of situation theory; it is a genuine semantic distinction between what's descriptive content and what may
only help to pick out what's described. And it is a consequence of that semantic distinction, the Absorption Principle says, that certain parameters must be absorbed at the same time as others.

With this in mind, we review a property of "parameter binding operators" put forth in Barwise (1987):

(292) \( \text{ABS}(X, \sigma) = \text{ABS}(Y, \tau) \) if \( \sigma = \tau[X \setminus Y] \)

Here \( X \) and \( Y \) are sets of parameters in \( \sigma \) and \( \tau \) respectively. \( \tau[X \setminus Y] \) is the result of replacing each of the parameters of \( Y \) with a distinct parameter of \( X \) in \( \tau \), with all of \( X \) used up. The gist of this requirement is this: suppose one parameterized object \( o_1 \) has a set of parameters \( X \) and that uniformly substituting for all the parameters in \( X \) with all the parameters in \( Y \) turns \( o_1 \) into \( o_2 \). Then a binding operation on \( X \) in \( o_1 \) and on \( Y \) in \( o_2 \) should give the same results in both instances. Type-abstraction is the only binding operation we have used in this book. Barwise's requirement guarantees among other things, that the following two objects are equal:

(293) \[
\begin{align*}
[x, y & \mid \langle \text{LOVE}, x, y \rangle] \\
[w, z & \mid \langle \text{LOVE}, w, z \rangle]
\end{align*}
\]

But now let us consider the sort of type forbidden by the Absorption Principle:

(294) \( T_1 = [x \mid \langle \text{WASH}, x, y \langle \langle \text{CAR}_a, y \rangle \land \langle \text{OWN}_s, y, x \rangle \rangle] \)

and compare that to:

(295) \( T_2 = [z \mid \langle \text{WASH}, z, y \langle \langle \text{CAR}_a, y \rangle \land \langle \text{OWN}_s, y, z \rangle \rangle] \)

Under Barwise's requirement for an abstraction operation, \( T_1 \) and \( T_2 \) should also be equal: substitute \( z \) for \( x \) in the psoa that gives rise to (294) and you have the psoa that gives rise to (295). Since they are parameterized objects, being equal means that, among other things, that every total anchor anchors them to the same objects. But consider the following anchor \( f \):

\[
x \rightarrow a \\
y \rightarrow b \\
z \rightarrow c
\]

We write \( f[T_1] \) for the result of anchoring all the parameters of \( T_1 \). Suppose that \( b \) is a car and \( a \) but not \( c \) owns \( b \). Then \( f[T_1] \) is:

\[
[x \mid \langle \text{WASH}, x, b \rangle]
\]

where \( \langle \langle \text{CAR}_s, b \rangle \rangle \land \langle \langle \text{OWN}_s, a, b \rangle \rangle \) is factual.
But consider $f[T_2]$. In order to anchor $y$, $f$ must anchor every parameter restricting $y$, and $y$ is restricted by $z$ in $T_2$. But $f$ takes $z$ to an individual that doesn’t own $f(y)$. So the condition on the parameter $y$ isn’t satisfied and $f$ isn’t an anchor for $T_2$. But $T_2$ equals $T_1$. So $f$ both is and isn’t an anchor for $T_1$.

To avoid this contradiction, something needs to give. What the Absorption Principle does is state a fundamental necessary property of any system that includes the assumption that parameter restrictions are restrictions on anchoring and Barwise’s Abstraction property.
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