Chapter 1
Deriving Logical Representations: A Proposal

1.1 Introduction

The main concern of this monograph is an interdisciplinary one: I investigate the relationship between the syntactic and semantic representations of sentences within the framework of generative grammar. In particular, I address the problem of deriving logical representations from the syntactic representations of sentences, focusing primarily on the issues of quantification (that is, the representation of the relative scope of operators and the determination of quantificational force) and the interpretation of indefinites. In doing this, I concentrate on two central questions, drawing primarily on data from English and German:

(1) What are the possible semantic interpretations of indefinite and quantificational NPs?

(2) What role does the syntactic representation play in the derivation of the semantic representation of NPs?

Although the syntactic representation of scope relations is a familiar concept (see May 1977), determining the quantificational force of an NP may at first blush appear to be purely an interpretive question concerning the semantics of determiners and the like, with the syntactic structure of the sentence playing no role. My aim here is to show that purely syntactic concerns such as word order and hierarchical structure do in fact play an important role in the process of "reading off" semantic representations of NPs from the syntactic forms of sentences. In other words, I am concerned primarily with developing an account of the interface between syntactic theory and semantic theory.

Specifically, I propose a means of relating a primarily syntactic theory, the Government-Binding Theory of Chomsky (1981) and others, with the

semantic theory of NP interpretation developed by Kamp (1981) and Heim (1982). In the analysis I propose, one of the contributions of purely syntactic configurations to the derivation of Kamp-Heim logical representations is stated in terms of a simple mapping algorithm that divides the syntactic tree into two parts, which have correlates in their associated "semantic partition"—the logical representation in which the scope and quantificational force of NPs is represented.

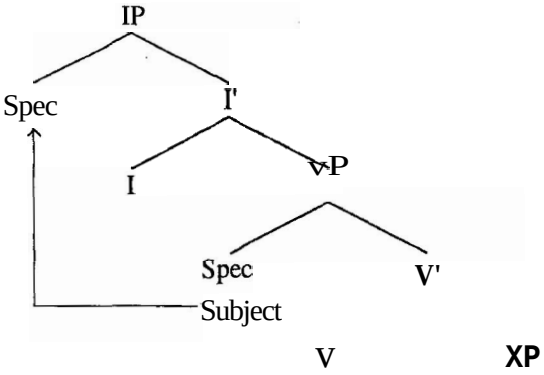
Before I proceed, some introductory background is necessary. In the next two sections I present the basics of the syntactic and semantic frameworks that I take as my starting point in this work.

1.2 The Syntactic Roots of Indefinite Interpretations

The basic syntactic framework I will be assuming is that of Government-Binding Theory, as developed by.Chomsky (1981, 1986a, 1986b) and others. I will not undertake to present a comprehensive overview of the theory here (a more thorough introduction can be found in Haegeman 1991), but will instead focus on two major components that are central to the main thesis of this monograph. The first concerns a recent development in the theory of phrase structure. A number .of works on phrase structure have converged on the hypothesis.that the subjectof a sentence can be base-generated within the verb projection (the VP). This yields a system of X-bar-theoretic phrase structure rules that differs somewhat from the original phrase structure rules as stated in chomsky 1986a.The revised clause structure posits two possible positions for the subject within the X-bar phrase structure. I will refer to this proposal as the ***VP-Internal Subject Hypothesis.***

As illustrated by the tree in (3), one subject position is situated as in the original ***Barriers*** framework (Chomsky 1986a),dominated immediately by IP (the [Spec, IP], or *IP* ***subject).*** The other subject position is located within the VP. I assume that this VP-internal subject position is the [Spec, VP] (referred to alternatively as the VP ***subject).***

(3) The VP-Internal Subject Hypothesis



As indicated by the arrow in (3), the subject in a sentence such as (4) is base-generated within the VP in the [Spec, VP] position and subsequently raises at S-structure to the [Spec, IP] position.

(4) Walter plays the contrabassoon.

An essential consequence of the VP-Internal Subject Hypothesis (and one of the theoretical arguments in its favor) is that subjects are Theta-marked within the VP, allowing an attractive simplification of theta-theory.

This structure has been proposed in a large number of different analyses to account for a correspondingly diverse range of phenomena (see Koopman and Sportiche 1985, Fukui and Speas 1986, Kuroda 1988, Pollock 1989, Diesing-1990a,Chomsky 1991, among many others). Since detailed arguments for the structure in (3) are given in these works and elsewhere, I will simply take the VP-Internal Subject Hypothesis as given.

One of the questions I wish to address in this monograph concerns the properties of the two subject positions. Namely, is there any difference (other than relative position) between a VP-internal subject and a VP-external subject? Does the **VP** have any properties that distinguish it from IP, and vice versa?' In this work I approach these questions by investigating the hypothesis that the VP and the area "outside" of **VP** (at the IP level) are distinct domains for different kinds of quantification, and that therefore IP subjects and VP subjects are distinguished in the derivations of the logical representations of sentences. Put in another' way, the two subject positions are distinguished in the mapping from S-structure to logical representations.

It may not be immediately obvious what role the syntactic structures of IP and VP can play in the semantics of quantified structures. Therefore, at this point it is necessary to introduce another component of the Governrnent-

Binding Theory: the level of logical form. The idea that the syntactic structure of a sentence can play a role in determining logical representations (scope relations in particular) has led Government-Binding theorists to posit an abstract intermediate syntactic level of logical form (LF) that mediates in the mapping from syntax to logical representations (May 1985).2 Just as S-structure is the level to which the phonological interpretations may be assigned, LF is the level from which the semantic interpretations are assigned. In parallel to the derivation of S-structure from D-structure, LF is a phrase structure representation that is derived from S-structure by the application of syntactic rules. Thus, the intermediate LF representations are modeled on their S-structure syntactic representations.

The LF movement rules fall under the general theory of transformational mappings as processes that can be subsumed under the form of the general Move a schema of Chomsky (1981). A central case of LF movement is the rule of ***quantifier raising*** (QR), which raises quantificational NPs to adjoin to IP, producing a structure in which an operator (that is, the quantificational NP) binds a variable (the trace left by the application of QR). The quantifier phrase in its adjoined position thus marks the scope of the quantifier in that its scope is the set of nodes c-commanded by the raised NP at LF. The result is of course not the final semantic representation. Within the Government-Binding framework, the LF level is regarded as intermediary between the syntax and the logical representations. It is from this abstract level of syntactic representation that the actual logical representations are derived. I make here the additional claim that it is at this level that the VP-internal and VP-external subject positions can be distinguished with respect to quantification.

There is a derivational "step" that still remains to be specified. A procedure is needed to indicate how the syntactic LF representation gets mapped into the logical representations (using here those of the type developed by Kamp and Heim). In explicating the derivation of the semantic representations of sentences from syntactic representations, I depend on the notion of a ***semantic partition*** of a sentence, in particular a type of partitioning developed in the theories of NP interpretation proposed by Kamp (1981) and Heim (1982). I initially propose to relate this semantic framework to syntactic structures such as that shown in **(3)** by an algorithm that splits the syntactic tree into two parts, corresponding to the major division (or partition) in the semantic representation.

1.3 Semantic Partition and the Interpretation of Indefinites

The idea of dividing a sentence into two parts on semantic and/or pragmatic grounds is by no means new. The notion of such partition has also taken a number of different forms throughout time, embodying intrasentential distinctions such as topic and comment, theme and rheme (e.g., Danes 1964, Firbas 1970), and subject and predicate. The division I am concerned with arises in analyses of restrictive quantification (particularly the analyses of Lewis (1975) and those following him). Using the terminology of Heim (1982), I refer to this division as the ***restrictive clause/nuclear scope partition.*** *I* focus mainly on the derivation of this partition at the sentence level, and then go on to consider some of its applications in the syntax-semantics interface.

1.3.1 A Brief Introduction to the Kamp-Heim Theory

In order to explain what the nature of the restrictive clause/nuclear scope partition is, I give here a brief introduction to the Kamp-Heim approach to the semantics of NPs. (This introduction is by no means complete; see, for example, Heim 1982 for a detailed exposition of the theory and the motivations that lie behind it.) In this introduction I concentrate on a few simple sentences to show by example how the restrictive clause/nuclear scope division functions at the sentence level.

A primary motivation for the Kamp-Heim theory is based on observations concerning the quantificational variability of indefinites (originally made by Lewis (1975)) that preclude their being analyzed as existential quantifiers (as proposed by Russell (1919)). The following sentences, with their paraphrases (given in the (b) examples), illustrate how indefinites can vary in quantificational force depending on the context in which they appear:

(5) a. A contrabassoonist usually plays too loudly:
b. Most contrabassoonists play too loudly.

(6) a. Cellists seldom play out of tune.
b. Few cellists play out of tune.

(7) a. If a violist plays a solo, the audience often leaves the room.
b. In many of the situations in which a violist plays a solo, the audience leaves the room.

The sentences in (5)–(7) show that rather than being simply existentially

quantified, indefinites can take their quantificational force from other elements in the sentence (such as adverbs like usually, seldom, and often).

To account for these observations, Heim claims that indefinites are not inherently quantified, but merely introduce variables into the logical representation. (I will refer mainly to Heim's work in the examples that follow, but most, if not all, of what I say is applicable to Kamp's theory as well.) To illustrate how this works, I will begin with a simple case:

(8) a. A man owns a llama.
b. $(\exists_{x,y})$ [x is a man ^ y is a llama ^ x owns y]

In (8a) the indefinite NPs a ***man*** and a llama are not represented as existential quantifiers; rather, they introduce variables. Another way of expressing this is to say that indefinites have no quantificational force of their own. They must receive quantificational force by being bound by some other operator. In this case there is no other quantificational element in the sentence that can function as the adverbs do in (5)–(7). Here the variable introduced by the indefinite is bound by an implicit existential quantifier that "existentially" closes off the nuclear scope, preventing the occurrence of unbound variables. In the case of the sentence in (8) the nuclear scope simply contains all instances of the variables introduced by the indefinites in a sentence. This can be seen in the logical representation given in (8b). The implicit existential quantifier is shown within parentheses, and it binds all the variables (in this case ***x*** and y) within the nuclear scope, which for purposes of illustration is enclosed within brackets. (I will dispense with unnecessary parentheses and brackets in the discussions that follow.)

The logical representation in (8b) can also be represented graphically in the "box notation" employed by Kamp (1981), which I present in (9).3The box represents the domain of existential closure, or the nuclear scope.

(9) Nuclear scope

x	*y*
A man owns a llama.	
man ***(x)***	
llama (y)	
x owns ***y***	

The example in **(8)** illustrates the simplest case involving the interpretation of NPs, which involves only simple indefinites. Only a nuclear scope is formed, and the Only quantificational (in the sense of variable binding)

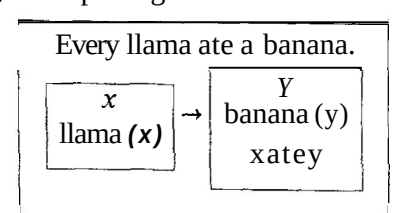
operation involved is existential closure. No restrictive clause is required in the logical representation shown in **(8b).** Thus, although every sentence undergoes the process of being mapped into logical representations, not every sentence ends up being divided into both a restrictive clause and ***a*** nuclear scope. In other words, the mapping to the semantic representation (however it is formulated) can in some cases yield a one-part representation. To see how restrictive clause formation works in Heim's framework, we need to consider a slightly more complicated case involving the interpretation of quantified NPs, such as the one shown in (10).

(10) a. Every llama ate a banana.
b. Every, [x is a llama] **(€y)** y is a banana ^ x ate y
↑ quantifier ↑ restrictive clause ↑ nuclear scope

An important property of quantifiers like every is that they quantify over a restricted set. The sentence in (10a) is true if and only if for all value assignments to the variable **x** that make the restrictive clause true, there is an assignment to the variable **y** that makes the nuclear scope true.4 Thus, in (10a) the quantifier every quantifies not over every thing, but over every thing that is a llama. This restriction on the quantifier is given an explicit representation in the restrictive clause ***([x*** is a llama]), as shown in (10b). The restrictive clause simply specifies the set that the quantifier quantifies over. The variables introduced by the **NPs** in (10a) are bound in the following way: the quantifier every binds all the variables that are established in the restrictive clause (the variable x in this case). Existential closure in turn binds all the remaining variables introduced in the nuclear scope (such as the variable ***y*** introduced by a banana in **(10)).**

In Kamp's box notation, restrictive clause formation can be represented as box splitting, as in (11).

(11) ***Box*** splitting



In this notation, the division of the sentence is represented by the embedded boxes. The left-hand, or antecedent, box corresponds to the restrictive clause, and the right-hand, or consequent, box corresponds to the nuclear scope.

The tripartite form exemplified in (10) also provides a means of representing the interpretations of the indefinites that are apparently bound by quantificational adverbs, such as the ones in (5)–(7). Here the variables introduced by the indefinites are introduced in a restrictive clause, and the quantificational adverb serves as the operator binding the variables, thereby giving them quantificational force:

(12) a. Usually, [x is a contrabassonist] x plays loudly
b. Seldom, [x is a cellist] x plays out of tune

From the representations in (12) it is clear how the quantificational variability of indefinites can arise. The number of true variable assignments to the indefinite required to make the sentence true depends on the choice of adverb.

The Kamp-Heim theory of NP interpretation is thus formulated in terms of restricted quantification, in which the domain of the quantifier is established by the restrictive clause.[5] To summarize this approach, in the Kamp-Heim theory indefinites are represented as variables, which are unselectively bound by abstract operators like existential closure, or overt operators like the quantifier every. Quantifiers like every introduce a restriction (which is represented by restrictive clause formation or box splitting). The resulting logical representations take a tripartite form consisting of an operator, a restrictive clause, and the nuclear scope, as shown in (10b).

Even with only the most elementary introduction, it should be clear that one of the main questions that arise in applying restricted quantification to natural language is how to determine the restrictive clause. In other words, how is the sentence divided into the "semantic partition" consisting of the restrictive clause and the nuclear scope? In the next section I will sketch a proposal for answering this question, and the bulk of this work will be devoted to motivating and supporting this hypothesis.

1.3.2 The Next Step: Deriving the Logical Representations

In this section I begin to consider the question of how sentences are divided into the restrictive clause and the nuclear scope in the mapping from S-structure to the logical representations. This is basically the question of what role the syntactic structure of a sentence (as described by the X-bar phrase structures introduced in section 1.2) can play in determining the interpretation of the NPs contained within it. In other words, how are the variables introduced by NPs to be mapped from the syntactic positions

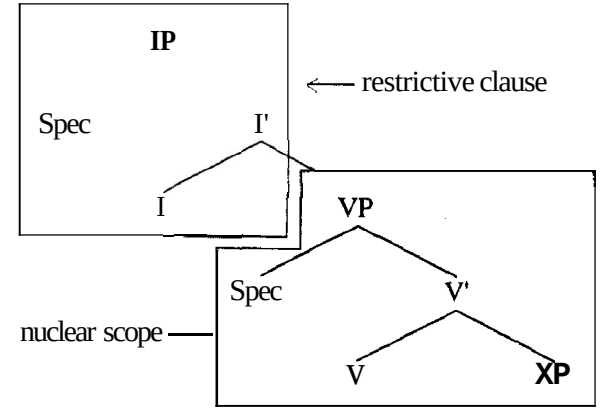
of NPs into nuclear scopes and restrictive clauses? Or stated in terms of box notation, what is the "box-splitting" algorithm?

For the purposes of this introduction, I limit myself to the question of where subjects are mapped, ignoring for the moment the issues involved in the interpretation of objects and adjuncts and such. The interpretation of objects will be dealt with in chapters 3 and 4. I will also limit myself to considering only the syntactic determinants of the partition. Therefore, I will not consider at this point the possible contributions of apparently nonsyntactic factors such as focus and intonation. This is not to deny that these factors are relevant, as the purely syntactic structure of a sentence is not the only determinant of semantic partition. I will discuss the role of focus to some extent in later chapters, but at this point it is instructive to concentrate on one particular phenomenon in order to clearly present the basic outlines of my approach.

In the chapters that follow, I propose and explore a fairly close syntactic link between the two-subject clause structure (the VP-Internal Subject Hypothesis) presented in section 1.2 and the Kamp-Heim-style tripartite logical representations introduced in section 1.3.1. This link, or interface, between the syntactic representation and the semantic representation takes the form of a mapping procedure that splits the syntactic tree into two parts. The two parts of the sentence are then mapped into the two major parts of the logical representation, the restrictive clause and the nuclear scope, producing the desired semantic partition.

The procedure works as follows: Assuming a two-subject model of phrase structure, divide the sentence into a restrictive clause and a nuclear scope as shown in (13) (for the purposes of exposition, assume that this splitting takes place at the level of LF).

(13) Mapping Hypothesis (tree splitting)



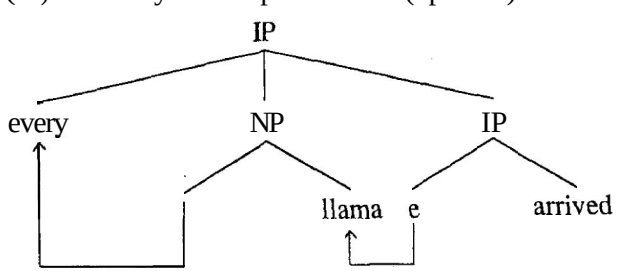
In (13) the two-subject tree is divided into two parts (outlined by boxes for purposes of illustration), one consisting of the VP, and the other consisting of the subtree dominating the **VP** (which I will refer to as the IP-level structure). My claim is that the tree-splitting process illustrated in (13) corresponds to box splitting in the Kamp-style box notation (see (11)). Expressed in words, the derivation of the representations shown in (13) is as follows:

(14) Mapping Hypothesis
Material from VP is mapped into the nuclear scope.
Material from IP is mapped into a restrictive clause.

The diagram in (13) can be intuitively thought of as the two-subject tree from (3) with the split boxes from the diagram in (11) superimposed upon it (where the boxes in (13) correspond to the embedded split boxes in (11)).

At this point some clarification concerning the representations in (8) and (10) is in order. I have claimed that the two parts of the split tree correspond to the two major parts of the logical representation, the restrictive clause and the nuclear scope. Of course, there is a third part in the logical representation, which is the quantifier itself. If the syntactic level of LF involves IP-adjoined quantifier phrases, there must still be a means of excluding the actual quantifier from both the restrictive clause and the nuclear scope. This issue is actually taken up by Heim. In deriving LF representations, Heim (1982, chap. 2) proposes a rule in addition to QR (which she calls "Quantifier Construal"), which adjoins every quantifier to S, or IP (following her QR-like rule of "NP-Prefixing"). This leads to a truly "tripartite tree," as shown in (15) for the sentence Every llama arrived.

(15) Heim-style LF representation (updated)



Thus, in Heim's derivation there are two adjunction operations. The NP-Prefixing rule raises the NP every llama out of IP, and then the Quantifier Construal rule moves every out of the NP to adjoin to IP itself. The Quantifier Construal rule is also used in deriving the logical representations of sentences with quantificational adverbs:

(16) a. Cellists seldom play out of tune.
b. seldom, [*x* is a cellist] *x* plays out of tune

In sentences such as (16a) the quantificational adverb takes sentential scope. This interpretation can be derived by adjoining the adverb to IP through the rule of Quantifier Construal. In the remainder of this monograph I will not concern myself further with the more articulated LF representation shown in (15), but will continue to use the representations in (8) and (10) as a form of shorthand for the representation in (15), with the assumption that some Quantifier Construal rule operates to separate the quantifier from the other two parts of the logical representation.

The Mapping Hypothesis establishes a straightforward relationship between syntactic structure and the form of the logical representations. Thus, the semantic partition of a sentence into a restrictive clause part and a nuclear scope part has its "syntactic roots" in the two-subject structure in (3), through the process in (13).

1.4 Syntactic Factors in the Semantics of NPs: A Preview

The Mapping Hypothesis proposed in (13) has the virtues of being simple and intuitively straightforward. The next step is to show that it is empirically well motivated as well. If the relationship between the syntactic and semantic representations is as straightforward as suggested by (13), this should be reflected in interactions between syntactic phenomena and the semantic interpretation(s) of NPs. In the chapters that follow I examine a range of empirical phenomena in syntax and semantics that demonstrate that there is in fact a connection between the syntax of a sentence and its logical representation of the sort illustrated in (13).

Chapter 2 is devoted to motivating the basic workings of the Mapping Hypothesis. I examine data from English and German that provide empirical support for the tree-splitting procedure. The supporting argument consists of several parts. In the first part I show that the two possible positions for the subject in the semantic representation do in fact correspond to two possible interpretations of the subject. These two interpretations are highlighted by a contrast in interpretation of bare plural subjects (noted originally by Carlson (1977b)) between temporary-state predicates (Carlson's stage-level predicates) and permanent-state (individual-level) predicates. I show that this contrast between the two types of predicates is actually syntactic in nature, but because of the workings of the Mapping

Hypothesis, it is reflected also in the available semantic interpretations of a bare plural subject.

Next, I show that the two syntactic subject positions posited in the VP-Internal Subject Hypothesis can be distinguished at S-structure in German. The German data show that the two subject positions are differentiated syntactically with respect to extraction operations. Finally, I show that the two syntactic subject positions correspond to the two positions in the semantic representations, as predicted by the Mapping Hypothesis. One major consequence of this chapter is that it appears that German and English are rather different in that in German the tree-splitting algorithm seems to reflect the S-structure word order of the sentence, whereas in English abstract **LF** movement operations are clearly involved.

In chapter **3** I extend the idea of deriving the Heim-style representations by the Mapping Hypothesis to the interpretation of quantified NPs. The central question of this chapter is that stated in **(2):** What are the possible interpretations of indefinite and quantified NPs? One major consequence of the data and analysis I present is that indefinites are not all treated uniformly. Specifically, I differentiate two types of indefinites, those that induce box splitting and those that do not (see also Partee 1988 for a discussion of the ambiguity of indefinites with the determiners *few* and many). This is a shift from the Kamp-Heim position in which all indefinites are treated uniformly as variables. I show that this differential treatment of indefinites is based on the contrast between presuppositional and cardinal determiners noted by Milsark (1974).

I also extend this analysis to the problem of quantifier scope determination. By differentiating the two interpretations syntactically with respect to the Mapping Hypothesis, I show that scope order preferences of quantifiers can be represented straightforwardly within a syntactic theory of quantifier scope. In investigating the connection between the two types of interpretations for indefinites and the derivation of the level of LF via the rule of quantifier raising (QR) in the sense of May (1977, 1985), I show that there is a relationship between presuppositionality and the obligatoriness of QR. This association is supported by data from English concerning a special case of VP-deletion, antecedent-contained deletions (ACDs). ACDs turn out to be an indicator for the presuppositional reading of an NP in that ACDs are only grammatical with presuppositional object NPs.

I also examine "specificity" in Dutch and Turkish and conclude that the "specific" indefinites in these languages correspond to the presuppositional, or box-splitting, reading of the indefinite. The Turkish data, which

involve a relationship between morphological case marking and the presuppositional (QR) reading of an NP, raise the possibility of there being S-structure syntactic "triggers" (such as a case marker) for LF raising of an **NP.**

In chapter 4 I look more closely at the consequences of the nonuniform interpretation of indefinites. The focus of this chapter is on extraction from "picture" NPs. The acceptability of extraction from NP is rather controversial, and judgments on the data are notoriously fragile in that they "shift" very easily, depending on the context. I show that the possibility of extraction is closely linked to the availability of a nonpresuppositional reading for the NP. Extraction is prohibited from presuppositional NPs. This close link to presuppositionality explains the "shiftiness" in judgments, since the presuppositional nature of an NP depends in part on context.

The syntactic issue of "locality constraints" on extraction becomes an additional concern in chapter 4. The link between nonextractability and presupposition raises questions about the traditional means of accounting for extraction islands (Ross 1967). I show that the standard derivational approach to extraction from NP as an S-structure constraint against movement across a certain number of "bounding nodes" or barriers (Subjacency; see Chomsky 1977, 1986a), or as a constraint against movement out of an ungoverned domain (such as the Condition on Extraction Domain posited by Huang (1982)), is not adequate to account for the effects of presupposition on extractability6 show that the relevant constraint must be stated in terms that take into account the ***LF*** structure of the sentence.

In contrast to chapter 2, which focuses on the interpretation of subject NPs, the emphasis in this chapter is on the interpretation of object NPs and the syntactic effects that follow from a particular interpretation. Given the workings of the Mapping Hypothesis and the results of chapter **3** concerning the syntactic differences between presuppositional and nonpresuppositional NPs, the presuppositional interpretation of object NPs in English requires that the NP be raised out of the VP by the rule of QR. The varying interpretations of object **NPs** are analyzed, taking into consideration the contexts in which they appear. I examine a number of different verb types and conclude that they differ with regard to which reading of an indefinite object, presuppositional or nonpresuppositional, they prefer.

Alongside the English data, I present German data involving S-structure "scrambling" of indefinite objects. I show that the semantic and

syntactic effects of German scrambling parallel the effects of LF QR in English in that scrambling of an indefinite object results in the restrictive clause interpretation of the indefinite. Thus, scrambling appears to act as "S-structure QR in these cases. This again raises the possibility that there may be S-structure triggers for QR, just as in the case of Turkish morphological case marking examined in chapter 3.

Finally, a few remarks are in order on the place of the Mapping Hypothesis within the overall picture of "semantic partition." Although I do not devote any attention to the more traditional forms of partitioning the sentence on semantic and/or pragmatic grounds, it is not my intention to suggest that the syntactic approach I take here should supplant notions such as topic/comment, theme/rheme, and subject/predicate. These sentential divisions encode various-semantic and pragmatic distinctions that fall outside the range of phenomena to be discussed here. Thus, the Mapping Hypothesis is simply an additional source of partitioning, which will be shown to be amply justified in its own domain.

Chapter 2
Initial Evidence in Favor of the Mapping Hypothesis

2.1 Introduction

The basic aim of this chapter is to provide specific empirical motivation for the relationship between syntactic and logical representations proposed in the previous chapter in the form of a "tree-splitting algorithm," or Mapping Hypothesis:

(1) Mapping Hypothesis
Material from VP is mapped into the nuclear scope.
Material from IP is mapped into a restrictive clause.

The procedure in (1) not only outlines the derivation of logical representations, but also makes a number of predictions concerning interactions between syntactic phenomena and the semantics of NPs. I present here a variety of data that support the notion that there is such a correspondence between the syntactic and logical representations.

Since the subject/nonsubject contrast is pivotal in the **VP/IP** distinction emphasized in (1), I first concentrate on the interpretation of indefinite subjects. My initial claim is that different predicate types show different properties with respect to the possible interpretations of subjects and their distribution, and these contrasts can be easily accounted for by the procedure in (1). As a starting point I introduce a particular distinction of predicate types that highlights the "splitting" of the sentence effected by the Mapping Hypothesis in a number of different ways. This classification is the stage/individual distinction of Carlson (1977b). Various syntactic and semantic properties of the subjects of these two predicate types provide support for the hypothesis in (1). In the final sections of this chapter I extend my approach to a number of other predicate types.