Dynamic Excursions on Weak Islands

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Voor mijn ouders, Arie en Annie,
en mijn vriendin, Anthi

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Preface

What this thesis is about. This thesis is about Weak Islands. Weak Islands are contexts that are transparent to some quantificational dependencies that involve an operator and a variable-expression, though not all of them. Consider for instance the contrast in (1), assuming a neutral context of utterance. Even though the *wh*-phrase *which man* can be connected to its gap across a *whether*-clause, the *wh*-adverb *how* cannot be so connected.

(1) a Which man did you wonder [whether to invite _]?
b *How did you wonder [whether to behave _]?

Weak Islands confront the conscientious linguist with the following basic questions. Firstly, what is the proper characterization of the class of those expressions that are sensitive to Weak Islands? Secondly, what is the proper characterization of the class of expressions that create Weak Islands? And finally, why can the first class of expressions not be combined in the required way with the second class of expressions?

The central idea of this thesis. The phenomenon of Weak Islands has been given a great this phenomenon to date is the theory developed by Szabolcsi & Zwarts (1993) which is framed in terms of algebraic semantics. In this thesis, we will develop an alternative semantic perspective on Weak Islands. Specifically, it will be argued that in addition to those constructions that motivate an algebraic perspective, there is a significant set of Weak Island effects, most notably those that involve so-called *split constructions*, that are best accounted for by making use of the tools of Dynamic Semantics, as originally conceived of by Groenendijk & Stokhof (1989,1990,1991). A dynamic approach to Weak Islands offers the following answers to the three basic questions raised above. Firstly, the expressions that are sensitive to Weak Islands are those that need to *dynamically bind* an indefinite as their restriction.

Secondly, the expressions that create Weak Islands are those that induce *inaccessible domains* for dynamic anaphora. Finally, the first class of expressions cannot be combined in the required way with the second class of expressions since in general, α cannot dynamically bind β if β is contained in an inaccessible domain for dynamic anaphora.

Further issues that will be explored. Our dynamic excursions will take us along many side-roads. A dynamic approach to Weak Islands raises a number of interesting questions, among which we will address the following more important issues. Firstly, why do opaque or intensional contexts not constitute inaccessible domains for dynamic binding? And secondly, what is the relationship between the Boolean properties of a given expression and its dynamic properties? On the basis of the answers we will provide to these questions, we will conjecture that, even though neither an algebraic nor a dynamic approach alone can account for all Weak Island effects, there is a more general theory combining the essential insights of both analyses that can derive the full range of facts.

How this thesis is organized. In the first chapter, we will discuss Szabolcsi & Zwarts's (1993) algebraic theory of Weak Islands, and compare it with Rizzi's (1990) Relativized Minimality as refined by Cinque (1990). We will conclude that it represents the most viable account of Weak Islands. Still, the fact that a substantial number of scopal interveners induce inaccessible domains for dynamic anaphora as well strongly suggests that there are Weak Islands that are best accounted for by applying the tools of Dynamic Semantics. The chapter will then be concluded with a more elaborate sketch of a possible dynamic approach to Weak Islands together with a brief overview of a range of split constructions whose sensitivity to Weak Islands appears susceptible to a dynamic treatment. Chapter 2 will then present a version of Dynamic Semantics which departs only in minor respects from Groenendijk & Stokhof's (1989,1990) Dynamic Montague Grammar and the system of Dynamic Semantics developed by Chierchia (1992,1995). Special attention will be paid to certain issues that arise in connection to quantificational adverbs, plural anaphora and collective versus distributive predication. Chapters 3 and 4 form the heart of this thesis. In Chapter 3, we will single out two of the split constructions that were briefly discussed in Chapter 1 for a more careful treatment, viz. *wat voor*-split in Dutch, and its counterpart in various other languages, and Negative Polarity licensing. Their sensitivity to Weak Islands will be accounted for in terms of Dynamic Semantics along the lines sketched above. Chapter 4 investigates both in empirical and in theoretical terms the precise relationship between a dynamic approach to Weak Islands and Szabolcsi & Zwarts's (1993) algebraic account. Even though we will see that neither

approach can be reduced to the other, the fact that the algebraic and dynamic approach to Weak Islands (almost) converge on the same class of 'bad interveners' still calls for an explanation. Somewhat speculatively, we will then develop a relatively simple but effective procedure which enables us to compute the dynamic properties of a given expression on the basis of its Boolean properties. Along these lines then, we may hope to arrive at a more general theory of Weak Islands which properly subsumes both the algebraic and dynamic approach. Finally, Chapter 5 will present the conclusions that have been reached in this thesis.

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1 Preamble: A Semantic Account of Weak Islands

1.1 Introduction, or Why Semantics is Part of Grammar

One of the more central dogmas of generative grammar is the idea that formal properties of natural language grammars can be fruitfully studied independently of meaning. Is it not true that Chomsky's celebrated *Colourless green ideas sleep furiously* strikes a native speaker of English as a perfectly grammatical sentence, even though it is agreed that this sentence expresses a semantically incoherent meaning? In a sense, the generative approach to natural language grammars shares much with for instance the approach to formal grammars in computational complexity theory, the latter a branch of mathematics which, too, studies formal, computational properties of grammars (decidability, tractability, etc.) in abstraction of what the symbols that are actually manipulated refer to. Conveniently abstracting away from phonology, we may refer to the generative view on the relationship between natural language grammar and semantics as the *Autonomy Thesis*, which states that principles of grammar are exclusively syntactic or computational, and thus in no way refer to principles of semantics. In present day Minimalism for example, the Autonomy Thesis is at the heart of the idea that the computational system (i.e. syntax) generates $\langle\phi,\lambda\rangle$ -pairs, where ϕ is some phonological representation that should be interpreted by the articulatory/ perceptual system, and where λ is some LF phrase-marker that provides the input to the conceptual/intentional system which maps λ into some appropriate semantic object. In this 'program for linguistic theory', it is perfectly well conceivable that the computational system accepts a given $\langle\phi,\lambda\rangle$ -pair as well-formed, even though the conceptual/intentional system cannot give a coherent interpretation to λ. Thus, Minimalism strictly adheres to the Autonomy Thesis in the sense that it views semantics as a theory of the conceptual/intentional system, where the latter, though perhaps part of human cognition generally, is distinct from the computational system which forms the proper object of linguistic theory.

There are several reasons why one may object to the Autonomy Thesis, as construed above. For one thing, the semantic ill-formedness of Chomsky's example resides in its violation of a number of meaning postulates which among

other things restrict the class of admissible models for English to those where sleepers are animate. But given the flexibility of word meaning, as manifested most evidently in creative use of language, meaning postulates at best represent 'soft' constraints in semantic theory, certainly not of equal status as 'hard' semantic constraints such as Conservativity or Extension. More importantly, however, following the lead of much recent work on the interface between syntax and semantics, we will show in this thesis that at least some grammatical principles governing well-formedness of sentences are purely semantic in nature. Specifically, inspired by the seminal work of Szabolcsi & Zwarts (1990,1993), this thesis will demonstrate that at least a significant portion of so-called Weak Islands can be derived from certain core principles of Dynamic Semantics, and thus reflect general semantic constraints on what meanings can be expressed. As was mentioned in our *Preface* (cf. also the much more detailed discussion in section 1.2 below), Weak Islands are domains that are transparent with respect to some, though not all quantificational dependencies that involve an operator and a variable-expression. Some illustrative examples of Weak Islands are given in (1) and (2), assuming a neutral context of utterance.

(1) a Which book didn't you read?
    b *How didn't you fix the car?

(2) a ?Which book did you wonder whether to read?
    b *How did you wonder whether to fix the car?

To the extent that we are successful in deriving similar constraints on well-formedness from certain fundamental assumptions of Dynamic Semantics, it will follow that semantics in general is just as much an integral and indispensable part of grammar as syntax is. Therefore, syntax may claim autonomy, but only in the same sense that semantics may claim autonomy: both are equally independent, though interacting modules of grammar.

1.1.1 The Plan

This introductory chapter will be organized as follows. In the next section, we will first present a representative sample of data which exemplifies the phenomenon of Weak Islands. These data will also serve as a basis for comparison between those syntactic and semantic approaches to Weak Islands that both in terms of their impact on subsequent research as well as in terms of their empirical scope deserve special mention. We will then single out one syntactic approach for further discussion, viz. the theory of Relativized Minimality as developed by Rizzi (1990) and refined by Cinque (1990). We

will see that, even though Relativized Minimality can explain a subset of the relevant facts, especially those Weak Island effects that are created by various quantified expressions cannot be accounted for in a principled fashion. In section 1.3, we will then extensively discuss Szabolcsi & Zwarts's (1993) semantic algebraic theory of Weak Islands. Szabolcsi & Zwarts pursue the implications of the idea that the Boolean properties with which Weak Island inducing expressions are associated are not defined in the denotation domain of island-sensitive expressions. Given the high degree of elegance with which it solves the various problems leveled earlier against Relativized Minimality, we will conclude that it represents the most viable theory of Weak Islands to date. Be that as it may, we will see that, given the data discussed thus far, there is another conceivable way in which the class of those quantified expressions and operators that give rise to Weak Islands can be characterized: they all 'freeze' the dynamic potential of any indefinite which occurs inside their scope. This observation therefore strongly suggests that, in addition to the constructions reviewed thus far, there are some constructions whose sensitivity to Weak Islands is best accounted for in terms of core principles of Dynamic Semantics. This idea forms the main theme of this dissertation. We will discuss the bare outlines of a dynamic semantic theory of Weak Islands in section 1.4. This chapter will be concluded in section 1.5 with a brief overview of those constructions whose sensitivity to Weak Islands can be straightforwardly derived from the basic assumptions of Dynamic Semantics, as we will show in much more detail in the remaining chapters.

1.2 Weak Islands and Relativized Minimality

Traditionally, Weak Islands (WIs) are distinguished from Strong Islands such as Adjunct Islands, Subject Islands, and Complex NP Islands in that the former only block some, but crucially not all quantificational dependencies that involve an operator and a variable-expression (cf. Cinque 1990). Hence, WIs are sometimes alternatively referred to as *Selective Islands*. The following contrasts provide representative examples of WIs. When browsing through this list, it should be borne in mind that the judgments on the biclausal examples concern the possibility of construing the *wh*-adverb *how* as modifying the embedded predicate. Moreover, all judgments reflect our response to these examples in a neutral context of utterance. The relevance of context in determining the impact of WI violations will be discussed shortly.

(3) *Wh-Island*

a ?Which man are you wondering [whether to invite _]?
b *How are you wondering [whether to behave _]?

Even though *Wh*-Islands are probably the most famous of all WIs, Szabolcsi & Zwarts (1993) point out that there is considerable variation between languages when it concerns extraction out of embedded constituent questions: they may be either (relatively) strong, as in Dutch or (at least for many speakers) English, or genuinely weak, as in Hungarian. However, it is important to bear in mind that, as far as I know at least, there is no language where any *wh*-phrase can be extracted freely out of an embedded interrogative. Thus, when we speak of embedded interrogatives as WIs, it is understood that the embedded interrogatives count as weak in the given language or dialect.

(4) *Scope Island*

a Which man did [-n't you invite _]?
b *How did [-n't you behave _]?

c Which teacher did [no student invite _]?
d *How did [no student behave _]?

e Which teacher did [less than/fewer than/at most five students invite _]?
f *How did [less than/fewer than/at most five students behave _]?

g Which teacher did [exactly/precisely five students invite _]?
h *How did [exactly/precisely five students behave _]?

i Which teacher did [at least/more than five students invite _]?
j ??How did [at least/more than five students behave _]?

k Which teacher did most students invite _]?
l ??How did [most students behave _]?

A few notes of clarification may be in order here. First, the well-informed reader will have noticed that Ross's (1984) Inner (or Negative) Islands form a proper subset of our Scope Islands. I believe the term 'Scope Island' is more appropriate than any other term that has been suggested in the literature since it directly expresses the fact that what distinguishes the WI inducing expressions in (3) and (5) below from the WI inducers in (4) is that only the latter are clearly scopal (abstracting away from intensionality). Finally, it is understood here that those WIs that are induced by various types of quantificational adverbs (such as *always*, *never*, *mostly*, *often*, *seldom* etc.; e.g. **How did you always/never/mostly/often/seldom/... behave?*) also belong in this class.

(5) *Presupposition Island*

a Which man did you [regret/know/realize ... that you invited _]?
b *How did you [regret/know/realize ... that you behaved _]?

c Which man did you [deny/verify/agree ... that Peter invited _]?
d *How did you [deny/verify/agree ... that Peter behaved _]?

Note here that our Presupposition Islands include the more familiar Factive Islands as a special case. As (5d) clearly shows, in addition to factive verbs such as *regret*, *know* and *realize*, verbs like *deny*, *verify* and *agree* also give rise to WIs, as was originally observed by Hegarty (1992). Cattell (1978) refers to the latter class of verbs as *response stance* verbs to indicate that they denote relations between individuals α and propositions *p* such that α responds in some way to the claim that *p*. Since factive (or, in Cattell's terminology, *non-stance*) verbs presuppose the truth of *p* and response stance verbs presuppose that there was a claim that *p*, where *p* stands for the proposition expressed by the complement clause, it seems natural to refer to the type of WI exemplified in (5) as Presupposition Islands. Note incidentally that not all sentence-embedding verbs give rise to WIs:

(6) a Which man did you [believe/think/say ... that you invited _]?
b How did you [believe/think/say ... that you behave _]?

More generally, the class of verbs that *believe*, *think* and *say* belong to (Cattell's *volunteered stance* verbs) should be distinguished from presuppositional verbs in that only the latter invariably induce WI effects.

(7) *Extraposition Island*

a Which man was it nice [that Peter invited _]?
b *How was it nice [that Peter behaved _]?

c To which man is it time (for us) [to speak _]?
d *How is it time (for us) [to behave _]?

We are simply following Cinque (1990) here in presenting Extraposition Islands as a special type of WIs. However, this was done mainly to stick as closely as we can to existing literature. Extraposition in general is associated with presupposition effects: in (7a), for example, it is presupposed that Peter invited someone (whose identity is unknown to the interrogator), and in (7b), it is presupposed that we should speak to someone (whose identity the interrogator again seeks to establish). We will henceforth assume that Extraposition Islands are just a special case of Presupposition Islands, and therefore need not be treated as a special category by a general theory of WIs.

The theory of Relativized Minimality (henceforth: RM), as developed by Rizzi (1990) and refined by Cinque (1990), probably represents the most

powerful and influential syntactic account that has been proposed in the literature.[1] RM intends to derive WIs by exploiting the following assumptions:

(8) a *Referential* Ā-phrases can be connected to their trace through binding, where binding requires identity of referential indices;
b *Non-referential* Ā-phrases need to be connected to their trace through an antecedent-government chain.

(9) The antecedent-government chain connecting a non-referential Ā-phrase and its trace is broken
a by other, intervening Ā-specifiers, or
b if the clause from which the non-referential Ā-phrase is extracted is not *properly head-governed* by a verbal head.

(10) Referential Ā-phrases are just those Ā-phrases that both bear a referential Θ-role (such as Agent, Patient, etc. but not Reason, Manner, Measure, etc.) and are *Discourse-linked*.

To see how the theory of RM works, consider for example the ungrammaticality of (3b) above. Since *how* does not receive a referential Θ-role from *behave* in the sense of (10), (8b) requires that this *wh*-adverb be connected to its trace through an antecedent-government chain. However, since the *wh*-complementizer *whether* occupies the specifier-position of CP on Rizzi's account, where Spec of CP is an Ā-position, *how* cannot be connected to its trace on account of (9a). The reason why (3a) on the other hand is grammatical ultimately resides in the fact that *which man* counts as a referential Ā-phrase according to (10): it receives a referential Θ-role from *invite* ànd is D(iscourse)-linked in the sense of Pesetsky (1987), i.e. it ranges over members of a set of individuals that has already been established in discourse. Therefore, given (8a), *which man* can be successfully connected to its trace through binding.[2] A

[1] Cf. Obenauer (1984/85) for important work which more or less anticipates the main tenets of RM. For more recent developments of RM which attempt to meet some of the objections mentioned here, cf. Dobrovie-Sorin (1992). For different syntactic approaches, cf. especially Chomsky (1986) and Lasnik & Saito (1992).

[2] As for the relevance of D-linking, Cinque notes, following Comorovski (1989) and Kroch (1989), that non-D-linked *wh*-phrases such as *how many dollars* and *who the hell* are also sensitive to WIs, even though both clearly receive a referential Θ-role in the sense of (10) in the following examples.

(i) a *How many dollars did you regret that I spent?
b *Who the hell did you regret that I invited?
(ii) a *How many dollars are you wondering whether to spend?
b *Who the hell are you wondering whether to invite?

Still, Szabolcsi & Zwarts (1993) argue that D-linking is not an essential parameter of the

similar reasoning will also account for the Scope Island effects in (4a-f), given that Rizzi argues that 'affective' operators such as sentential negation and *no student* occupy an Ā-specifier position at S-structure or LF. In addition, Cinque argues that clausal complements of factive/non-stance verbs and extraposed clauses are not properly head-governed by a verbal head, i.e. they are not Θ-marked sisters of a verb. This means that the non-referential *wh*-adverb *how* in (5b) and (7b,d) cannot be connected to its trace via an antecedent-government chain on account of (9b).

RM suffers from some major empirical and theoretical shortcomings. Firstly, as it stands, RM cannot account for the remaining Scope Island effects in (4g-l) and Presupposition Island effects in (5c-d). It is not implausible to assume that there is a (phonologically) empty DP shell in between a response stance verb and its clausal complement whose meaning we might roughly paraphrase as *the claim*. Then response stance verbs are like factive/non-stance verbs in that they do not properly head-govern their CP complement. Whatever the merits of this particular proposal or similar ones may be, it is simply implausible to assume that quantified expressions such as *exactly five students* and *more than five students* occupy an Ā-specifier position as well, either at S-structure or LF. Such a move would turn the central concept of Ā-position into a perfectly *ad hoc* notion. Secondly, even though *which picture of his$_i$ mother* in (11) below clearly counts as a referential *wh*-phrase in the sense of (10), it nevertheless cannot be connected to its trace across a WI:[3]

(11)
a *Which picture of his$_i$ mother did you wonder whether every student$_i$ likes?
b *Which picture of his$_i$ mother did you find out that every student$_i$ likes?

Finally, even though RM claims to provide a purely syntactic account of WIs, it is interesting to observe that it appeals to intrinsically semantic notions such

general problem posed by WIs. They note that a felicitous use of a *wh-the-hell* expression requires unquestionable evidence that some person or object has the property expressed by the rest of the *wh*-interrogative. Normal contexts do not provide us with the kind of unquestionable evidence required to make the use of *who the hell* felicitous in (ib) or (iib). For example, most contexts will not give us a strong reason to believe that you are wondering whether to invite some person. However, if this particular property of *wh-the-hell* expressions is controlled for, extraction of such a phrase across a WI improves considerably. Consider for instance a context in which someone is madly searching through a dictionary (cf. also Szabolcsi & Zwarts 1993: p. 262). In such a context, (iii) becomes perfectly acceptable.

(iii) What the hell do you still not know how to spell?

It is for this reason that we will not speak much of D-linking in this thesis. The ungrammaticality of (ia) and (iia) can be treated on a par with the unacceptability of extracting *how* across the same interveners if we agree with Szabolcsi & Zwarts (1990,1993) that the class of 'bad extractees' should be characterized in semantic terms as those expressions which range over elements of a partially ordered domain, such as amounts and manners.

[3] For extensive discussion of this type of WI, cf. Honcoop (to appear).

as 'referentiality'. To the extent that these notions do capture an important aspect of the phenomenon of WIs, one would naturally expect that a semantic theory is far more suitable to the task of explicating and applying these notions in a formally precise and explanatory way.[4] This is the main source of inspiration for Szabolcsi & Zwarts's (1993) attempt to account for WIs in semantic terms.

1.3 A Semantic Algebraic Approach to Weak Islands

In this section, we will first discuss in some detail Szabolcsi & Zwarts's (1993) (henceforth: Sz&Z) semantic algebraic account of WIs. Historically, Sz&Z developed their semantic theory not only to overcome the empirical and theoretical shortcomings of RM discussed above. It was also designed to improve on their earlier account which sought to derive WIs from general laws governing the preservation of monotonicity properties under function composition.[5] We will see that in terms of this theory, the facts reviewed in section 1.2 can be explained in a uniform and elegant way. We will discuss some further nice consequences of this analysis in section 1.3.2.

1.3.1 Szabolcsi & Zwarts (1993)

Sz&Z's attempt to explain the phenomenon of WIs in semantic terms centers around the following principle:[6]

(12) *Scope and Operations* (cf. Sz&Z: 6)

> Each scopal element SE is associated with certain [Boolean; MH] operations. For a *wh*-phrase [or any quantified expression, for that matter; MH] to take scope over some SE means that the operations associated with SE need to be performed in the *wh*-phrase's denotation domain. If the *wh*-phrase denotes in a domain for which the requisite operation is not defined, it cannot scope over SE.

Before we will provide a simple illustration of this principle, let us first

[4] Cf. also Frampton (1991) for a similar criticism of RM, who subsequently refines this theory in such a way that it takes into account the semantic type of the relevant trace.

[5] Cf. Szabolcsi & Zwarts (1990). For detailed criticism of this alternative semantic approach, cf. Sz&Z.

[6] Parts of Sz&Z already appeared in Szabolcsi (1992). Sz&Z (together with a couple of clarifying footnotes) has been reprinted as Szabolcsi & Zwarts (1997). For a somewhat related approach to Negative Island effects, cf. Rullmann (1994,1995).

establish what is meant with the claim that a scopal element SE (i.e. an expression which can participate in scopal ambiguities) is associated with certain Boolean operations. In the present context, we may take this claim to mean that each and every SE in conjunction with a distributive verbal predicate can be interpreted as a Boolean combination of 'singular' predications.[7] Thus, assuming a model where John, Bill and Mary are the only students, the left-hand side of the equations in (13) expresses the same meaning as the corresponding right-hand side (where 'W' refers to set of individuals that walked, and 'j', 'b' and 'm' refer to John, Bill and Mary respectively).

(13)

a *John walked* = W(j)

b *John did not walk* = ¬ (W(j))

c *no student walked* = ¬ (W(j) ∨ W(b) ∨ W(m))

d *at most one/less than two student(s) walked*
= ¬ ((W(j) ∧ W(b)) ∨ (W(j) ∧ W(m)) ∨ (W(b) ∧ W(m)))

e *exactly/precisely one student walked* = (13d) ∧ (13f)

f *at least two/more than one student(s) walked*
= (W(j) ∧ W(b)) ∨ (W(j) ∧ W(m)) ∨ (W(b) ∧ W(m))

g *every student walked* = W(j) ∧ W(b) ∧ W(m)

h *a student walked* = W(j) ∨ W(b) ∨ W(m)

These observations can be generalized into the following statements (cf. I in the Appendix to this chapter for definitions of the lattice-theoretic operations *meet*, *join* and *complement*), which are intended to apply in the expected way to quantificational adverbs as well:

(14)

Types of Scopal Expressions and their Boolean Operations

a *Negation* corresponds to taking Boolean *complement* (i.e. ¬ in the propositional calculus, – set-theoretically);

b *Universal* quantification corresponds to taking Boolean *meet* (i.e. ∧ in the propositional calculus, ∩ set-theoretically);

c *Existential* quantification corresponds to taking Boolean *join* (i.e. ∨ in the propositional calculus, ∪ set-theoretically);

d *Numerical* quantification corresponds to a combination of at least Boolean *meet* and *join* (and, in case of a monotone decreasing or non-monotone numerical quantifier, *complement*).

[7] Keenan & Faltz (1985), who pursue a Boolean semantics for natural language, formally explicate this claim as follows: each Generalized Quantifier is a Boolean compound of individual filters, where the latter are generated by a singleton set containing some individual in the domain of discourse (cf. also the discussion surrounding 21 in the main text). If we assume that quantificational adverbs together with their restriction denote Generalized Quantifiers as well, these too can be considered Boolean compounds of individual filters, where the latter are now generated by a singleton set containing some event or 'case' (i.e. some assignment of objects to variables; cf. Lewis 1975). Cf. Section 2.3.3 and section 3.4 for discussion on quantificational adverbs.

We may now turn to a simple illustration of the principle in (12). Consider the *wh*-interrogatives in (15) on a wide scope reading of the *wh*-phrase *who*. In order to answer (15a), we need to construct the set of people that John likes, as indicated by ':=' where 'L' stands for 'likes´'. In (15b), we take the complement of the set constructed in (15a), where *D* stands for the domain of discourse. In (15c), we construct for each student *s* the set of people that *s* likes, union the results and then take its complement. In (15d), we need to perform a variety of operations. First, we construct for each distinct pair of students *s* and *s´* the set of people that *s* likes and those that *s´* likes. We then intersect for each distinct pair *s* and *s´* the sets thus created. Finally, we union all these intersections. The members of this union will be the people that at least two/more than one student(s) like(s). In (15e), we construct for each student *s* the set of people liked by *s*, and then intersect these sets.

(15)

a *Who does John like?* $:= \{a: \langle j,a\rangle \in [\![L]\!]\}$

b *Who doesn't John like?* $:= D - \{a: \langle j,a\rangle \in [\![L]\!]\}$

c *Who does no student like?*

$:= D - \bigcup\{\{a: \langle j,a\rangle \in [\![L]\!]\},\{a: \langle b,a\rangle \in [\![L]\!]\},\{a: \langle m,a\rangle \in [\![L]\!]\}\}$

d *Who do(es) at least two/more than one student(s) like?*

$:= \bigcup\{\{a: \langle j,a\rangle \in [\![L]\!]\} \cap \{a: \langle b,a\rangle \in [\![L]\!]\},\{a: \langle b,a\rangle \in [\![L]\!]\} \cap \{a: \langle m,a\rangle \in [\![L]\!]\}, \{a: \langle j,a\rangle \in [\![L]\!]\} \cap \{a: \langle m,a\rangle \in [\![L]\!]\}\}$

e *Who does every student like?*

$:= \bigcap\{\{a: \langle j,a\rangle \in [\![L]\!]\},\{a: \langle b,a\rangle \in [\![L]\!]\},\{a: \langle m,a\rangle \in [\![L]\!]\}\}$

Thus, these examples show that when a *wh*-phrase takes scope over some scopal expresson SE, the computation/verification of the relevant answer requires performing the Boolean operations that are associated with SE in the denotation domain of the *wh*-phrase. At this point, one could object that the construction or verification of answers to questions does not have to be so 'computational'. For example, we could answer the questions in (15) by checking every individual in the domain of discourse to see whether it has the property of being liked by John, not being liked by John, not being liked by anyone, and so on. We may call such an alternative procedure for constructing or verifying answers Look-Up. However, Sz&Z (p.255) first note that one would not like to exclude in general the possibility of computing even that type of information that can be retrieved by looking it up. Secondly, they observe that Look-Up can not be general. For example, it is simply implausible to assume that in answering *How much does John love Mary?*, we check each individual degree of romantic affection to see whether John loves Mary to that degree. On the basis of these considerations, Sz&Z conclude that even though Look-Up may play an important role in a pragmatic/procedural model, it does not eliminate the need for 'computation'.

To return to our discussion of the principle in (12), the reason why it can be executed so smoothly in examples such as those in (15) resides in the fact that a *wh*-phrase such as *who* ranges over individuals. Individuals can be collected

into unordered sets, such as the set of individuals that John likes. All Boolean operations are defined on sets of individuals, since the power set of any set of individuals forms a Boolean algebra.[8]

(16) *A Small Typology of Partially Ordered Domains*
- a A *Boolean algebra* is a partially ordered set closed under meet, join and complement.
- b A (proper) *lattice* is a partially ordered set closed only under meet and join.
- c A (proper) *join semilattice* is a partially ordered set closed only under join.

But what would happen if some *wh*-phrase does not range over discrete individuals, but rather over elements of a partially ordered domain? In principle, a partially ordered domain might take any of the forms listed in (16) (among some others that need not concern us here). Hence, given the principle stated in (12), we predict that depending on the type of structure the elements of which we take a given *wh*-phrase (on a certain reading) to range over, that *wh*-phrase will not be able to take wide scope over those SEs that are associated with at least one of the Boolean operations that are not defined in that type of structure. We will now see how this reasoning gives us a handle on the WI problem.

To begin with, Sz&Z redefine in formal semantic terms the distinction in RM between good extractees such as *which man* (i.e. the referential Ā-phrases) and bad extractees such as *how* (i.e. the non-referential Ā-phrases) as follows:[9]

(17) *Good versus Bad Extractees*
- a Good extractees range over a domain of individuals.
- b Bad extractees range over a domain that has a *partial ordering* defined on it.

Sz&Z construct a novel empirical argument to support the claim that the *wh*-adverb *how* ranges over a partially ordered domain. They first observe that the adverb *only* is ambiguous in that it can either mean "exclusively" or "merely". *Only* is used in its first sense when it applies to elements of unordered sets (i.e. sets of individuals), and it is used in its second sense when it applies to elements of partially ordered sets. In Dutch, these two senses are

[8] A partial ordering is a reflexive, anti-symmetric and transitive relation (typically: inclusion ⊆). Cf. I in the Appendix to this chapter for more discussion on partial orders, (proper) lattices, (proper) semilattices and Boolean algebras.

[9] The term 'individual' here should be understood in a technical sense. It refers both to inherently discrete individuals that have no partial ordering defined on them (apart from the identity relation) and to contextually individuated properties, manners, amounts etc. whose overlap we choose to ignore.

morphologically distinguished, where *alleen* means "exclusively" and *slechts* "merely" (cf. Sz&Z: ex. 72):

(18)
a Er zijn alleen drie stoelen in de kamer
there are only three chairs in the room
"There are only three chairs (and nothing else) in the room"
b Er zijn slechts drie stoelen in de kamer
"There are only three chairs (and no more) in the room"

The following contrast (based on Sz&Z: ex. 73) therefore shows that manner adverbs denote in a domain which is partially ordered.

(19)
a *Hij kon het probleem **alleen** met moeite om 2:00 oplossen
He could the problem only with difficulty at 2:00 solve
"He could solve the problem at 2:00 only [= exclusively] with difficulty"
b Hij kon het probleem **slechts** met moeite om 2:00 oplossen
"He could solve the problem at 2:00 only [= merely] with difficulty"

More specifically, Sz&Z show that the *wh*-adverb *how* ranges over elements of a (proper) join semilattice. Thus, according to the principle in (12) above, if some scopal element takes narrow scope with respect to *how*, the Boolean operations associated with the former must be performed in the denotation domain of the latter (cf. II in the Appendix for a more precise characterization of this claim). However, given that meet and complement are not defined on a (proper) join semilattice, it is predicted that *how* cannot scope over those scopal expressions that are associated with meet and/or complement. This immediately explains the whole gamut of WI effects reviewed in section 1.2 if it can be shown that i) all harmful interveners in (3-7) above cannot outscope *how* (or support a scopally independent -i.e. cumulative or branching- interpretation, a possibility that can be safely ignored here), and ii) all harmful interveners in these constructions are associated with Boolean meet and/or complement.

As for the first claim, it is clear that neither negation nor any of the interveners in (3) and (5-7) can take 'inverse' scope over a c-commanding *wh*-phrase. Moreover, it is almost unanimously agreed that in English, only universal distributive noun phrases in subject position can take wide scope over a *wh*-phrase in a matrix clause (cf. especially Beghelli 1997; Szabolcsi 1997b). This entails that none of the scopal interveners in (4) can outscope *how* either. As for the second claim, note first that (14) already informs us that all scopal interveners in (4) are associated with meet and/or complement.[10] Secondly, as

[10] The observation that WI effects induced by monotone increasing quantifiers tend to be somewhat weaker than those induced by non-monotonic or monotone decreasing quantifiers might be related to the fact that only the former marginally support a collective reading. This latter finding can be explained as follows (cf. also Szabolcsi 1997a). Only monotone

will be discussed in much more depth in Chapter 4, Sz&Z argue that the set of Boolean operations that characterize the denotation of both interrogative complements and presuppositional verbs includes at least Boolean meet. On the assumption that Extraposition Islands form a proper subclass of Presupposition Islands (cf. also section 1.2), it follows that Sz&Z can account for the whole pattern of WI effects revealed in (3-7) above. In fact, Honcoop (to appear) argues that Sz&Z's approach can naturally be extended to account for the WI effects in (11) above as well. As was already pointed out above, these data are highly problematic for an approach to WIs in terms of RM.

1.3.2 Further Predictions

We will resume our exposition of Sz&Z's semantic algebraic approach to WIs by discussing a number of additional observations that lend further support to their analysis. Firstly, as was already pointed out by Kiss (1992), universally quantified noun phrases on their narrow scope construal block *how*-extraction.[11] Consider for example (20) below. This sentence allows for a so-called *pair-list* reading, as paraphrased in (20a), and what Kiss refers to as the 'presupposed uniformity' reading, as glossed in (20b). Crucially, however, this sentence does not allow for the so-called *single-constituent* reading on which the universally quantified noun phrase takes narrow scope, as shown in (20c). This observation follows naturally on Sz&Z's account. Recall that it was already observed in (14b) above that universal quantification corresponds to taking Boolean meet.

(20) How did everyone behave?
- a *pair-list reading*: For every person x, how did x behave?
- b *presupposed uniformity reading*: What was the uniform behavior exhibited by everyone?
- c *single-constituent reading*: *For what manner, everyone behaved in that manner?

increasing quantifiers allow us to talk about their *witnesses* without having to stipulate a maximality condition. That is, for any right monotone increasing determiner D, we have:

(i) $D(A)(B) = \exists W\,(W \in D(A) \wedge W \subseteq A \cap B)$

where W is called a *witness* of the Generalized Quantifier $D(A)$. The collective reading of a monotone increasing noun phrase NP can then be represented (roughly) as $\lambda P \exists W$ (Witness($[\![\text{NP}']\!],W) \wedge W \in [\![P]\!]$), where $[\![P]\!]$ can be true of collectives (i.e. sets of individuals). As it is existentially quantified, the latter representation is only associated with Boolean join, as desired. The distinction between collective versus distributive predication will be addressed in Chapter 2.

[11] Within the context of her discussion of the Dutch *wat voor*-split construction and French *combien*-extraction, de Swart (1992) makes a similar observation concerning the blocking potential of narrow scope universally quantified noun phrases. The *wat voor*-split construction in Dutch will be extensively discussed in Chapter 3.

Secondly, conveniently confining ourselves to quantified interveners, Sz&Z predict that those expressions that are not Boolean as well as those that are exclusively associated with Boolean join do not induce WIs. The first class of harmless quantified interveners consists of singular *referential* expressions and plural referential expressions on their collective construal. Anticipating our discussion of collective versus distributive predication in Chapter 2, let us call an individual *atomic* or *singular* just in case it is a singleton set containing one 'simple' object (e.g. {j}), and *plural* just in case it is a multi-membered set containing at least two 'simple' objects (e.g. {j,b,m}). *Referential* expressions may then be defined as those expressions which denote an *individual filter*, where an individual filter I_a is a principal filter generated by a singleton set containing an atomic or plural individual a.[12] For instance, *John* denotes the individual filter $I_{\{j\}} = \{P\colon \{\{j\}\} \subseteq P\}$, and *John, Bill and Mary* on its collective construal denotes the individual filter $I_{\{j,b,m\}} = \{P\colon \{\{j,b,m\}\} \subseteq P\}$. The examples in (21a) and (21b) indicate that non-Boolean noun phrases are indeed harmless interveners.

(21) a How did John/that man/the woman John invited behave?
b How did John, Bill and Mary/those men/the women John invited behave?
c ?How did a man behave?
d ?How did three men behave?

The second class of harmless quantified interveners consists of bare singular indefinites (e.g. *a man*) and plural bare numeral indefinites (e.g. *three men*) on their collective construal (but cf. footnote 10). The truth-conditional meaning of both types of indefinites, which we will henceforth refer to as *simple indefinites*, can be represented in terms of existential quantification, and thus corresponds to taking Boolean join, if it is assumed for now that the collective construal of *n men*, for any numeral *n* other than *one*, can be represented as $\lambda P \exists X\ (\forall x \sqsubseteq X\ (\text{man}'(x)) \wedge |X| = n' \wedge P(X))$, where X ranges over plural individuals and x over atomic ones.[13] As shown in (21c) and (21d), bare singular indefinites and bare numeral indefinites on their collective reading do not give rise to WIs, as predicted.[14]

[12] A Generalized Quantifier $Q(A)$ is a *principal filter* just in case $\exists G \forall B\colon B \in Q(A) \leftrightarrow G \subseteq B$. G is then called the *generator* of the principal filter $Q(A)$ (cf. also Barwise & Cooper 1981). For example, $[\![\text{Every}'(\text{man}')]\!] = \{P\colon [\![\text{man}']\!] \subseteq P\}$ is a principal filter, where $[\![\text{man}']\!]$ is its generator.

[13] Cf. again Chapter 2 for more discussion on plural quantification.

[14] Note that the marked status of the examples in (21c) and (21d) should not be mistaken for a weak WI effect, as ?*Which book did a/three student(s) read?*, on a non-specific interpretation of the indefinites, sounds equally strange. At present, I am not sure what is responsible for this effect.

Thirdly, the relevance of contextualization or Discourse-linking in determining the acceptability of *wh*-extraction across WIs receives a very natural explanation on Sz&Z's account. Recall that Sz&Z characterize good extractees as those expressions that range over individual domains (i.e. sets of elements that exhibit no partial ordering), and bad extractees as those expressions that range over elements of partially ordered domains. On this approach, D-linking can be relevant in essentially two ways: "A salient checklist or relevance criterion (i) may individuate a naturally ordered domain, and/or (ii) may speed up the manipulation of an already individual domain by making Look-Up available" (Sz&Z: p. 256). The effect of (i) can be discerned in (22) below (taken over from Sz&Z: ex. 65b), which becomes acceptable in a context where there is a list of potential scores and receivers' names on a blackboard:

(22) How many scores did no one receive? (Answer: 22 and 27)
"Which of the figures on the blackboard have no name next to them?"

The effect of (ii) can be felt in (23) (Sz&Z: ex. 66) when *who* ranges over a set of people that was previously established in discourse. Enforcing a D-linked interpretation on this *wh*-phrase facilitates Look-Up. This procedure makes it substantially easier to compute or verify the relevant answer than by intersecting all sets of people that are supported by someone. Thus, the effect of D-linking here is just to make the question more felicitous.

(23) Who did everybody support? (Answer: The candidate from Ohio)

A fourth observation that provides strong support to Sz&Z's approach to WIs concerns the fact that the theory correctly predicts that extractees that only differ from each other in the lattice-algebraic structure of their denotation domain will be sensitive to different interveners. So far, we have only discussed the case of the *wh*-adverb *how*, whose denotation domain forms a (proper) join semilattice. However, Sz&Z observe that in certain contexts a *how many*-phrase may receive a so-called *number reading* on which it ranges over elements of a (proper) lattice (note that $\langle \mathbb{N}, \leq \rangle$, where $\mathbb{N}$ is the set of natural numbers $\{0,1,2,...\}$ and $\leq$ is the 'smaller than or equal to' relation, is a lattice which lacks a top element). Since lattices are closed under join ànd meet, as indicated in (16b), it is predicted that a *how many*-phrase on its number reading, as opposed to *how*, can take wide scope over a universally quantified noun phrase. And indeed, (24) below (Sz&Z: ex. 85a), when uttered say in a context in which we are evaluating how appropriate the midterm test was in comparison with the level of the class, quite naturally allows for a number reading which can be paraphrased as indicated. It is hard to see how such semantic 'Relativized Minimality' effects can be accounted for on any alternative

approach to WIs.[15]

(24) How many problems did every student solve?
"For what number, every student solved at least that number of problems?"

Finally, although this may ultimately be a matter of taste, I believe there is a clear sense in which Sz&Z's theory of WIs appeals more strongly to notions of elegance and 'virtual conceptual necessity' than any of the alternative theories discussed or mentioned in this chapter. The reason is that this theory should not be construed as a theory of WIs specifically. Rather, it aims at explicating the much more general notion of scopal dependency in algebraic semantic terms. And the particular explication of the notion of scopal dependency that this theory offers fits in rather naturally with any approach to meaning which concedes that natural language expressions take their denotation in structures whose properties can be analyzed by making use of the tools of algebra. It seems that it is this natural connection with general views on the mathematical structure of meaning that Sz&Z have in mind when they confidently remark that "(...) [i]f our semantic claim concerning scope taking is logically correct, then it captures an absolute limitation on what meanings are expressible. It is not a matter of elegance whether one invokes it in the explanation of certain phenomena: it will be in effect even if the readings it excludes can be exluded in syntactic terms as well" (Sz&Z: p. 278).

1.4 Toward a Dynamic Semantic Approach to Weak Islands

The passage quoted above continues with: "In this sense it is truly not a rival of syntactic accounts. We expect that the syntactic and semantic explanations of weak island facts will eventually properly overlap". In fact, pursuing the logic of their reasoning a bit further, the same point should also apply to alternative semantic accounts of WIs, provided we can find any. This thesis will demonstrate there is indeed such an alternative semantic approach in terms of which a significant subset of WI effects is best accounted for. This alternative semantic approach is primarily concerned with the *dynamic* properties of expressions, rather than their *static* algebraic ones.

In this section, we will briefly discuss the logic underlying a dynamic theory of WIs, as well as some of its original motivation. The discussion will be organized as follows. In the next subsection, we will see that the scopal expressions which induce WI effects constitute a natural class in Dynamic Semantics as well. Observations such as these stongly suggest the possibility of

[15] Cf. also section 4.4.

an alternative, dynamic semantic account of WIs. The bare outlines of a dynamic theory of WIs will then be discussed in section 1.4.2.

1.4.1 A Dynamic Semantic Characterization of Bad Interveners

The possibility of an alternative, dynamic semantic account of WIs is most strongly suggested by the fact that the expressions which induce WI effects constitute a natural class in Dynamic Semantics as well. Leaving aside for the moment other types of harmful interveners, the examples in (25) below show that the expressions that we already saw in (4) above give rise to Scope Island effects as well as universally quantified noun phrases also 'freeze' the dynamic potential of an indefinite. That is, an indefinite contained inside the scope of any of the quantified subject noun phrases in (25) can no longer introduce a 'discourse referent' that can be picked up by a pronoun in subsequent sentences. Following standard terminology, we will henceforth refer to the general phenomenon exemplified in (25) as *inaccessibility*.

(25) *Inaccesibility*

a *John doesn't have a car_i. It_i is too expensive.
b *No student has a car_i. It_i is too expensive.
c *Less than/fewer than/at most five students have a car_i. It_i is quite expensive.
d *Exactly/precisely five students have a car_i. It_i is quite expensive.
e *At least/more than five students have a car_i. It_i is quite expensive.
f *Most students have a car_i. It_i is quite expensive.
g *Every student has a car_i. It_i is quite expensive.

In addition to the quantified subject noun phrases in (25), it should be noted that the same inaccesibility effects can be observed with various types of quantificational adverbs as well, e.g. **Last year, when it rained, John always/never/mostly/often/seldom bought an Italian newspaper$_i$. It$_i$ reminded him of his summer love*. (The latter judgments concern the possibility of a token-interpretation of the indefinite antecedent.) Since Dynamic Semantics is a compositional semantic theory which aims to account for the conditions under which a simple indefinite can be used to introduce a discourse referent, one would naturally expect in view of (25) that Dynamic Semantics has fruitful applications in the realm of WIs as well.[16]

[16] Interestingly, after having examined similar correlations between WIs and inaccessibility, Szabolcsi & Zwarts (1990: pp. 551,552) already contemplated the possibility of reformulating their monotonicity-based account in dynamic terms.

1.4.2 A Sketch of a Dynamic Semantic Approach to Weak Islands

We will now explore rather informally one particular way in which Dynamic Semantics might be invoked in the analysis of at least some WI constructions. The rest of this thesis is dedicated to elaborating this idea both in terms of its formal and empirical content and to exploring its status *vis à vis* Sz&Z's algebraic account of WIs.

Just like Discourse Representation Theory (DRT; cf. Kamp 1981; Kamp & Reyle 1993), Dynamic Semantics (cf. Groenendijk & Stokhof 1989,1990,1991; Chierchia 1992,1995; Dekker 1993a,b,1995 among many others) is mainly concerned with accounting for the conditions under which simple indefinites can introduce discourse referents. However, unlike DRT, Dynamic Semantics offers a fully compositional theory in which the dynamics of simple indefinites is uniformly represented in terms of existential quantification. Within such a theory, the issue immediately arises how to cope with the well-known fact that indefinites often behave as (restricted) bound variables, rather than as (restricted) existential quantifiers. In Dynamic Semantics, it is relatively easy to design a compositional procedure which enables us to address an indefinite as though it denotes a (restricted) variable.[17] The operation that performs this trick is called Existential Disclosure (ED). As will become clear from its formal definition in Chapter 2, ED requires the indefinite which is in need of disclosure to bind a variable which occurs outside of its syntactic scope or c-command domain. It is therefore predicted that any (semantically sensible) application of ED is governed by inaccessibility, a restriction which we saw in (25) governs the well-formedness of anaphoric links between a variable expression and a non-c-commanding indefinite antecedent.

How does all this relate to WIs? To take a somewhat abstract case, suppose the indefinite in a structure such as (26a) is interpreted as a (restricted) variable quantified over by Q. This is indicated by their shared index i. Putting it somewhat differently, the indefinite here is to be interpreted as a property restricting the range of the index i bound by Q. In order to obtain this interpretation within the framework of Dynamic Semantics, we must so to speak *dynamically abstract* over the index associated with the indefinite by means of ED, roughly in the way indicated in (26b) where '$\underline{\lambda}$' stands for 'dynamic λ-abstraction'. By the definition of ED, (26b) reduces to (26c), where '$\underline{\wedge}$' stands for *dynamic conjunction*. Note that in the latter representation, the index i which needs to be bound by the indefinite, occurs outside of its syntactic scope or c-command domain, which is properly contained in Ψ.

[17] Admittedly, this is sloppy language. Strictly speaking, variables are not model-theoretic entities, and therefore they cannot be the denotation of any expression. However, to avoid unnecessary complications, we will henceforth abstract away from these technicalities.

(26) a ... Q_i [$_\Phi$ ... [$_\Psi$ X ... indefinite$_i$ ... $_\Psi$] ... $_\Phi$] ... ↦ (translates as)
b ... Q'($\underline{\lambda} i$ ($_\Phi$ ... ($_\Psi$ X′ ... indefinite′$_i$ ... $_\Psi$) ... $_\Phi$)) ...
c ... Q'(λj (($_\Phi$ ... ($_\Psi$ X′ ... indefinite′$_i$ ... $_\Psi$) ... $_\Phi$) $\underline{\wedge}$ $i = j$)) ... (def. of ED)

To facilitate the discussion, let us fix some terminology first. We will henceforth refer to all those constructions that can be analyzed along the lines of (26a) as *split constructions*. Furthermore, we will say that in structures such as (26a), *Q dynamically binds* the indefinite. Now, anticipating our discussion in the next section, it appears that split constructions in general are subject to the following restriction: if *X* in (26a) is replaced by some operator-expression which gives rise to WI effects (such as negation), the resulting structure is either ill-formed or severely degraded. This generalization will from now on be referred to as the *Intervention Generalization*. It is stated in (27) for our convenience.

(27) *The Intervention Generalization*
* ... Q_i [$_\Phi$ ... [$_{\text{Weak Island}}$ Operator ... indefinite$_i$ ... $_\Phi$] ...] ...

Informally, we can now explain the Intervention Generalization as follows. Let us first generalize our observations in (25) above into the following claim:

(28) *Claim: Weak Island Inducers are Inaccessibility Inducers*
The class of expressions that induce WIs coincides with the class of expressions that create inaccessible domains for dynamic anaphora.

Assuming (28), it follows that if some WI inducing expression *Operator′* is substituted for *X′* in (26c), the indefinite can no longer bind the second occurrence of the index *i*. This is due to the inaccessible domain for dynamic anaphora created by *Operator′*. Thus, an application of ED in this case will not yield the desired semantic effect of shifting the standard interpretation of an indefinite into that of a property-denoting expression. Since no other well-defined interpretation can be ascribed to (26c) with *Operator′* replacing *X′*, the structure in (26a) will be ruled out on semantic grounds, as desired. In this way, we can reduce the Intervention Generalization to the same principles of Dynamic Semantics that account for inaccessibility. In the next chapter, we will present a version of Dynamic Semantics in terms of which this reasoning can be made formally precise. And as was already mentioned at the beginning of this section, the formal and empirical elaboration of this reasoning and its relationship with Sz&Z's semantic algebraic approach to WIs will take up the rest of this thesis. This chapter will now be concluded with a brief discussion of a number of split constructions, i.e. constructions that can be analyzed along the lines of (26a). Their sensitivity to WIs will be seen to fully corroborate the Intervention Generalization.

1.5 An Overview of Split Constructions: The Viability of the Intervention Generalization

In this last section, we will present a small overview of split constructions from different languages and demonstrate their sensitivity to WIs. When going through the list of split constructions below, it should be borne in mind that this list certainly does not cover the whole range of relevant data. Nor is the discussion of any particular item that appears on this list meant to be exhaustive, although the first two constructions to be discussed below will be investigated in much more detail in Chapter 3. Finally, it is important to realize that the informal definition of a split construction we presented in the previous section is not theory-neutral. For example, in section 1.5.1 below, the *wat voor*-split construction in Dutch will be referred to as a split construction. This seems intuitively justified on account of the fact that the *wh*-operator *wat* needs to bind an indefinite NP as its restriction, even though it does not form a constituent with it. However, not all researchers working on *wat voor*-split agree that the indefinite NP does function semantically as a restriction on the range of the *wh*-operator.[18] This claim therefore stands in need of serious justification. We will address this issue in Chapter 3.

1.5.1 What For-Split

In Dutch, there are two ways of forming a *wh*-interrogative with the complex *wh*-determiner *wat voor* (lit. 'what for', meaning "what kind of"). Either the whole *wh*-phrase is fronted to sentence-initial position, which is the standard way of constructing a *wh*-interrogative in Dutch (cf. 29a), or just the *wh*-operator *wat* is moved into sentence-initial position, leaving the so-called 'remnant' *voor*-NP in its base position (cf. 29b). As indicated by their paraphrases, there is no detectable difference in meaning between (29a) and (29b).

(29) *What For-Split*

a Wat voor een boek heeft Jan gelezen?
What for a book has Jan read
"What kind of book did Jan read?"

b Wat heeft Jan voor een boek gelezen?
"What kind of book did Jan read?"

The type of interrogative construction exemplified in (29) is by no means

[18] Throughout this thesis, when we say that an indefinite NP functions as a restriction on the range of some operator *Q*, we mean that the indefinite NP must be interpreted as a property that restricts the range of possible valuations of the variable quantified over by *Q*. Thus, the way in which the term 'restriction' is used here should not be confused with the way in which this term is used in the literature on Generalized Quantifiers.

particular to Dutch. Close equivalents of this construction occur in other Germanic languages as well, in addition to some Slavic languages (cf. Pafel 1995; Beermann 1997). In view of the cross-linguistic dimension of this construction, it is wise to follow Beermann (1997) in referring to the type of interrogative construction illustrated in (29) as What For-interrogatives. Consequently, we will henceforth refer to the split construction in (29b) as What For-split.

As demonstrated by the examples in (30-32), What For-split is highly sensitive to WIs, in contradistinction to the other variant of What For-interrogatives in which the whole What For-phrase is fronted to sentence-initial position.[19]

(30) *Wh-Island*
- a ??Wat voor een boek vroeg jij je af [of je _ moest lezen]?
  "What kind of book did you wonder whether you should read?"
- b *Wat vroeg jij je af [of je _ voor een boek moest lezen]?

(31) *Scope Island*
- a Wat voor een boek hoeft [niemand _ te lezen]?
  "What kind of book does noone have to read?"
- b *Wat hoeft [niemand _ voor een boek te lezen]?
- c Wat voor een boek hebben [precies drie studenten _ gelezen]?
  "What kind of book did exactly three students read?"
- d *Wat hebben [precies drie studenten _ voor een boek gelezen]?

(32) *Presupposition Island*
- a ?Wat voor een boek betreur je [dat je _ moest lezen]?
  "What kind of book did you regret that you should read?"
- b *Wat betreur je [dat je _ voor een boek moest lezen]?
- c ?Wat voor een boek herhaalde Peter [dat je _ moest lezen]?
  "What kind of book did Peter repeat that you should read?"
- d *Wat herhaalde Peter [dat je _ voor een boek moest lezen]?

In Chapter 3, we will enter into a much more extensive discussion of What For-split and its sensitivity to WIs. For now, we may conclude that we have found one piece of evidence in favor of the Intervention Generalization, according to which, it will be recalled, all split constructions are subject to WIs.

1.5.2 Negative Polarity

[19] As was mentioned in section 1.2, *Wh*-Islands are relatively strong in Dutch. I have included them here and in section 1.5.3, as many informants still detect a difference in acceptability between extraction of a *wh*-phrase headed by *wat voor* or *welk(e)* ("which") and 'subextraction' of *wat* out of a *Wh*-Island.

A second piece of evidence in favor of the Intervention Generalization can be constructed on the basis of Negative Polarity. Negative Polarity may be assimilated to split constructions in general if we make the following two assumptions: i) Negative Polarity Items (NPIs) are indefinite expressions; and ii) NPIs act semantically as restricted variables, quantified over by the (denotation of the) 'negative' trigger. Both assumptions seem unproblematic in the face of examples such as (33a) below (where both the trigger and NPI have been indicated by italics) the meaning of which may be represented as in (33b) (assume the predicate *red-cent´* in its NPI usage to be true of amounts of money; cf. also Chapter 3).

(33) *Negative Polarity*
  a *Noone* gave the beggar *a red cent*
  b No´x,y (person´(x) ∧ red-cent´(y) ∧ give´(x,ιz (beggar´(z)),y))

The two assumptions above with respect to Negative Polarity will be discussed in much more detail in Chapter 3.

As is well-known, the licensing relationship between trigger and NPI can be disturbed by all sorts of intervening expressions. As suggested by the data in (34) and (35), the licensing relationship between trigger and NPI cannot span *Wh*-Islands and Presupposition Islands.

(34) *Wh-Island*
  *John did*n't*</u> wonder [whether Mary gave *a red cent* to the beggar]

Note that this example is marginally acceptable under an interpretation on which the embedded interrogative is construed as a rhetorical question. On that interpretation, 'wonder whether' itself licenses the NPI. The meaning of (34) may then be paraphrased as *John was (almost) certain that Mary didn't give a red cent to the beggar*. A more careful examination of Negative Polarity licensing in interrogative contexts is deferred to Chapter 3 as well.

(35) *Presupposition Island*
  a *John did*n't*</u> regret [that Mary gave *a red cent* to the beggar]
  b *John did*n't*</u> repeat [that Mary gave *a red cent* to the beggar]
  c *It is*n't*</u> time [that John drinks *anymore*]

A word of caution, though: there is reason to believe that our observations in (34) and (35) should not be subsumed under a theory of WIs. *Wh*-Islands and Presupposition Islands do not allow NEG-Raising either. That is, the examples in (36) below cannot be construed in such a way that negation scopes under the matrix predicate.

(36) a Hoover didn't wonder whether Oswald shot JFK ⊭

Hoover wondered whether Oswald didn't shoot JFK

b John didn't regret that his wife lost weight ⊭
John regretted that his wife didn't lose weight

c John didn't repeat that he wants to go to the toilet ⊭
John repeated that he didn't want to go to the toilet

d It isn't nice that John beats his wife ⊭
It is nice that John doesn't beat his wife

It is well-known that biclausal NPI licensing is sensitive to the NEG-raising properties of the matrix predicate. For example, (37a) below is only well-formed if it is interpreted in such a way that it entails and is entailed by (37b). One might say then that biclausal NPI licensing is possible to the extent that one can interpret the licensing relationship in a strictly local fashion.

(37) a I do*n't* think that Bill drinks *anymore* ⇔
b I think that Bill does*n't* drink *anymore*

Now, the contrast in (38) suggests that our observations in (34) and (35) above concern restrictions on NEG-raising, rather than WIs.

(38) a *Ik zei *niet* dat Peter zich *hoeft* te verontschuldigen
"I didn't say that Peter has to apologize"
b Wat zei jij [dat Peter _ voor een boek moest lezen]?
"What kind of book did you say that Peter should read?"

Thus, even though the verb *zeggen* ("to say") in Dutch does not infere with What For-split, it does induce a barrier for biclausal NPI licensing. Presumably, the latter observation follows from the fact that *zeggen* is not a NEG-raising verb, as illustrated in (39).

(39) Ik zei niet dat Peter zich heeft verontschuldigd ⊭
"I didn't say that Peter apologized"
Ik zei dat Peter zich niet heeft verontschuldigd
"I said that Peter didn't apologize"

Therefore, in order to determine whether Negative Polarity is indeed sensitive to WIs, we must check whether NPI licensing is blocked by Scope Islands, since it is only this type of island which can be examined in a monoclausal structure. The examples in (40) indicate that Negative Polarity is indeed sensitive to Scope Islands.

(40) *Scope Island*
a **Noone* gave [at most three beggars *a red cent*]
b **Noone* gave [exactly three beggars *a red cent*]

Even if we disregard our earlier observations in (34) and (35) above, facts such as those in (40) do suggest that the harmful interveners in Negative Polarity constructions may be characterized as those expressions which create WIs. The reader is again referred to Chapter 3 for a much more extensive discussion of Scope Island effects on Negative Polarity. We will henceforth refer to the intervention effects on NPI licensing simply as WI effects.

To the extent then that the two assumptions with respect to NPIs discussed at the beginning of this subsection are tenable, we have discovered another type of split construction whose sensitivity to WIs corroborates the Intervention Generalization.

1.5.3 What On-Split

In Dutch, it is possible to form a *wh*-question or relative clause by means of what has been referred to as *wat aan*-split (cf. Corver 1990). In this type of split construction, the *wh*-operator *wat* obligatorily occurs in clause-initial position, whereas the prepositional 'remnant' stays put in its base position.[20] As indicated by the paraphrases in (41) below, the (prepositional) bare plural clearly functions semantically as a restriction on the range of the *wh*-operator.

(41) *What On-Split*

a Wat heb jij aan boeken gelezen?
what have you on books read
"What books have you read?"

b Alles wat jij aan boeken hebt gelezen past op één klein plankje
everything what you on books have read fits on one small shelf
"All books that you have read fit on one small shelf"

Beck (1996) observes that a close equivalent of this construction exists in German as well, i.e. the so-called *was an*-split construction. In view of its cross-linguistic nature, it seems more neutral to refer to this split construction as What On-split.

The facts in (42-44) demonstrate that What On-split is sensitive to WIs as well.

(42) *Wh-Island*
*Wat vroeg jij je af [of Jan aan boeken heeft gelezen]?
"What books did you wonder whether Jan has read?"

(43) *Scope Island*

[20] We will not address the issue here whether this type of split construction is derived through movement. Cf. Corver (1990) for relevant discussion.

a *Wat heeft [niemand aan boeken gelezen]?
"What books did noone read?"
b *Wat hebben [precies drie studenten aan boeken gelezen]?
"What books did exactly three students read?"
c ??Wat hebben minstens drie studenten aan boeken gelezen?
"What books did at least three students read?"

(44) *Presupposition Island*
a *Wat betreur jij [dat Jan aan boeken heeft gelezen]?
"What books did you regret that Jan has read?"
b *Wat herhaalde jij [dat Jan aan boeken heeft gelezen]?
"What books did you repeat that Jan has read?"

We will not discuss What On-split any further in this thesis, except to note that this type of split construction provides further evidence for the validity of the Intervention Generalization.

1.5.4 Partial Wh-Movement

In many languages, *wh*-extraction from out of an embedded sentence can be partial in that the *wh*-phrase does not move to the position from where it takes scope, but lands in an intermediate Spec of CP position instead. As illustrated in (45a) for German, the position where the partially moved *wh*-phrase is interpreted is occupied by a 'minimal' *wh*-word (i.e. *was* "what" in German). Assuming a Karttunen-style semantics of interrogative sentences, according to which an interrogative denotes the set of all true answers to it, the meaning of (45a) can be represented as in (45b) (where *w* stands for the actual world).[21]

(45) *Partial Wh-Movement*
a Was denkst du mit wem Hans gesprochen hat?
what think you with whom Hans talked has
"To whom do you think that Hans has talked?"
b $\lambda p \exists y\ (p(w) \wedge p = \lambda w'\ (\text{think}'_{w}(\text{you}', \lambda w''\ (\text{person}'_{w}(y) \wedge \text{has-talked}'_{w}(\text{hans}', y)))))$

As a first step toward an analysis of this construction, we thus note that an appropriate interpretation for this structure can be obtained on an analysis

[21] Thus, we will assume a two-sorted type-logic with explicit quantification and abstraction over possible worlds *w*, as in Gallin's (1975) TY2. Cf. the next chapter for more discussion. The *de re* construal of person´ might then be represented by indexing this predicate with *w*, where *w* stands for the actual world.

whereby the *wh*-operator *was* binds the indefinite *wh*-phrase *wem* as its restriction, even though it does not form a constituent with it. There is therefore no reason, at least in principle, to suppose that the LF of (45a) will look in any way different from its overt structure. I take such an approach to be conceptually more attractive than an alternative approach to partial *wh*-movement according to which the intermediate *wh*-phrase must replace the *wh*-'expletive' *was* at LF, as proposed for instance by Beck (1996). Note that the principal motivation for the latter approach resides in the alleged semantic vacuity of *was*, an assumption which can be challenged as we have just shown. Moreover, on our account, the *wh*-operator *was* denotes an existential quantifier, an interpretation which this expression receives in most (if not all) contexts in which it can appear. An example of a plain existential interpretation of *was* is provided in (46).

(46) Ich habe gestern abond was gesehen
"I have seen something yesterday evening"

Even though a more principled discussion falls outside the purview of this section, we will for concreteness adopt Cheng's (1997) Minimalist approach to partial *wh*-movement. According to her analysis, partial *wh*-movement is the result of full *wh*-extraction to some intermediate Spec of CP and subsequent movement of the *wh*-feature of the partially moved *wh*-phrase to the position from where it takes scope. On this approach, the *wh*-word *was* in German is analyzed as a 'minimal' spell-out of the *wh*-feature of the partially moved *wh*-phrase. Cheng (1997) shows that this analysis has a number of interesting properties. It can naturally account for the fact that partial *wh*-movement is successive cyclic (cf. also McDaniel 1989), and it directly explains that (German) partial *wh*-movement exhibits clear Subjacency effects (i.e. it is blocked by Subject and Adjunct Islands). In line with what was said above, we propose to minimally extend Cheng's (1997) analysis in such a way that the spelled-out *wh*-feature is directly interpreted as a *wh*-operator which binds the partially moved *wh*-phrase as its restriction.[22]

[22] Cf. Dayal (1995) for yet another approach to partial *wh*-movement, according to which the meaning of (45) for example is analyzed as in (i) below. Thus, according to Dayal, a partial *wh*-movement construction such as (45) should be split into two parts: i) the main clause, which expresses a question about what proposition *q* you stand in the think-relation to; and ii) the embedded *wh*-clause which has its usual question-denotation, viz. a set of possible answers (as in Hamblin 1973). The latter set of propositions is then taken to restrict the range of *q*.

(i) $\lambda p \exists q\,(C(q)(w) \wedge p = \lambda w'(\text{think}'_{w'}(\text{you}', q)))$,
where $C = \lambda p\,\lambda w' \exists y\,(\text{person}'_{w'}(y) \wedge p' = \lambda w''(\text{has-talked}'_{w''}(\text{hans}', y)))$

Since (i) is equivalent to (ii), there is no need for either 'expletive' *was*-replacement or 'unselective' binding of *mit wem* by *was*.

(ii) $\lambda p \exists y\,(\text{person}'_{w}(y) \wedge p = \lambda w'(\text{think}'_{w'}(\text{you}', \lambda w''(\text{has-talked}'_{w''}(\text{hans}', y)))))$

However, as pointed out especially by Horvath (1996), there is reason to believe that this

As has already been pointed out by Rizzi (1992), Sz&Z and Beck (1996), partial *wh*-movement (in German) is blocked by WIs. This is shown by the following set of facts.

(47) *Wh-Island*
- a ?Mit wem fragtest du dich ab [ob Hans _ gesprochen hat]?
  "To whom did you wonder whether Hans has talked?"
- b *Was fragtest du dich ab [mit wem Hans gesprochen hat]?

(48) *Scope Island*
- a Mit wem denkt [niemand daß Hans _ gesprochen hat]?
  "To whom does no one think that Hans talked?"
- b *Was denkt [niemand mit wem Hans gesprochen hat]?
- c Mit wem denken [genau drei Studenten daß Hans _ gesprochen hat]?
  "To whom do exactly three students think that Hans has talked?"
- d *Was denken [genau drei Studenten mit wem Hans gesprochen hat]?
- e Mit wem denken [mindestens drei Studenten daß Hans _ gesprochen hat]?
  "To whom do at least three students think that Hans has talked?"
- f *Was denken [mindestens drei Studenten mit wem Hans gesprochen hat]?

(49) *Presupposition Island*
- a ?Mit wem bedauerst du [daß Hans _ gesprochen hat]?
  "To whom do you regret that Hans has talked?"
- b *Was bedauerst du [mit wem Hans gesprochen hat]?
- c ?Mit wem wiederholtest du [daß Hans _ gesprochen hat]?
  "To whom did you repeat that Hans has talked?"
- d *Was wiederholtest du [mit wem Hans gesprochen hat]?

Partial *wh*-movement (specifically) will not be further discussed in this thesis. To the extent then that it is correct to analyze partial *wh*-movement as a split construction, we have found yet another construction which accords with,

type of approach should be restricted to partial *wh*-movement in languages such as Hindi, since partial *wh*-movement in (Hungarian and) German displays somewhat different properties. For example, partial *wh*-movement in German is sensitive to Presupposition Islands (cf. 49 in the main text), whilst partial *wh*-movement in Hindi is at least insensitive to Factive Islands (cf. Dayal 1995). Moreover, the Hindi equivalent of the *wh* scope-marker *was* can be linked to an embedded yes/no interrogative (cf. again Dayal 1995), whereas in German this is impossible. Consequently, Cheng's (1997) analysis as adopted in the text should be confined to partial *wh*-movement in German. (Incidentally, we just note here that Horvath's 1996 own analysis of partial *wh*-movement in Hungarian cannot be carried over to German partial *wh*-movement either, since the former is insensitive to Presupposition and *Wh*-Island effects and does not exhibit the same Subjacency effects as the latter.) Again, due to reasons of space, we cannot enter into a more thorough discussion of partial *wh*-movement and its properties in different languages (but cf. Horvath 1996 for some discussion).

and thereby further corroborates, the Intervention Generalization. This concludes our overview of split constructions. In the next chapter, we will present a theory of Dynamic Semantics in terms of which the Intervention Generalization can be formally derived along the lines sketched earlier in section 1.4.2.

Appendix to Chapter 1

I Posets, Lattices, Join Semilattices and Boolean Algebras

In the following, we will find it convenient to define the concept of 'lattice' in terms of *partially ordered sets* (or *posets*), rather than in algebraic terms. *Posets* can be defined as follows (where any relation R is a partial ordering just in case R is reflexive, anti-symmetrical and transitive; e.g. the subset relation $\subseteq$ is a partial order):

(1) *Poset*
A *poset* is any $\langle A,\leq\rangle$, where $\leq$ is a partial order on A.

Before we can define *lattices* in terms of posets, we first need to introduce the dual notions of *infimum* and *supremum*.

(2) *Infimum and Supremum*. Let $\langle A,\leq\rangle$ be a poset. For any $X \subseteq A$,
- a The *infimum* of X, $\bigwedge X$, is the *greatest lower bound* for X, where $a \in A$ is a *lower bound* for X just in case for every $x \in X$, $a \leq x$;
- b The *supremum* of X, $\bigvee X$, is the *least upper bound* for X, where $a \in A$ is an *upper bound* for X just in case for every $x \in X$, $x \leq a$.

Note that $\bigwedge X = \bigvee(LB(X))$ and $\bigvee X = \bigwedge(UB(X))$, where $LB(X) = \{a \in A$: for every $x \in X$, $a \leq x\}$ and $UB(X) = \{a \in A$: for every $x \in X$, $x \leq a\}$. Now that we have the notions of infimum and supremum at our disposal, we can define the lattice-theoretic operations of *meet* $\wedge$ and *join* $\vee$ as follows:

(3) *Meet and Join*. Let $\langle A,\leq\rangle$ be a poset, and $a,b \in A$.
- a $a \wedge b =_{def} \bigwedge\{a,b\}$. Thus, we see that $a \wedge b \leq a$ and $a \wedge b \leq b$.
- b $a \vee b =_{def} \bigvee\{a,b\}$. Thus, we see that $a \leq a \vee b$ and $b \leq a \vee b$.

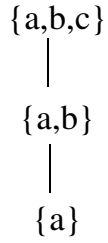
We may now turn to the definition of a *lattice*.

(4) *Lattice*
A *lattice* is a poset $\langle A,\leq\rangle$ which is closed under meet and join, i.e. for every $a,b \in A$, $a \wedge b \in A$ and $a \vee b \in A$. Equivalently, a poset $\langle A,\leq\rangle$ is a lattice just in case for every non-empty finite $X \subseteq A$, $\bigwedge X \in A$ and $\bigvee X \in A$.

For instance, the poset $\langle\{\{a\},\{a,b\},\{a,b,c\}\},\subseteq\rangle$, where $\subseteq$ is the subset relation, is a lattice which is closed under meet (set-theoretic intersection $\cap$) and join (set-theoretic union $\cup$). Its structure can be represented in terms of a so-called *Hasse diagram*, where the connecting lines (reading them from bottom to top)

stand for $\subseteq$.

(5)

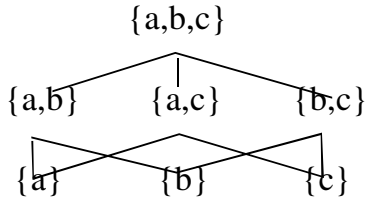


A *join semilattice* can then simply be defined as the 'upper half' of a lattice:

(6) *Join Semilattice*
A *join semilattice* is a poset $\langle A,\leq\rangle$ which is closed under join, i.e. for every $a,b \in A$, $a \vee b \in A$.

A *meet semilattice* can be similarly defined as the 'lower half' of a lattice. We will call a join/meet semilattice *proper* if the poset is only closed under join/meet. Thus, both (5) and (7) below are join semilattices, but only (7) is a proper join semilattice since $\{a\} \wedge \{b\}$ for example is not in $\wp(\{a,b,c\})-\{\varnothing\}$.

(7)



Before we can introduce and discuss our final algebraic structure, viz. that of a *Boolean algebra*, we need to define the property of *boundedness* first.

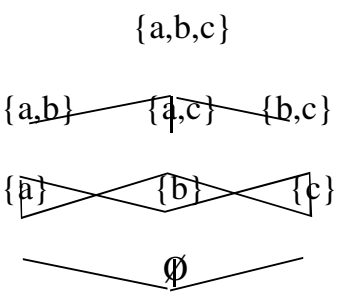
(8) *Bounded Lattice*
A lattice $\langle A,\leq\rangle$ is *bounded* just in case it has a *bottom* element $\bot$ and a *top* element $\top$, where for any $a \in A$, $a \wedge \bot = \bot$ and $a \vee \top = \top$.

For example, the lattice in (5) is bounded as it has $\{a\}$ as its bottom element and $\{a,b,c\}$ as its top element: for every $x \in \{\{a\},\{a,b\},\{a,b,c\}\}$, $x \wedge \{a\} = \{a\}$ and $x \vee \{a,b,c\} = \{a,b,c\}$. However, the (proper) join semilattice displayed in (7) is not bounded since it lacks a bottom element. According to the following definition, neither (5) nor (7) is a *Boolean algebra*.

(9) *Boolean Algebra*
A *Boolean algebra* is a poset $\langle A,\leq\rangle$ which is closed under meet, join and (unique!) complement, where $a \in A$ is a *complement* of $b \in A$ just in case $a \wedge b = \bot$ and $a \vee b = \top$.

For any set A, $\wp(A)$ is a Boolean algebra with $\varnothing$ as its bottom element and A as its top. For instance, the poset $\langle \wp(\{a,b,c\}),\subseteq\rangle$ as represented in (10) is a Boolean algebra. Note that if we would have added $\varnothing$ to the structure in (7), it would have become a Boolean algebra.

(10)



II Event Structure and Set Formation

What exactly does it mean to say that if a *wh*-phrase takes scope over some scopal expression SE, the Boolean operations that are associated with SE need to be performed in *wh*'s denotation domain, as stated in (12) in the main text? In the context of Sz&Z's analysis of WIs, as discussed in section 1.3, we know what it should mean. It should mean that in (1a), the segment *John saw* _ denotes the set of individuals that John saw. Since for any set A, $\wp(A)$ is a full-fledged Boolean algebra, we can take the complement of the set of individuals that John saw in order to compute the denotation of the segment *didn't John see* _. On the other hand, it should mean that in (1b), the segment *John behaved* _ does not denote the set of manners in which John behaved, but rather the manner in which John behaved. Since by assumption the set of manners forms a (proper) join semilattice, we cannot take the complement of the manner in which John behaved so as to compute the denotation of the segment *didn't John behave* _: complement is not defined in a (proper) join semilattice. As there is no way we can proceed beyond this point, we cannot ascribe a proper interpretation to (1b), as desired.

(1) a Who didn't John see _?
b *How didn't John behave _?

How do we ensure that *John saw* _ denotes the set of individuals that John saw, whilst *John behaved* _ denotes the manner in which John behaved? Let us now first introduce some notions in terms of which Sz&Z (section 6.2) provide an answer to this question. We will call an event *e minimal* (henceforth: e_m) with respect to a relation R between events and objects and an object x just in case R holds of e_m and x and there is no proper part e' of e_m and a part x' of x such

that R holds of e' and x' as well.[23] Formally:

(2) *Minimal Event*
An event e_m is *minimal* with respect to a relation $R \subseteq$ EVENT $\times$ OBJECT and an object $x \in$ OBJECT iff
$R(e_m,x) \wedge \neg\exists e'\exists x'(e' \subset e_m \wedge x' \subseteq x \wedge R(e',x'))$

where we will assume that EVENT $= \langle \wp(E) - \{\varnothing\}, \subseteq \rangle$ (a proper join semilattice, where E is some arbitrary set of events) and OBJECT $= \langle \wp(O) - \{\varnothing\}, \subseteq \rangle$ (again a proper join semilattice, where O is some arbitrary set of objects).[24] Furthermore, we will call a relation $R \subseteq$ EVENT $\times$ OBJECT *summative* just in case whenever R holds of a pair $\langle e,x \rangle$ and of a pair $\langle e',x' \rangle$, then R holds of the join of e and e' (here: $e \cup e'$) and the join of x and x' (i.e. $x \cup x'$) as well:[25]

(3) *Summativity*
A relation $R \subseteq$ EVENT $\times$ OBJECT is *summative* iff
$\forall e\forall e'\forall x\forall x'(R(e,x) \wedge R(e',x') \rightarrow R(e \cup e', x \cup x'))$

For example, the event relation denoted by *John saw* _ is summative: if John saw Bill at e and Mary at e', then John saw Bill and Mary at $e \cup e'$. Finally, (4) defines what it means for an event relation to be *iteratible*.

(4) *Iteratibility*
A relation $R \subseteq$ EVENT $\times$ OBJECT is *iteratible* with respect to an event e and an object x, ITER(e,x,R) for short, iff
$R(e,x) \wedge \exists e'\exists e''\exists x'(e' \subseteq e \wedge e'' \subseteq e \wedge e' \neq e' \wedge x' \subseteq x \wedge R(e',x') \wedge R(e'',x'))$

We may then call an event relation R iterable just in case $\Diamond\exists e\exists x$ (ITER(e,x,R)). Thus, the event relation denoted by *John saw* _ is iterable as it is possible that John saw Bill at two different events.

Now, Sz&Z stipulate that set formation can only take place when the relevant event relation is both summative and iterable. To see the intuition behind this stipulation, consider once more the event relation denoted by *John saw* _. Starting from minimal events of John seeing something, we can lump

[23] Sz&Z define minimal events in terms of thematic uniqueness. However, if summativity (cf. 3 in the main text) holds of at least some event relations, then thematique uniqueness can hold of non-minimal events as well.

[24] Cf. the next chapter for some discussion on how this second structure can be used in analyzing plural quantification and cross-sentential anaphora. Even independently of the merits of that analysis, it should be noted that the assumption that the domain of events and the domain of objects each form a join semilattice is relatively uncontroversial.

[25] The definitions of summativity and iteratibility have been taken over from Krifka (1989).

these minimal events together while at the same time collecting the unique objects corresponding to the 'gap' parameter into an unordered set, as illustrated in (5) where *I* fixes the relevant event interval. This yields the standard denotation of the predicate *John saw* _. Note that the objects corresponding to the 'gap' parameter are unique per event if we assume along with Carlson (1984) that thematic roles are *functions* mapping events into their agents, patients, or what have you.

(5) $[\![\text{John saw } \_]\!] = \{a\colon \exists e \exists I\ (e = \bigcup_{i \in I} e_m^i \wedge a \in \bigcup_{i \in I} \{b\colon b \in [\![\text{saw}'(\text{john}')(e_m^i)]\!]\})\}$

The extra requirement on set formation, viz. that the relevant event relation is iterable, guarantees that summativity is non-vacuous; i.e. it ensures that is at least possible for there to be two distinct events that can be lumped together.

Note that the iterability requirement on set formation entails that the predicate _ *destroy Rome* does not denote the set of individuals that destroyed Rome on account of the fact that the corresponding event relation is non-iterable: Rome cannot be destroyed more than once. Rather, _ *destroy Rome* denotes the unique object $a \in$ OBJECT which destroyed Rome. Since OBJECT has the structure of a (proper) join semilattice, Sz&Z observe that it is now correctly predicted that questioning this unique parameter is sensitive to WIs:

(6) *Who didn't destroy Rome?

One might object that this analysis wrongly predicts *Which city didn't Hannibal destroy _?* to be ill-formed as well, given that *Hannibal destroyed* _ clearly denotes a non-iterable relation as well. However, we can take mileage out of the fact that there can be at most one event of destroying Rome, whereas there may be several events of Hannibal destroying something that *bi-uniquely* correspond with the objects being destroyed. We can then construct the standard denotation of the predicate *Hannibal destroyed* _ as follows, where f_e is a function which maps any object x to the unique event at which Hannibal destroyed x:

(7) $[\![\text{Hannibal destroyed } \_]\!] =$
$\{a\colon \exists e \exists I\ (e = \bigcup_{i \in I} f_e(x^i) \wedge a \in \bigcup_{i \in I} \{b^i\colon b^i \in [\![\text{destroy}'(\text{hannibal}')(f_e(b^i))]\!]\})\}$

Thus, we have seen that the event relation denoted by *John saw* _ can feed set formation as it is both summative and iterable. However, we already observed above that if Sz&Z's account of the ill-formedness of (1b) is to go through, the segment *John behaved* _ should not denote the set of manners in which John behaved, but rather the manner in which John behaved. This would follow if the event relation denoted by *John behaved* _ is either non-summative or non-iterable. Now, Sz&Z (ex. 114) observe that the event relation denoted by *John behaved* _ can indeed not feed set formation as it is non-summative:

(8) John behaved kindly at e and John behaved stupidly at e' $\not\vdash$
John behaved kindly and stupidly at $e \cup e'$

To conclude, Sz&Z's claim concerning the interaction between scope and Boolean operations is based on certain intuitively plausible assumptions with respect to the interplay between event structure and set formation. In the main text, however, we will treat the principle in (12) as basic to avoid unnecessary complications.

2 A Dynamic Semantics

2.1 Introduction

In classical Montague semantics, which builds on the important insights of Frege, the (extensional) meaning of a sentence *S* is identified with its truth-value. On this view, knowing the meaning of *S* amounts to knowing what must be the case for *S* to be true. Such a view entails that the meaning of any constituent of *S* should be analyzed in terms of its contribution to the truth-conditions of the entire sentence. Hence, we may say that classical Montague semantics adheres to the truth-conditional view on meaning.

How would a truth-conditional account of the meaning of a sentence such as (1a) look like? Suppose we interpret (1a) relative to a model $M = \langle D,I \rangle$ (where D constitutes the domain of discourse, and I is the interpretation function mapping any n-place predicate P into a set of n-tuples of individuals in D) and an assignment of objects to variables g, as indicated in (1b).

(1) a A man came in
b $[\![\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x))]\!]^{M,g}$

The truth-conditions associated with (1b) may then be spelled out as in (2), assuming the usual semantics for the existential quantifier and conjunction. That is, $[\![\exists x\varphi]\!]^{M,g} = 1$ *iff* for some $u \in D$, $[\![\varphi]\!]^{M,g[x/u]} = 1$ (where $g[x/u]$ is just like g, except that it assigns the value u to x), and $[\![\varphi \wedge \chi]\!]^{M,g} = 1$ *iff* $[\![\varphi]\!]^{M,g} = 1$ and $[\![\chi]\!]^{M,g} = 1$. According to the last line in (2) then, (1a) comes out true just in case there is an individual who is a man and came in. This accords reasonably well with our intuitions concerning the meaning of (1a).

(2) a $[\![\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x))]\!]^{M,g} = 1$ *iff*
b for some $u \in D$, $[\![\text{man}'(x) \wedge \text{came-in}'(x)]\!]^{M,g[x/u]} = 1$ *iff*
c for some $u \in D$, $[\![\text{man}'(x)]\!]^{M,g[x/u]} = 1$ and $[\![\text{came-in}'(x)]\!]^{M,g[x/u]} = 1$ *iff*
d for some $u \in D$, $u \in I(\text{man}')$ and $u \in I(\text{came-in}')$

There is a sense in which the truth-conditional account of meaning can be called *static*. Here is what we mean by that. In natural language discourse, the interpretation of a sentence almost never proceeds in a vacuum. In the normal case, a sentence will be evaluated relative to a given body of information. And, evidently, a particular sentence itself may be used to introduce new pieces of information relative to which subsequent sentences will be interpreted. A typical situation is one where a sentence introduces a new entity into the scene which pronouns in subsequent sentences in the discourse can refer back to. A simple illustration of this phenomenon is provided by (3a).

(3) a A man$_x$ came in. He$_x$ whistled.
b $[\![\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x)) \wedge \text{whistled}'(x)]\!]^{M,g} = 1$ *iff*
c $[\![\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x))]\!]^{M,g} = 1$, and $[\![\text{whistled}'(x)]\!]^{M,g} = 1$ *iff*
d for some $u \in D$, $[\![\text{man}'(x) \wedge \text{came-in}'(x)]\!]^{M,g[x/u]} = 1$, and $g(x) \in I(\text{whistled}')$ *iff*
e for some $u \in D$, $u \in I(\text{man}')$ and $u \in I(\text{came-in}')$, $g(x) \in I(\text{whistled}')$

A classical Montagovian, strictly truth-conditional approach to meaning cannot possibly account for this dynamic aspect of natural language interpretation. To see that, consider the truth-conditions in (3b) that such an approach would ascribe to the tiny stretch of discourse in (3a). As indicated by the last line in (3), the assignment $g[x/u]$, which encodes the information that u is a man who came in, cannot be used to resolve the pronoun in the second sentence. This is a straightforward consequence of the fact that this pronoun translates as a free variable. Free variables in general are interpreted by means of the initial assignment (i.e. that assignment in terms of which the interpretation function $[\![\ ]\!]^{M,g}$ is parametrized, in this case g), which maps them to some arbitrary entity in D. We may therefore conclude that a classical Montagovian, strictly truth-conditional approach to meaning cannot accomodate cross-sentential anaphora, which require a richer (dynamic) conception of meaning. The reason for its failure can be described in general terms as follows. If we regard assignments as parameters on which the denotation of a sentence may depend, we see that truth-conditional semantics views sentence meaning as a function $\lambda g\ ([\![\varphi]\!]^g)$ which checks a given input assignment g' to see whether it has certain properties (i.e is $g' \in \{g: g \text{ verifies } \varphi\}$?). Crucially, this function cannot map g' to another assignment in terms of which an immediately following sentence can be interpreted. It is this feature that makes truth-conditional semantics static.

In this thesis, we will explore a dynamic conception of meaning instead, and discuss its far-reaching consequences with respect to one particular facet of the syntax/semantics interface, viz. Weak Islands. In theories of Dynamic Semantics (cf. especially Groenendijk & Stokhof 1989,1990,1991 and Chierchia 1992,1995), sentence meaning when taken in extension is no longer identified

with a truth-value (or, alternatively, a function from assignments into truth-values). Rather, it is identified with its potential to change the input context, for example by introducing new entities into the scene to which pronouns in subsequent discourse may refer back. To rephrase the same idea in slightly more technical jargon, theories of Dynamic Semantics identify sentence meaning with *its set of possible continuations*. According to that view, we might represent the meaning of (1a) as in (4a). The variable *p* here is a place-holder for propositions (denoting sets of assignments) that are compatible with the information that a man came in. The interpretation of (4a) will then proceed as in (4b-e), where $[\![\hat{}\varphi]\!]^g = [\![\varphi]\!]^g(g)$ (cf. also the next section). We will henceforth omit making reference to models *M* whenever confusion is not likely to arise.

(4) a $\lambda p\ (\exists x\ (\text{man}'(x) \wedge \text{came-in}(x) \wedge \hat{}p))$

b $[\![\lambda p\ (\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x) \wedge \hat{}p))]\!]^g$ ≡

c $\{\boldsymbol{p}: [\![\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x) \wedge \hat{}p)]\!]^{g[p/\boldsymbol{p}]} = 1\}$ ≡

d $\{\boldsymbol{p}$: for some $u \in D$, $[\![\text{man}'(x) \wedge \text{came-in}'(x) \wedge \hat{}p]\!]^{g[p/\boldsymbol{p}][x/u]} = 1\}$ ≡

e $\{\boldsymbol{p}$: for some $u \in D$, $[\![\text{man}'(x)]\!]^{g[p/\boldsymbol{p}][x/u]} = 1$ and $[\![\text{came-in}'(x)]\!]^{g[p/\boldsymbol{p}][x/u]} = 1$ and $[\![\hat{}p]\!]^{g[p/\boldsymbol{p}][x/u]} = 1\}$ ≡

f $\{\boldsymbol{p}$: for some $u \in D$, $[\![\text{man}'(x)]\!]^{g[p/\boldsymbol{p}][x/u]} = 1$ and $[\![\text{came-in}'(x)]\!]^{g[p/\boldsymbol{p}][x/u]} = 1$ and $[\![p]\!]^{g'}(g[p/\boldsymbol{p}][x/u]) = 1\}$ ≡

g $\{\boldsymbol{p}$: for some $u \in D$, $u \in I(\text{man}')$ and $u \in I(\text{came-in}')$ and $g[x/u] \in \boldsymbol{p}\}$

Interpreting (4a) dynamically facilitates an easy account of the cross-sentential binding evidenced in (3a). To see that, suppose we substitute the (static) meaning of *He$_x$ came in*, i.e. $\{g: g(x) \in I(\text{whistled}')\}$, for $\boldsymbol{p}$ in (4g). Then $g[x/u](x) = u$ is required to be element of $I(\text{whistled}')$. Thus, in words, the individual *u*, of whom we already know that he is a man who came in, is also required to whistle. This is as it should be. Why is it then that a dynamic approach to meaning along the lines sketched above is so successful in accounting for cross-sentential anaphora? The reason is that the interpretation of functions such as (4a) (henceforth: Context Change Potentials; CCPs for short) has the effect of changing the initial assignment *g* into another assignment relative to which subsequent discourse can be interpreted. This is made possible by two key features of (4a): i) it identifies the meaning of *A man came in* with a CCP (i.e. a set of sets of assignments), ii) the place-holder *p* for subsequent propositions (denoting sets of assignments) in (4a) occurs within the scope of the existential quantifier. It is these two features combined that make the alternative approach to the meaning of (1a) dynamic.

2.1.1 The Plan

In the next two sections, we will provide a logic in terms of which the dynamic meaning of the usual logical connectives and first-order quantifiers (i.e. $\exists$ and $\forall$), and Generalized Quantifiers can be represented. In section 2.4, we will add some structure to the domain of discourse. This will enable us to deal with relatively simple cases of plural dynamic anaphora. This chapter will be concluded in section 2.5 with a brief discussion of the relationship between Dynamic Semantics and its close cousin Discourse Representation Theory, as developed by Kamp (1981) and Kamp & Reyle (1995). Assuming a GB syntax throughout, we will also discuss some tools here that are necessary to compositionally translate LF structures into CCPs.

It should be stressed at the outset that the version of Dynamic Semantics which we will present below is rather minimal. It is intended to cover only those facts concerning dynamic anaphora that most scholars in the field consider to be basic. That is, there is a fair amount of concensus that a more general theory of dynamic anaphora which can also account for such well-known but complex problems as (modal) subordination, telescoping and the distribution of weak and strong readings of donkey anaphora should have at least our minimal system of Dynamic Semantics (or something that amounts to that) at its core. Its limited empirical coverage should not disturb us, though. Our interest in this minimal version of Dynamic Semantics solely derives from the fact that it directly supports a cogent theory of Weak Islands, as we will see in the next chapters.

2.2 A Dynamic Logic

In this section, we will closely follow the formalization (of some version) of Dynamic Predicate Logic offered by Chierchia (1995), which in many respects resembles Groenendijk & Stokhof's (1989,1990) Dynamic Montague Grammar. This section will be structured as follows. In the next subsection, we will present a version of Dynamic Predicate Logic which departs from Chierchia's only in minor respects. Dynamic existential quantification and conjunction, dynamic negation and dynamic implication will then be discussed in sections 2.2.2-2.2.4 respectively.

2.2.1 A Dynamic Predicate Logic

Assume that the truth-conditional static content of some atomic sentence *S* in which no quantified expression occurs is adequately represented as φ in our extensional representation language, the language of Predicate Logic, say. We are now interested in how we might define the corresponding CCP $\uparrow\varphi$ in terms

of notions that are well-established in our representation language. In the previous section, it was suggested that we define ↑φ as in (5).

(5) $\uparrow\varphi =_{def} \lambda p\,(\varphi \wedge \hat{}p)$

For the definition in (5) to work, we must first explicate the meaning of the *cup* operator '^' (and its close companion, the *cap* operator ' '). To this end, we first need to 'intensionalize' Predicate Logic along the lines of Montague's Intensional Logic (IL), with this difference that we will use partial assignments rather than possible worlds as the parameter on which the interpretation of a given expression depends. In such a modified logic then, propositions for example no longer denote truth-values, but functions from partial assignments to truth-values. Given this 'intensionalized' version of Predicate Logic, ' ' and '^' can be straightforwardly defined as in (6), where Ω is the set of all partial assignments of objects to variables.[1] Note that (6) automatically entails that for any φ of arbitrary type *a*, $\hat{}\,\varphi = \varphi$. This fact will henceforth be referred to as '^ -cancellation', in keeping with standard IL terminology.

(6) a $[\![\ \varphi]\!]^g =_{def}$ that function $h \in D_a^{\Omega}$ such that $h(g) = [\![\varphi]\!]^g$ for all $g \in \Omega$, where φ is of type *a*.
b $[\![\hat{}\varphi]\!]^g =_{def} [\![\varphi]\!]^g(g)$

From now on, we will reserve the type *s* for partial assignments. Thus, the type of a CCP is ⟨⟨s,t⟩,t⟩, which will henceforth be abbreviated as *cc*. In general, we will distinguish the following semantic domains in which the typed expressions of our dynamic logic are going to be interpreted:

(7) a $D_e = D$ (i.e. the domain of discourse)
b $D_t = \{0,1\}$ (i.e. the domain of truth-values)
c $D_{\langle a,b\rangle} = D_b^{D_a}$ (i.e. the set of all functions from D_a into D_b)
d $D_{\langle s,a\rangle} = D_a^{\Omega}$

On the basis of the recipe in (5) while sticking closely to Montague's IL, it is relatively easy now to determine how the dynamic meaning of any *n*-place predicate *R* should be defined. Evidently, the dynamic meaning of *R* (i.e. ↑R) should be a function that maps *n*-tuples of individuals to CCPs. Thus, ↑R can be defined as follows:

[1] The reason for using *partial* assignments rather than *total* ones will become clear when we come to discuss the role of free variables in a dynamic semantics (cf. the discussion surrounding 16 and 17 in section 2.2.3). The definitions in (6) depart slightly from the ones employed by Chierchia (1995, p. 80), who defines ' ' and '^' in terms of abstraction over assignments to so-called *discourse markers*. For the purposes of this thesis, however, the simpler definitions in (6) suffice (but cf. section 4.6.2).

(8) $\uparrow R =_{def} \lambda x_1 \ldots x_n\, (\uparrow R(x_1,\ldots,x_n))$ $\quad (= \lambda x_1 \ldots \lambda x_n \lambda p\, (R(x_1,\ldots,x_n) \wedge \hat{}p)$ by def. 5)

For example, *walk* $\mapsto$ (translates as) $\uparrow$walk´ which, thanks to (8), reduces to λx ($\uparrow$walk´(x)). Thus, intransitive verbs such as *walk* are of type $\langle e,cc \rangle$.

We will now turn to the definition of the dynamic counterparts of the usual logical connectives and first-order quantifiers. Since we will find it convenient to define these in terms of the familiar static ones, we must first specify a general procedure by means of which we can extract the truth-conditional (static) component φ out of a CCP Φ. Here is one way in which this can be achieved.

(9) $\downarrow\Phi =_{def} \Phi(\top)$ (where $\top$ is a tautology)

Before we will proceed with presenting our version of a Dynamic Predicate Logic, let us first find out how (9) works. Consider the example in (10a), and its corresponding CCP in (10b).

(10) a John came in
b $\uparrow$came-in´(john´)

The set of reductions in (11) show that the $\downarrow$-operator as defined in (9) appropriately extracts the static component came-in´(john´) out of the CCP in (10b).

(11)	a	$\downarrow\uparrow$came-in´(john´)	
	b	$\uparrow$came-in´(john´)($\top$)	(def. of $\downarrow$)
	c	λp (came-in´(john´) $\wedge \hat{}p$)($\top$)	(def. of $\uparrow$)
	d	came-in´(john´) $\wedge \top$	(λ-conversion, $\hat{}$ -cancellation)
	e	came-in´(john´)	(elementary logic)

As promised, we will now present our version of a Dynamic Predicate Logic, which is the one proposed and argued for by Chierchia (1995). It should be stressed that the system layed out in (12) is nothing more than *a* version of Dynamic Predicate Logic. As one quick look at the literature on Dynamic Semantics already suggests, there are many different implementations of Dynamic Predicate Logic possible (up to first-order logical equivalence), all of them meeting the general demands of economy and elegance with more or less the same degree of success. Choosing one implementaton over the other therefore requires serious empirical justification, as we are soon to find out. Note that in (12), we have silently adopted the convention that two-place logical connectives are underlined.

(12) *A Version of Dynamic Predicate Logic* (cf. also Chierchia 1995)

a $\Phi \mathbin{\underline{\wedge}} \Psi \quad =_{def} \lambda p\ (\Phi(\ \Psi(p)))$

b $\sim\Phi \quad =_{def} \uparrow\neg\downarrow\Phi$

c $\Phi \mathbin{\underline{\vee}} \Psi \quad =_{def} \sim (\sim\Phi \mathbin{\underline{\wedge}} \sim\Psi)$

d $\Phi \mathbin{\underline{\rightarrow}} \Psi \quad =_{def} \sim\Phi \mathbin{\underline{\vee}} (\Phi \mathbin{\underline{\wedge}} \Psi)$

e $\mathcal{E}x\ (\Phi) \quad =_{def} \lambda p\ (\exists x\ (\Phi(p)))$

f $\mathcal{A}x\ (\Phi) \quad =_{def} \sim\mathcal{E}x\ (\sim\Phi)$

In the next subsections, we will engage in a brief discussion of the empirical claims that underly some of the definitions in (12).

2.2.2 Dynamic Existential Quantification and Conjunction

Take a look first at the definition of dynamic conjunction in (12a) and dynamic existential quantification in (12e). Among the scholars working on Dynamic Semantics, there exists unanimity on both these definitons (cf. for instance Groenendijk & Stokhof 1989,1990,1991; Dekker 1993a,b,1995 and Kanazawa 1994, to name but a few). These definitions yield a straightforward account of the anaphoric dependency in (3a), repeated below as (13a). To see that, let us first make the (simplifying) assumption that the meaning of a sequence of sentences S_1 ... S_n should be represented as the dynamic conjunction $S'_1 \mathbin{\underline{\wedge}} \ldots \mathbin{\underline{\wedge}} S'_n$. Given that assumption, we may represent the meaning of the tiny discourse in (3a) in terms of (our version of) Dynamic Predicate Logic as follows.[2]

(13) a A_x man came in. He_x whistled.

b $\mathcal{E}x\ (\uparrow\text{man}'(x) \mathbin{\underline{\wedge}} \uparrow\text{came-in}'(x)) \mathbin{\underline{\wedge}} \uparrow\text{whistled}'(x)$

By systematically applying the pertinent definitions to the various operators and connectives that occur in (13), we eventually wind up with a formula in which the variable that translates the pronoun *he* is appropriately bound by the (restricted) existential quantifier which translates the indefinite noun phrase *a man*. This is shown in (14).

[2] We will follow Groenendijk & Stokhof (1989) by representing possible anaphoric dependencies by means of indices. Even though this is common practice, it should be noted that the indexing in (13a) and similar examples cannot be interpreted by means of the same mechanism (in Montague's IL: Quantifying-In) that relates quantified expressions to syntactic variables/traces. The reader is referred to II in the Appendix to Chapter 4 for a detailed proposal with respect to how the type of indexing illustrated in (13a) can be properly interpreted. For now, just assume that an index *x* on a determiner will be translated into the variable *x* bound by the relevant quantifier, as shown for (13a) in (13b).

(14) a $\exists x$ ($\uparrow$man´(x) $\underline{\wedge}$ $\uparrow$came-in´(x)) $\underline{\wedge}$ $\uparrow$whistled´(x)

b $\exists x$ (λp (man´(x) $\wedge$ $\hat{}p$) $\underline{\wedge}$ λp_1 (came-in´(x) $\wedge$ $\hat{}p_1$)) $\underline{\wedge}$ λp_2 (whistled´(x) $\wedge$ $\hat{}p_2$) (def. of $\uparrow$)

c $\exists x$ (λp_3 (λp (man´(x) $\wedge$ $\hat{}p$)(λp_1 (came-in´(x) $\wedge$ $\hat{}p_1$)(p_3)))) $\underline{\wedge}$ λp_2 (whistled´(x) $\wedge$ $\hat{}p_2$) (def. of $\underline{\wedge}$)

d $\exists x$ (λp_3 (man´(x) $\wedge$ came-in´(x) $\wedge$ $\hat{}p_3$)) $\underline{\wedge}$ λp_2 (whistled´(x) $\wedge$ $\hat{}p_2$) (λ-conversion, $\hat{}$ -cancellation)

e λp ($\exists x$ (λp_3 (man´(x) $\wedge$ came-in´(x) $\wedge$ $\hat{}p_3$)(p))) $\underline{\wedge}$ λp_2 (whistled´ (x) $\wedge$ $\hat{}p_2$) (def. of $\exists$)

f λp ($\exists x$ (man´(x) $\wedge$ came-in´(x) $\wedge$ $\hat{}p$)) $\underline{\wedge}$ λp_2 (whistled´(x) $\wedge$ $\hat{}p_2$) (λ-conversion)

g λp_1 (λp ($\exists x$ (man´(x) $\wedge$ came-in´(x) $\wedge$ $\hat{}p$))(λp_2 (whistled´(x) $\wedge$ $\hat{}p_2$)(p_1))) (def. of $\underline{\wedge}$)

h λp_1 ($\exists x$ (man´(x) $\wedge$ came-in´(x) $\wedge$ whistled´(x) $\wedge$ $\hat{}p_1$)) (λ-conversion, $\hat{}$ -cancellation)

i $\exists x$ ($\uparrow$man´(x) $\underline{\wedge}$ $\uparrow$came-in´(x) $\underline{\wedge}$ $\uparrow$whistled´(x)) (def. of $\exists$ and $\underline{\wedge}$)

The result in (14) can be generalized into fact (15). This theorem (*aka* the Donkey Equivalence) constitutes the core of Dynamic Semantics. It states that the scope of an existential quantifier can be extended to the right indefinitely. (15) therefore entails that in Dynamic Semantics, the syntactic scope of a quantifier (i.e. the bracketed domain on the left-hand side of the bi-conditional in 15) need not coincide with its semantic scope.

(15) *Fact.* $\exists x$ (Φ) $\underline{\wedge}$ Ψ $\Leftrightarrow$ $\exists x$ (Φ $\underline{\wedge}$ Ψ)

In the next subsection, we will have a look at the definition of dynamic negation in (12b), and see what empirical claim underlies it.

2.2.3 Dynamic Negation

Again, all researchers in Dynamic Semantics agree on the core idea expressed by this definition, viz. that negation functions as a *test* (cf. also Groenendijk & Stokhof 1991). Just like any static operator, dynamic negation cannot modify a given input assignment in such a way that subsequent discourse is interpreted relative to that assignment (cf. section 2.1). Rather, it merely checks a given assignment to see whether it has certain properties. As a result, an existential quantifier locked up inside the scope of negation cannot bind a variable outside the scope of negation. This property manifests itself in natural language. As long as we make sure that the indefinite *a car* in (16) has narrow scope with respect to sentence negation (indicated as '*n't* > *a car*'), the pronoun *it* cannot

be bound by it. As is customary, we will refer to the general phenomenon whereby the dynamic potential of an indefinite is bounded by the syntactic scope of a c-commanding operator as *inaccessibility* (cf. also section 1.5).

(16) *John doesn't have a_y car. It_y was too expensive. (*n't* > *a car*)

The set of inferences in (17) (only the crucial steps are presented) shows how the system set up thus far accounts for facts such as (16). Due to the way we have defined the ↓-operator, prefixing a given formula Φ with this operator has the effect of shutting off all 'active' quantifiers inside Φ. Consequently, all 'active' quantifiers inside the scope of negation are no longer able to bind variables outside of their syntactic scope.

(17) a $\sim\mathscr{E}y\ (\uparrow\text{car}'(y) \underline{\wedge} \uparrow\text{have}'(\text{john}',y)) \underline{\wedge} \uparrow\text{too-expensive}'(y)$

b $\sim\mathscr{E}y\ (\lambda p\ (\text{car}'(y) \wedge \hat{}p) \underline{\wedge} \lambda p_1\ (\text{have}'(\text{john}',y) \wedge \hat{}p_1)) \underline{\wedge} \lambda p_2\ (\text{too-expensive}'(y) \wedge \hat{}p_2)$ (def. of ↑)

c $\sim\mathscr{E}y\ (\lambda p\ (\text{car}'(y) \wedge \text{have}'(\text{john}',y) \wedge \hat{}p)) \underline{\wedge} \lambda p_2\ (\text{too-expensive}'(y) \wedge \hat{}p_2)$ (def. of $\underline{\wedge}$)

d $\sim\lambda p\ (\exists y\ (\text{car}'(y) \wedge \text{have}'(\text{john}',y) \wedge \hat{}p)) \underline{\wedge} \lambda p_2\ (\text{too-expensive}'(y) \wedge \hat{}p_2)$ (def. of $\mathscr{E}$)

e $\uparrow\neg\downarrow\lambda p\ (\exists y\ (\text{car}'(y) \wedge \text{have}'(\text{john}',y) \wedge \hat{}p)) \underline{\wedge} \lambda p_2\ (\text{too-expensive}'(y) \wedge \hat{}p_2)$ (def. of ~)

f $\uparrow\neg\exists y\ (\text{car}'(y) \wedge \text{have}'(\text{john}',y)) \underline{\wedge} \lambda p_2\ (\text{too-expensive}'(y) \wedge \hat{}p_2)$ (def. of ↓)

g $\lambda p\ (\neg\exists y\ (\text{car}'(y) \wedge \text{have}'(\text{john}',y)) \wedge \hat{}p) \underline{\wedge} \lambda p_2\ (\text{too-expensive}'(y) \wedge \hat{}p_2)$ (def. of ↑)

h $\lambda p\ (\neg\exists y\ (\text{car}'(y) \wedge \text{have}'(\text{john}',y)) \wedge \text{too-expensive}'(y) \wedge \hat{}p)$ (def. of $\underline{\wedge}$)

i $\uparrow\neg\exists y\ (\text{car}'(y) \wedge \text{have}'(\text{john}',y)) \wedge \text{too-expensive}'(y)$ (def. of ↑)

As the last occurrence of *y* in (17i) is not bound by the existential quantifier, we have accounted for the ill-formed anaphoric dependency in (16). Again, this result can be generalized into the following fact:

(18) *Fact.* $\sim(\Phi) \underline{\wedge} \Psi \not\equiv \sim(\Phi \underline{\wedge} \Psi)$

Before we proceed with a discussion of dynamic implication in section 2.2.4, let us first briefly ponder the question what interpretation (if any) should be assigned to (17i). Since the last occurrence of *y* is free here, it will be interpreted by means of the initial assignment. If we assume assignments to be *total* functions, as would be the case for classical Predicate Logic, then the initial assignment would assign some arbitrary individual *u* as the value of the free occurrence of *y* in (17i). However, it is more than doubtful that arbitrary initial

assignments are responsible for assigning semantic content to unbound, deictic pronouns. For example, to account for the fact that deictic pronouns refer to contextually salient individuals, we would have to assume that assignments can be made contextually salient. One wonders how this might come about (cf. also Jacobson 1997 for a similar point). A much more natural way to proceed would be to assume that i) assignments are *partial* functions (cf. 7d above), and ii) each discourse is interpreted relative to an *empty* initial assignment $\varnothing$ (cf. Dekker 1996 for a formal implementation of both assumptions). Note now that these assumptions directly entail that the interpretation of (17i) is simply undefined, i.e. $[\![(17i)]\!]^{\varnothing} = \bot$. More generally then, given these two assumptions, we derive the following fact.

(19) *Fact*. $[\![\Phi]\!]^{\varnothing} = \bot$, if Φ contains a free variable.

Given (19), the issue immediately arises of course how free pronouns such as *it* in (16) should be interpreted. Following Chierchia (1995), we will just assume here without discussion that free pronouns should be analyzed as definite descriptions 'in disguise'; that is, free pronouns are E-type pronouns.

2.2.4 Dynamic Implication

As a final illustration of the empirical claims underlying the system in (12), consider Chierchia's (1995) definition of dynamic implication in (12d). We see that it is defined in terms of the disjunction $\sim\Phi \underline{\vee} (\Phi \underline{\wedge} \Psi)$. On account of Fact 15, we understand that this definition will allow an 'active' existential quantifier in the antecedent Φ of a conditional to bind a pronoun in the consequent Ψ of that conditional. Adopting Groenendijk & Stokhof's (1991) terminology, this property makes implication *internally dynamic*. Furthermore, as dynamic disjunction itself is defined in terms of the conjunction $\sim (\sim\Phi \underline{\wedge} \sim\Psi)$ (cf. 12c), Chierchia's definition of dynamic implication eventually boils down to this:

(20) $\Phi \underline{\rightarrow} \Psi \equiv \sim (\sim\sim\Phi \underline{\wedge} \sim (\Phi \underline{\wedge} \Psi))$

Now, given that we have already seen that negation functions as a test, it will follow that implication is *externally static* (cf. also Groenendijk & Stokhof 1991): no 'active' existential quantifier in either the antecedent or the consequent of a conditional is able to bind a pronoun outside the scope of that conditional. Chierchia's claim that implication is internally dynamic but externally static is uncontroversial in the Dynamic Semantics literature. However, the implementation of both aspects in terms of disjunction is controversial, and therefore deserves some discussion. To see what is at stake, consider the (donkey-) sentence in (21a). Observe first that the fact that the

indefinite *a donkey* in the antecedent can bind *it* in the consequent of the conditional supports the claim that implication is internally dynamic. However, the fact that this is possible only if the indefinite is construed with universal force, as indicated by the first-order formula in (21b), cannot be accounted for in terms of our dynamic logic.

(21) a If John owns a_y donkey, he beats it_y
b $\forall y$ (donkey´(y) $\wedge$ owns´(john´,y) $\rightarrow$ beats´(john´,y))

To see what truth-conditions Chierchia's system would ascribe to (21a), consider first its representation in terms of (our version of) Dynamic Predicate Logic in (22a). By systematically applying the various definitions in (12), (22a) can be reduced to (22h).

(22) a $\mathfrak{E}y$ ($\uparrow$donkey´(y) $\underline{\wedge}$ $\uparrow$owns´(john´,y)) $\underline{\rightarrow}$ $\uparrow$beats´(john´,y)
b $\mathfrak{E}y$ (λp (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\hat{}p$)) $\underline{\rightarrow}$ $\uparrow$beats´(john´,y)
(def. of $\underline{\wedge}$)
c λp ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\hat{}p$)) $\underline{\rightarrow}$ $\uparrow$beats´(john´,y)
(def. of $\mathfrak{E}$)
d $\sim\lambda p$ ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\hat{}p$)) $\underline{\vee}$ (λp_1 ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\hat{}p_1$)) $\underline{\wedge}$ $\uparrow$beats´(john´,y)) (def. of $\underline{\rightarrow}$)
e $\sim\lambda p$ ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\hat{}p$)) $\underline{\vee}$ (λp_1 ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ beats´(john´,y) $\wedge$ $\hat{}p_1$))) (def. of $\underline{\wedge}$)
f $\sim$ ($\sim\sim\lambda p$ ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\hat{}p$)) $\underline{\wedge}$ $\sim$ (λp_1 ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ beats´(john´,y) $\wedge$ $\hat{}p_1$)))) (def. of $\underline{\vee}$)
g $\uparrow\neg\downarrow$ ($\uparrow\neg\downarrow\uparrow\neg\downarrow\lambda p$ ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\hat{}p$)) $\underline{\wedge}$ $\uparrow\neg\downarrow\lambda p_1$ ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ beats´(john´,y) $\wedge$ $\hat{}p_1$))) (def. of $\sim$)
h $\uparrow\neg\downarrow$ ($\uparrow\neg\downarrow\uparrow\neg\exists y$ (donkey´(y) $\wedge$ owns´(john´,y)) $\underline{\wedge}$ $\uparrow\neg\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ beats´(john´,y))) (def. of $\downarrow$)

At this point, we can make use of the following fact:

(23) *Fact* ($\downarrow\uparrow$-cancellation). $\downarrow\uparrow\varphi \equiv \varphi$
Proof. $\downarrow\uparrow\varphi \equiv \downarrow\lambda p$ ($\varphi \wedge \hat{}p$) (def. of $\uparrow$) $\equiv \lambda p$ ($\varphi \wedge \hat{}p$)($\top$) (def. of $\downarrow$) $\equiv \varphi$ (λ-conversion, $\hat{}$ -cancellation, elementary logic).□

Thus, (22h) can be further reduced as follows:

(22) i $\uparrow\neg\downarrow$ ($\uparrow\exists y$ (donkey´(y) $\wedge$ owns´(john´,y)) $\underline{\wedge}$ $\uparrow\neg\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ beats´(john´,y)))
($\downarrow\uparrow$-cancellation, Law of Double Negation)
j $\uparrow\neg\downarrow\lambda p$ ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y)) $\wedge$ $\neg\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ beats´(john´,y)) $\wedge$ $\hat{}p$) (def. of $\underline{\wedge}$)

k $\uparrow\neg$ ($\exists y$ (donkey´(y) $\wedge$ owns´(john´,y)) $\wedge$ $\neg\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ beats´(john´,y))) (def. of $\downarrow$)

Note now that the Predicate Logic formula embedded under the $\uparrow$-operator has the following form: $\neg$ ($\varphi \wedge \neg\chi$). This is provably equivalent to: $\varphi \rightarrow \chi$. Therefore, (22k) may be replaced by (24).

(24) $\uparrow\exists y$ (donkey´(y) $\wedge$ owns´(john´,y)) $\rightarrow$ $\exists y$ (donkey´(y) $\wedge$ owns´ (john´,y) $\wedge$ beats´(john´,y))

We can extract the truth-conditional (static) component out of (24) by applying the $\downarrow$-operator to it. The result is equivalent to (25a), which may be paraphrased as in (25b). Since (21a/b) cannot be true in a situation where John does not beat all the donkeys he owns, we must conclude that on Chierchia's (1995) version of Dynamic Predicate Logic, we do not get the intended result for (21a), given earlier in (21b).

(25) a $\exists y$ (donkey´(y) $\wedge$ owns´(john´,y)) $\rightarrow$ $\exists y$ (donkey´(y) $\wedge$ owns´ (john´,y) $\wedge$ beats´(john´,y))
b If John owns a(ny) donkey, John owns a donkey that he beats

It is relatively easy to improve on this situation: simply change the definition of dynamic implication in (12d) into the one given in (26) below. We will refer to this version of dynamic implication as $\underline{\rightarrow}_{\forall}$. The definition of $\underline{\rightarrow}_{\forall}$ is identical (*modulo* some overall differences in implementation) to Groenendijk & Stokhof's (1989,1990,1991) original formulation of dynamic implication.

(26) $\Phi \underline{\rightarrow}_{\forall} \Psi =_{def} \sim (\Phi \underline{\wedge} \sim\Psi)$

Suppose we would have used definition (26), instead of (12d). Then (22a) would have come out as identical to (27).

(27) $\uparrow\neg\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\neg$beats´(john´,y))

Again, by applying the $\downarrow$-operator to (27), we can extract the truth-conditional (static) component out of this CCP. The result is equivalent to (28a). Since $\neg\exists x$ ($\varphi \wedge \neg\chi$) is logically equivalent to $\forall x$ ($\varphi \rightarrow \chi$), we know that (28a) is identical to (28b), which is what we want.

(28) a $\neg\exists y$ (donkey´(y) $\wedge$ owns´(john´,y) $\wedge$ $\neg$beats´(john´,y)) $\equiv$
b $\forall y$ (donkey´(y) $\wedge$ owns´(john´,y) $\rightarrow$ beats´(john´,y)) (cf. 21b)

We have seen that apparently minute differences in the way dynamic

implication can be defined yield rather different predictions as to the conditions under which an indefinite in the antecedent may bind a pronoun in the consequent of a conditional. On Chierchia's definition of dynamic implication, as given in (12d), we predict that an indefinite in the antecedent can bind a pronoun in the consequent on a (weak) existential construal. On the other hand, on a Groenendijk & Stokhof-style definition of dynamic implication, we predict that an indefinite can only participate in this type of anaphoric dependency on a (strong) universal construal. This means that it is not the case that, up to first-order logical equivalences, we can choose any definition of a dynamic operator or connective we want. On the contrary, each such definition is nontrivial in that it embodies a specific empirical claim about which anaphoric dependencies are possible under what conditions.

Having thus clarified the empirical commitment of Dynamic Semantics, we will conclude this section by addressing the issue what counts as the proper definition of dynamic implication: (12d) or (26). Even though it is true that a (weak) existential construal of the antecedent of the donkey-pronoun in (21a) is impossible or hard to get, Chierchia (1995) points out that in a number of cases this is in fact the most natural interpretation of the indefinite antecedent. The following example (based on an example discussed by Pelletier & Schubert 1989) exemplifies this possibility.

(29) If John has a_y dime in his pocket, he puts it_y in the parking meter
  a (Strong) Universal Reading: ??*If John has a dime in his pocket, he puts every dime he has in his pocket in the parking meter*
  b (Weak) Existential Reading: *If John has a dime in his pocket, he puts a dime he has in his pocket in the parking meter*

In fact, Chierchia (1995) observes that, given an appropriate context, even the prototypical donkey-sentence (21a) allows for a (weak) existential reading of the indefinite antecedent. These observations might suggest that existential readings of donkey-sentences are in some sense basic, and that universal readings should be derived through other means, an option which is explored by Chierchia. However, at the other side of the coin, even donkey-sentences of the 'dime'-variety can give rise to universal readings, as shown in (30) (an observation attributed to Dekker).

(30) If John has a_y dime in his pocket, he does not put it_y in the parking meter
  a (Strong) Universal Reading: *If John has a dime in his pocket, then for every dime he has in his pocket, he does not put it in the parking meter*

  b (Weak) Existential Reading: ??*If John has a dime in his pocket, then*

there is a dime he has in his pocket that he does not put in the parking meter

It is fair to say that at present, there is no definite answer yet to the question exactly which factors determine a weak or strong construal of donkey-anaphora in conditional sentences. Since nothing much hinges on this for present purposes anyway, we will just assume there are two types of dynamic implication, viz. the ones defined in (12d) and (26). When nothing is crucially at stake, however, it is understood for the sake of convenience that $\underline{\rightarrow}$ is defined as in (12d). Future research should then decide which definition reveals the true meaning of the sentential connective *if ... then*. This concludes our presentation of a Dynamic Predicate Logic.

2.3 Dynamic Generalized Quantifiers and Quantification over Events

In section 2.5, we will discuss how natural language sentences can be compositionally translated into their corresponding CCPs. To make this possible, we must first address the issue how Generalized Quantifiers (henceforth: GQs) are to be defined in a dynamic setting. In the next subsection, we will first discuss Chierchia's (1992,1995) so-called 'weak' definition of dynamic GQs. This definition will then be contrasted with a strong definition in section 2.3.2, where we will see that the latter definition provides a straightforward semantic account of universal readings of donkey-sentences. Given our present lack of understanding as to what governs the distribution of weak and strong readings of donkey-anaphora in quantified sentences, we will simply assume both definitions of dynamic GQs for the time being, again leaving it to future research to decide which one should be considered basic. We will conclude this section in 2.3.3 by extending our approach to dynamic GQs to quantificational adverbs.

2.3.1 A Weak Definition of Dynamic Generalized Quantifiers

In a static-intensional framework, GQs are normally taken to be functions from properties (type $\langle w,\langle e,t\rangle\rangle$, where possible worlds are of type *w*) to truth-values (type *t*; cf. also Barwise & Cooper 1981; Keenan & Stavi 1986, among others). In the last section, we saw that CCPs denote functions from propositions (i.e. sets of assignments) to truth-values; i.e. CCPs are of type $cc = \langle\langle s,t\rangle,t\rangle$. This means then that Dynamic GQs (henceforth: DGQs) must be analyzed as functions from *dynamic* properties (type $\langle s,\langle e,cc\rangle\rangle$) to CCPs. But what kind of functions? To answer this question, we will first discuss the detailed proposals set forth by Chierchia (1992,1995).

We know that static determiners *D* are functions from properties to GQs that

obey a number of constraints, the most important of which is Conservativity (cf. again Barwise & Cooper 1981; Keenan & Stavi 1986). This constraint entails that $D(\lambda x\,(\varphi))(\lambda x\,(\chi)) \equiv D(\lambda x\,(\varphi))(\lambda x\,(\varphi \wedge \chi))$; i.e. *Most men drink* is true just in case *Most men are men who drink* is also true. A plausible extension of Conservativity to dynamic determiners $\mathscr{D}$ (denoting functions from dynamic properties to DGQs) would then read as follows:

(31) *Dynamic Conservativity* (cf. also Chierchia 1995: p. 97)
$\mathscr{D}(\lambda x\,(\Phi))(\lambda x\,(\Psi)) \equiv \mathscr{D}(\lambda x\,(\Phi))(\lambda x\,(\Phi \mathbin{\underline{\wedge}} \Psi))$

Thus, a reasonable way to proceed would be to look for a suitable definition of dynamic determiners (and derivatively, DGQs) that automatically satisfies Dynamic Conservativity in (31). The quest for this definition only concerns dynamic *quantificational* determiners, though, such as those denoted by *no*, *less than/fewer than/at most five*, *exactly/precisely five*, *at least/more than five*, *every*, *not every*, *more than one*, *most* etc.[3] From what was said in the preceding section, one can easily extract a suitable definition of the dynamic determiner denoted by *some* or *a*. To wit:

(32) $\mathscr{S}\!\mathit{ome} \equiv \lambda P \lambda Q\,(\mathscr{E}x\,(\hat{}P(x) \mathbin{\underline{\wedge}} \hat{}Q(x)))$
(where P and Q are of type $\langle s,\langle e,cc\rangle\rangle$)

Apart from Dynamic Conservativity, we can identify another constraint that our definition of dynamic quantificational determiners must satisfy. Dynamic quantificational determiners must be externally static: they are not able to bind anything outside of their syntactic scope (cf. 33).[4]

(33) *Dynamic Quantificational Determiners are Externally Static*
a *No$_x$ man came in. He$_x$ whistled.
b *Every$_x$ man came in. He$_x$ whistled.
c *Not every$_x$ man came in. He$_x$ whistled.
d *More than one$_x$ man came in. He$_x$ whistled.

[3] The question here of course is whether the notion 'quantificational determiner' can be explicated other than in terms of the observations concerning dynamic anaphora that will be discussed shortly. This issue will be taken up in section 4.7. Since this issue need not concern us here, we will use this notion in a rather intuitive way.

[4] In section 2.4, where we will discuss a possible extension of the system of Dynamic Semantics set up so far in order to handle plural anaphora, we will see that all (syntactically) plural determiners (except the so-called bare-numerals such as *three*, *ten* etc.) denote externally static functions as well.

Consequently, an existential quantifier locked up in either the first or the second argument of a dynamic quantificational determiner cannot bind a variable outside the syntactic scope of that determiner either, as illustrated in (34). That is, dynamic quantificational determiners induce inaccesible domains for dynamic anaphora. The following judgments concern the well-formedness of anaphoric links where the indefinite is construed as having narrow scope with respect to the pertinent determiner.

(34) *Dynamic Quantificational Determiners Induce Inaccessibility*

a *No man who has a_y car, takes the train. It_y is superior to public transportation.
b *No man who likes Bach, goes to a_y pop concert. It_y is too noisy.

c *Less than/fewer than/at most five men who have a_y car took the train today. It_y needs to be fixed.
d *Less than/fewer than/at most five men who like Bach went to a_y pop concert. It_y was quite noisy.

e *Exactly/precisely five men who have a_y car took the train today. It_y needs to be fixed.
f *Exactly/precisely five men who like Bach went to a_y pop concert. It_y was quite noisy.

g *At least/more than five men who have a_y car took the train today. It_y needs to be fixed.
h *At least/more than five men who like Bach went to a_y pop concert. It_y was quite noisy.

i *Every/not every/more than one man who has a_y car took the train today. It_y needs to be fixed.
j *Every/not every/more than one man who likes Bach went to a_y pop concert. It_y was quite noisy.

k *Most men who have a_y car took the train today. It_y needs to be fixed.
l *Most men who like Bach went to a_y pop concert. It_y was quite noisy.

Finally, we can impose a third constraint on a suitable definition of dynamic quantificational determiners. The definition must be set up in such a way that these determiners come out as internally dynamic: an ‘active’ existential quantifier in the first argument of a dynamic quantificational determiner can bind a variable in the second argument of that determiner. This possibility is exemplified in (35).

(35) *Dynamic Quantificational Determiners are Internally Dynamic*

a No man who has a_y car, likes to wash it_y

b Less than/fewer than/at most five men who have a_y car like to wash it_y

c Exactly/precisely five men who have a_y car like to wash it_y

d At least/more than five men who have a_y car like to wash it_y

e Every/not every/more than one man who has a_y car likes to wash it_y

f Most men who have a_y car like to wash it_y

The following definition of dynamic quantificational determiners (and derivatively, DGQs) satisfies all three constraints identified here simultaneously. It does so by making use of the $\downarrow$-operator by means of which a dynamic determiner $\mathscr{D}$ can be systematically related to its static counterpart *D*.

(36) *Definition: Dynamic Quantificational Determiners*

(cf. Chierchia 1995: p. 98)

$\mathscr{D}(P)(Q) =_{def} \uparrow D(\downarrow P)(\downarrow(P \mathbin{\underline{\wedge}} Q))$, where

i) *P* and *Q* are of type $\langle s,\langle e,cc\rangle\rangle$ (i.e. they denote dynamic properties) and *D* is a static determiner;

ii) $\downarrow P = \lambda x\ (\downarrow \hat{}P(x))$;

iii) $P \mathbin{\underline{\wedge}} Q = \lambda x\ (\hat{}P(x) \mathbin{\underline{\wedge}} \hat{}Q(x))$

Let us find out how the definition in (36) complies with the three demands discussed above. Firstly, Chierchia (1995) proves that (36) yields dynamic determiners that are dynamically conservative in the sense of (31). Secondly, the dynamic conjunction referred to on the right-hand side of the definition in (36) will enable an 'active' existential quantifier in the first argument *P* of a dynamic determiner $\mathscr{D}$ to bind a pronoun in the second argument *Q* of $\mathscr{D}$. That is, (36) makes sure that dynamic quantificational determiners are internally dynamic. Finally, the mere fact that dynamic quantificational determiners are defined in terms of their static counterparts guarantees their external statics. We may illustrate the last two properties of the definition in (36) by considering the anaphoric dependency in (37), a typical donkey-sentence.

(37) Most farmers who own a_y donkey beat it_y. (*It_y doesn't like this.)

Assume for now that this sentence can be compositionally translated into (38a) below (in section 2.5, we will see how this can be accomplished).

(38) a $\mathscr{M}ost$ (λx ($\uparrow$farmer´(x) $\mathbin{\underline{\wedge}}$ $\mathscr{E}y$ ($\uparrow$donkey´(y) $\mathbin{\underline{\wedge}}$ $\uparrow$owns´(x,y))))(λx ($\uparrow$beats´(x,y)))

The CCP in (38a) can be further reduced to (38f) by applying the various definitions introduced thus far.

(38) b $\uparrow$Most´($\downarrow$ λx ($\uparrow$farmer´(x) $\wedge$ $\mathfrak{E}y$ ($\uparrow$donkey´(y) $\underline{\wedge}$ $\uparrow$owns´(x,y))))($\downarrow$(λx ($\uparrow$farmer´(x) $\underline{\wedge}$ $\mathfrak{E}y$ ($\uparrow$donkey´(y) $\wedge$ $\uparrow$owns´(x,y))) $\underline{\wedge}$ λx ($\uparrow$beats´(x,y))))

(def. 36i)

c $\uparrow$Most´(λx ($\downarrow$($\uparrow$farmer´(x) $\underline{\wedge}$ $\mathfrak{E}y$ ($\uparrow$donkey´(y) $\underline{\wedge}$ $\uparrow$owns´(x,y)))))($\downarrow$(λx ($\uparrow$farmer´(x) $\underline{\wedge}$ $\mathfrak{E}y$ ($\uparrow$donkey´(y) $\underline{\wedge}$ $\uparrow$owns´(x,y)) $\underline{\wedge}$ $\uparrow$beats´(x,y))))

(def. 36ii and iii)

d $\uparrow$Most´(λx ($\downarrow$($\uparrow$farmer´(x) $\underline{\wedge}$ $\mathfrak{E}y$ ($\uparrow$donkey´(y) $\underline{\wedge}$ $\uparrow$owns´(x,y)))))(λx ($\downarrow$($\uparrow$farmer´(x) $\underline{\wedge}$ $\mathfrak{E}y$ ($\uparrow$donkey´(y) $\underline{\wedge}$ $\uparrow$owns´(x,y)) $\underline{\wedge}$ $\uparrow$beats´(x,y))))

(def. 36ii)

e $\uparrow$Most´(λx ($\downarrow$(λp (farmer´(x) $\wedge$ $\exists y$ (donkey´(y) $\wedge$ owns´(x,y) $\wedge$ $\hat{}p$)))))(λx ($\downarrow$(λp_1 (farmer´(x) $\wedge$ $\exists y$ (donkey´(y) $\wedge$ owns´(x,y) $\wedge$ beats´(x,y) $\wedge$ $\hat{}p_1$)))))

(def. of $\underline{\wedge}$ and $\mathfrak{E}$)

f λp (Most´(λx (farmer´(x) $\wedge$ $\exists y$ (donkey´(y) $\wedge$ owns´(x,y))))(λx (farmer´(x) $\wedge$ $\exists y$ (donkey´(y) $\wedge$ owns´(x,y) $\wedge$ beats´(x,y)))) $\wedge$ $\hat{}p$)

(def. of $\uparrow$ and $\downarrow$)

Observe that in (38f), the variable y in beats´(x,y), which translates the donkey-pronoun *it*, is appropriately bound by the existential quantifier which translates the indefinite *a donkey*. Thus, (36) adequately models the internally dynamic behavior of *Most*. Furthermore, we see that in (38f), the place-holder p for subsequent discourse is outside the syntactic scope of the static determiner Most´. This then accounts for the externally static behavior of *Most*: this determiner, nor any other quantifier inside its first or second argument, will be able to bind a variable occurring in subsequent CCPs.

2.3.2 Weak or Strong Dynamic Generalized Quantifiers

Consider the truth-conditions associated with (38f). Chierchia's account of the anaphoric dependency in (37) entails that this sentence comes out true just in case most farmers who have a donkey beat a donkey they own. More generally, Chierchia's definition of dynamic quantificational determiners will always yield a (weak) existential interpretation of an indefinite in donkey-contexts. This position may be criticized precisely on account of donkey-sentences like (37). Note that its predominant interpretation is one where the indefinite receives a (strong) universal reading, rather than a (weak) existential reading. This situation recalls our earlier discussion of dynamic implication in section 2.2.4, which in Chierchia's system generates a weak reading of an indefinite in donkey-contexts. There, we saw that a slight modification in the definition of dynamic implication (cf. 26) will yield a strong reading of the indefinite instead. So we might contemplate replacing the so-called weak definition of *Most* as obtained through (36) by the strong one in (39).

(39) $\mathcal{M}ost_{\forall}(P)(Q) =_{def} \uparrow \text{Most}'(\downarrow P)(\downarrow(P \underline{\rightarrow}_{\forall} Q))$, where
i) P and Q are of type $\langle s,\langle e,cc\rangle\rangle$ (i.e. they denote dynamic properties);
ii) $\downarrow P = \lambda x\,(\downarrow \hat{} P(x))$;
iii) $P \underline{\rightarrow}_{\forall} Q = \lambda x\,(\hat{} P(x) \underline{\rightarrow}_{\forall} \hat{} Q(x))$

If we would have used (39) instead of the weak definition of $\mathcal{M}ost$ generated by (36), (38a) above would have come out equivalent to (40) below, as the reader may check for him/herself. Note that the truth-conditions associated with (40) appropriately capture the (predominant) universal interpretation of the indefinite in (37).

(40) $\uparrow \text{Most}'(\lambda x\,(\text{farmer}'(x) \wedge \exists y\,(\text{donkey}'(y) \wedge \text{owns}'(x,y))))(\lambda x\,(\text{farmer}'(x) \wedge \forall y\,(\text{donkey}'(y) \wedge \text{owns}'(x,y) \rightarrow \text{beats}'(x,y))))$

Should we then opt for a strong definition of dynamic quantificational determiners rather than a weak one? Chierchia argues that since $\mathcal{M}ost_{\forall}$ is not dynamically Conservative in the sense of (31) above, universal readings of donkey-anaphora should be obtained through other means instead. However, assuming for the moment that Conservativity does indeed hold of dynamic determiners as well, Kanazawa (1994) shows that $\mathcal{M}ost_{\forall}$ as defined in (39) does satisfy a different version of Dynamic Conservativity. Arguably, Kanazawa's formulation of Dynamic Conservativity is no less natural than the one proposed by Chierchia as it too reduces to static Conservativity in cases that do not involve donkey-anaphora, as desired.[5] Given our present concerns, we need not engage in a detailed discussion of all intricacies revolving around the issue of weak versus strong readings of indefinites in donkey-contexts. This would take us too far afield. It should be pointed out, however, that Kanazawa's own account of the distribution of weak and strong readings of indefinites in donkey-contexts suffers from a number of problems. Firstly, it rather unexpected from Kanazawa's point of view that complex determiners such as *less than 90%* (a $\uparrow D\downarrow$ static determiner) for example do not trigger a strong reading of an indefinite in their restriction, as pointed out by Krifka (1996a). Secondly, we observe that in the following sentence (again based on an example discussed by Pelletier & Schubert 1989), a weak reading of the indefinite is not only possible, but in fact the most natural one.

(41) Most men who have a_y dime in their pocket put it_y in the parking

[5] Kanazawa's (1994) approach to weak vs. strong readings of indefinites in donkey-contexts is based on the assumption that the monotonicity properties of static determiners should be preserved by their dynamic counterparts. This entails that the dynamic counterpart of both left and right monotone in- or decreasing determiners (i.e. $\uparrow D\uparrow$ or $\downarrow D\downarrow$) are to be defined according the weak schema in (36), whereas the dynamic counterpart of the remaining class of static determiners should be defined along the lines of (39).

meter

a (Strong) Universal Reading: ??*Most men who have a dime in their pocket, put every dime they have in their pocket in the parking meter*

b (Weak) Existential Reading: *Most men who have a dime in their pocket, put a dime they have in their pocket in the parking meter*

Finally, Chierchia has convincingly shown that even a sentence like (37) admits of a weak construal of the indefinite when uttered in an appropriate context.

It might seem that the problems just reviewed for Kanazawa's account can be construed as arguments in favor of Chierchia's weak definition of dynamic quantificational determiners. However, the following variant of Dekker's dime-sentence in (30) above strongly suggests that it may not be possible in general to decide for each and every determiner whether its weak or strong construal should be regarded as basic.

(42) Most men who have a_y dime in their pocket do not put it_y in the parking meter

a (Strong) Universal Reading: *For most men who have a dime in their pocket, every dime they have in their pocket is such that they do not put it in the parking meter*

b (Weak) Existential Reading: ??*For most men who have a dime in their pocket, there is a dime they have in their pocket that they do not put in the parking meter*

Again, it is immaterial for the purposes of this thesis whether a given dynamic quantificational determiner $\mathcal{D}$ is to be defined along the lines of (36) or (39). We will therefore just assume for the time being that $\mathcal{D}$ can be defined in either way, leaving it to future research to decide whether it is (36) or (39) which best captures the true meaning of $\mathcal{D}$. When nothing is crucially at stake, however, it is understood for the sake of our convenience that dynamic quantificational determiners are defined as in (36). In the next section, we will minimally extend our current treatment of dynamic quantificational determiners to quantificational adverbs.

2.3.3 Dynamic Quantificational Adverbs

In her dissertation, de Swart (1991) argues that quantificational adverbs (henceforth Q-adverbs) such as *always*, *never*, *mostly* etc. can be analyzed essentially on a par with determiners, viz. as denoting relations between two sets of events. For example, the truth-conditions of (43a), where $[_F\ \alpha]$ indicates that

the constituent α is in focus, can be represented as in (43b), whereas those of (44a) are adequately captured by (44b). We assume for both cases that prepositions can denote relations between locations and events (cf. also Parsons 1990).

(43) a John always sings in [$_F$ the bathtub]
b ⟦John always sings [$_F$ in the bathtub]⟧ = 1 *iff*
{*e*: for some location *l*, ⟨j,*e*⟩ ∈ *I*(sings´) and ⟨*l*,*e*⟩ ∈ *I*(in´)} ⊆
{*e*: ⟨j,*e*⟩ ∈ *I*(sings´) and ⟨⟦ιx (bathtub´(*x*))⟧,*e*⟩ ∈ *I*(in´)}

(44) a Always when John goes to the market, he buys some flowers
b ⟦Always when John goes to the market, he buys some flowers⟧ = 1 *iff*
{*e*: ⟨j,*e*⟩ ∈ *I*(goes´) and ⟨⟦ιx (market´(*x*))⟧,*e*⟩ ∈ *I*(to´)} ⊆
{*e*: |{*a*: ⟨j,*a*,*e*⟩ ∈ *I*(buys´)} ∩ {*a*: *a* ∈ *I*(flower´)}| ≥ 1}

Furthermore, de Swart shows that a number of constraints that are satisfied by natural language determiners are satisfied by the denotations of Q-adverbs as well, the most important of which is Conservativity. Thus, note for instance the two equivalences in (45) below.

(45) a When Paul is in bed, he is never tired ⇔
When Paul is in bed, he is never in bed and tired
b Mostly when Paul goes abroad, he buys a souvenir ⇔
Mostly when Paul goes abroad, he goes abroad and buys a souvenir

Adopting de Swart's analysis, the issue again arises how to define the concept of a DGQ over events. To preserve de Swart's insight that Q-adverbs exhibit the same logic as determiners, we would like as before to define dynamic Q-adverbs (and derivatively DGQs over events) in such a way that they immediately satisfy Dynamic Conservativity, where $\mathcal{Q}$-$\mathcal{A}dv$ is dynamic conservative just in case $\mathcal{Q}$-$\mathcal{A}dv$ (λ*e* (Φ))(λ*e* (Ψ)) ≡ $\mathcal{Q}$-$\mathcal{A}dv$ (λ*e* (Φ)) (λ*e* (Φ $\underline{\wedge}$ Ψ)). The simplest way to proceed then is to trivially extend (36) above (and 39, when needed; cf. also footnote 9) to the domain of events, as done in (46) where events are assumed to be of type *o*.

(46) *Definition: Dynamic Quantificational Adverbs*
$\mathcal{Q}$-$\mathcal{A}dv$ (*P*)(*Q*) =$_{def}$ ↑*Q-Adv*(↓*P*)(↓(*P* $\underline{\wedge}$ *Q*)), where
i) *P* and *Q* are of type ⟨s,⟨o,cc⟩⟩ (i.e. they denote dynamic properties of events) and *Q-Adv* denotes a relation between sets of events;
ii) ↓*P* = λ*e* (↓^*P*(*e*));
iii) *P* $\underline{\wedge}$ *Q* = λ*e* (^*P*(*e*) $\underline{\wedge}$ ^*Q*(*e*))

In view of their truth-conditional similarity, one would naturally expect that

the pairs *always*/*every*, *never*/*no*, *mostly*/*most* etc. also receive a similar dynamic interpretation. If we accordingly define the dynamic interpretation of these Q-adverbs in terms of (46), we make two welcome predictions. Firstly, since (46) brands dynamic quantificational adverbs as externally static, it is expected that Q-adverbs such as *always*, *never*, *mostly*, *often*, *seldom* etc. just like their nominal counterparts cannot extend their scope into subsequent discourse. This expectation is borne out by the contrast between (47) and (48) below. On its most natural reading, the discourse in (47a) entails that the event of John's going to the kitchen to get some food is immediately preceded by yesterday's event of John's waking up in the middle of the night. This temporal sequencing can be treated as a donkey-type anaphoric dependency along the lines of (47b-c), where '<' stands for 'temporally precedes'.[6]

(47) a Yesterday, John woke up in the middle of the night. He went to the kitchen to get some food.

b $\exists e\,(\uparrow\text{woke-up}'(\text{john}',e)) \underline{\wedge} \exists e'\,(\uparrow e \prec e' \underline{\wedge} \uparrow\text{went}'(\text{john}',e') \underline{\wedge} \uparrow\text{to}'\,(\iota x\,(\text{kitchen}'(x)),e'))$ ⇔ (Fact 15)

c $\exists e\,(\uparrow\text{woke-up}'(\text{john}',e) \underline{\wedge} \exists e'\,(\uparrow e \prec e' \underline{\wedge} \uparrow\text{went}'(\text{john}',e') \underline{\wedge} \uparrow\text{to}'(\iota x\,(\text{kitchen}'(x)),e')))$

The examples in (48), however, cannot be construed in the same way as (47). That is, the discourse in (48a) cannot be taken to mean that last week, when John woke up, he always woke up in the middle of the night and went to the kitchen to get some food. In fact, when uttered out of the blue, the following examples sound strange, as indicated by '#'.

(48) *Dynamic Quantificational Adverbs are Externally Static*

a #Last week, John always woke up in [$_F$ the middle of the night]. He went to the kitchen to get some food.

b #Last week, John never woke up in [$_F$ the middle of the night]. He went to the kitchen to get some food.

c #Last week, John mostly woke up in [$_F$ the middle of the night]. He went to the kitchen to get some food.

d #Last week, John often woke up in [$_F$ the middle of the night]. He went to the kitchen to get some food.

e #Last week, John seldom woke up in [$_F$ the middle of the night]. He went to the kitchen to get some food.

Due to their external statics, a simple indefinite locked up inside either the

[6] Cf. Partee (1984) for the basic insight that temporal anaphora can be treated on a par with nominal anaphora.

first or second argument of a Q-adverb will not be able to bind a pronoun in subsequent discourse. That is, Q-adverbs induce inaccessible domains for dynamic anaphora, as illustrated in (49) below.[7]

(49) *Dynamic Quantificational Adverbs induce Inaccessibility*

a *In the past, when John met a_y girl, he was always nervous. She_y didn't like that.
b *Last year, when John went to the liquor store, he always bought a_y bottle of French wine. It_y was quite expensive.

c *In the past, when John met a_y girl, he was never nervous. She_y liked that.
d *Last year, when John went to the liquor store, he never bought a_y bottle of French wine. It_y was too expensive.

e *In the past, when John met a_y girl, he was mostly nervous. She_y didn't like that.
f *Last year, when John went to the liquor store, he mostly bought a_y bottle of French wine. It_y was quite expensive.

g *In the past, when John met a_y girl, he was often nervous. She_y didn't like that.
h *Last year, when John went to the liquor store, he often bought a_y bottle of French wine. It_y was quite expensive.

i *In the past, when John met a_y girl, he was seldom nervous. She_y liked that.
j *Last year, when John went to the liquor store, he seldom bought a_y bottle of French wine. It_y was too expensive.

Secondly, the definition in (46) correctly predicts that all dynamic quantificational adverbs just like their nominal counterparts are internally dynamic. To show this prediction to be correct, we must control for the fact that the Q-adverb cannot be understood as quantifying over the indefinite itself

[7] Of course, the examples in (49) become perfectly acceptable if the second sentence contains a Q-adverb. Contrast (49a) for instance with (i) below.
(i) In the past, when John met a_y girl, he was always nervous. She_y never liked that.
But this is just an instance of (temporal) subordination, a phenomenon which we chose to ignore for the reasons discussed in section 2.1.1 (but cf. Chapter 4 for some discussion of modal subordination). Care should therefore be taken not to interpret the the examples in (49) in a 'subordinate' fashion.

through 'unselective' binding.[8] As pointed out by Chierchia (1995), an indefinite which bears focal stress cannot be 'unselectively' bound by a Q-adverb. The following examples, based on Chierchia (1995: ex. 106a), therefore unequivocally demonstrate the internal dynamics of Q-adverbs.[9]

(50) *Dynamic Quantificational Adverbs are Internally Dynamic*
- a When a trainer from here trains [$_F$ a$_y$ dolphin], she always makes it$_y$ do wonderful things
- b When a trainer from here trains [$_F$ a$_y$ dolphin], she never makes it$_y$ do wonderful things
- c When a trainer from here trains [$_F$ a$_y$ dolphin], she mostly makes it$_y$ do wonderful things
- d When a trainer from here trains [$_F$ a$_y$ dolphin], she often makes it$_y$ do wonderful things
- e When a trainer from here trains [$_F$ a$_y$ dolphin], she seldom makes it$_y$ do wonderful things

This concludes our discussion of the interpretation of Q-adverbs in a dynamic setting. In the next section, we will explore a possible extension of the system of Dynamic Semantics as discussed so far in order to come to terms with plural dynamic anaphora.

2.4 Plural Quantifiers and Dynamic Semantics

Most theories of Dynamic Semantics are essentially theories of the binding potential of singular indefinites as opposed to that of quantificational noun phrases. Chierchia's (1995) system of Dynamic Semantics is no exception to this. However, it quite clear from examples such as (51) that some plural indefinites can bind into subsequent discourse just as much as singular indefinites can.

(51) Three$_X$ men walked in the park. They$_X$ whistled.

This sentence should be contrasted with the ones in (52) below. In the latter examples, the plural noun phrases do not bind the pronoun in the second sentence. For instance, (52a) requires more than a set of at least/more than three

[8] The issue whether Q-adverbs can also 'unselectively' bind any number of indefinites in its restriction will be discussed at some length in section 3.4.

[9] Note that the definition in (46) will only generate weak readings of the donkey-sentences in (50). Strong readings can be derived by defining $\mathcal{Q}$-$\mathcal{A}dv_\forall$ along the lines of (39) in section 2.3.2.

men that walk in the park and whistle in order for truth to obtain. If in fact exactly ten men walk in the park, (52a) can only count as true if all these pedestrians in addition whistle. That is, it would not do if just a subset of at least/more than three pedestrians whistled in the park. Furthermore, (52b) requires that the number of men who walked in the park be identical to three. This is unexpected if *exactly/precisely three men* really does bind the plural pronoun *them*, since if this were the case, only the number of men who walked in the park and whistled should be identical to three. Essentially the same reasoning applies to the remaining cases in (52c) and (52d).

(52) a At least/more than three men walked in the park. They whistled.
b Exactly/precisely three men walked in the park. They whistled.
c Less than/fewer than/at most three men walked in the park. They whistled.
d Most men walked in the park. They whistled.

In the following two sections, we will outline a somewhat simplified theory of plurality (essentially a set-theoretic reformulation of the account proposed by Link 1983; cf. Landman 1989a,b for more details) which, when integrated in the system of Dynamic Semantics presented in the previous sections, provides an easy explanation for the contrast between (51) and (52). There is some controversy in the literature as to what mechanism licenses the pronouns in (52). Does this mechanism involve some form of binding (as argued for by van den Berg 1990,1996 and Krifka 1996b), or does the resolution of the pronouns in examples such as (52) rely on some other strategy instead? For the purposes of this thesis, nothing much hinges on this choice. We will therefore refrain from making a stance on this issue.[10]

2.4.1 A New Structure for the Domain of Discourse

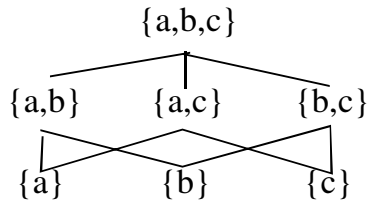
Suppose we give some structure to our domain of discourse D. Specifically, following Landman (1989a,b), we will give it the structure of a *complete, atomic, free (proper) join semilattice* $\langle D,\subseteq\rangle$, where $D = \wp(O) - \{\varnothing\}$, O is a set of objects and $\subseteq$ is the familiar subset-relation. As a simple example of such a structure, consider $\langle \wp(\{a,b,c\}) - \{\varnothing\},\subseteq\rangle$, as graphically displayed in (53) on the next page. (Observe that $\wp(\{a,b,c\}) - \{\varnothing\} = \{\{a\},\{b\},\{c\},\{a,b\}, \{b,c\},\{a,c\}, \{a,b,c\}\}$. We will henceforth refer to this set as 'X'.)

Firstly, to see that the structure in (53) is a *join semilattice*, check that it has the following property: for every $A,B \in X$, the join of A and B (notated: $A \vee B$; or, in the present context: $A \cup B$) is also in X (cf. I in the Appendix to Chapter

[10] But cf. footnote 28 in Chapter 4 for a proposal with respect to cases such as (52b).

1 for more discussion on join semilattices). Secondly, to call the structure in (53) *complete* means in the present context that it observes the following property: for every non-empty $A \subseteq X$, $\bigvee A \in X$. Thus, suppose $A = \{\{a\},\{a,c\}\}$, then $\bigvee A$ (or, in the present context: $\bigcup A$) $= \bigcup\{\{a\},\{a,c\}\} = \{a\} \cup \{a,c\} = \{a,c\} \in X$. Thirdly, consider the following definition of an *atom* in some set Z:

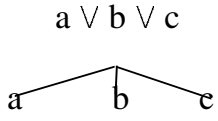
(53)



(54) A is an atom in Z (henceforth: $\mathrm{AT}_Z(A)$) just in case
For every $B \in Z$, if $B \subseteq A$, then $B = A$

Note that the atoms in (53) are the singleton sets on the bottom row, i.e. $\{a\}$, $\{b\}$ and $\{c\}$. Now, the structure in (53) is *atomic* in that for every $B \in X$, there is an A such that $\mathrm{AT}_X(A)$ and $A \subseteq B$. For instance, if $B = \{a,c\}$, then both $\{a\}$ and $\{c\}$ are atoms in B. Finally, $\langle X,\subseteq\rangle$ is *free* as it observes the following property: for every $A \in X$ and $Y \subseteq X$, if AT(A) and $A \subseteq \bigcup Y$, then there is a $B \in Y$ such that $A \subseteq B$. Suppose for example that $A = \{a\}$ and $Y = \{\{a\},\{b\}\}$. Observe that there is indeed a $B \in \{\{a\},\{b\}\}$ such that $\{a\} \subseteq B$, viz. $\{a\}$ itself. Freedom guarantees that whenever two pairs of elements are distinct, their unions are distinct as well. For instance, we may observe that the structure in (55) too is a complete, atomic (proper) join semilattice. However, it is not free since, even though a is an atom and $a \subseteq b \vee c$, there is no $x \in \{b,c\}$ such that $a \subseteq x$. Or, to put it somewhat differently, even though a,b and b,c are two distinct pairs of elements, their unions $a \vee b$ and $b \vee c$ respectively are the same.

(55)



In the next section, we will integrate this enriched model-structure in our system of Dynamic Semantics.

2.4.2 Plural Quantification in Dynamic Semantics

In our new model $M = \langle D,I\rangle$, $D = \langle \wp(O) - \{\varnothing\},\subseteq\rangle$ and I is the interpretation function mapping any n-place predicate P into a set of n-tuples of elements in D. However, it is no trivial matter to decide for any given predicate P which

elements in $\wp(O)$ - $\{\varnothing\}$ will figure in the extension of P. To do that, we need to inquire from a bird's eye into matters of collectivity and distributivity.[11] Let us first assume that singular predicates unambiguously denote properties of atomic individuals in structures such as (53). Then the sentence in (56a) will come out true just in case the set of atoms that are men is included in the set of atoms that walk, as indicated in (56b-c).

(56) a Every man walks
b $[\![\downarrow\mathscr{A}x\ (\uparrow\text{man}'(x) \underline{\rightarrow} \uparrow\text{walks}'(x))]\!]^{M,g} = 1$ *iff*
c $\{\{a\}: \{a\} \in [\![\text{man}']\!]\} \subseteq \{\{a\}: \{a\} \in [\![\text{walks}']\!]\}$

Let us furthermore assume (as is standard) that a conjunction of proper names refers to the union of the singleton-sets denoted by the respective proper names. Given the truth-conditions associated with sentences like *John and Mary walk*, we observe that the property of walking holds of a collection (i.e. {j,m}) just in case this property (distributively) holds of each atomic individual (i.e. {j} and {m}) in that collection. To capture the inherent distributivity of predicates like *walk*, *sneeze*, *snore* etc., we will translate these predicates by means of the Σ-operator, as defined in (57) (cf. van den Berg 1990 who proposed a generalization of Link's 1983 *-operator very similar to the one adopted here). We might view the Σ-operator as a *pluralization* operator, as it establishes a direct link between the singular use of a predicate and its plural use.

(57) $\Sigma^{X_i}\text{P}(x_1,\ldots,X_i,\ldots,x_n) =_{def} \forall y \subseteq X_i\ (\text{P}(x_1,\ldots,y,\ldots,x_n))$

where X_i ranges over multi-membered sets/collections, $1 \leq i \leq n$ and y ranges over singleton-sets/atoms. The truth-conditional content of (58a) will therefore be represented as in (58b). Given the definition of the Σ-operator in (57), (58c) turns out to be equivalent to (58d). Thus, we have derived both the inherent distributivity of *walk* (i.e. 58a entails 58g) as well as its so-called *cumulative reference* property (i.e. 58g entails 58a).

(58) a John and Mary walk
b $\downarrow \lambda P\ (\hat{}P(\text{john}' \cup \text{mary}'))(\ \lambda X\ (\uparrow\Sigma^X\text{walk}'(X)))$
c $\downarrow \lambda X\ (\uparrow\Sigma^X\text{walk}'(X))(\text{john}' \cup \text{mary}')$ (λ-conversion, ^ -cancellation)
d $\downarrow \lambda X\ (\uparrow\forall y \subseteq X\ (\text{walks}'(y)))(\text{john}' \cup \text{mary}')$ (def. 57)
e $\forall y \subseteq (\text{john}' \cup \text{mary}')\ (\text{walks}'(y))$ (λ-conversion, ↓↑-cancellation) ≡
f $\text{walks}'(\text{john}') \wedge \text{walks}'(\text{mary}')$ ≈
g John walks and Mary walks

[11] Most of the discussion that follows is based on the seminal work of Scha (1981) and Link (1983), taking Landman's (1989a,b) set-theoretic reformulation of Link's approach as our point of reference.

In addition to these intransitive verbs, all (intransitive) nominal predicates are clearly inherently distributive. In translating these predicates, we must therefore make use of the Σ-operator too. Furthermore, each set of sets X denoted by a nominal predicate N´ is mapped to its so-called *supremum* (i.e. $\bigcup X$; cf. again I in the Appendix to Chapter 1) by the definite article, which will be translated by the ι-operator. By assumption, the supremum of X must be in the extension of N´ as well (note that this condition is trivially satisfied in case N´ has cumulative reference). This immediately gives us the standard maximality effect in case we have a plural noun (without a numeral!): *the men* denotes the maximal set of men, presently under consideration. For instance, suppose $[\![\lambda X\ (\Sigma^X \text{men}'(X))]\!] = \{\{a\},\{b\},\{a,b\}\}$. Then $[\![\iota X\ (\Sigma^X \text{men}'(X))]\!] = \bigcup\{\{a\},\{b\},\{a,b\}\} = \{a,b\} \in [\![\lambda X\ (\Sigma^X \text{men}'(X))]\!]$. However, in case we are dealing with a singular count noun or a plural noun modified by a numeral, we automatically derive the standard uniqueness effects. For suppose that $[\![\text{man}']\!] = \{\{a\},\{b\}\}$. Then $[\![\iota x\ (\text{man}'(x))]\!] = \bigcup\{\{a\},\{b\}\} = \{a,b\} \notin [\![\text{man}']\!]$. Since by assumption $\{a,b\}$ has to be a member of $[\![\text{man}']\!]$, it follows that $[\![\text{the}'(\text{man}')]\!]$ is undefined in this case, as desired.

Apart from inherently distributive predicates, we also have 'mixed' predicates such as *write a paper*. These predicates may give rise to both distributive and collective readings. This is illustrated in (59).

(59) a John and Mary write a paper (✓DIST, ✓COLL)
DIST: *John and Mary each write a paper*
COLL: *John and Mary write a paper together*
b The students write a paper (✓DIST, ✓COLL)
c Three students write a paper (✓DIST, ✓COLL)

Interestingly, the distributive reading of 'mixed' predicates cannot be accounted for in terms of the Σ-operator. For suppose we tried to do that. Then, we would no longer be able to explain the fact that on the distributive reading of (59a) for instance, John and Mary may have written different papers. The failure of the Σ-operator to accomodate this co-variance reading of (59a) is illustrated in (60).

(60) a $\downarrow \lambda P\ (\hat{}P(\text{john}' \cup \text{mary}'))(\ \lambda X\ \mathfrak{E}y\ (\uparrow\text{paper}'(y) \underline{\triangle} \uparrow\Sigma^X\text{write}'(X,y)))$
b $\downarrow \mathfrak{E}y\ (\uparrow\text{paper}'(y) \underline{\triangle} \uparrow\forall x \subseteq (\text{john}' \cup \text{mary}')\ (\text{writes}'(x,y)))$
(λ-conversion, $\hat{}$ -cancellation, def. 57)
c $\exists y\ (\text{paper}'(y) \wedge \forall x \subseteq (\text{john}' \cup \text{mary}')\ (\text{writes}'(x,y)))$
(def. of $\underline{\triangle}$ and $\mathfrak{E}$, $\downarrow\uparrow$-cancellation)

We will therefore follow Link (1983) in assuming that the distributive reading of 'mixed' predicates such as *write a paper* comes about by means of a 'silent' distributive operator Δ. Δ may be considered to be the covert counterpart of the floating quantifier *each* (cf. Kamp & Reyle 1993; Beghelli & Stowell 1997;

Szabolcsi 1997a). As for its syntax, we will simply assume that the link between Δ and its noun phrase antecedent is local in the sense that no other noun phrase may occur in between (cf. the next section for more discussion). As for its semantics, Δ can be defined as follows:

(61) $\Delta^X\Phi =_{def} \mathscr{A}x \subseteq X\ (\Phi)$

where all free occurrences of X in Φ have been replaced by x, and x is free in Φ. Observe that the definition of Δ in terms of $\mathscr{A}$ will see to it that the distributive operator is (externally) static. The pleasant consequences of this will become apparent shortly.

The truth-conditions associated with the distributive reading of (59a) will then be represented as in (62a). As (62a) reduces to (62e), we conclude that this analysis can account for the possibility of co-variance between the subject noun phrase and the object noun phrase on a distributive construal of (59a).

(62) a $\downarrow \lambda P\ (\hat{}P(\text{john}' \cup \text{mary}'))(\ \lambda X\ (\Delta^X\ \mathscr{E}y\ (\uparrow\text{paper}'(y)\ \underline{\wedge}\ \uparrow\text{write}'(X,y))))$

b $\downarrow \lambda X\ (\Delta^X\ \mathscr{E}y\ (\uparrow\text{paper}'(y)\ \underline{\wedge}\ \uparrow\text{write}'(X,y)))(\text{john}' \cup \text{mary}')$

(λ-conversion, $\hat{}$ -cancellation)

c $\downarrow \lambda X\ (\mathscr{A}x \subseteq X\ \mathscr{E}y\ (\uparrow\text{paper}'(y)\ \underline{\wedge}\ \uparrow\text{writes}'(x,y)))(\text{john}' \cup \text{mary}')$ (def. 61)

d $\downarrow \mathscr{A}x \subseteq (\text{john}' \cup \text{mary}')\ \mathscr{E}y\ (\uparrow\text{paper}'(y)\ \underline{\wedge}\ \uparrow\text{writes}'(x,y)))$ (λ-conversion)

e $\forall x \subseteq (\text{john}' \cup \text{mary}')\exists y\ (\text{paper}'(y) \wedge \text{writes}'(x,y))$

(def. of $\mathscr{A}$ and $\mathscr{E}$, $\downarrow\uparrow$-cancellation)

Turning now to the collective reading of (59a-c), we can derive this interpretation on the assumption that the denotation of a verb phrase such as *write a paper* can be predicated over a collection. The truth-conditions that are involved in the collective reading of (59c) for example may then be represented as in (63), where the vertical bars count the number of atoms in X.

(63) a $\downarrow\mathscr{E}X\ (\uparrow\Sigma^X\text{students}'(X)\ \underline{\wedge}\ \uparrow|X| = 3\ \underline{\wedge}\ \mathscr{E}y\ (\uparrow\text{paper}'(y)\ \underline{\wedge}\ \uparrow\text{write}'(X,y)))$

b $\exists X\ (\Sigma^X\text{students}'(X) \wedge |X| = 3 \wedge \exists y\ (\text{paper}'(y) \wedge \text{write}'(X,y)))$

(def. of $\underline{\wedge}$ and $\mathscr{E}$, $\downarrow\uparrow$-cancellation)

As originally pointed out by Kamp & Reyle (1993) in their extensive discussion of plurals, it appears that only conjunctions of proper names, plural definite descriptions and bare numeral indefinites are compatible with a collective construal of a 'mixed' predicate. The complement class of plural quantified noun phrases seems only compatible with a distributive interpretation of a 'mixed' predicate, or only marginally supports a collective construal. This class consists of exactly those quantified expressions that cannot support cross-sentential anaphora. Thus, the data in (64) below should be compared with our earlier findings with respect to (52) above.

(64) a At least/more than three students wrote a paper (✓DIST, ??COLL)
DIST: *At least/more than three students are such that each of them wrote a (possibly different) paper*
COLL: ??*At least/more than three students wrote a paper together*
b Exactly/precisely three students wrote a paper (✓DIST, ??COLL)
c Less than/fewer than/at most three students wrote a paper (✓DIST, ??COLL)
d Most students wrote a paper (✓DIST, ??COLL)

On the basis of data such as those in (64), Kamp & Reyle argue that the (static) meaning of the determiner expressions that figure in these examples should be analyzed as relations between two sets of atomic individuals. Of course, this is very similar to their standard analysis in Generalized Quantifier theory. According to this analysis then, even though the nominal and verbal predicates in (64) are morpho-syntactically plural, they are semantically singular in that they apply to atomic individuals only. We will henceforth adopt Kamp & Reyle's proposal to distinguish between those noun phrases that are compatible with collective readings of 'mixed' predicates (i.e. conjunctions of proper names, plural definite descriptions and bare numeral indefinites) and those (henceforth: Quantified Noun Phrases, or Q-NPs for short) that cannot. The dynamic meaning of the latter type of noun phrase can be obtained by means of the schema in (36) which defines dynamic quantificational determiners. The truth-conditions that are involved in the distributive reading of (64a) for instance will then be correctly analyzed as in (65).[12]

(65) a $\downarrow$ *At Least Three* (λx ($\uparrow$student´(x)))(λx *E*y ($\uparrow$paper´(y) $\underline{\wedge}$ $\uparrow$wrote´(x,y)))
b $\downarrow \lambda p$ (At Least Three´(λx (student´(x)))(λx (student´(x) $\wedge \exists y$ (paper´(y) $\wedge$ wrote´(x,y)))) $\wedge$ $\hat{}p$)
(def. of dynamic quantificational determiner -cf. 38 above-)
c At Least Three´(λx (student´(x)))($\lambda x \exists y$ (paper´(y) $\wedge$ wrote´(x,y)))
(Conservativity, def. of $\downarrow$)

One important piece of evidence in favor of the above treatment of the

[12] For a substantial elaboration of Kamp & Reyle's basic insight that Q-NPs denote externally static quantifiers (or, in DRT terms, do not introduce a discourse referent), cf. Szabolcsi (1997a). It should be pointed out though that Szabolcsi groups the universal, distributive Q-NPs with the 'simple' indefinites in that they introduce a discourse referent (a set of atomic individuals) as well. From our perspective, it is immaterial whether the inaccessibility effects induced by universal, distributive Q-NPs should be ascribed to the fact these Q-NPs denote externally static quantifiers themselves, the position taken here, or rather to the fact that the operator which is ultimately responsible for distributing a property over the atomic members of a 'universal' discourse referent (the head of DistP on Szabolcsi's account, who follows Beghelli & Stowell 1997 in this respect) denotes an externally static function.

distributive readings in (64) is offered by the fact that floating quantifier *each* cannot take any of the subject noun phrases in (64) as antecedent, as illustrated in (66) below. This generalization therefore exemplifies the inherent distributivity of the relevant determiner expressions. The latter property is as expected under an account which states that the (static) meaning of these determiner expressions relates two sets of atomic individuals.

(66) a * { At least/more than / Exactly/precisely } three students each wrote a paper

b * { Less than/fewer than/at most three / Most } students each wrote a paper

Now, it would seem that our assumptions with respect to the inherently distributive nature of the determiner expressions in (64)/(66) will get us into trouble when we turn to collective predicates such as *gather*, *meet*, *assemble* and so on. As suggested in (67), all noun phrases seem equally capable of combining with a collective predicate. Obviously, we cannot analyze the collective predication in (67b) along the lines of (68), which represents the truth-conditions associated with the collective predication in (67a). Or else, we would be left without any account of our earlier observations in (64) and (66).

(67) a Three students gather (on the square)

b At least three students gather (on the square)

(68) a $\downarrow\mathfrak{E}X\ (\uparrow\Sigma^X\text{students}'(X) \mathbin{\underline{\wedge}} \uparrow|X| > 3 \mathbin{\underline{\wedge}} \uparrow\text{gather}'(X))$

b $\exists X\ (\Sigma^X\text{students}'(X) \wedge |X| > 3 \wedge \text{gather}'(X))$

(def. of $\underline{\wedge}$ and $\mathfrak{E}$, $\downarrow\uparrow$-cancellation)

Given the relative ease with which the subject Q-NPs in (64)/(66) can participate in collective predication, we must try to provide more solid evidence in favor of Kamp & Reyle's claim that these noun phrases are inherently distributive. We will return to this issue in the next chapter. For now, we will be satisfied with the following intuitive principle (which was already contemplated by Kamp & Reyle 1993) in order to account for the contrast between (64)/(66) on the one hand, and (67) on the other:

(69) *The 'Collective Elsewhere' Principle*
Interpret the VP-argument of a inherently distributive Q-NP

distributively if you can. If you cannot, interpret the relevant noun phrase in such a way so as to make a collection available for collective predication.

We will not specify here the ways in which a Q-NP can make a collection available for collective predication, as this would take us outside the purview of this introductory chapter (but cf. Kamp & Reyle 1993 for relevant discussion).

2.4.3 Plural Anaphora, Distributivity and Cross-Sentential Binding

We are finally in the position to address some of the issues that arise in connection with the contrast between (51) and (52) above. The relevant contrast has been repeated in (70) and (71) below for ease of reference. The stars preceding the examples in (71) indicate that these sentences cannot receive an interpretation whereby the subject Q-NPs bind the pronoun cross-sententially.

(70) Three$_X$ men walked in the park. They$_X$ whistled.

(71) a *At least/more than three$_x$ men walked in the park. They$_x$ whistled.
b *Exactly/precisely three$_x$ men walked in the park. They$_x$ whistled.
c *Less than/fewer than/at most three$_x$ men walked in the park. They$_x$ whistled.
d *Most$_x$ men walked in the park. They$_x$ whistled.

Firstly, our present approach to plural noun phrases immediately accounts for the cross-sentential binding observed in (70). As shown in (72) below, this type of binding can be treated in essentially the same way as that attested in *A man walked in the park. He whistled*, provided we analyze the plural pronoun *they* as a variable ranging over collections. Thus, (72) should be compared to (14) above.

(72) a $\exists X\,(\uparrow\Sigma^X\text{men}'(X) \mathbin{\underline{\wedge}} \uparrow|X| = 3 \mathbin{\underline{\wedge}} \uparrow\Sigma^X\text{walked}'(X)) \mathbin{\underline{\wedge}} \uparrow\Sigma^X\text{whistled}'(X)$
b $\exists X\,(\uparrow\Sigma^X\text{men}'(X) \mathbin{\underline{\wedge}} \uparrow|X| = 3 \mathbin{\underline{\wedge}} \uparrow\Sigma^X\text{walked}'(X) \mathbin{\underline{\wedge}} \uparrow\Sigma^X\text{whistled}'(X))$
(Fact 15)

Secondly, the fact that the Q-NPs in (71) cannot support cross-sentential binding follows from our earlier claim that the dynamic meaning of these noun phrases is fixed through the schema in (36). Since (36) brands dynamic quantificational determiners as externally static, we know that the DGQs

denoted by the subject noun phrases in (71) cannot bind anything beyond their syntactic scope. This is illustrated for (71a) in (73), where the variable x in whistled´(x) is free. Due to this free occurrence of x, (73) cannot be assigned a well-defined interpretation on account of Fact (19). Note that the ill-formedness of the anaphoric dependencies in (71) cannot be derived from the fact that plural pronouns cannot denote variables ranging over atomic individuals. Under such an account, the grammaticality of *At least three students*$_x$ *talked to their*$_x$ *supervisor* for example would be a complete mystery.

(73) a $\mathcal{At\ Least\ Three}$ (λx ($\uparrow$man´(x)))(λx ($\uparrow$walked´(x))) $\underline{\wedge}$ $\uparrow$whistled´(x)

b λp (At Least Three´(λx (man´(x)))(λx (man´(x) $\wedge$ walked´(x))) $\wedge$ $\hat{}p$) $\underline{\wedge}$ $\uparrow$whistled´(x)
(def. of dynamic quantificational determiner -cf. 65 above-)

c λp (At Least Three´(λx (man´(x)))(λx (walked´(x))) $\wedge$ whistled´(x) $\wedge$ $\hat{}p$) (Conservativity, def. of $\underline{\wedge}$ and $\uparrow$)

But there is more to the interaction of plural quantifiers and anaphora than what we have seen thus far. To conclude this section, we will consider the fact that on a distributive construal of the 'mixed' predicate in (74a), the singular indefinite *a paper* cannot bind the pronoun *it* if it scopes under the (c)overt distributive operator. Again, this observation follows immediately from the rather conservative way in which we incorporated plural quantification in our system of Dynamic Semantics. We may recall that we defined the distributive operator Δ in terms of $\mathcal{C\!A}$ (cf. 61 above), and thus ultimately in terms of (static) negation and $\mathcal{E}$ (cf. 12f above). Thus, Δ will inherit its static properties from ~. Consequently, any quantifier locked up inside the scope of Δ cannot bind a variable which occurs outside the syntactic scope of Δ. This is demonstrated in (74b-e), where y in terrible´(y) is free in (74e). Due to this free occurrence, (74e) does not receive any interpretation on account of Fact (19).

(74) a Three students$_X$ (each^X) wrote a$_y$ paper. It$_y$ was terrible. (*Δ > *a paper*)

b $\mathcal{E}X$ ($\uparrow\Sigma^X$students´(X) $\underline{\wedge}$ $\uparrow|X| = 3$ $\underline{\wedge}$ Δ^X $\mathcal{E}y$ ($\uparrow$paper´(y) $\underline{\wedge}$ $\uparrow$wrote´(X,y))) $\underline{\wedge}$ $\uparrow$terrible´(y)

c $\mathcal{E}X$ ($\uparrow\Sigma^X$students´(X) $\underline{\wedge}$ $\uparrow|X| = 3$ $\underline{\wedge}$ $\mathcal{CA}x \subseteq X$ $\mathcal{E}y$ ($\uparrow$paper´(y) $\underline{\wedge}$ $\uparrow$wrote´(x,y))) $\underline{\wedge}$ $\uparrow$terrible´(y) (def. 61)

d $\mathcal{E}X$ ($\uparrow\Sigma^X$students´(X) $\underline{\wedge}$ $\uparrow|X| = 3$ $\underline{\wedge}$ $\mathcal{CA}x \subseteq X$ $\mathcal{E}y$ ($\uparrow$paper´(y) $\underline{\wedge}$ $\uparrow$wrote´(x,y)) $\underline{\wedge}$ $\uparrow$terrible´(y)) (Fact 15)

e $\lambda p \exists X$ (Σ^Xstudents´(X) $\wedge$ $|X| = 3$ $\wedge$ $\forall x \subseteq X$ $\exists y$ (paper´(y) $\wedge$ wrote´(x,y)) $\wedge$ terrible´(y) $\wedge$ $\hat{}p$) (def. of $\mathcal{CA}$, $\mathcal{E}$ and $\underline{\wedge}$)

Of course, many aspects of the interaction between plural quantification and Dynamic Semantics have been left out of consideration, or deserve a much more

thorough treatment than given here.[13] Be that as it may, I do believe that the above discussion warrants the conclusion that a rather conservative extension of the system of Dynamic Semantics we have adopted is capable of handling at least the very basics of the interaction between plural quantification, distributivity and dynamic anaphora.

2.5 Compositionality and a Comparison with Discourse Representation Theory

One of the more central methodological principles in formal semantics is the Principle of Compositionality (attributed to Frege). It states that the meaning of a constituent *C* is a function of the meaning of its subconstituents *c* and the way these are combined syntactically. As we will be mostly concerned with representations of meanings in some logical language, the Principle of Compositionality will be understood here as follows: the translation of some constituent *C* into some logical language *L* is a function of the translation of its subconstituents *c* into *L* and the way these are put together syntactically. We will assume that the syntactic structures which provide the input to the compositional translation procedure are the Logical Form (henceforth: LF)-representations of current GB-theory, where LF will be construed here as the level of representation where the scopal properties of quantified noun phrases are disambiguated.[14] Specific assumptions with respect to some aspects of the syntax of LF that are not necessarily shared by everyone will be discussed and defended when appropriate. The semantic combination rules, which correspond to syntactic combination rules, will minimally include: i) *Functional Application* (FA), where FA(α,β) = α(β), β(α), α(β) or β(α) (whatever fits; cf. Rullmann 1995 and Cresti 1995); and ii) *Generalized Conjunction* (GC), where GC(α,β) = λx (α(x) $\underline{\wedge}$ β(x)) and α and β have the same semantic type (cf. also Partee & Rooth 1983). Another important rule of semantic composition that we will make extensive use of relates the translation of indexed XPs with the translation of

[13] Consider for instance the fact that (74) becomes significantly better if the second sentence contains a plural pronoun, as shown in (i).
(i) Three$_X$ students (each^X) wrote a$_y$ paper. They$_X$ (each^X) sent it$_y$ to L&P.
It seems as though the plural pronoun together with the distributive operator it is associated with opens a pathway through which the distributive operator in the first sentence can bind into subsequent discourse. That is, the phenomenon illustrated in (i) has the feel of a standard subordination effect. A full discussion of this phenomenon thus falls outside the purview of the discussion in this chapter for the reasons mentioned in section 2.1.1 (but cf. Chapter 4 for some discussion of modal subordination). Cf. Krifka (1996b) for an account of facts such as (i) which is intended to extend to standard subordination effects.

[14] Cf. Hornstein (1995) for a state-of-the-art overview of LF research in the GB framework.

their sister constituents. We will call this operation *binding-in* (a generalization of Montague's *quantifying-in*). It is stated in (75).

(75) *Definition: Binding-In*
i. $B_x(XP',\Phi) =_{def} FA(XP',\lambda x\,(\Phi))$, where Φ is of type *cc*;
ii. $B_x(XP',\Psi) =_{def} \lambda v\,(B_x(XP',\Psi(v)))$, where Ψ's type ends in *cc*.

Since we will want to be able to deal with intensions proper in later chapters, we will redefine the type of *cc* as $\langle\langle s,\langle w,t\rangle\rangle,\langle w,t\rangle\rangle$, where *w* is the type of possible worlds and *s* the type of assignments (as before). We will henceforth refer to the complex type $\langle w,t\rangle$ simply as *p*. Given this slight change in the typing of CCPs, the meaning of any *n*-place predicate *R* should now be defined as a function from individuals into the new type of *cc*. That is:

(76) $\uparrow R = \uparrow\lambda w\,(R_w) = \lambda x_1 ... \lambda x_n\,(\uparrow\lambda w\,(R_w(x_1,...,x_n)))$

All in all then, we can distinguish the following semantic domains in which the various expressions of our dynamic logic will be interpreted:

(77)
a $D_e = D$ (i.e. the domain of discourse)[15]
b $D_{\langle a,b\rangle} = D_b^{D_a}$ (i.e. the set of all function from D_a into D_b)
c $D_p = \{0,1\}^W$ (where *W* is the set of all possible worlds)
d $D_{\langle s,a\rangle} = D_a^{\Omega}$ (where Ω is the set of all partial assignments)

A separate semantic domain D_o for events will be assumed when needed. The addition of possible worlds will effect some minor changes in the static logic which is meant to support the dynamic logic outlined in the preceding sections (cf. I in the Appendix to this chapter).

By way of illustration, consider the example in (78a) the intended meaning of which is represented in (78c). At LF, both the subject and object noun phrase are occupying the SPEC-positions of their respective Agr-projections (i.e. AgrSP and AgrOP) in which their Case- and agreement-features are checked (cf. Chomsky 1993,1995). From now on, we will label the class of noun phrases as DP, following Abney (1987). As indicated in the LF-representation in (78b), we will furthermore assume that the distributive operator Δ is attached to a position immediately below its antecedent DP (cf. Beghelli & Stowell 1997 for detailed arguments supporting this view).

(78) a Every athlete greeted three fans

[15] That is, we will still reserve the type *e* for individual-denoting expressions, even though these individuals are now modelled as (singleton or multi-membered) sets. This is only done for reasons of simplicity, however.

b $[_{\text{AgrSP}}\ [_{\text{DP}}$ every student$]_x\ [_{\text{AgrOP}}\ [_{\text{DP}}$ three fans$]_Y\ \Delta^Y\ [_{\text{VP}}\ e_x$ greeted $e_Y]]]$

c $\lambda p \lambda w$ (Every´(λx (athlete´$_w(x)$))($\lambda x \exists Y$ (Σ^Yfans´$_w(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y$ (greeted´$_w(x,y)$)))) $\wedge$ ^$p(w)$)

The LF in (78b) can be compositionally translated into a formula which can be (further) reduced to (78c). This is shown by the *semantic analysis tree* in (78d) below, which is structurally isomorphic to the LF representation in (78b). Each terminal node in the tree represents the meaning of some lexical element (or the meaning of some constituent the internal structure of which we want to take for granted). Each nonterminal node in the tree represents a more structured meaning which is the result of composing the meaning of one of its immediate daughters with the meaning of its other immediate daughter according to one of the rules of semantic composition specified above.[16]

(78) d B_x(every athlete´,$\mathscr{E}Y$ ($\uparrow\Sigma^Y$fans´$(Y) \mathbin{\underline{\wedge}} \uparrow|Y| = 3 \mathbin{\underline{\wedge}} \Delta^Y\uparrow$greeted´$(x,Y)$))

$\mathscr{E}very$ (λx ($\uparrow$athlete´(x)))(λx $\mathscr{E}Y$ ($\uparrow\Sigma^Y$fans´$(Y) \mathbin{\underline{\wedge}} \uparrow|Y| = 3 \mathbin{\underline{\wedge}} \Delta^Y\uparrow$greeted´$(x,Y)$)) (def 75i)

$\lambda p \lambda w$ (Every´(λx (athlete´$_w(x)$))($\lambda x \exists Y$ (Σ^Yfans´$_w(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y$ (greeted´$_w(x,y)$)))) $\wedge$ ^$p(w)$) (= 78c; cf. II in the Appendix)

every athlete´$_x$ ~~B_Y(three fans´,$\Delta^Y\uparrow$greeted´(x,Y))~~ (def 75i)

λP $\mathscr{E}Y$ ($\uparrow\Sigma^Y$fans´$(Y) \mathbin{\underline{\wedge}} \uparrow|Y| = 3 \mathbin{\underline{\wedge}}$ ^$P(Y)$)(λY ($\Delta^Y\uparrow$greeted´(x,Y)))

$\mathscr{E}Y$ ($\uparrow\Sigma^Y$fans´$(Y) \mathbin{\underline{\wedge}} \uparrow|Y| = 3 \mathbin{\underline{\wedge}} \Delta^Y\uparrow$greeted´$(x,Y)$)

(^ -cancellation, λ-conversion)

three fans´$_Y$ Δ^Y(λY ($\uparrow$greeted´(x,Y)))

$\Delta^Y\uparrow$greeted´(x,Y) (^ -cancellation, λ-conversion)

Δ^Y λu ($\uparrow$greeted´(u,Y))(x)

$\uparrow$greeted´(x,Y) (λ-conversion)

x $\lambda v \lambda u$ ($\uparrow$greeted´(u,v))(Y)

λu ($\uparrow$greeted´(u,Y)) (λ-conversion)

$\lambda v \lambda u$ ($\uparrow$greeted´(u,v)) Y

[16] Assume that Δ^Y combines with its sister constituent through some appropriately generalized version of Binding-In.

Just as much as the LF of (78a) can be compositionally translated into the logical representation in (78c), so can the LF of the typical donkey-sentence in (79a) (as presented in 79b) be compositionally translated into the logical representation in (79c). It is its strict allegiance to the Principle of Compositionality which makes Dynamic Semantics so different from other theories of the dynamics of meaning, most notably Discourse Representation Theory (DRT; cf. Kamp 1981; Kamp & Reyle 1993).

(79) a Most farmers who own a donkey beat it

b $[_{AgrSP}\ [_{DP}$ most farmers $[_{CP}$ who $[_{AgrOP}\ [_{DP}$ a donkey$]_y$ own $e_y]]]_x\ [_{VP}\ e_x$ beat $it_y]]$

c $\lambda p \lambda w$ (Most´(λx (farmer´$_w(x) \wedge \exists y$ (donkey´$_w(y) \wedge$ owns´$_w(x,y)$))) (λx (beats´$_w(x,y)$)) $\wedge\ \hat{}p(w)$)

In order to deal with donkey-anaphora as well as similar problems involving non-c-command anaphora in general, DRT postulates an additional level of representation called *Discourse Representation Structure* (DRS) in between syntax and semantics proper. Even though DRSs can be translated into some logical representation language in a strictly compositional fashion, the construction of these DRSs is not 'compositional' (that is, structure-preserving) in that the processing of new material may lead to substantial modifications of the DRSs that had already been built. Still, the relationship between Dynamic Semantics and DRT should be regarded as one between two intimate soulmates, as both theories share the conviction that meaning should be analyzed in terms of its potential to change the context. As a historical sidenote, Dynamic Semantics was originally invented by Groenendijk & Stokhof (1989,1990,1991) to explore the extent in which a theory of meaning with a strong commitment to Compositionality could attain the same level of success as DRT.

Apart from this difference in 'ideological' commitment, there is another, more salient distinction that catches the eye. One of the more important trademarks of DRT is that it represents singular and bare numeral indefinites as bound variables in the semantics. On such a view, an indefinite derives its quantificational force from whatever quantifier 'unselectively' binds it. If the indefinite is to receive existential force, a tacit existential quantifier will 'unselectively' bind it by means of an operation called Existential Closure. If the indefinite is to receive a quantificational force other than that of an existential quantifier, an overt quantificational expression (usually a Q-adverb) will 'unselectively' bind it, as in examples such as (80) and (81). *Unselective* binding in this context just means that the adicity of the arguments of the relevant quantifier is flexible, rather than fixed once and for all. Thus, in (80b), the (static and extensional) meaning of *usually* (i.e. Most´) relates two sets of individuals, whereas in (81b), it relates two sets of ordered pairs.

(80) a Usually$_x$, if a$_x$ man drinks, he$_x$ gets drunk

b Most´(λx (man´(x) $\wedge$ drinks´(x)))(λx (gets-drunk´(x)))

(81) a Usually$_{x,y}$, if a$_x$ cat sees a$_y$ mouse, he$_x$ attacks it$_y$
b Most´($\lambda x \lambda y$ (man´(x) $\wedge$ cat´(y) $\wedge$ sees´(x,y)))($\lambda x \lambda y$ (attacks´(x,y)))

In Dynamic Semantics, on the other hand, singular indefinites (and bare numeral indefinites, as we have argued above) are invariably represented as (restricted) existential quantifiers in the semantics, as the reader may have learned already from our preceding discussion. This raises the issue then how Dynamic Semantics can account for observations such as those in (80) and (81), which constitute one of the empirical cornerstones of DRT. Assuming for now that singular and bare numeral indefinites do act as bound variables in the semantics at times, we must find a way then of getting rid of the existential quantifier in terms of which these indefinites are interpreted.[17] Dekker (1990,1993a,b) has found an ingenious way in which this task might be accomplished. The present formulation of Dekker's solution (called Existential Disclosure for obvious reasons) is based on Chierchia (1995) (we will ignore intensions as they are irrelevant in the present context, a practice we will follow throughout):

(82) *Definition: Existential Disclosure (ED)*
$\underline{\lambda} x\ (\Phi) =_{def} \lambda x´\ (\Phi \mathbin{\underline{\wedge}} \uparrow x = x´)$ (where $x´$ is not free in Φ)

Let us see how ED might be of use to us in trying to account for the fact that (80a) can be interpreted in such a way that its truth-conditions come out as indicated in (80b) (but cf. footnote 17). Suppose (80a) can be compositionally translated into the logical representation in (83a).[18] By the definition of ED, (83a) is equivalent to (83b). The latter can be further reduced to (83c) on account of Fact 15, the basic law of Dynamic Semantics.

(83) a $\mathcal{M}ost$ ($\underline{\lambda} x$ ($\exists x$ ($\uparrow$man´(x) $\mathbin{\underline{\wedge}}$ $\uparrow$drinks´(x))))(λx ($\uparrow$gets-drunk´(x)))
b $\mathcal{M}ost$ ($\lambda x´$ ($\exists x$ ($\uparrow$man´(x) $\mathbin{\underline{\wedge}}$ $\uparrow$drinks´(x)) $\mathbin{\underline{\wedge}}$ $\uparrow x = x´$))(λx ($\uparrow$gets-drunk´(x))) (def. 82)

c $\mathcal{M}ost$ ($\lambda x´$ ($\exists x$ ($\uparrow$man´(x) $\mathbin{\underline{\wedge}}$ $\uparrow$drinks´(x) $\mathbin{\underline{\wedge}}$ $\uparrow x = x´$)))(λx ($\uparrow$gets-

[17] However, it is far fom obvious that this assumption is motivated on account of examples such as (80) and (81). Cf. the next chapter (section 3.4) for some discussion of the issues involved.

[18] Along the lines of what was said in footnote 2, coindexing *usually* with *a* must have the effect that the variable bound by the existential quantifier will be abstracted over by means of ED, as shown in (83a). The reader is referred to II in the Appendix to Chapter 4 for a discussion on how this can be accomplished by making use of Groenendijk & Stokhof's (1989) so-called *state-switchers*.

drunk´(*x*))) (Fact 15)

The following set of reductions essentially falls out from our definition of the dynamic determiner *Most*, as fixed through (36).

(83) d ⇑Most´(↓λ*x*´ (∃*x* (⇑man´(*x*) ∧ ⇑drinks´(*x*) ∧ ⇑*x* = *x*´)))(↓λ*x*´ (∃*x* (⇑man´(*x*) ∧ ⇑drinks´(*x*) ∧ ⇑*x* = *x*´)) ∧ λ*x* (⇑gets-drunk´(*x*))) (def. 36i)

e ⇑Most´(λ*x*´ (↓∃*x* (⇑man´(*x*) ∧ ⇑drinks´(*x*) ∧ ⇑*x* = *x*´)))(↓λ*x*´ (∃*x* (⇑man´(*x*) ∧ ⇑drinks´(*x*) ∧ ⇑*x* = *x*´) ∧ ⇑gets-drunk´(*x*´))) (def. 36ii and iii)

f ⇑Most´(λ*x*´ (↓∃*x* (⇑man´(*x*) ∧ ⇑drinks´(*x*) ∧ ⇑*x* = *x*´)))(λ*x*´ (↓∃*x* (⇑man´(*x*) ∧ ⇑drinks´(*x*) ∧ ⇑*x* = *x*´) ∧ ⇑gets-drunk´(*x*´))) (def. 36ii)

g ⇑Most´(λ*x*´ (∃*x* (man´(*x*) ∧ drinks´(*x*) ∧ *x* = *x*´)))(λ*x*´ (∃*x* (man´(*x*) ∧ drinks´(*x*) ∧ *x* = *x*´) ∧ gets-drunk´(*x*´))) (def. of ↓)

At this point, it is important to observe that the following proposition must hold (its proof is elementary; cf. III in the Appendix).

(84) *Fact*. λ*x*´ (∃*x* (P*x* ∧ *x* = *x*´)) ≡ λ*x*´ (P*x*´)

In the light of (84), we know that (83g) is equivalent to (83h) below. Observe finally that (83h) can be reduced to (83i) due to static Conservativity. The static component of (83i) is identical to (80b) above, as desired.

(83) h ⇑Most´(λ*x*´ (man´(*x*´) ∧ drinks´(*x*´)))(λ*x*´ (man´(*x*´) ∧ drinks´(*x*´) ∧ gets-drunk´(*x*´)))

i ⇑Most´(λ*x*´ (man´(*x*´) ∧ drinks´(*x*´)))(λ*x*´ (gets-drunk´(*x*´))) (Static Conservativity)

Naturally, one might wonder how one can distinguish between DRT and Dynamic Semantics with ED in its toolkit *vis à vis* their claims with respect the proper semantic analysis of simple indefinites. Despite appearances, however, the choice between these two perspectives on the semantics of simple indefinites may not be an entirely academic issue. As was already mentioned above, according to one of the most fundamental premisses of DRT, the quantificational force of an indefinite is determined by whatever quantifier 'unselectively' binds it. Chierchia (1995) points out that by extending this view to indefinites occurring in the restrictive clause of some determiner (cf. 85), as in 'classical' DRT, we no longer have a unified, cross-categorial account of conjunction at our disposal. On that account, a conjunction of expressions of some arbitrary type τ will be interpreted by means of Generalized Conjunction (GC), an operation which is defined for all types τ´.

(85) a Every$_{x,y}$ farmer$_x$ who owns a$_y$ donkey beats it$_y$

b ∀*x*,*y* (farmer´(*x*) ∧ donkey´(*y*) ∧ owns´(*x*,*y*) → beats´(*x*,*y*))

To see the issue at stake here, suppose we would want to compose the (static) meaning of the first DP-conjunct in (86a), as represented in (86b), with that of the second DP-conjunct, as represented in (86c), by means of GC. We will have a hard time in doing that, since the semantic type of the first conjunct (i.e. ⟨⟨e,⟨e,⟨e,t⟩⟩⟩,t⟩ -a set of sets of triples-) does not match that of the second (i.e. ⟨⟨e,⟨e,t⟩⟩,t⟩ -a set of sets of pairs-).

(86) a (every$_{x,y,z}$ -one$_x$ who borrowed a$_y$ paper from a$_z$ teacher) and (every$_{x,y}$ -one$_x$ who bought a$_y$ book at the bookstore)
b $\lambda R'$ ($\forall x,y,z$ (person$'(x) \wedge$ paper$'(y) \wedge$ teacher$'(z) \wedge$ borrowed$'$ (x,y,z) $\rightarrow R'(z)(y)(x)$))
c λR ($\forall x,y$ (person$'(x) \wedge$ book$'(y) \wedge$ bought-at-the-bookstore$'(x,y) \rightarrow R(y)(x)$))

In Dynamic Semantics, we would encounter no such problem as all DPs are assigned a uniform type, viz. the type of Dynamic Generalized Quantifier (i.e. ⟨⟨s,⟨e,cc⟩⟩,cc⟩ -a function from dynamic properties to CCPs; cf. section 2.3-). The meaning of the conjunction in (86a) can therefore be obtained through GC in a rather straightforward fashion, as demonstrated in (87).

(87) a GC(λP ($\subset\!\!\mathscr{A}x$ ($\uparrow$person$'(x)$ $\underline{\wedge}$ $\mathscr{E}y$ ($\uparrow$paper$'(y)$ $\underline{\wedge}$ $\mathscr{E}z$ ($\uparrow$teacher$'(z)$ $\underline{\wedge}$ $\uparrow$borrowed$'(x,y,z)$)) $\underline{\rightarrow}$ $\hat{}P(x)$)),$\lambda P'$ ($\subset\!\!\mathscr{A}x$ ($\uparrow$person$'(x)$ $\underline{\wedge}$ $\mathscr{E}y$ ($\uparrow$book$'$ (y) $\underline{\wedge}$ $\uparrow$bought-at-the-bookstore$'(x,y)$) $\underline{\rightarrow}$ $\hat{}P'(x)$)))) ≡
b λP ($\subset\!\!\mathscr{A}x$ ($\uparrow$person$'(x)$ $\underline{\wedge}$ $\mathscr{E}y$ ($\uparrow$paper$'(y)$ $\underline{\wedge}$ $\mathscr{E}z$ ($\uparrow$teacher$'(z)$ $\underline{\wedge}$ $\uparrow$borrowed$'(x,y,z)$)) $\underline{\rightarrow}$ $\hat{}P(x)$) $\underline{\wedge}$ $\subset\!\!\mathscr{A}x$ ($\uparrow$person$'(x)$ $\underline{\wedge}$ $\mathscr{E}y$ ($\uparrow$book$'(y)$ $\underline{\wedge}$ $\uparrow$bought-at-the-bookstore$'(x,y)$) $\underline{\rightarrow}$ $\hat{}P(x)$))

Concluding our presentation of a dynamic semantics, I would like to raise another issue in terms of which the aforementioned two views on the semantics of simple indefinites can be compared. In DRT, it is assumed that the interpretation of simple indefinites can be represented in terms of bound variables. The theory does not offer a principled answer to the question why the interpretation of other types of DPs cannot be represented in terms of bound variables. It seems to me that Dynamic Semantics is in a considerably better position to account for the observation that only simple indefinites sometimes act as bound variables in the semantics. This assessment is based on two observations. Firstly, it is easy to see that ED only yields sensible results in case the quantifier which is in need of disclosure is the existential quantifier. Only this type of quantifier is able to bind the relevant variable occurrence in the

equation-part of ED, thanks to its (externally) dynamic behavior. This observation already uniquely singles out simple indefinites as potential denoters of bound variables. Secondly, and more importantly, even if the world would be such that more quantifier-types turned out to be (externally) dynamic, the application of ED would still only yield sensible results in case its target is the existential quantifier. This is so since the fact in (84) holds regardless of the particular model in which natural language expressions are to be interpreted. However, if we would substitute any other quantifier for the existential quantifier in (84), the resulting statement will be contingent, true in some models but false in others.

Appendix to Chapter 2

I Adding Possible Worlds

In the following, we will discuss the consequences of redefining the type of *cc* as ⟨⟨s,p⟩,p⟩ for the underlying static logic. As the standard connectives and quantifiers are only defined for expressions of type *t*, we must extend their definitions so that they can apply to expressions of type *p* as well. This can be done by means of the following pointwise definition:

(1) If φ and χ are of type *p*, then:

a	$\varphi \wedge \chi$	$=_{def} \lambda w\ (\varphi(w) \wedge \chi(w))$
b	$\varphi \vee \chi$	$=_{def} \lambda w\ (\varphi(w) \vee \chi(w))$
c	$\neg\varphi$	$=_{def} \lambda w\ (\neg\varphi(w))$
d	$\varphi \rightarrow \chi$	$=_{def} \lambda w\ (\varphi(w) \rightarrow \chi(w))$
e	$\exists x\ \varphi$	$=_{def} \lambda w\ (\exists x\ \varphi(w))$
f	$\forall x\ \varphi$	$=_{def} \lambda w\ (\forall x\ \varphi(w))$
g	$\boldsymbol{D}(\lambda x\ (\varphi))(\lambda x\ (\chi))$	$=_{def} \lambda w\ (D(\lambda x\ (\varphi(w)))(\lambda x\ (\chi(w))))$

where *D* is of type ⟨⟨e,t⟩,⟨⟨e,t⟩,t⟩⟩ and ***D*** of type ⟨⟨e,p⟩,⟨⟨e,p⟩,p⟩⟩. Provided we remind ourselves of the fact that the underlying logic is now an intensional one of the sort just presented, we can keep to the various definitions of the dynamic connectives and quantifiers given in the main text.

II Proof

We will now show that (1a) and (78c) in the main text (repeated here as 1b) are logically equivalent.

(1) a $\mathscr{E}very\ (\ \lambda x\ (\uparrow \text{athlete}'(x)))(\ \lambda x\ (\mathscr{E}Y\ (\uparrow\Sigma^{Y}\text{fans}'(Y)\ \underline{\wedge}\ \uparrow|Y| = 3\ \underline{\wedge}\ \Delta^{Y}\uparrow\text{greeted}'(x,Y))))$

b $\lambda p\lambda w\ (\text{Every}'(\lambda x\ (\text{athlete}_w(x)))(\lambda x \exists Y\ (\Sigma^{Y}\text{fans}'_w(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y\ (\text{greeted}'_w(x,y)))) \wedge \hat{}p(w))$

We will first apply the various definitions in (36) to (1a), where it is understood that (36) defines dynamic quantificational determiners $\mathscr{D}$ in terms of their static, intensional counterparts ***D***.

(2) a $\mathscr{E}very\ (\ \lambda x\ (\uparrow \text{athlete}'(x)))(\ \lambda x\ (\mathscr{E}Y\ (\uparrow\Sigma^{Y}\text{fans}'(Y)\ \underline{\wedge}\ \uparrow|Y| = 3\ \underline{\wedge}\ \Delta^{Y}\uparrow\text{greeted}'(x,Y))))$

b $\uparrow\textbf{Every}'(\downarrow \lambda x\ (\uparrow\text{athlete}'(x)))(\downarrow \lambda x\ (\uparrow\text{athlete}'(x))\ \underline{\wedge}\ \lambda x\ (\mathscr{E}Y\ (\uparrow\Sigma^{Y}\text{fans}'(Y)$

$\underline{\wedge}\uparrow|Y| = 3 \underline{\wedge} \Delta^{Y}\uparrow\text{greeted}'(x,Y))))$ (def. 36i)

c $\uparrow\mathbf{Every}'(\downarrow \lambda x\,(\uparrow\text{athlete}'(x)))(\downarrow \lambda x\,(\uparrow\text{athlete}'(x) \underline{\wedge} \mathscr{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} \Delta^{Y}\uparrow\text{greeted}'(x,Y))))$ (def. 36iii)

We can simplify the second argument of **Every**′ as follows:

(3)

a $\uparrow\text{athlete}'(x) \underline{\wedge} \mathscr{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} \Delta^{Y}\uparrow\text{greeted}'(x,Y))$

b $\uparrow\text{athlete}'(x) \underline{\wedge} \mathscr{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} \mathscr{C}y \subseteq Y\,(\uparrow\text{greeted}'(x,y)))$ (def. 61)

c $\uparrow\text{athlete}'(x) \underline{\wedge} \mathscr{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} {\sim}\mathscr{E}y \subseteq Y\,{\sim}\uparrow\text{greeted}'(x,y))$ (def. of A)

d $\uparrow\text{athlete}'(x) \underline{\wedge} \text{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} {\sim}\text{E}y \subseteq Y\,(\uparrow\neg\downarrow\uparrow\text{greeted}'(x,y)))$ (def. of ~)

e $\uparrow\text{athlete}'(x) \underline{\wedge} \text{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} {\sim}\text{E}y \subseteq Y\,(\uparrow\neg\text{greeted}'(x,y)))$ ($\downarrow\uparrow$-cancellation)

f $\uparrow\text{athlete}'(x) \underline{\wedge} \text{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} {\sim}\lambda p\,(\exists y \subseteq Y\,(\neg\text{greeted}'(x,y) \wedge \check{}p)))$ (def. of E)

g $\uparrow\text{athlete}'(x) \underline{\wedge} \text{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \uparrow|Y| = 3 \underline{\wedge} \lambda p\,(\forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p))$ (def. of ~, duality of $\exists$ and $\forall$)

h $\uparrow\text{athlete}'(x) \underline{\wedge} \text{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \lambda p_1\,(\lambda p_2\,(|Y| = 3 \wedge \check{}p_2)(\,\lambda p\,(\forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p)(p_1))))$ (def. of $\uparrow$ and $\underline{\wedge}$)

i $\uparrow\text{athlete}'(x) \underline{\wedge} \text{E}Y\,(\uparrow\Sigma^{Y}\text{fans}'(Y) \underline{\wedge} \lambda p_1\,(|Y| = 3 \wedge \forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p_1))$ (λ-conversion, $\check{}$-cancellation)

j $\uparrow\text{athlete}'(x) \underline{\wedge} \text{E}Y\,(\lambda p\,(\Sigma^{Y}\text{fans}'(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p))$ (def. of $\underline{\wedge}$, def. of $\uparrow$)

k $\uparrow\text{athlete}'(x) \underline{\wedge} \lambda p\,(\exists Y\,(\Sigma^{Y}\text{fans}'(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p))$ (def. of E)

l $\lambda p\,(\text{athlete}'(x) \wedge \exists Y\,(\Sigma^{Y}\text{fans}'(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p))$ (def. of $\uparrow$ and $\underline{\wedge}$)

Thus, (2c) is equivalent to (2d), *w*hich can be further reduced as follo*w*s.[19]

(2)

d $\uparrow\mathbf{Every}'(\downarrow \lambda x\,(\uparrow\text{athlete}'(x)))(\downarrow \lambda x\lambda p\,(\text{athlete}'(x) \wedge \exists Y\,(\Sigma^{Y}\text{fans}'(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p)))$

e $\uparrow\mathbf{Every}'(\lambda x\,(\downarrow\check{}\,\lambda x\,(\uparrow\text{athlete}'(x))(x)))(\lambda x\,(\downarrow\check{}\,\lambda x\lambda p\,(\text{athlete}'(x) \wedge \exists Y\,(\Sigma^{Y}\text{fans}'(Y) \wedge |Y| = 3 \wedge \forall y \subseteq Y\,(\text{greeted}'(x,y)) \wedge \check{}p))(x)))$ (def. 36ii)

[19] As is standard, we will assume that the domain of individuals D is the same for all worlds, and that '=' denotes $\{\langle a,a\rangle: a \in D\}$ in all worlds. These two assumptions entail that $\lambda x\,(|x| \leq n)$, $\lambda x\,(|x| = n)$ and $\lambda x\,(|x| > n)$ (where $n > 0$, and x is a variable ranging over singular or plural individuals) denote the same set of sets in all worlds. In view of this, there is no need to index '|...|' (just like '=') with a world parameter.

f $\uparrow$**Every**´(λx (athlete´(x)))(λx (athlete´(x) $\wedge$ $\exists Y$ (Σ^Yfans´(Y) $\wedge$ $|Y| = 3 \wedge \forall y \subseteq Y$ (greeted´(x,y)))))
(λ-conversion, $\check{}$ -cancellation, $\downarrow\uparrow$-cancellation)

g $\uparrow$**Every**´($\lambda x \lambda w$ (athlete´$_w$(x)))(λx (λw (athlete´$_w$(x)) $\wedge$ $\exists Y$ ($\lambda w'$ (Σ^Yfans´$_{w'}$(Y)) $\wedge$ $|Y| = 3 \wedge \forall y \subseteq Y$ ($\lambda w''$ (greeted´$_{w''}$(x,y))))))
($R =_{def} \lambda x_1 ... \lambda x_n \lambda w$ ($R_w(x_1,...x_n)$))

h $\uparrow$**Every**´($\lambda x \lambda w$ (athlete´$_w$(x)))($\lambda x \lambda w$ (athlete´$_w$(x) $\wedge$ $\exists Y$ (Σ^Yfans´$_w$(Y) $\wedge$ $|Y| = 3 \wedge \forall y \subseteq Y$ (greeted´$_w$(x,y))))) (cf. 1 in I above)

i $\lambda p \lambda w$ (Every´(λx (athlete´$_w$(x)))($\lambda x \exists Y$ (Σ^Yfans´$_w$(Y) $\wedge$ $|Y| = 3 \wedge \forall y \subseteq Y$ (greeted´$_w$(x,y))) $\wedge$ $\check{}p(w)$) (def. **Every**´, $\uparrow$ and Conservativity)

We have thus established the equivalence of (1a) and (1b) above.

III An Important Fact

(1) *Fact*. λx ($\exists x'$ ($Px' \wedge x' = x$)) $\equiv$ λx (Px)

Proof. Taking the liberty of representing λ-abstracts as sets, we must show that $\{a$: $[\![\exists x'$ ($Px' \wedge x' = x$)$]\!]^{M,g[x/a]} = 1\} = \{a$: $a \in I(P)\}$. First, observe that $\{a$: $[\![\exists x'$ ($Px' \wedge x' = x$)$]\!]^{M,g[x/a]} = 1\} \subseteq \{a$: $a \in I(P)\}$. For suppose that that would not be the case. Then there is an a identical to a $b \in I(P)$ which is not in $I(P)$ itself. But since $a = b$, if $b \in I(P)$, $a \in I(P)$. Conversely, $\{a$: $a \in I(P)\} \subseteq \{a$: $[\![\exists x'$ ($Px' \wedge x' = x$)$]\!]^{M,g[x/a]} = 1\}$, for assume that this is not so. Then there is a $b \in I(P)$ such there is no $a \in I(P)$ which is identical to b. But since $\forall x$ ($x = x$), the latter is impossible. Therefore, we have shown that $\{a$: $[\![\exists x'$ ($Px' \wedge x' = x$)$]\!]^{M,g[x/a]} = 1\} = \{a$: $a \in I(P)\}$.□

3 Dynamic Binding across Weak Islands*

3.1 Introduction

We saw in the previous chapter that the meaning of various natural language expressions is rendered in Dynamic Semantics as an (externally) static function. In general, a function $\mathcal{F}$ (over some variable X) is called (externally) static just in case its meaning can be represented as $\lambda X\ (\uparrow F(\downarrow X))$. For instance, the translations we provided for sentence negation, the inherently distributive Q-NPs (such as *every student*, *most books*, *at least three goals* etc.), and Q-adverbs (such as *always*, *never*, *often* etc.) all adhered to this general form. The motivation behind this particular treatment of the meaning of these expressions is for a substantial part empirical: sentence negation, Q-NPs, and Q-adverbs all induce inaccessible domains for dynamic anaphora. That is, a simple indefinite locked up inside the syntactic scope of an expression which belongs to any of the former categories cannot bind a pronoun that occurs outside the syntactic scope of that expression. Consider now the table in (1).

(1) *Boolean and Dynamic Properties of Quantifiers*

	Examples	**Boolean Operations**	**Dynamic Properties**
Negation	*not*	complement	static
Universal Quantification	*every student*, *always*, ...	meet	static
Existential Quantification	*a man*, *three women*, ...	join	dynamic
Numerical Quantification	*most books*, *at least/most three goals*, *often*, ...	(at least) join and meet	static

*Parts of the material contained in this chapter appeared in Honcoop (1996a,b,1997a).

We thus observe a substantial overlap between the class of (externally) static functions on the one hand, and the class of those functions whose meaning is defined in terms of the Boolean operations meet and/or complement on the other, as discussed in Chapter 1. For example, the meaning of sentence negation is explicated in terms of Boolean complement, the meaning of the Q-NP *every student* is analyzed in terms of Boolean meet, and the meaning of the Q-adverb *at most three times* is defined in terms of all Boolean operations, viz. join, meet, and complement. We may furthermore recall from Chapter 1 that this class of functions correlates with Szabolcsi & Zwarts's (1993) notion of a *bad intervener* in Weak Island constructions. We may therefore reformulate our original observation as in (2) below.

(2) *Observation: Bad Interveners for Dynamic Anaphora and Extraction*
The notion of a bad intervener in Dynamic Semantics is (almost) coextensional with Szabolcsi & Zwarts's (1993) notion of a bad intervener in Weak Island constructions.

In view then of (2), one might naturally expect the following to hold: There is a set of constructions the sensitivity of which to Weak Islands calls for an analysis which characterizes bad interveners primarily in terms of their (external) statics. In this chapter, we will focus our attention on one such set of constructions, viz. the split constructions of Chapter 1 (cf. section 1.5 and immediately below). We will argue in this chapter that split constructions constitute the paradigm case for a dynamic, rather than an algebraic approach to Weak Islands.

3.1.1 Dynamic Binding across Weak Islands in Split Constructions

Let us briefly recapitulate the gist of a dynamic theory of Weak Islands, as outlined in Chapter 1. There, we observed that in many languages, it is possible to express the relation of a restrictive noun phrase to its quantificational determiner *Q* in a discontinuous fashion. The restrictive noun phrase that is adrift invariably appears as a simple indefinite (possibly preceded by a preposition). Such a relation may be schematized as in (3). We referred to all those constructions that exemplify (3) as *split constructions*. This term is intended to be neutral with respect to the issue whether or not the relation of the restrictive indefinite to *Q* should be explicated in terms of movement. We furthermore referred to the binding of the restrictive indefinite by the quantificational determiner *Q*, as expressed from now on by the sharing of some index *i* between *Q* and the indefinite determiner of the restrictive noun phrase, as *dynamic binding*.

(3) *Dynamic Binding in Split Constructions*

... [$_{\Phi}$ Q_i ... [$_{\Psi}$ X ... [$_{\text{indefinite}}$ D_i NP] ... $_{\Psi}$] ... $_{\Phi}$] ...

For example, it was tentatively claimed in section 1.5.1 that the infamous *wat voor*-split construction in Dutch, of which (3)´ provides an illustration, fits well our description of a split construction. Intuitively, the *wh*-determiner *wat* in (3)´ needs to bind the indefinite *een boek*, as the latter provides a restriction on the range of the former. The relation between the *wh*-determiner and the indefinite is obviously discontinuous in that the *wh*-determiner does not form a syntactic constituent with its restrictive noun phrase. We claimed furthermore that other types of constructions that can be analyzed along the lines of (3) include Negative Polarity, What On-split and partial *wh*-movement in German.

(3)´ Wat$_i$ heeft Jan voor een$_i$ boek gelezen?
What has Jan for a book read
"What kind of book did Jan read?"

Given the facts discussed in section 1.5, we argued that split constructions in general are subject to the following restriction: whenever an operator-expression which is known to create a Weak Island (such as negation, for instance) intervenes between the quantificational determiner and its indefinite restriction, as schematized in (4) (cf. also 27 in Chapter 1), the resulting structure is judged to be ill-formed, or at least severely degraded.

(4) *The Intervention Generalization*
*... [$_{\Phi}$ Q_i ... [$_{\text{Weak Island}}$ Operator ... [$_{\text{indefinite}}$ D_i NP] ...] ...] ...

This descriptive generalization was referred to as the *Intervention Generalization*. It is our task in this chapter to explain in some detail why it is that split constructions are subject to the Intervention Generalization.

As already anticipated in section 1.4, I will argue that the Intervention Generalization can be straightforwardly derived from the system of Dynamic Semantics as presented in the previous chapter. There, we observed that the well-known chameleontic nature of simple indefinites can be modelled in that theory by means of Existential Disclosure (ED), a strictly compositional procedure that allows us to address an indefinite as though it acts as a restricted variable in the semantics. Since the indefinite DP in structures such as (3) is quantified over by a quantificational determiner, we need to apply ED to it. This puts the Intervention Generalization inside the scope of Dynamic Semantics. ED requires the indefinite which is in need of disclosure to bind a variable which occurs outside of its syntactic scope. We therefore predict that any (semantically sensible) application of ED is conditioned by inaccessibility, a restriction which governs the well-formedness of anaphoric links between a variable expression and a non-c-commanding antecedent. Let us now tentatively strengthen the

empirical correlations established by our observation in (2) above, such as those between the Scope Island effects in (4) of Chapter 1 and the Inaccessibility effects in (34) and (49) of Chapter 2, into the following claim:

(5) *Claim: Weak Island Inducers are Inaccessibility Inducers*

The class of expressions that induce Weak Islands coincides with the class of expressions that create inaccessible domains for dynamic anaphora.

If claim (5) is correct, we have explained the Intervention Generalization: as ED cannot be (sensibly) applied in the relevant structures, the quantificational determiner is left without a proper restriction on its range. The relevant structures will therefore be ruled out on semantic grounds.

As for the correctness of claim (5), note that at this point it solely depends on two things: i) *Wh*-Islands and Presupposition Islands (the latter including Extraposition Islands, as explained in Chapter 1) create inaccessible domains for dynamic anaphora; and ii) all expressions which create inaccessible domains for dynamic anaphora also induce Weak Islands. Both these issues will be taken up in Chapter 4, where we will explore the connection between our dynamic approach to Weak Islands and Szabolcsi & Zwarts's (1993) algebraic account. Anticipating the outcome of that discussion, we will assume for now the validity of (5).

3.1.2 The Plan

This chapter is organized as follows. Two of the split constructions that were briefly discussed in section 1.5, viz. What For-split and Negative Polarity, will be treated much more thoroughly in sections 3.2 and 3.3 respectively. The intervention effects on both types of split constructions will be accounted for in dynamic terms along the lines sketched above. Each of these sections will be concluded by contrasting our dynamic approach with alternative proposals in the literature that are more or less problem-specific in that they are not primarily intended to apply to other types of constructions that exhibit the same range of intervention effects. We will conclude this chapter in section 3.4 by addressing an obvious caveat in the discussion up to that point: Does our account of the Intervention Generalization predict that cases that have been argued to involve 'unselective' binding (most notably, those that involve Q-adverbs) must observe the Intervention Generalization as well? In a certain sense it does, but we will argue that the potential heuristic and theoretical significance of this answer must not be overestimated, as other conceivable approaches to the semantics of Q-adverbs are as of yet too unclear in the relevant respects.

3.2 Dynamic Binding across Weak Islands: the Case of What For-Split

This section will focus on What For-split, with a special emphasis on its sensitivity to Weak Islands (WIs). This section will be organized as follows: in section 3.2.1, we will ponder the issue whether it is correct to analyze the indefinite remnant in What For-split as a restriction on the range of the *wh*-operator. We will argue that it is by pointing out some interesting syntactic and semantic similarities between What For-split and the pseudo-partitive construction *what kind of a N*. Our view will be contrasted with an alternative analysis of the semantics of What For-split, advocated by Beermann (1997) and Beck (1996), according to which the *wh*-operator in this type of construction quantifies over properties that modify the indefinite remnant. We will show that one of the observations this analysis cannot account for is the fact that only 'predicative' DPs can be licit heads of What For-phrases. To ensure that the indefinite remnant of What For-split is interpreted as a property restricting the range of the *wh*-operator, we will (re)introduce the operation of Existential Disclosure (ED) in section 3.2.2. From the perspective of trying to account for certain restrictions on What For-split constructions, ED has two interesting properties. Firstly, only externally dynamic quantifiers and operators can be existentially disclosed. On the basis of this property of ED, we can directly explain the fact that only 'predicative' DPs are licit heads of What For-phrases. This will be demonstrated in section 3.2.3. Secondly, ED cannot be (sensibly) applied across inaccessible domains for anaphor-binding. This second property of ED will give us a handle on the WI sensitivity of What For-split. Here is why. According to claim (5), the expressions which induce WIs all create inaccessible domains for dynamic anaphora. This, in conjunction with the fact that the quantified expressions which give rise to Weak (Scope) Islands necessarily take narrow scope with respect to a c-commanding *wh*-phrase, as will be established in section 3.2.4, allows us to account for the WI effects on What For-split on the basis of the same dynamic principles that derive inaccessibility. This will be shown in section 3.2.5. Finally, section 3.2.6 will conclude our discussion of What For-split from the point of view of the Intervention Generalization by comparing our dynamic account of the WI-sensitivity of this type of split construction with the one developed by de Swart (1992). We will argue that our account and de Swart's are highly compatible. In fact, the dynamic approach should be viewed as an attempt to derive the fundamental premiss on which de Swart's account is based from independently motivated principles of Dynamic Semantics.

3.2.1 Quantification over Kinds or Properties?

Recall that we already commented in section 1.5 on the theory-laden content of the notion of split construction. As we have defined this notion in the

Introduction to this chapter, the characteristic property of a split construction is that a quantificational determiner *Q* needs to bind an indefinite noun phrase as its restriction, even though it does not form a constituent with it. By describing What For-split as a split construction, we are therefore committed to the view that the indefinite remnant in this type of construction is interpreted as a restriction on the range of the *wh*-operator. More specifically, in this section, we will defend the claim that the indefinite remnant of What For-split denotes a property which restricts the kind-variable quantified over by the *wh*-operator. Thus, assuming Karttunen's (1977) approach to the semantics of interrogatives according to which an interrogative denotes the set of all its true answers, our analysis will ascribe the (static) meaning represented in (6b) to the What For-interrogative in (6a).[1]

(6) a Wat heeft Jan voor een boek gelezen?
"What kind of book did Jan read?"
b $\lambda p \exists \kappa\, (p(w) \wedge p = \lambda w'\, (\text{kind-of-book}'_{w'}(\kappa) \wedge \text{read}'_{w'}(\text{jan}', \kappa)))$

Some notes of clarification concerning the representation in (6b) may be in order. Here, we analyzed the meaning of the remnant *voor een boek* as a set of subkinds of books. That is, *voor een boek* → (translates as) kind-of-book´, where kind-of-book´ stands short for $\lambda\kappa\lambda w \forall x \forall w' \sim w\, (\text{R}_{w'}(x, \kappa) \rightarrow \text{book}'_{w'}(x))$.[2] '~' is the so-called *accessibility relation* between possible worlds familiar from modal logic and *R* is Carlson's (1977) *realization relation* which holds between 'ordinary' individuals and kinds. Thus, (6b) denotes in the actual world *w*, for some κ, the set of all propositions which state that Jan read a κ kind of book. This captures the meaning of the What For-interrogative in (6a) on a *de dicto* reading of *voor een boek* reasonably well.

Our account of the semantics of What For-interrogatives is inspired by Carlson's (1977) account of the kind-interpretation of the pseudo-partitive construction *what kind of book*, with which What For-phrases share some interesting syntactic properties as well. Carlson represents the kind-interpretation of this type of pseudo-partitive as in (7) below (cf. also Wilkinson 1995). Note the similarity between (7) and our analysis of the semantic contribution of the indefinite remnant in (6a).

[1] A *de re* construal for the indefinite remnant can be obtained by indexing kind-of-book´ with *w*, where *w* stands for the actual world. In the following, we will abstract away from *de re* versus *de dicto* readings of the indefinite remnant of What For-split. We will furthermore abstract away from certain issues that arise in connection with the way in which verbs such as *read* can predicate properties of kinds. Cf. Carlson (1977) for extensive discussion of these issues.

[2] In view of the fact that the preposition *voor* in the Dutch What For-interrogatives is semantically inert, we may represent its meaning as the identity function $\lambda x\, (x)$. The meaning of the indefinite remnant *voor een boek* can then be compositionally determined as follows: for´(kind-of-book´) = $\lambda x\, (x)$(kind-of-book´) = kind-of-book´.

(7) $\lambda P \exists \kappa\, (\forall x \forall w' \sim w\, (\mathrm{R}_{w'}(x, \kappa) \rightarrow \mathrm{book}'_{w'}(x)) \wedge P_w(\kappa))$

Apart from the fact that What For-phrases and the *what kind of* N-construction display similar semantic properties, there are some striking similarities in their syntactic behavior as well, as observed by Bennis *et al*. (1996). For example, there exists a variant on both types of construction in which the modifier-expression follows the head noun, as illustrated in (8) below. To account for these pairs, Bennis *et al*. argue that the first member of each pair in (8) below is derived from the same structure which underlies the second member by means of DP-internal Predicate Movement, an operation which inverts the basic order head noun + modifier-expression. Even though nothing much hinges on this from our present point of view, we will adopt Bennis *et al*.'s position with respect to the syntax of both constructions for clarity's sake. Another point of syntactic similarity between What For-phrases and the pseudo-partitive *what kind of* N-construction concerns the type of noun phrase which can be modified in the 'inverted' structure. We already remarked above that only 'predicative' noun phrases may head What For-phrases. As observed by Wilkinson (1995) and suggested by facts such as those in (9), where the examples on the right provide the English translations of the examples on the left, the same class of noun phrases is singled out as licit heads in the *what kind of* N-construction.[3]

(8)
a wat voor een kerel - een kerel als wat
"what for a guy" "a guy as what" (i.e. 'quite a guy')
b what/a kind of a guy - a guy of a/what kind

(9)

wat voor boek	-	*what kind of book*
wat voor een boek	-	*what kind of a book*
wat voor boeken	-	*what kind of books*
**wat voor de meeste boeken*	-	**what kind of most books*
**wat voor elk boek*	-	**what kind of every book*
**wat voor dat boek*	-	**what kind of that book*
**wat voor het/de boek(en)*	-	**what kind of the book(s)*

In view of their parallel DP-internal syntax and semantics, we prefer a unified analysis of What For-phrases and the *what kind of* N-construction. This implies an account of the semantics of What For-interrogatives in terms of quantification over kinds, rather than properties.

Now, contrast such an account with the one developed by Beck (1996) (cf.

[3] Cf. section 3.2.3 for a more thorough discussion of the class of licit heads in the *wat voor*-construction.

also Beermann 1997). On her analysis, the *wh*-operator in What For-interrogatives quantifies over properties that modify the indefinite remnant. This account would ascribe the meaning represented in (10) below to the What For-interrogative in (6a). (10) denotes in the actual world *w*, for some property *P*, the set of all propositions which state that Jan read a book that has property *P*.[4] It is fair to say that Beck's (1996) account seems to capture the meaning of What For-interrogatives just as well as ours, as represented in (6b) above.

(10) $\lambda p \exists P\ (p(w) \wedge p = \lambda w' \exists y\ (P_{w'}(y) \wedge \text{book}'_{w'}(y) \wedge \text{read}'_{w'}(\text{jan}',y)))$

The reason why it is difficult to distinguish between (6b) and (10) in terms of their truth-conditions resides in the more general fact that the property-referring use of a nominal predicate is intimately related to its kind-referring use. In fact, as pointed out by Krifka *et al.* (1995), we can define the property-referring use δ_p of a common noun δ in terms of its kind-referring use δ_k; i.e. $\delta_p = \lambda x\ (R_w(x,\delta_k))$, where *R* is Carlson's realization relation. And likewise, we can easily define δ_k in terms of δ_p: $\delta_k = \iota x \forall y\ (\delta_p(y) \leftrightarrow R_w(y,x))$.

Still, there are good reasons to favor our account of the semantics of What For-interrogatives, which relies on quantification over kinds, over the one advocated by Beck (1996), which involves quantification over properties, apart from the parallel we already noted between What For-phrases and the pseudo-partitive *what kind of* N. First of all, on the approach taken by Beck, one must make heavy use of Reconstruction in the context of non-split What For-interrogatives, on pains of ascribing the wrong semantics to simple cases such as (11a).[5] If we take the LF-representation of this sentence to be as in (11b), where no Reconstruction has taken place, we compositionally obtain an interpretation (as represented in 11c) on which we would expect *War and Peace* to be a possible answer to the question posed by (11a), contrary to fact.[6] On our approach to the semantics of What For-interrogatives, however, no such Reconstruction is needed, as (11b) can be compositionally translated into (12), which captures the intended reading of (11a).[7]

(11) a Wat voor een boek heeft Jan gelezen?
"What kind of book did Jan read?"

[4] The properties quantified over would somehow have to be severely contextually restricted, assuming we do want to exclude irrelevant answers to (6a) such as 'Een boek' ("a book").

[5] In fact, this problem was already acknowledged by Beck (1996).

[6] Of course, this answer becomes perfectly acceptable only if *War and Peace* can be considered a representative example of a particular type of book.

[7] Cf. Appendix I for how Hamblin/Karttunen-denotations of interrogatives can be compositionally derived.

b $[_{CP}\ [_{DP}$ wat voor een boek$]_y$ heeft $[_{AgrSP}$ Jan $[_{AgrOP}\ t_y$ gelezen$]]]$
c $\lambda p \exists P \exists y\ (P_w(y) \wedge \text{book}'_w(y) \wedge p(w) \wedge p = \lambda w'\ (\text{read}'_{w'}(\text{jan}',y)))$

(12) $\lambda p \exists \kappa\ (\text{kind-of-book}'_w(\kappa) \wedge p(w) \wedge p = \lambda w'\ (\text{read}'_{w'}(\text{jan}',\kappa)))$

Secondly, an analysis of the semantics of What For-interrogatives in terms of quantification over properties does not impose any restrictions on the class of noun phrases that might constitute a licit remnant of What For-split. For example, there is clearly nothing wrong with the meaning represented by (13b) below. However, the What For-interrogative the meaning of which it intends to express is ill-formed, as demonstrated in (13a).

(13) a *Wat heeft Jan voor de meeste boeken gelezen?
b $\lambda p \exists P\ (p(w) \wedge p = \lambda w'\ (\text{Most}'\ (\lambda x\ (P_{w'}(x) \wedge \text{book}'_{w'}(x)))$
$\lambda x\ (\text{read}'_{w'}(\text{jan}',x)))))$

It appears that the class of DPs that constitute licit remnants of What For-split consists of the so-called 'predicative' DPs; i.e. those DPs that can denote properties such as singular common nouns, bare plurals, and singular and plural 'simple' indefinites (cf. the next section for more discussion on this). This restriction on what counts as a proper remnant of What For-split falls out naturally from our account. Since we analyze the indefinite remnant of What For-split as a property-denoting expression which restricts the kind-variable quantified over by the *wh*-operator, it will follow that only 'predicative' DPs constitute licit remnants.

A third, and final, reason to adopt a kind-based approach to the semantics of What For-interrogatives is that it directly facilitates an account of the sensitivity of What For-split to WIs, as will be shown in section 3.2.5. As was already pointed out by Beck (1996), the same cannot be said of an analysis of What For-interrogatives which relies on quantification over properties. On Beck's approach, WI effects on split constructions in general derive from the fact that i) the floated-off restriction must raise at LF to join its associated operator, and ii) WI contexts define syntactic barriers for this type of LF movement. Such an approach leaves the WI sensitivity of What For-split unaccounted for, as we already observed in connection with (11) above that an analysis of What For-interrogatives in terms of quantification over properties entails that the *wh*-operator must be separated from its restriction at LF.

Concluding this subsection then, we have seen that there are good reasons to prefer an analysis of the semantics of What For-interrogatives which relies on quantification over kinds, rather than quantification over properties. This means that our earlier assessment of What For-split as providing an example of a split construction was correct. In this type of construction, a *wh*-operator needs

to bind an indefinite DP as its restriction, even though it does not form a constituent with it.

3.2.2 Applying Existential Disclosure in What For-Interrogatives

There is an interesting tension between the general claim of Dynamic Semantics that simple indefinites invariably denote restricted existential quantifiers, and our specific claim that the indefinite remnant of What For-split denotes a property restricting the range of the *wh*-operator. How can this tension be resolved? We may recall from our discussion in Chapter 2 that Dynamic Semantics offers a compositional procedure by means of which existential quantification can be dissolved in the semantics. This procedure is called Existential Disclosure. We repeat its definition in (14) for convenience.

(14) *Definition: Existential Disclosure (ED)*

$\underline{\lambda}x\,(\Phi) =_{def} \lambda x'\,(\Phi \mathbin{\underline{\wedge}} \uparrow x = x')$ (where x' is not free in Φ)

To keep the discussion in this and the coming sections maximally simply, we will assume that *wh*-interrogatives denote (the characteristic functions of) sets of objects, rather than sets of propositions as on Karttunen's (1977) account. On this assumption, the static meaning of the What For-interrogative in (15a) for example will be represented as in (15b) (where kind-of book$'_w$ = $\lambda\kappa\forall x\forall w' \sim w$ ($R_w(x, \kappa) \rightarrow$ book$'_{w'}(x)$)). This view yields a straightforward characterization of the notion of a true answer α: α constitutes a true answer to a question Q just in case the characteristic function associated with Q yields the value True when applied to α.

(15) a Wat heeft Jan voor een boek gelezen?
"What kind of book did Jan read?"

b $\lambda\kappa$ (kind-of-book$'_w(\kappa) \wedge$ read$'_w$(jan$', \kappa$))

c $\lambda\kappa$ ($\uparrow$kind-of-book$'(\kappa) \mathbin{\underline{\wedge}} \uparrow$read$'$(jan$', \kappa$))

In a dynamic setting, the meaning of a *wh*-interrogative will be analyzed accordingly as a function from individuals to CCPs, as illustrated for (15a) in (15c). Thus, both the static and the dynamic view on the semantics of *wh*-interrogatives entail in the present set-up that the meaning of a *wh*-determiner can be represented as a λ-operator. It should be stressed though that the conclusions reached in this and the coming sections do not hinge on our present analysis of the meaning of *wh*-interrogatives. In II in the Appendix to this chapter, we will provide a dynamic semantics for *wh*-interrogatives which is directly based on a more conventional approach to the semantics of interrogatives, i.e. the one developed by Karttunen (1977). The analysis of What For-interrogatives that we will present in this and the coming sections can be

easily reformulated in terms of this alternative account of the dynamics of questions.

Having clarified our position with respect to how a semantics for *wh*-interrogatives might look like in a dynamic setting, we now turn to an illustration of ED in the context of What For-interrogatives. Consider the simple What For-split construction in (15a), repeated as (16a). Bearing the conclusions of section 3.2.1 in mind, we propose to interpret the given indexing in terms of ED as indicated in (16b). That is, the effect of index-sharing between the *wh*-operator and the indefinite determiner of the remnant DP will be that the variable quantified over by the (interpretation of the) indefinite remnant is dynamically abstracted over by means of ED.[8] In accordance with the terminology fixed in 3.1.1, we will henceforth say that in constructions such as (16a), the *wh*-operator *wat* 'dynamically binds' the indefinite remnant. We will show in this section how ED affords an interpretation of the indefinite remnant of What For-split on which it denotes the property of being a subkind of books.

(16)
a Wat$_\kappa$ heeft Jan voor een$_\kappa$ boek gelezen?
"What kind of book did Jan read?"
b $\underline{\lambda}\kappa\,(\mathfrak{E}\kappa\,(\uparrow\text{kind-of-book}'(\kappa) \mathbin{\underline{\wedge}} \uparrow\text{read}'(\text{jan}', \kappa)))$

By applying the definition of ED, which we had repeated in (14) above for convenience, we can reduce (16b) as follows:[9]

(17)
a $\lambda\kappa'\,(\mathfrak{E}\kappa\,(\uparrow\text{kind-of-book}'(\kappa) \mathbin{\underline{\wedge}} \uparrow\text{read}'(\text{jan}', \kappa)) \mathbin{\underline{\wedge}} \uparrow\kappa = \kappa')$
b $\lambda\kappa'\,(\mathfrak{E}\kappa\,(\uparrow\text{kind-of-book}'(\kappa) \mathbin{\underline{\wedge}} \uparrow\text{read}'(\text{jan}', \kappa) \mathbin{\underline{\wedge}} \uparrow\kappa = \kappa'))$(Fact 2.15) ≡
c $\lambda\kappa\,(\uparrow\text{kind-of-book}'(\kappa) \mathbin{\underline{\wedge}} \uparrow\text{read}'(\text{jan}', \kappa))$ (= 15c)

The equivalence of (17b) and (17c) follows from a generalization of Fact 84 in Chapter 2. Since (17c) is equivalent to (15c), we may conclude that ED allows us to address the indefinite remnant of What For-split as though it denotes the property of being a subkind of books, restricting the range of the *wh*-operator. This is as desired.

Stepping back now from the technical details of our analysis of the semantics of What For-split constructions, let us have a closer look at the operation which is so pivotal in our account: ED. Given its formulation in (14) above, we can identify at least one condition that must be fulfilled by any

[8] This is identical to our proposal in section 2.5 with respect to how to interpret the indexing in *Ususally$_x$, if a$_x$ man drinks, he$_x$ gets drunk.* Cf. II in the Appendix to Chapter 4 for a detailed discussion on the exact way in which coindexing some operator with an indefinite determiner can be made to correspond with abstraction over the index of the indefinite determiner through ED.

[9] From now on, whenever we want to refer to a definition or fact (x) in Chapter X, we do this by having the number of the chapter precede the number of the definition or fact, as in (X.x).

(semantically sensible) application of ED: Φ must contain a quantifier which can bind a variable (i.e. *x* on the right-hand side of Definition 14) which occurs outside of its syntactic scope. This predicts first of all that only 'simple' indefinites (i.e. bare singular indefinites, such as *a man*, and plural bare numeral indefinites, such as *three books*) can be existentially disclosed, as only these expressions denote externally dynamic (existential) quantifiers which can bind variables that occur outside of their syntactic scope. This prediction enables us to account for the observation that only 'predicative' DPs are licit remnants of What For-split, as we will show in the next subsection. Secondly, it is predicted that the quantifier which is in need of disclosure cannot occur inside the scope of an externally static operator (such as negation) which does not have scope over the variable introduced by ED (again, *x* on the right-hand side of Definition 14). This is so since an existential quantifier cannot extend its syntactic scope beyond that of an externally static operator which c-commands the existential quantifier. For example, we may recall Fact 18 of Chapter 2, repeated here as (18), which states that the dynamic potential of any quantifier in Φ will be destroyed when Φ is c-commanded by negation.

(18) $\sim (\Phi) \barwedge \chi \not\equiv \sim (\Phi \barwedge \Psi)$ (Fact 2.18)

This second prediction suggests an explanation for the WI-sensitivity of What For-split, as we will see in sections 3.2.4 and 3.2.5.

3.2.3 Predicative DPs in What For-Interrogatives

We already observed in section 3.2.1 that not every DP constitutes a licit head of a What For-phrase. We tentatively identified the class of licit heads as the class of 'predicative' DPs. That is, singular common nouns (count or mass; cf. 19a,b below), bare plurals (possibly preceded by an occurrence of the 'spurious' article *een*; cf. Bennis *et al*. 1996 and 19c,d below), bare singular indefinites (cf. 19e below), and (somewhat marginally) 'simple' plural indefinites (plural bare numeral indefinites; cf. 19f below) can all head (split) What For-phrases.

(19) a Wat (voor boek) heeft Jan (voor boek) gelezen?
What (for book) has Jan (for book) read
"What kind of book did Jan read?"

b Wat (voor bier) heeft Jan (voor bier) besteld?
What (for beer) has Jan (for beer) ordered
"What kind of beer did Jan order?"

c Wat (voor boeken) heeft Jan (voor boeken) gelezen?
What (for books) has Jan (for books) read
"What kind of books did Jan read?"

d Wat (voor een boeken) heeft Jan (voor een boeken) gelezen?

What (for a books) has Jan (for a books) read
"What kind of books did Jan read?"

e Wat (voor een boek) heeft Jan (voor een boek) gelezen?
What (for a book) has Jan (for a book) read
"What kind of a book did Jan read?"

f ?Wat (voor drie boeken) heeft Jan (voor drie boeken) gelezen?
What (for three books) has Jan (for three books) read
"What sort of three books did Jan read?"

Note that there is also another way of describing the class of licit heads of What For-phrases. All the 'strandable' DPs listed in (19) can support cross-sentential (and donkey-) anaphora; i.e they all denote externally dynamic quantifiers in the sense of Chapter 2. We have already commented extensively on this property in connection to bare singular indefinites and plural bare numeral indefinites. Now, the singular count noun which appears in (19a) for example might be analyzed on a par with the singular indefinite in (19e) if we assume, along with Bennis *et al*. (1996), that singular count noun heads of What For-phrases are licensed by a $\varnothing$-allomorph of the indefinite article *een*. The remaining class of DPs (i.e. mass nouns and bare plurals -possibly preceded by 'spurious' *een*-) must denote externally dynamic quantifiers as well, in view of the well-formed anaphoric dependencies illustrated in (20).[10]

(20)
a There is $\varnothing_x$ water in the tank. You can use it$_x$ for the garden (but not all of it).
b If John has $\varnothing_x$ quarters, he'll put them$_x$ in the slot machine (though perhaps not all of them).

The well-formed What For-interrogatives in (20) should be contrasted with the ill-formed ones in (21) below. The only relevant difference between these two sets of constructions is that in the latter, the DPs preceded by the preposition *voor* cannot support cross-sentential (or donkey-) anaphora. That is, these DPs denote the externally static (generalized) quantifiers of Chapter 2.

(21)
a *Wat (voor elk boek) heeft Jan (voor elk boek) gelezen?
What (for every book) has Jan (for every book) read
b *Wat (voor de meeste boeken) heeft Jan (voor de meeste boeken) gelezen?
What (for most books) has Jan (for most books) read
c *Wat (voor minstens drie boeken) heeft Jan (voor minstens drie

[10] It is assumed here that bare mass nouns and bare plurals are licensed by an empty determiner. Furthermore, as shown by the additions between brackets, the pronouns in (20) can clearly have a non-maximal reference. This is important, since if such pronouns necessarily have maximal reference, their interpretation is not fixed through 'ordinary' binding but rather through some other strategy instead (cf. section 2.4). Thanks to Anna Szabolcsi for discussing this issue in connection with these examples.

boeken) gelezen?
What (for at least three books) has Jan (for at least three books) read

d *Wat (voor hoogstens drie boeken) heeft Jan (voor hoogstens drie boeken) gelezen?
What (for at most three books) has Jan (for at most three books) read

Our analysis of the semantics of What For-split interrogatives, which we presented in the preceding section, provides a straightforward account of the contrast between (19) and (21). As the DP heads of the What For-phrases in (19) denote externally dynamic quantifiers (ranging over subkinds of books), they can be existentially 'disclosed' by means of ED. Thus, these indefinite DPs can be properly interpreted as a restriction on the range of the *wh*-operator, as illustrated for (19f), repeated below as (22), in (23). Note that the equivalence of (23a) and (23b) can be demonstrated in a similar fashion as the equivalence of (17a) and (17c) discussed in the preceding section.

(22) ?Wat (voor drie boeken) heeft Jan (voor drie boeken) gelezen? (cf. 19f)

(23)
a $\underline{\lambda}\kappa\,(\mathcal{E}\kappa\,(\uparrow\lambda w\forall X\forall w'\sim w\,(\mathrm{R}_{w'}(X,\kappa) \rightarrow \Sigma^{X}\mathrm{books}'_{w'}(X) \wedge |X| = 3) \mathbin{\underline{\triangle}} \uparrow\mathrm{read}'(\mathrm{jan}',\kappa)))$

b $\lambda\kappa\,(\uparrow\lambda w\forall X\forall w'\sim w\,(\mathrm{R}_{w'}(X,\kappa) \rightarrow \Sigma^{X}\mathrm{books}'_{w'}(X) \wedge |X| = 3) \mathbin{\underline{\triangle}} \uparrow\mathrm{read}'(\mathrm{jan}',\kappa))$

We could attribute the oddity of (19f), the (dynamic) meaning of which (23b) intends to express, to the fact that it is hard to construct kinds whose realizations are packaged in groups of three members. Observe in this respect also the slightly marked status of the pseudo-partitive *what kind(s) of three books* in English.

Given the fact that the DP heads of the What For-phrases in (21) denote externally static (generalized) quantifiers, an application of ED in these cases will not result in an interpretation on which the remnant DP properly restricts the range of the *wh*-operator. Let us illustrate this point for (21a) above. The dynamic question corresponding to this sentence is represented in (24a) below (where, again, $\text{kind-of-book}'(\kappa) = \lambda w\forall x\forall w'\sim w\,(\mathrm{R}_{w'}(x,\kappa) \rightarrow \mathrm{book}'_{w'}(x))$). Here, we see that the dynamic generalized quantifier corresponding to the remnant *voor elk boek* in (21a) quantifies over subkinds of books. By working out all the definitions implicit in the definition of dynamic quantificational determiners (cf. definition 2.36) and applying the definition of ED, (24a) eventually reduces to (24b).

(24) a $\underline{\lambda}\kappa\,(\mathcal{E}_{very}\,(\,\lambda\kappa\,(\uparrow\text{kind-of-book}'(\kappa)))(\,\lambda\kappa\,(\uparrow\mathrm{read}'(\mathrm{jan}',\kappa)))) \quad \equiv$

b $\lambda\kappa'\lambda p\lambda w\,(\forall\kappa\,(\text{kind-of-book}'_{w}(\kappa) \rightarrow \mathrm{read}'_{w}(\mathrm{jan}',\kappa)) \wedge \underline{\kappa} = \kappa' \wedge {}^{\vee}p(w))$

Crucially, the kind-variable κ in (24b) which has been introduced by ED (i.e. the underlined occurrence of κ) appears outside the scope of the universal quantifier that interprets *voor elk boek*. This is just a reflection of the fact that (dynamic) generalized quantifiers are externally static, and as such unable to bind the relevant variable introduced by ED. Therefore, we may conclude that the pertinent DP head of the What For-phrase cannot be interpreted as a property restricting the range of the *wh*-operator. In fact, we can draw a conclusion which is even stronger than that. Recall Fact (2.19), according to which any formula in Dynamic Semantics which contains a free variable does not receive any interpretation. It is repeated in (25) for our convenience.

(25) *Fact*. $[\![\Phi]\!]^{\circ} = \perp$, if Φ contains a free variable.

Since (25) directly entails that (24b) does not have a well-defined interpretation, we have thus accounted for the ill-formedness of (21a), as well as all the other examples in (21), in terms of Dynamic Semantics.

3.2.4 Scope, Inaccessibility and Dynamic Semantics

We may recall that we concluded our discussion of ED and What For-split in section 3.2.2 by deriving two distinctive properties of ED on the basis of its formulation in (14) above. Firstly, ED can only 'disclose' externally dynamic quantifiers. On the basis of this property, we derived certain restrictions on what counts as a proper head of a What For-phrase in the preceding section. Secondly, ED does not yield the intended semantic result if the referential dependency between the quantifier which needs to be 'disclosed' and the variable introduced by ED (i.e. x on the right-hand side of the equation in 14) crosses an inaccessible domain for anaphor-binding. On the basis of this second property of ED, we can account for the sensitivity of What For-split to WIs. Consider the type of situation as schematically represented in (26).

(26) a $\underline{\lambda}i\ (_{\Phi}\ldots(_{\Psi}\ X'\ldots \text{for}'(\text{indefinite}'_i)\ \ldots{}_{\Psi})\ldots{}_{\Phi})$
b $\lambda j\ ((_{\Phi}\ldots(_{\Psi}\ X'\ldots \text{for}'(\text{indefinite}'_i)\ldots{}_{\Psi})\ldots{}_{\Phi}) \mathbin{\underline{\triangle}} \uparrow i = j)$ (def. of ED)

where *X* creates an inaccessible domain for non-c-command anaphora. Due to the intervening *X*, the variable *i* which has been introduced by ED cannot be bound by the dynamic existential quantifier denoted by the indefinite. Thus, this occurrence of *i* remains free. Since free variables cannot be assigned any value in Dynamic Semantics (cf. 25), (26) will be ruled out on account of the fact that it cannot be given a well-defined interpretation.

Recall now claim (5) in the Introduction to this chapter according to which the class of expressions which create inaccessible domains for dynamic anaphora coincides with the class of expressions which induce WI effects.

Given this observation, the second property of ED entails that we can derive the WI effects on What For-split on the basis of the same principles of Dynamic Semantics that account for inaccessibility. Note that there is one important issue that needs to be settled before we can pursue this line of reasoning. Since (26) concerns logical representations, rather than 'surface' syntactic representations, we need to be sure that *X* does not take scope over the *wh*-operator in What For-split constructions. This issue will be addressed in the rest of this subsection.

Of the various expressions which create inaccessible domains for anaphor-binding, it is fairly obvious that negation and those predicates that induce *Wh*-Islands, and/or Presupposition Islands cannot take scope over a *wh*-phrase in general. From this, it follows that the same expressions cannot take scope over the *wh*-operator in What For-split constructions either. It may be less obvious to see that the 'inherently distributive' Q-NPs and Q-adverbs too cannot take scope over a *wh*-phrase in matrix contexts, i.e. that these expressions fail to support so-called *Pair-List* (PL) readings. However, it has recently been argued by Beck (1996), Beghelli (1997) and Szabolcsi (1997b) among others that only universal, distributive Q-NPs can support PL-readings in matrix interrogatives in languages such as German and English.[11] The same generalization appears to hold for Dutch as well, as suggested by the facts in (27-29).

(27) *Q*: Welk boek heeft elke student gelezen? (? PL)
"Which book did every student read?"
A: ?Jan heeft *Nooit Meer Slapen* gelezen, Peter de *Max Havelaar*, ...
"Jan read *Nooit Meer Slapen*, Peter read the *Max Havelaar*, ... "

(28) a *Q*: Welk boek hebben minstens/meer dan drie studenten gelezen? (* PL)
"Which book did at least/more than three students read?"
A: *Jan heeft *Nooit Meer Slapen* gelezen, Peter de *Max Havelaar*, Marie *Een Vlucht Regenwulpen*, ...

b Welk boek hebben de meeste studenten gelezen? (* PL)
"Which book did most students read?"

c Welk boek hebben precies drie studenten gelezen? (* PL)
"Which book did exactly three studens read?"

d Welk boek hebben hoogstens/minder dan drie studenten gelezen? (* PL)
"Which book did at most/less than three students read?"

e Welk boek heeft geen enkele student gelezen? (* PL)
"Which book did no student read?"

(29) a *Q*: Welk boek wil Jan altijd lezen? (* PL)
"Which book does Jan always want to read?"
A: *Jan wil *Nooit Meer Slapen* op maandag lezen, *Een Vlucht Regenwulpen* op dinsdag, ...

[11] The interesting behavior of universal, distributive Q-NPs in What For-split constructions will be discussed at length in the following subsection.

"Jan wants to read *Nooit Meer Slapen* on Monday, *Een Vlucht Regenwulpen* on Tuesday, ... "

b Welk boek wil Jan nooit lezen? (*PL)
"Which book does Jan never want to read?"

c Welk boek wil Jan meestal lezen? (*PL)
"Which book does Jan mostly want to read?"

d Welk boek wil Jan vaak lezen? (* PL)
"Which book does Jan often want to read?"

e Welk boek wil Jan zelden lezen?" (* PL)
"Which book does Jan seldom want to read?"

The above judgments concerning the availability of PL readings in Dutch matrix interrogatives can be cashed out in terms of grammaticality judgments when we turn to verbs such as *opsommen* "to sum up". Interestingly, when it takes a *wh*-interrogative as complement headed by a singular *wh*-phrase, it effectively forces a PL reading on this *wh*-interrogative. In terms of our present approach to the semantics of *wh*-interrogatives, as outlined in section 3.2.2, we may describe the basic properties of this verb as follows. *Opsommen* can take a *wh*-interrogative as complement provided that it take the maximal element in the 'extension' of the question Q denoted by the *wh*-interrogative as argument. Moreover, this maximal element needs to be a plural object of some sort, a condition which *opsommen* imposes on any internal argument it combines with.[12] Thus, for those cases where the complement *wh*-interrogative denotes the characteristic function Q_1 of a set of individuals, we might as a first approximation formally represent the (static and extensional) semantics of *opsommen* as in (30).

(30) $\text{sum-up}_1' = \lambda Q_1 \lambda x\ (\text{sum-up}'(\text{MAX}(Q_1))(x))$

where for any property-denoting expression P, $\text{MAX}(P) = \iota x\ (P(x) \wedge \forall x'\ (P(x') \rightarrow x' \subseteq x))$.[13] Furthermore, we will assume that where $\text{MAX}(Q_1)$ is defined, sum-up'(MAX(Q_1)) is defined just in case $|\text{MAX}(Q_1)| > 1$. This analysis is directly motivated by some elementary facts about *opsommen*. Consider for example the basic contrast between (31a) and (31b).

(31) a De verkoper somde vervolgens op welke boeken Jan wilde bestellen
"The salesman then summed up which books Jan wanted to order"

[12] Note that Dutch *opsommen* shares this property with *to sum up* in English. Contrast for instance the well-formedness of *The politician summed up his achievements* with the ill-formedness of **The politician summed up his achievement*. In fact, whatever will be said of *opsommen* below appears to apply to its English counterpart as well.

[13] That is, MAX maps a set of elements into its 'biggest' element (cf. also Rullmann 1995).

b *De verkoper somde vervolgens op welk boek Jan wilde bestellen
"The salesman then summed up which book Jan wanted to order"

In (31a), MAX(λX (Σ^Xbooks´(X) $\wedge$ $\forall x \subseteq X$ (wanted-to-order´(jan´,x)))) is a suitable plural object sum-up´ can combine with. In (31b), however, there are in principle two possibilities to consider. Either λx (book´(x) $\wedge$ wanted-to-order´(jan´,x)) denotes a multi-membered set of atomic individuals, in which case MAX will not be defined for it.[14] Or it denotes a singleton set, in which case sum-up´(MAX(λx (book´(x) $\wedge$ wanted-to-order´(jan´,x)))) will not be defined since MAX(λx (book´(x) $\wedge$ wanted-to-order´(jan´,x))) is an atomic object.

As mentioned, verbs such as *opsommen* are interesting from the present perspective as they effectively force a PL reading of their interrogative complement when headed by a singular *wh*-phrase. Contrast the ill-formedness of (31b) for example with (32), where the latter is acceptable only if the embedded interrogative receives a PL construal.

(32) ?De verkoper somde vervolgens op welk boek elke student wilde bestellen
"The salesman then summed up which book every student wanted to order"

The reason for this contrast seems intuitively clear. We already observed above that the difficulty with (31b) is we cannot construct a set of books whose atomic parts can be summed up. In (32), however, if the complement *wh*-interrogative receives a PL construal, there is a set of books whose individual members can be summed up, viz. the set of all books each member of which a student wanted to order. This intuition can be cashed out as follows. On our current approach to the semantics of *wh*-interrogatives, the complement interrogative in (32) on its PL reading denotes the characteristic function of a set of ordered pairs, viz. the one which can be represented as $\lambda u \lambda v$ (student´(u) $\wedge$ book´(v) $\wedge$ wanted-to-order´(u,v)). Let us assume now that when it combines with a characteristic function Q_2 of a set of ordered pairs, *opsommen* roughly denotes the following function:

(33) sum-up$_2$´ = $\lambda Q_2 \lambda z$ (sum-up$_1$´($\lambda Y \forall y \subseteq Y \exists x$ ($Q_2(x)(y)$))(z))

This gives us the right result for (32). To see that, suppose Jan, Piet and Marie are all the students in our domain of discourse, where Jan wants to order *Nooit Meer Slapen*, Piet *Een Vlucht Regenwulpen* en Marie *Camera Obscura*. Given this state of affairs, (32) comes out true just in case the salesman summed up the latter three books. This is as predicted by (33), since MAX($[\![\lambda Y \forall y \subseteq Y \exists x$ (student´(x) $\wedge$ book´(y) $\wedge$ wanted-to-order´(x,y))$]\!]$) = MAX({{nms,evr},{nms,

[14] In fact, this possibility will never arise since *wh*-interrogatives in Dutch headed by a *welke*-phrase require a unique answer, just like *wh*-interrogatives in English headed by a *which*-phrase.

co},{evr,co},{nms,evr,co}}) = {nms,evr,co}.

Consider now the ill-formedness of the examples in (34). In the light of our discussion of (32), this can only be taken to mean that the embedded subject Q-NPs cannot support PL readings. The contrast between (32) and the examples in (34) then further strengthens our observations in (27-29) with respect to the pattern of PL readings in Dutch matrix interrogatives.

(34) *De verkoper somde vervolgens op ...
"The salesman then summed up ...

a ... welk boek minstens/meer dan drie studenten wilden bestellen
... which book at least/more than three students wanted to order"
b ... welk boek de meeste studenten wilden bestellen
... which book most students wanted to order"
c ... welk boek precies drie studenten wilden bestellen
... which book exactly three students wanted to order"
d ... welk boek hoogstens/minder dan drie studenten wilden bestellen
... which book at most/less than three students wanted to order"
e ... welk boek geen enkele student wilde bestellen
... which book no student wanted to order"
f ... welk boek Jan altijd wilde ophalen
... which book Jan always wanted to pick up"
h ... welk boek Jan nooit wilde ophalen
... which book Jan never wanted to pick up"
i ... welk boek Jan meestal wilde ophalen
... which book Jan mostly wanted to pick up"
j ... welk boek Jan vaak wilde ophalen
... which book Jan often wanted to pick up"
k ... welk boek Jan zelden wilde ophalen
... which book Jan seldom wanted to pick up"

. To conclude, there are good reasons to believe that the pattern of PL readings in the interrogative complement of *opsommen* should be identical to that in matrix interrogatives. This holds even in the light of Szabolcsi's (1997b) recent claim according to which extensional interrogative complements (i.e. interrogative complements of verbs such as *know*, *remember* etc.) differ from other types of interrogatives with respect to which quantified expressions can support PL readings. Szabolcsi argues that the specific pattern of PL readings in extensional complement interrogatives is best explained by an analysis according to which extensional PL readings (and only these) require quantification into lifted questions. On that account, the PL reading of the embedded *wh*-interrogative in (35a) for example is to be paraphrased as in (35b). Moreover, Szabolcsi argues that the fact that only a smaller class of Q-NPs support PL readings in matrix interrogatives follows from the fact that matrix PL readings do not rely on quantification into lifted questions. Note now that the obligatory PL construal of the embedded *wh*-interrogative in (32)

cannot be paraphrased as in (36). The latter is semantically ill-formed for essentially the same reasons that (31b) is. But then, the pattern of PL readings in the interrogative complement of *opsommen* must coincide with that in matrix interrogatives.

(35) a The salesman knows which book every student wants to order
b The salesman knows of every student which book he wants to order

(36) *De verkoper somde voor elke student op welk boek hij wilde bestellen
"The salesman summed up for every student which book he wants to order"

We have now assembled all the necessary ingredients for an analysis on which the WI effects on What For-split are deduced from the same dynamic principles that account for inaccessibility.

3.2.5 Dynamic Binding, Existential Disclosure and Weak Island Effects on What For-Split

We are now ready to tackle the problem of accounting for the WI sensitivity of What For-split. Since we haven't discussed the dynamic properties of interrogative and presuppositional verbs yet, we will limit ourselves in this section to providing an account of the Scope Island effects on What For-split. However, our discussion will be set up so that once we have settled on the proper treatment of interrogative and presuppositional verbs in Dynamic Semantics, it should be easy to extend our approach to the remaining cases involving *Wh*-Islands and Presupposition Islands. The dynamic semantics of interrogative and presuppositional verbs will be extensively discussed in the next chapter, where we will systematically compare our dynamic approach to WIs with Szabolcsi & Zwarts's (1993) algebraic account.

As we have extensively argued for in the above, in order to obtain a correct interpretation of What For-split constructions, the *wh*-operator must dynamically bind the indefinite remnant so that the latter can be interpreted as a restriction on the range of the former. In Dynamic Semantics, this means we need to apply ED to dissolve the existential quantifier denoted by the indefinite remnant. If we try to apply this reasoning to any of the Scope Island cases involving What For-split considered in section 1.5.1, we get into trouble. As was established in the preceding subsection, we know that any expression *X* which induces a WI cannot take scope over *wh*-expressions in general. Furthermore, according to our claim in (5), any such *X* induces an inaccessible domain for dynamic anaphora. Thus, if we were to apply ED in these cases, we stumble into the problematic situation we schematized earlier in (26), repeated here as (37) for ease of reference.

(37) a $\underline{\lambda}i$ ($_{\Phi}$ ... ($_{\Psi}$ X´ ... for´(indefinite´$_i$) ... $_{\Psi}$) ... $_{\Phi}$) (cf. also 26)
b λj (($_{\Phi}$ ... ($_{\Psi}$ X´ ... for´(indefinite´$_i$) ... $_{\Psi}$) ... $_{\Phi}$) $\underline{\wedge}$ $\uparrow i = j$) (def. of ED)

Due to the inaccessible domain created by *X*, the indefinite cannot bind the variable *i* introduced by ED in (37b). Since this variable is free, (37) receives no interpretation in view of Fact (25) according to which free variables are not assigned any value in Dynamic Semantics. In this way, we have truly derived the sensitivity of What For-split to Scope Islands from the same principles of Dynamic Semantics which account for inaccessibility. And our discussion of the dynamic semantics of interrogative and presuppositional verbs in the next chapter will make it clear that a similar reasoning can be applied to the remaining WI effects on What For-split.

To illustrate, consider the somewhat extended set of Scope Island effects presented in (38-40). For ease of exposition, we will take (39a) to be representative of the sensitivity of What For-split to Scope Islands. The question that will be of central concern to us is whether ED allows us to derive a sensible interpretation for (39a), preferably one on which the indefinite remnant denotes a property that restricts the range of the *wh*-operator.

(38) *Wat heeft Jan niet voor een boek gelezen?
"What kind of book didn't Jan read?"

(39) a *Wat heeft geen enkele student voor een boek gelezen?
"What kind of book did no student read?"
b *Wat hebben hoogstens/minder dan drie studenten voor een boek gelezen?
"What kind of book did at most/less than three students read?"
c *Wat hebben precies drie studenten voor een boek gelezen?
"What kind of book did exactly three students read?"
d ??Wat hebben minstens/meer dan drie studenten voor een boek gelezen?
"What kind of book did at least/more than three students read?"
e ??Wat hebben de meeste studenten voor een boek gelezen?
"What kind of book did most students read?"

(40) a *Wat heeft Jan nooit voor een boek gelezen?
"What kind of book did Jan never read?"
b ??Wat heeft Jan altijd voor een boek gelezen?
"What kind of book did Jan read every time?"
c *Wat heeft Jan meestal voor een boek gelezen?
"What kind of book did Jan read most of the times?"
d ??Wat heeft Jan vaak voor een boek gelezen?
"What kind of book did Jan often read?"
e *Wat heeft Jan zelden voor een boek gelezen?
"What kind of book did Jan seldom read?"

Observe first that the c-command relation that holds between the *wh*-operator and the subject Q-NP in (39a) reflects the scopal ordering of the

corresponding quantifiers at LF, in line with our earlier observations in the preceding subsection. This is indicated by the LF-representation in (41).[15]

(41) *[$_{CP}$ Wat$_{\kappa}$ heeft [$_{AgrSP}$ [$_{DP}$ geen enkele student]$_{x}$ [$_{AgrOP}$ [$_{PP}$ voor een$_{\kappa}$ boek]$_{\kappa'}$ [$_{VP}$ e$_{x}$ gelezen e$_{\kappa'}$]]]]

The LF in (41) can be compositionally translated into (42a) in a rather straightforward manner (where, as before, kind-of-book$'$ = $\lambda\kappa\lambda w\forall w'{\sim}w$ ($R_{w}(x,\kappa)$ $\rightarrow$ $book'_{w}(x)$)). Essentially by applying the definition of dynamic quantificational determiners (cf. again Definition 2.36) and ED, (42a) can be reduced to (42b).

(42) a $\underline{\lambda}\kappa(\mathcal{N}o(\lambda x(\uparrow student'(x)))(\lambda x\,\mathcal{E}\kappa(\uparrow kind\text{-}of\text{-}book'(\kappa)\,\underline{\wedge}\uparrow read'(x,\kappa))))$

b $\lambda\kappa'\lambda p\lambda w(No'(\lambda x(student'_{w}(x)))(\lambda x\exists\kappa(kind\text{-}of\text{-}book'_{w}(\kappa)\wedge read'_{w}(x,\kappa)))\wedge\underline{\kappa}=\kappa'\wedge{}^{\vee}p(w))$

Note that the underlined kind-variable in (42b) falls outside the syntactic scope of the existential quantifier. This is due to the inaccessible domain created by the externally static quantifier denoted by *geen enkele student* in (39a). Does (42) express a reading of this sentence on which the indefinite remnant denotes a property that restricts the range of the *wh*-operator *wat*? The answer must be: "No". Firstly, due to the fact that the underlined kind-variable in (42) falls outside the syntactic scope of the existential quantifier denoted by the indefinite remnant, we know that applying ED in a Scope Island context does not have the desired effect of dissolving the existential quantifier denoted by the indefinite remnant in the semantics. Consequently, (42) does not express a reading of (39a) on which the indefinite remnant denotes a property that restricts the range of the *wh*-operator. Secondly, as the underlined kind-variable in this representation is free, (42) does not have a well-defined interpretation on account of Fact (25). It will thus be ruled out on semantic grounds alone. Since (39a) is equivalent in all relevant respects to the other examples in (38-40), we can therefore account for the Scope Island effects on What For-split by exploiting the same principles of Dynamic Semantics that derive inaccessibility.

Now, contrast the ill-formed What For-split constructions reviewed thus far with the perfectly grammatical What For-split constructions in (43) below. As suggested by these examples, proper names, (simple) singular indefinites, singular definite descriptions, and plural simple indefinites and definite

[15] I am analyzing Dutch as underlyingly SVO for the sake of simplicity, not necessarily because of any theoretical commitments, a practice I will follow throughout. Moreover, I assume that the indefinite remnant receives structural Case, which must be checked in the appropriate Agr-projection. Even though nothing much hinges on this, it is clear from German which has overt Case morphology that the indefinite DP is assigned structural Case, and not some oblique Case controlled by the preposition *für* ("for").

descriptions (on a collective construal!) may (more or less) happily intervene between the *wh*-operator and the indefinite remnant. These facts are as predicted under our analysis. Crucially, the innocent interveners (on the relevant construal) identified above never create inaccessible domains for dynamic anaphora. The latter observation immediately follows from the system of Dynamic Semantics we presented in the previous chapter: the innocent interveners (on the relevant construal) either directly pick out a (singular or plural) individual (i.e. they are 'referential' expressions in the sense of section 1.3.2) or denote an externally dynamic quantifier.[16]

(43) a Wat heeft Jan voor een boek gelezen?
"What kind of book did Jan read?"
b ?Wat heeft een student voor een boek gelezen?
"What kind of book did a student read?"
c Wat heeft de student voor een boek gelezen?
"What kind of book did the student read?"
d ?Wat hebben drie studenten (*elk) voor een boek gelezen?
"What kind of book did three students (each) read?"
e Wat hebben de drie studenten (*elk) voor een boek gelezen?
"What kind of book did the three students (each) read?"

Before concluding this section, I would like to point out that the fact that plural (simple) indefinites and plural definite descriptions do constitute WIs for What For-split in case they receive a distributive interpretation accords rather well with the predictions our theory makes in this connection. Recall that we analyzed distributive predication involving these plural expressions in terms of the silent distributive operator Δ (cf. section 2.4). In view of the fact that this distributive operator induces an inaccessible domain for non-c-command anaphora (much like floating quantifier *each*; cf. 2.74), we proposed to analyze the meaning of Δ in terms of $\subset\!\!\!\!\not$, which is externally static. Furthermore, we know that the silent distributive operator (again, much like floating quantifier *each*) scopes immediately under its plural antecedent (cf. Deprez 1994, and Beghelli & Stowell 1997 for relevant observations). Therefore, both Δ and *each* will never be able to outscope a c-commanding *wh*-phrase. Consider now in the light of these observations the ungrammaticality of (43d) under a distributive reading of *drie studenten*. We may take its LF to be as in (44a), which can be compositionally translated and further reduced into (44b).

(44) a $[_{CP}$ Wat$_{\kappa}$ hebben $[_{AgrSP}$ $[_{DP}$ drie studenten$]_X$ Δ^X $[_{AgrOP}$ $[_{PP}$ voor een$_{\kappa}$ boek$]_{\kappa'}$ $[_{VP}$ e$_X$ gelezen e$_{\kappa'}]]]]$

[16] The somewhat peculiar behavior of simple indefinites in WI constructions (and *wh*-constructions in general) was already commented on in Chapter 1, footnote 14.

b $\lambda\kappa'\lambda p\lambda w\exists X\ (\Sigma^X\text{students}'_w(X) \wedge |X| = 3 \wedge \forall x \subseteq X\ (\exists\kappa\ (\text{kind-of-book}'_w(\kappa) \wedge \text{read}'_w(x,\kappa))) \wedge \underline{\kappa} = \kappa' \wedge^\vee p(w))$

Again, we observe that the underlined κ-variable in (44b) occurs outside the syntactic scope of the existential quantifier over subkinds of books, denoted by the indefinite remnant. This is due to the inaccessible domain created by the universal quantifier over atomic students, which, as said, is externally static. Therefore, the indefinite remnant in (43d) cannot possibly be interpreted as a property restricting the range of the *wh*-operator. Moreover, given that the underlined κ-variable is free, there is no well-defined interpretation for (44b) on account of Fact (25), as desired.

To conclude this section, let me emphasize the fact that our theory does not preclude the possibility of an externally static quantifier intervening between the *wh*-operator and its indefinite remnant. Specifically, our theory predicts that an externally static quantifier can intervene between the *wh*-operator and its indefinite remnant just in case it takes scope over the *wh*-operator to yield a pair-list reading. The reason is that on a wide scope construal, the kind-variable introduced by ED will occur inside the syntactic scope of the externally static quantifier rather than outside. Thus, the situation represented in (37) above will not arise, and the *wh*-operator can dynamically bind the indefinite remnant. Now, as was already observed in the preceding section, only universal distributive Q-NPs can support a pair-list reading of matrix interrogatives in Dutch. Therefore, given that universal distributive Q-NPs denote externally static quantifiers, we now predict that they can intervene between *wat* and its remnant DP in a matrix What For-interrogative only if the latter receives a pair-list construal. Interestingly, de Swart (1992) observes that universal distributive Q-NPs can intervene in the Dutch What For-split construction only if the predicted conditions are met. De Swart's observations are based on examples such as (45) below (where SC refers to the so-called *single-constituent* reading, on which the *wh*-phrase has wide scope, and PL to the *pair-list* reading).

(45) ?Wat heeft elke student voor een boek gelezen? (*SC, ?PL)
"What kind of book did every student read?"

To be sure, even though a pair-list answer to (45) is far more natural, it is still possible for many speakers of Dutch to give a single-constituent answer (e.g. "A historical novel") to questions such as (45). Although de Swart (1992) does not explicitly address the possibility of providing a single-constituent answer to questions like (45), I think it is consistent with her assessment of these data to claim that the apparent single-constituent answers are nothing but pair-list answers in disguise. That is, a 'single-constituent' answer to questions such as (45) should be regarded as a convenient shorthand for a list of ordered pairs in which the second coordinate is the same for all pairs.

There are two independent sources of evidence that support this assessment

of data such as (45). Firstly, What For-split constructions can also occur in Dutch free relatives, as illustrated in (46a) below. As is well-known, quantified expressions inside a relative clause can never take scope outside that clause. Therefore, if we are correct in claiming that sentences such as (45) are ungrammatical on a reading in which the *wh*-operator takes wide scope over a universal distributive quantifier, that quantifier should not be able to intervene between *wat* and its indefinite remnant in a free relative. As demonstrated by the ill-formedness of (46b), this prediction is indeed borne out.

(46) a Het was werkelijk schandalig wat Jan voor commentaar
It was really outrageous what Jan for comments
op het optreden van de scheidsrechter gaf
on the performance of the referee gave
"The comments Jan gave on the performance of the referee were really outrageous"

b *Het was werkelijk schandalig wat elke trainer voor commentaar op het optreden van de scheidsrechter gaf
"The comments every coach gave on the performance of the referee were really outrageous"

Secondly, Pafel (1995) has devised an ingenious test to determine whether an intervening universal distributive quantifier must take scope over the *wh*-operator in What For-split constructions. If we apply his test to the Dutch *wat voor*-split construction, we can reproduce his reasoning as follows. He first notes that the complex conjunction *maar ... niet* ("but ... not") in the coordinated structure in (47a) is licensed on account of the fact that the interrogative complement in the first conjunct receives a SC reading, whereas the interrogative complement in the second conjunct receives a PL reading. Now, if an intervening universal distributive Q-NP must outscope the *wh*-operator in a What For-split construction to yield a PL reading, it follows that we cannot replace the interrogative complement in (47a) by its split analogue on pains of ascribing contradictory knowledge to the librarian. That is, the librarian cannot know P but not know P at the same time, where P = *for every student x, what kind of book does x want to read*. Judging from the marked status of (47b), we conclude that this prediction squares well with the facts.

(47) a De bibliothecaris weet wat voor een boek elke student wil lezen, maar hij weet niet van elke student afzonderlijk wat voor een boek hij wil lezen
"The librarian knows what kind of book every student wants to read, but he does not know of each student individually what kind of book he wants to read"

b ??De bibliothecaris weet wat elke student voor een boek wil lezen, maar hij weet niet van elke student afzonderlijk wat voor een boek hij

wil lezen

We have seen two good reasons for assuming that de Swart's (1992) assessment of the scopal properties of universal distributive Q-NPs in What For-split constructions is essentially correct, despite the fact that questions such as (45) apparently allow for single-constituent answers. As was already noted above, de Swart's observations are straightforwardly accounted for on our analysis of What For-spit. To reiterate this point here, if the externally static quantifier denoted by a universal distributive Q-NP takes narrow scope with respect to the *wh*-operator in a What For-split construction, this operator can no longer dynamically bind its indefinite remnant on account of the inaccessible domain created by the relevant Q-NP. In other words, we exclude a narrow scope construal of an intervening universal distributive Q-NP in a What For-split construction in exactly the same way in which we excluded earlier an intervening negative quantifier (cf. the discussion of 39a above). If, on the other hand, the externally static quantifier denoted by a universal distributive Q-NP takes wide scope over the *wh*-operator in a What For-split construction, the kind-variable introduced by ED must occur in the syntactic scope of that externally static quantifier, even independently of which particular semantic approach to PL readings one eventually chooses. Since the abstract situation represented in (37) above will not arise in that case, the *wh*-operator can dynamically bind its indefinite remnant without problem.

3.2.6 A Tribute to de Swart (1992)

Most of the data on What For-split in the preceding sections were already discussed by de Swart (1992). Since our dynamic approach to the WI sensitivity of What For-split owes an obvious debt to her analysis, we will engage in a brief discussion of de Swart's proposals in order to emphasize their compatibility with the position taken here. In fact, we will see that our approach can be viewed as an attempt to derive the fundamental premiss on which de Swart's account is based from independently motivated principles of Dynamic Semantics. As de Swart is mainly concerned with intervention effects that are brought about by quantified expressions, the ensuing discussion will be primarily restricted to Scope Islands.

In order to account for Scope Island effects on What For-split such as those presented in (38-40), de Swart (1992: 52) invokes the following semantic principle:[17]

[17] It should be noted that de Swart (1992) intends (48) to apply to various other constructions as well, most notably *combien*-extraction in French. It seems to me that most of these other constructions can be characterized as split constructions. If true, their sensitivity to WI effects

(48) A quantifier Q_1 can only separate a quantifier Q_2 from its restrictive clause if Q_1 has wide scope over Q_2 (or is scopally independent from Q_2).

To illustrate the working of the principle in (48), consider once again the ill-formedness of (39a), repeated below as (49). According to de Swart's principle, the (generalized) quantifier denoted by *geen enkele student* can only separate the *wh*-quantifier *wat* from its restrictive clause *voor een boek* if it has wide scope over *wat* (or is scopally independent from *wat*). Given the results of our discussion in section 3.2.4, we know that a negative quantifier cannot scope over a *wh*-quantifier to yield a pair-list reading. Furthermore, it is my understanding that de Swart interprets scopal independence (which is the case in cumulative or branching quantification) as a property which holds exclusively of 'referential' expressions such as rigid designators and (plural) definite descriptions. Since the subject Q-NP in (49) is certainly not a 'referential' expression, it follows that it is not scopally independent from the *wh*-quantifier *wat*. As neither of the two necessary conditions on well-formedness is satisfied, (49) will be ruled out by de Swart's principle in (48).

(49) *Wat heeft geen enkele student voor een boek gelezen?
"What kind of book did no student read?"

The intuition behind de Swart's semantic principle in the context of What For-split seems to be this: whenever a quantificational expression which syntactically separates (at Surface Structure) the *wh*-quantifier What from its indefinite remnant needs to take narrow scope with respect to What, it will also semantically (that is, either at the level most relevant for semantic interpretation, or at the level of semantic interpretation directly) separate the *wh*-quantifier from its restrictive clause. Thus, (48) appeals to some notion of semantic locality: a quantifier Q_2 may be separated from its restrictive clause RC only if Q_2 *locally binds* RC, where *X* locally binds Y just in case no *Z* scopally intervenes between *X* and *Y*. Now, the intuition behind the dynamic approach to the WI sensitivity of What For-split may be formulated similarly, with this important difference that now *X* locally binds *Y* just in case no *Z* scopally intervenes between *X* and *Y*, where *Z* induces an inaccessible domain for dynamic anaphora. On this reformulation of the intuitive content of de Swart's principle in (48), we can actually explain why this principle must hold of What For-split. As was discussed in great detail in the last section, if some quantified expression Q_1 scopally intervenes between the *wh*-quantifier What and its

follows directly from our dynamic approach (for some suggestions with respect to *combien*-extraction, cf. footnote 24). The impatient reader is referred to section 3.4 where we will see how the Intervention Generalization, to which all split constructions are subject, can be derived from basic principles of Dynamic Semantics.

indefinite remnant, and if furthermore Q_1 induces an inaccessible domain for dynamic anaphora, What can no longer dynamically bind its indefinite remnant. As a result, the *wh*-quantifier does not have a properly restricted domain to quantify over, and the construction in which it appears is semantically deviant. To the extent then that our reformulation of (48) is consistent with the overall spirit of de Swart's approach, we can look at our dynamic account of the WI sensitivity of What For-split as an attempt to derive de Swart's central explanatory principle from independently motivated, core assumptions of Dynamic Semantics.

3.3 Dynamic Binding across Weak Islands: the Case of Negative Polarity Licensing

Recall the Intervention Generalization as we stated it in the Introduction to this chapter: in all split constructions, in which a quantificational expression Q needs to bind an indefinite noun phrase as its restriction (even though it does not form a constituent with it), no WI inducing expression may intervene between Q and its indefinite restriction. In section 1.5.2, we suggested that structures involving Negative Polarity can be characterized as split constructions. If so, the well-known fact that Negative Polarity is sensitive to intervention effects, as was demonstrated in that same section, would properly fall within the scope of the Intervention Generalization. In this context then, the question naturally arises whether the dynamic approach to the WI sensitivity of What For-split, as developed in the preceding section, can be carried over to account for this consequence of the Intervention Generalization as well. This issue will be explored at some length in this section.

Our discussion of the intervention effects on Negative Polarity will be organized as follows. In the next subsection, we will lay out and defend some basic assumptions with respect to Negative Polarity in terms of which our account will be couched. In section 3.3.2, we will significantly expand our database of Scope Island effects on Negative Polarity. When examining these additional facts, it will become clear that the set of harmful interveners for Negative Polarity exactly coincides with the set of expressions that create WIs for What For-split. This observation therefore fully justifies our earlier practice of referring to the intervention effects on Negative Polarity simply as WI effects. We will then show in section 3.3.3 how the WI sensitivity of Negative Polarity can be derived from the system of Dynamic Semantics, given the basic assumptions that were spelled out in section 3.3.1. The argument will essentially proceed along the same lines as our account of the WI sensitivity of What For-split. Section 3.3.4 addresses some problems concerning modal and definite NPIs that might cast doubt on our claim that NPI licensing requires ED. We will argue that these problems can be tackled in a way which is consistent with the overall approach advocated here. We will conclude our discussion of the WI

sensitivity of Negative Polarity in section 3.3.5 by contrasting our account with the one developed by Kas (1993). The latter approach attempts to derive the fact that NPIs are sensitive to WIs from an abstract algebraic calculus which determines what Boolean properties of a 'negative' trigger survive under function composition. We will show that Kas's approach, despite its strong initial appeal, suffers from two major shortcomings, one empirical and one theoretical.

3.3.1 Three Basic Assumptions concerning Negative Polarity Licensing

Any serious study that seeks to address a certain aspect of Negative Polarity must clarify its position with respect to three basic issues. First of all, we must provide a suitable characterization of the class of (various types of) potential triggers for NPIs. Along with Ladusaw (1980), Zwarts (1981,1986) and van der Wouden (1994) (among many others), we will make the relatively uncontroversial assumption that the defining property of a 'negative' trigger is that it denotes a *monotone decreasing* function. To refresh our memory, monotone decreasing functions, such as the functions denoted by *no student* and *at most three goals*, can be defined as in (50).

(50) A function f is *monotone decreasing* just in case
$\forall A,B: f(A) \wedge A \supseteq B \Rightarrow f(B)$

A second issue that the phenomenon of Negative Polarity confronts us with concerns the proper identification of the class of (various types of) NPIs. In the vast literature on Negative Polarity, different types of NPIs are often distinguished in terms of what particular semantic property of their trigger they are sensitive to. For instance, it is customary to distinguish between so-called *weak* and *strong* NPIs on account of the fact that the latter type of NPI is only licensed by a proper subset of the potential triggers for the first type of NPI. According to such a criterion, *a red cent* would be classified as a strong NPI, whereas *any* would count as a weak NPI. This follows from the fact that *a red cent* can only be licensed by a proper subset of the potential triggers for *any*, as suggested by the contrast between (51) and (52).

(51) a Nobody gave anything to the beggar
b Less than five people gave anything to the beggar

(52) a Nobody gave a red cent to the beggar
b *Less than five people gave a red cent to the beggar

We will follow Zwarts (1986), Kas (1993) and van der Wouden (1994) (among others) in assuming that strong NPIs require their trigger to denote an *anti-*

additive function. Anti-additive functions can be defined as follows:

(53) A function f is *anti-additive* just in case
$\forall A,B: f(A \vee B) \Leftrightarrow f(A) \wedge f(B)$

where $\vee$ is the Boolean join (corresponding to disjunction in the truth-value algebra $\{0,1\}$, and set-theoretic union $\cup$ in the power-set algebra), and $\wedge$ is the Boolean meet (corresponding to conjunction in the truth-value algebra $\{0,1\}$, and set-theoretic intersection $\cap$ in the power-set algebra).

Thus, since (54a) and (54b) entail each other, we know that *nobody* denotes an anti-additive function. In (55), on the other hand, (55b) is entailed by (55a), but not the other way around. We may therefore conclude that *less than five people* does not denote an anti-additive function. More generally, we can prove that the set of anti-additive functions constitutes a proper subset of the set of monotone decreasing functions (cf. Zwarts 1986). This observation therefore directly accounts for the fact that strong NPIs can only be licensed by a proper subset of the potential triggers for weak NPIs.

(54) a Nobody (sleeps or talks) $\Leftrightarrow$
b Nobody (sleeps) and nobody (talks)

(55) a Less than five people (sleep or talk) $\Rightarrow$ (but $\not\Leftarrow$)
b Less than five people (sleep) and less than five people (talk)

One may wonder whether it is possible to provide a uniform characterization of the class of NPIs in a way which does not refer to the particular semantic conditions they impose on their triggers. A particularly interesting proposal in this connection has been put forward by Jackson (1994), according to which all NPIs denote (restricted) existential quantifiers. Obviously, for lack of space, we cannot defend this claim on a case by case basis. We will therefore confine ourselves to giving some arguments in support of this view, partially extending the arguments that were already provided by Jackson. Firstly, nominal NPIs invariably appear as 'simple' (preferably singular) indefinites.[18] Secondly, VP idioms that act as NPIs (such as *budge an inch*, *give a damn*, *lift a finger*, and so on) can be straightforwardly analyzed as denoting (restricted) existential quantifiers over events in an event-based semantics.[19] Thirdly, and more importantly, there are many languages (such as Japanese and Albanian, to mention but two) in which NPIs appear in productive morphological paradigms

[18] The reader is referred to Carlson (1981) for a battery of arguments to buttress his claim that Negative Polarity *any* denotes an existential quantifier.

[19] Cf. Jackson (1994) for an analysis of the adverbial NPI *yet* in terms of existential quantification.

with simple indefinites. In view of these observations, I will adopt Jackson's characterization of NPIs as uniformly denoting (restricted) existential quantifiers. A discussion of potential counterexamples to this claim is deferred to section 3.3.4.

A third and final issue that must be settled before we can proceed with our analysis of the WI effects on Negative Polarity relates to the proper characterization of the licensing relationship which holds between trigger and NPI. Ideally, the semantics of NPI licensing is worked out in such a fashion that it gives substance to our earlier suggestion in section 1.5.2 that structures involving Negative Polarity can be characterized as split constructions. In the remainder of this section, we will discuss two attempts at providing such a semantics of Negative Polarity licensing, where the second attempt, though both empirically as well as theoretically more motivated than the first, requires a minor revision of our notion of a split construction.

First Attempt: Negative Polarity Licensing as a Special Case of Dynamic Binding. Negative Polarity constructions can be straightforwardly characterized as split constructions if we view the licensing of an NPI by a 'negative' trigger as a special case of dynamic binding. That is, in line with our earlier analysis of What For-split, we might assume that NPIs act in the semantics as restricted variables, quantified over by the 'negative' trigger. This assumption entails that we represent the truth-conditions of (56a) as in (56b), where red-cent´ in its NPI usage is true of amounts of money. This squares reasonably well with intuition.

(56) a Nobody gave a red cent to John
b $\neg\exists x,y$ (person´(x) $\wedge$ red-cent´(y) $\wedge$ gave´(x,john´,y))

It appears that there is a tension between this particular assumption concerning the semantics of NPI licensing and our earlier claim that all NPIs denote (restricted) existential quantifiers. The reader may have guessed by now how we are going to resolve this. The two assumptions can be reconciled by means of Existential Disclosure (ED). We are thus led to represent (in its unreduced form) the meaning of (56a) as in (57), conveniently abstracting away from certain tricky problems with respect to exactly how logical representations such as (57) can be compositionally determined in general.

(57) $\lambda R \sim \mathfrak{E}x,y$ ($^{\vee}R(x)(y)$)($\lambda u \underline{\lambda} v$ ($\uparrow$person´(u) $\underline{\wedge}$ $\mathfrak{E}v$ ($\uparrow$red-cent´(v) $\underline{\wedge}$ $\uparrow$gave´(u,john´,v))))

Thanks to the definition of ED in (14) above, the argument expression in (57) can be reduced as follows:

(58) a $\lambda u \underline{\lambda} v$ ($\uparrow$person´(u) $\underline{\wedge}$ $\mathfrak{E}v$ ($\uparrow$red-cent´(v) $\underline{\wedge}$ $\uparrow$gave´(u,john´,v)))

b $\lambda u \lambda v' (\uparrow \text{person}'(u) \underline{\wedge} \mathfrak{E} v (\uparrow \text{red-cent}'(v) \underline{\wedge} \uparrow \text{gave}'(u, \text{john}', v)) \underline{\wedge} \uparrow v = v')$
(def. of ED)

c $\lambda u \lambda v' (\uparrow \text{person}'(u) \underline{\wedge} \mathfrak{E} v (\uparrow \text{red-cent}'(v) \underline{\wedge} \uparrow \text{gave}'(u, \text{john}', v) \underline{\wedge} \uparrow v = v'))$
(def. of $\mathfrak{E}$ and $\underline{\wedge}$)

d $\lambda u \lambda v' (\uparrow \text{person}'(u) \underline{\wedge} \uparrow \text{red-cent}'(v') \underline{\wedge} \uparrow \text{gave}'(u, \text{john}', v'))$
(elementary logic)

Thus, (57) can be reduced eventually to (59).

(59) $\sim \mathfrak{E} x, y (\uparrow \text{person}'(x) \underline{\wedge} \uparrow \text{red-cent}'(y) \wedge \uparrow \text{gave}'(x, \text{john}', y))$

By applying the $\downarrow$-operator to (59), we obtain its truth-conditional content, which can be represented as in (60) below. As desired, this representation directly conforms to our assumptions concerning the (static and extensional) semantics of NPI licensing. That is, (60) is equivalent to (56b) above.

(60) $\neg \exists x, y (\text{person}'(x) \wedge \text{red-cent}'(y) \wedge \text{gave}'(x, \text{john}', y))$ (= 56b)

Thus, if we conveniently limit ourselves to relatively simple cases involving strong NPIs such as *a red cent*, there seems to be no problem (apart from the one mentioned immediately above 57) in claiming that the semantics of NPI licensing requires dynamic binding. If so, these cases can indeed be looked upon as split constructions.

Second Attempt: Negative Polarity Licensing as a Special Case of Focus-Sensitive Quantification. A first problem that can be noted with respect to the above attempt at working out a semantics for Negative Polarity licensing relates to the fact that it does not shed any light on the question why NPIs require a monotone decreasing function as trigger. That is, there is no reason to suspect that a monotone decreasing quantifier makes a better dynamic binder than any other type of quantifier. A second, more serious problem concerns the fact that the former approach to the semantics of NPI licensing cannot be extended to constructions involving weak NPIs. For example, while it is certainly true that the truth-conditions of *Nobody gave a red cent to John* can be paraphrased as in (61) below, as in fact required by a dynamic binding account of NPI licensing, we cannot ascribe similar truth-conditions to sentences such as (62a). The meaning of this sentence can certainly not be paraphrased as in (62b). To see that, consider a situation in which John ate twelve candy bars, and apart from John, nobody ate anything. Then (62a) is true with respect to this situation, even though there are more than three pairs of people and things eaten (twelve, to be precise).

(61) *There are no pairs* x,y *where person* x *gives an amount of money* y *to John*

(62) a At most three people ate anything
b *There are at most three pairs* x,y *where person* x *eats thing* y (≠ 62a)

Evidently, then, if we want to represent the semantics of weak NPI constructions through pair-quantification as well, we need a different way of counting. For example, we might propose that for two ordered pairs $\langle a,b\rangle$ and $\langle c,d\rangle$ to count as distinct, and thus count for two, it must be that $a \neq c$. On this non-standard conception of non-distinctness as applying to ordered pairs, $\langle \text{john,candybar}_1\rangle$ could no longer be distinguished from $\langle \text{john,candybar}_2\rangle$ (cf. also May 1989 for different variations on this theme). We will not pursue this line of reasoning here, however. It seems to me that such a conception of non-distinctness as applying to ordered pairs is motivated solely by the concern not to embarrass the dynamic binding approach to the licensing of weak NPIs. The rest of this section will therefore be devoted to working out an alternative semantics for NPI licensing. This alternative semantics still requires ED, but avoids the unwelcome consequences of the previous approach.

Both within and across languages, there is a very strong tendency for NPIs to denote minimal amounts of some sort.[20] For example, *a red cent* denotes a minimal amount of money, *a drop of wine* denotes a minimal amount of wine, and *a single book* denotes a minimal amount of books. In view of this, one would like any adequate treatment of NPIs to reflect this strong universal tendency. Let us therefore adopt the proposal put forth in Krifka (1991) according to which every NPI is semantically associated with a *lattice* $\mathbf{L}_{\text{NPI}}$ with respect to which the NPI denotes the smallest element or bottom (cf. also Fauconnier 1975 for the basic idea).[21] On the basis of this assumption, we might then attribute the following (extensional) lattice to the NPI *a single book* (an expression in capitals designates its model-theoretic interpretation).

(63) $\mathbf{L}_{\text{A SINGLE(BOOK)}} = \langle \text{A SINGLE(BOOK)}, L_{\text{BOOK}}, \leq_{\text{BOOK}}\rangle$, where
a L_{BOOK} is the set of all amounts of books*;
b $\leq_{\text{BOOK}}$ is a partial order**;
c A SINGLE(BOOK) $\in L_{\text{BOOK}}$, and L_{BOOK} contains at least one more element; and
d A SINGLE(BOOK) is the unique Y such that for every $X \in L_{\text{BOOK}}$, $Y \leq_{\text{BOOK}} X$.

* That is, $L_{\text{BOOK}} = \{Q\text{: for some } n > 1, Q = \{P\text{: } |\text{BOOK} \cap P| > n\}\}$
** Say, subsumption (i.e. set-theoretic inclusion $\supseteq$)

[20] To be sure, it is a tendency, rather than a universal. There are NPIs that seem to denote maximal amounts/degrees, such as illustrated in *Wild horses wouldn't drag me there*. Thanks to Manfred Krifka (p.c.) for reminding me of these cases. Unfortunately, NPIs denoting maximal amounts/degrees cannot be discussed in any detail here.

[21] Cf. I in the Appendix to Chapter 1 for discussion on (semi)lattices.

Some notes of clarification may be in order here. Firstly, the notion that NPIs refer to minimal amounts is captured here in techical terms as follows. Suppose *a* and *b* are amounts of books. To say then that *a* is a minimal amount of books is to say that whatever property *P* can be attributed to *b* can be attributed to *a* as well (but not necessarily *vice versa*): if Bill bought three books, then Bill bought a (single) book.[22] In terms of (63): A SINGLE(BOOK) (= $[\![\lambda P \exists x\ (\text{book}'(x) \wedge P(x))]\!]$) = $\{P: |\text{BOOK} \cap P| > 1\} \supseteq \{P: |\text{BOOK} \cap P| > n\}$, for any $n > 1$. If NPIs must refer to minimal amounts, it becomes understandable why the semantics of these expressions can be represented through existential quantification: '∃' is the quantifier of minimal amount *par excellence*.

Secondly, as argued for by Krifka (1991), we may think of the association of a lattice sort to an NPI as the association of a set of alternative semantic values to an expression in focus, as in Rooth's (1985,1992) alternative semantics. To illustrate the basics of Rooth's alternative semantics approach to focus, we will go through a simple example involving focus-sensitive *only*. The semantics of focus-sensitive *only* can be stated as in (64). According to (64b), focus-sensitive *only* has the following quantificational force: if a property *P* is in a certain set of properties *C*, and if *P* furthermore holds of John, then *P* is identical to the property denoted by the VP.

(64) a John only VP

b $\forall P \in C\ (P(\text{john}') \rightarrow P = \text{VP}')$

Crucially, the contextually given set of properties *C* will be identified with the focus semantic value of VP. In general, the focus semantic value of an expression α (notated: $[\![\alpha]\!]^f$) is the set of *alternative* semantic values obtainable from the ordinary semantic value of α (notated: $[\![\alpha]\!]^o$) by making a substitution in the position of the focused phrase. To see how this works, consider the example in (65a). Imagine that this sentence is uttered in a situation in which Sue and Mary are the only relevant alternatives to Bill. In this situation, $[\![[_F \text{Bill}]]\!]^f$ is {bill,sue,mary}.

(65) a John only $[_{VP}$ saw $[_F$ Bill]]

b $\forall P \in C\ (P(\text{john}') \rightarrow P = \lambda x\ (\text{saw}'(x,\text{bill}')))$

c $C = [\![\text{VP}']\!]^f = \{\{a: \langle a,b\rangle \in [\![\text{saw}']\!]\}: b \in \{\text{bill,sue,mary}\}\}$

d $\forall x\ ((x = \text{bill}' \vee x = \text{sue}' \vee x = \text{mary}') \wedge \text{saw}'(\text{john}',x) \rightarrow x = \text{bill}')$

In line with (64), the semantics of (65a) will be represented as in (65b). As indicated in (65c), the free variable *C* in (65b) will be identified with $[\![\text{VP}]\!]^f$. In view of $[\![[_F \text{Bill}]]\!]^f$, $[\![\text{VP}']\!]^f$ will be $\{\{a: \langle a,b\rangle \in [\![\text{saw}']\!]\}: b \in \{\text{bill,sue,mary}\}\}$ =

[22] Observe that this entailment pattern is only expected to arise with upward entailing predicates. With downward entailing predicates such as *to be enough/weigh 2 lbs.*, the entailment pattern will be reversed: *Three books are enough/weigh 2 lbs.* ⊭ *One book is enough/weighs 2 lbs*. Thanks to Anna Szabolcsi for discussion.

$\{\{a: \langle a,\text{bill}\rangle \in [\![\text{saw}']\!]\},\{a: \langle a,\text{sue}\rangle \in [\![\text{saw}']\!]\},\{a: \langle a,\text{mary}\rangle \in [\![\text{saw}']\!]\}\}$. If *C* in (65b) then is evaluated to this set, it is easy to see that (65b) expresses the same truth-conditions as (65d). The latter representation correctly captures the intended (static) meaning of (65a).

There are good reasons to believe that this notion of alternative semantics also bears on the proper analysis of Negative Polarity. First of all, in languages such as English and Dutch, NPIs are invariably marked with a high-pitch accent, and sometimes with a focus particle (such as *ook maar* "also but" in Dutch). Secondly, it has often been observed that NPIs exploit so-called *scalar implicatures*. This requires computing entailment relations between *alternative propositions* which can be obtained from the original proposition by making a substitution in the position of the NPI. It is natural then to conceive of this set of alternative propositions as the focus semantic value of the sentence which contains the NPI. This focus semantic value can then be determined on the basis of the focus semantic value of the NPI, i.e. $\mathbf{L}_{\text{NPI}}$. That is, each proposition in the focus semantic value of a sentence containing an NPI can be obtained by substituting some $Q \in \text{L}_{\text{NPI}}$ in the position of the NPI.

Consider for example the sentence in (66) below, which, as will be recalled, posed a problem for extending the dynamic binding approach to the licensing of weak NPIs.

(66) $[_{\text{S}}$ At most three people $[_{\text{VP}}$ ate $[_{\text{F}}$ anything$]]]$

This sentence entails not only that at most three people ate two things, but also that at most three people ate three things, ninety-nine things, and so on. Viewing this set of alternative propositions as the focus semantic value of S, i.e. $[\![\text{S}']\!]^{\text{f}}$, it is relatively easy to see how this set can be (recursively) defined on the basis of $[\![\text{VP}']\!]^{\text{f}}$, and ultimately on the basis of $[\![\text{anything}']\!]^{\text{f}} = \mathbf{L}_{\text{THING}}$. Each proposition *p* in $[\![\text{S}']\!]^{\text{f}}$ is the result of applying the Generalized Quantifier denoted by *At most three people* to some property *P* in $[\![\text{VP}']\!]^{\text{f}}$, which in turn is defined in terms of $[\![\text{anything}']\!]^{\text{f}} = \mathbf{L}_{\text{THING}}$ as indicated in (67a) on the next page. This is shown in (67b), where each node in the graph entails all the nodes it dominates. Note that the structure of this graph resembles that of a scale, as required. Observe furthermore that the entailment pattern as reflected in the scale in (67) only applies to monotone decreasing quantifiers as triggers: given that at least two people ate a thing, it does not necessarily follow that at least two people ate two things or more. If a sentence S containing an NPI must express a maximally informative statement, in the sense of entailing all the other propositions in $[\![\text{S}']\!]^{\text{f}}$, we have an explanation for the fact that all NPIs require a monotone decreasing function as trigger. That is, on this account, *At least two people ate anything* is ill-formed not because it does not express a coherent meaning, but simply

because it does not express a maximally informative statement (cf. also Krifka 1991).[23]

(67) a $[\![\text{VP}']\!]^f = \{\{a: \{b: \langle a,b\rangle \in [\![\text{ate}']\!]\} \in Q\}: Q \in L_{\text{THING}}\}$

b At Most Three′(λx (person′(x)))
(λx ($\lambda P \exists y$ (thing′(y) $\wedge$ $P(y)$)(λz (ate′(x,z)))))
At Most Three′(λx (person′(x)))($\lambda x \exists y$ (thing′(y) $\wedge$ ate′(x,y)))
(λ-conversion)
|

At Most Three′(λx (person′(x)))
(λx ($\lambda P \exists_2 y$ (thing′(y) $\wedge$ $P(y)$)(λz (ate′(x,z)))))
At Most Three′(λx (person′(x)))($\lambda x \exists_2 y$ (thing′(y) $\wedge$ ate′(x,y)))
(λ-conversion)
|

...
|

At Most Three′(λx (person′(x)))
(λx ($\lambda P \exists_{99} y$ (thing′(y) $\wedge$ $P(y)$)(λz (ate′(x,z)))))
At Most Three′(λx (person′(x)))($\lambda x \exists_{99} y$ (thing′(y) $\wedge$ ate′(x,y)))
(λ-conversion)
|

...

In essence then, our current alternative semantics approach to the licensing of NPIs demands that, in order to calculate entailment relations between alternative propositions in $[\![\text{S}']\!]^f$, we make a substitution in the position of the NPI. This requires that we abstract over the position occupied by the NPI. Let us now assume that this abstraction is effected by means of ED. In the case of (66) for instance, we can abstract over the position of the NPI through ED as in (68a).[24] Each property P in $[\![\text{ate-anything}']\!]^f$ (= 67a), in terms of which $[\![(66)']\!]^f$ (=

[23] Note that this reasoning leaves the fact that strong NPIs require an anti-additive trigger, rather than just a monotone decreasing one, unexplained. One could try to formulate the notion of maximal informativeness in such a way that the distribution of strong NPIs can be made to follow from it. However, I will not do so here (but cf. Jackson 1994 for interesting suggestions).

[24] The most natural way to do this would be to define a type-lifted version of ED in terms of Λ along the following lines: $\Lambda x\,(\Phi) = \lambda Q\,(Q\,(\underline{\lambda} x\,(\Phi)))$. Interestingly, this type-lifted ED might give us a handle on the WI sensitivity of *combien*-extraction in French, a fact that has been studied by a number of scholars (cf. Obenauer 1984/85; de Swart 1992; Dobrovie-Sorin

67b) is defined, is then the result of applying the function in (68a) to some $Q \in L_{THING}$. This holds since (68a) and (68d) are equivalent, and each $Q \in L_{THING}$ is conservative.

(68) a $\lambda Q \lambda x\ (Q\ (\downarrow \underline{\lambda} y\ \mathfrak{E} y\ (\uparrow \text{thing}'(y) \mathbin{\underline{\wedge}} \uparrow \text{saw}'(x,y))))$
b $\lambda Q \lambda x\ (Q\ (\downarrow \lambda y'\ (\mathfrak{E} y\ (\uparrow \text{thing}'(y) \mathbin{\underline{\wedge}} \uparrow \text{saw}'(x,y)) \mathbin{\underline{\wedge}} \uparrow y = y')))$ (def. of ED)
c $\lambda Q \lambda x\ (Q\ (\downarrow \lambda y'\ \mathfrak{E} y\ (\uparrow \text{thing}'(y) \mathbin{\underline{\wedge}} \uparrow \text{saw}'(x,y) \mathbin{\underline{\wedge}} \uparrow y = y')))$ (def. of $\mathfrak{E}$ and $\underline{\wedge}$)
d $\lambda Q \lambda x\ (Q\ (\lambda y\ (\text{thing}'(y) \wedge \text{saw}'(x,y))))$ (elementary logic, def. of $\downarrow$ in 2.36)

We have now arrived at an alternative semantics for NPI licensing, one which is inspired by Krifka's (1991) claim that NPI licensing is a special case of focus-sensitive quantification. As this semantics does away with Dynamic Binding (and its problematic consequences), we can no longer characterize Negative Polarity as a split construction in the narrow sense of the latter term. However, the proposed alternative semantics for NPI licensing retains ED in order to compute entailment relations between alternative propositions. Thus, given that this semantics still requires dynamic abstraction through ED over the argument position bound by the NPI in the scope of its trigger, on a par with our earlier analysis of the semantics of What For-split, there seems to be no harm in characterizing Negative Polarity as a split construction in a somewhat broader sense of this term.

According to the Intervention Generalization as stated in (4) then, we expect Negative Polarity to be sensitive to WI effects. In the light of the data discussed in section 1.5.2, we already have some reason to believe that this prediction is correct. However, in order to fully appreciate the accuracy of this prediction, we will consider a number of additional WI contexts in the next section. It will be shown that these contexts too disrupt the licensing of NPIs.

1992,1994, among others). Since possible answers to *how many*-questions in general involve Generalized Quantifiers, we might analyze the dynamic question expressed by (i) in terms of Λ along the lines of (ii). If this analysis is essentially on the right track, the dynamic theory of WIs presently under consideration would straightforwardly account for intervention effects on *combien*-extraction.

(i) Combien as-tu lu de livres?
How many have-you read of books

(ii) a $\Lambda x\ (\text{E}x\ (\uparrow \text{book}'(x) \mathbin{\underline{\wedge}} \uparrow \text{read}'(\text{you}',x)))$
b $\lambda Q\ (Q\ (\ \underline{\lambda} x\ (\text{E}x\ (\uparrow \text{book}'(x) \mathbin{\underline{\wedge}} \uparrow \text{read}'(\text{you}',x)))))$ (def. Λ)
c $\lambda Q\ (Q\ (\ \lambda x'\ (\text{E}x\ (\uparrow \text{book}'(x) \mathbin{\underline{\wedge}} \uparrow \text{read}'(\text{you}',x)) \mathbin{\underline{\wedge}} \uparrow x = x')))$ (def. ED)
d $\lambda Q\ (Q\ (\ \lambda x\ (\uparrow \text{book}'(x) \mathbin{\underline{\wedge}} \uparrow \text{read}'(\text{you}',x))))$ (Fact 2.15, elementary logic)

A more thorough elaboration of this suggestion will be left for another occasion, though. Note finally that in (68), we have abstracted away from intensionality. This is done only for reasons of simplicity, however.

3.3.2 More on Negative Polarity and Scope Islands

Of course, the observation that Negative Polarity is sensitive to properties of the intervening material is not new. This fact was already remarked upon by various scholars.[25] The aim of this section is merely to present a systematic overview of relevant observations that can be made in this connection. This will enable us to directly compare the intervention effects on Negative Polarity with those on What For-split. To the extent that both What For-split and NPIs display the same sensitivity to the same set of interveners, we are justified in referring to the intervention effects on Negative Polarity as WI effects.

First, we observe in (69) below that different types of Q-NPs of varying monotonocity may not intervene between trigger and NPI, where (69a) and (69b) repeat our earlier observations in section 1.5.2.[26] The indirect object constructions in (69) should be contrasted with their dative shift counterparts in (70), where the prepositional dative no longer intervenes between trigger and NPI.

(69) a *Nobody gave at most/fewer than/less than three beggars a red cent
b *Nobody gave exactly/precisely three beggars a red cent/anything
c *Nobody gave at least/more than three beggars a red cent/anything
d *Nobody gave most beggars a red cent/anything
e *Nobody gave every beggar a red cent/anything

(70) a Nobody gave a red cent/anything to at most/fewer than/less than three beggars
b Nobody gave a red cent/anything to exactly/precisely three beggars
c Nobody gave a red cent/anything to at least/more than three beggars
d Nobody gave a red cent/anything to most beggars
e Nobody gave a red cent/anything to every beggar

Secondly, it is a well-known fact that the occurrence of a strong NPI in an interrogative sentence forces a rhetorical interpretation of that sentence. This is illustrated in (71) below, where 'rhQ' stands for the rhetorical question interpretation and 'y/nQ' for the yes/no-question interpretation. Even though nothing much hinges on this in the present context, we might speculate that the reason why a yes/no-question interpretation is lacking here ultimately resides in the fact that we cannot construct a positive answer to the question (71) expresses on the basis of its structure; i.e. *Yes, (it is true that) John gave a red*

[25] Cf. Linebarger (1987), Szabolcsi & Zwarts (1990), Kas (1993) and Jackson (1994), among others.

[26] In (69a), I left *anything* out from consideration, as the indirect object Q-NPs might license this weak NPI themselves.

cent to that beggar is ill-formed (cf. also below).

(71) Did John give a red cent to that beggar? (✓rhQ, *y/nQ)
rhQ: *John didn't give a red cent to that beggar*
y/nQ: **Is it true that John gave a red cent to that beggar?*

This observation concerning the interpretive properties of interrogatives containing strong NPIs suggests a test to determine whether negation and 'negative' quantifiers too induce intervention effects on Negative Polarity. To see that they do, we need only observe that the sentences in (72) below lack the rhetorical interpretation. For these sentences to be well-formed, the relevant negative expression must license the NPI itself. This yields an ordinary yes/no-question interpretation for the interrogative.[27]

(72) a Didn't John give a red cent to that beggar? (*rhQ, ✓y/nQ)
b Did no one give a red cent to that beggar? (*rhQ, ✓y/nQ)
c Did John never give a red cent to that beggar? (*rhQ, ✓y/nQ)

Finally, Q-adverbs in general create barriers for NPI licensing, as can be gleaned from the examples in (73) below. Again, the rhetorical reading is missing here. The only relevant difference between (72) and (73) is that in the latter cases, the intervening Q-adverbs do not denote anti-additive functions. Consequently, these interrogatives do not admit of an ordinary y/n-question interpretation either, as this reading would have required the Q-adverbs themselves to license the strong NPI. Given that there is no alternative reading available, the interrogative sentences in (73) are ruled out.

(73) a *Did John always give a red cent to that beggar? (*rhQ, *y/nQ)
b *Did John mostly give a red cent to that beggar? (*rhQ, *y/nQ)
c *Did John often give a red cent to that beggar? (*rhQ, *y/nQ)
d *Did John seldom give a red cent to that beggar? (*rhQ, *y/nQ)

Now, the cases discussed up to this point should be contrasted with the Negative Polarity constructions in (74) below. As these constructions are perfectly well-formed, we cannot but conclude that proper names, (simple) singular indefinites and singular definite descriptions may happily intervene between trigger and NPI, in contradistinction to Q-NPs, Q-adverbs and negation, as discussed above.

(74) a Nobody gave John a red cent/anything
b Nobody gave a beggar a red cent/anything
c Nobody gave the beggar a red cent/anything

[27] Cf. Khalaily (1995) for similar observations concerning the blocking effects on NPIs in interrogative contexts.

Observe finally that plural (simple) indefinites and definite descriptions do not obstruct NPI licensing either, as long as these types of expressions receive a collective construal. This point is illustrated in (75) below, where the presence of a floating quantifier will force a distributive construal of its plural antecedent.

(75)
a ?Did three women (*each) give a red cent to that beggar?
b Did the three women (*each) give a red cent to that beggar?

The generalization that emerges from these data is that Negative Polarity displays the exact same sensitivity to intervention effects as What For-split: if a given expression denotes an externally static function, it cannot intervene between trigger and NPI. This correlation between What For-split and Negative Polarity therefore justifies our earlier practice of referring to the intervention effects on NPI licensing as WI effects. If we are correct in characterizing Negative Polarity as a split construction, as we claimed in the preceding subsection, its sensitivity to WIs follows directly from the Intervention Generalization. In the next section, we will account for this consequence of the Intervention Generalization.

3.3.3 Negative Polarity, Existential Disclosure and Weak Islands

Recall the two crucial claims we made in section 3.3.1: NPIs are uniformly interpreted as (restricted) existential quantifiers, and NPIs are dynamically abstracted over in the scope of the 'negative trigger by means of ED in order to calculate entailment relations between alternative propositions. This analysis paves the way for a dynamic approach to the WI sensitivity of Negative Polarity. We already commented at various points that the expressions which create WIs also induce inaccessible domains for dynamic anaphora. We therefore predict that we cannot dynamically abstract over an NPI in the scope of its trigger if the NPI is contained in a WI, as ED cannot be sensibly applied in an inaccessible domain for dynamic anaphora. On the basis of this reasoning, we can correctly rule out all the ill-formed NPI constructions reviewed in section 3.3.2. This line of reasoning will be fleshed out in section 3.3.3.2. But first, we need to make sure that the harmful interveners in Negative Polarity constructions cannot outscope a 'negative' trigger. This will be the topic of discussion in the next subsection.

3.3.3.1 Scope

Earlier, we assumed that the reason why a strong NPI in an interrogative sentence forces a rhetorical reading lies in the fact that it is impossible to give

positive answers to the question it expresses on the basis of its form. Let us make this a bit more precise. Consider a situation in which I pose to you the question expressed by the interrogative sentence in (71) above, repeated here as (76a). On Karttunen's approach to the (static) semantics of interrogatives, the meaning of (76a) can be represented as in (76b). Now, the assumption under consideration here essentially boils down to this: since the sentence *that John gives a red cent to that beggar* is ill-formed, due to the fact that there is no appropriate trigger for the NPI *a red cent*, there will be no proposition p = *that John gives a red cent to that beggar* which counts as an appropriate answer in this or any other world. This assumption therefore entails that (76a) can be safely taken to denote the set consisting only of the proposition *that John does not give a red cent to that beggar*, as indicated in (76c).

(76)
a Did John give a red cent to that beggar?

b $\lambda p\,(p(w) \wedge (p = \lambda w' \exists y\,(\text{red-cent}'_{w'}(y) \wedge \text{give}'_{w'}(\text{john}', \text{that-beggar}', y))) \vee (p = \lambda w' \neg \exists y\,(\text{red-cent}'_{w'}(y) \wedge \text{give}'_{w'}(\text{john}', \text{that-beggar}', y))))$

c {p: p is true in the actual world, and p = that John does not give a red cent to that beggar}

As you may safely assume that I am aware of the fact that (76a) can be taken to denote the set in (76c), you will infer that I uttered this interrogative just for rhetorical reasons, i.e. that I intend this sentence to convey the proposition that John did *not* give a red cent to that beggar. More generally, on this analysis, any interrogative *?*ϕ where ϕ contains an occurrence of a (strong) NPI will give rise to the implicature $\neg\phi$, and it is this implicature which licenses the NPI. This accounts for the observation that interrogative sentences such as (76a) only allow a rhetorical interpretation.

With this much in mind, let us now turn to matters of scope, as promised. Given our implicature-based account of strong NPIs in interrogative contexts, it is now predicted that the 'negative' expressions in (72), the Q-adverbs in (73) and floating quantifier *each* (or its 'silent' counterpart Δ) in (75) scopally intervene between the negation and the NPI in the would-be implicated statement. Consider for instance (73a) above. Firstly, since *that John always gives a red cent to that beggar* does not count as an appropriate answer in this or any other world, we might consider the singleton set of propositions in (77) below as a possible denotation for (73a). Note now that the universal quantifier over events denoted by *always* scopally intervenes here between the negation and the existential quantifier denoted by the NPI. For reasons that will be uncovered in the next subsection, this is an impossible state of affairs. As both ϕ and $\neg\phi$ do not count as possible answers to (73a), where ϕ = *that John always gives a red cent to that beggar*, this sentence does not express a proper question. Whence its ill-formedness.

(77) {p: p is true in the actual world, and $p = \neg$ (that John always gives a

red cent to that beggar)}

Observe finally that our implicature-based analysis can account for the fact that the examples in (72) above can receive an 'ordinary' yes/no-question interpretation. If for example sentence negation in (72a) itself is taken to license the NPI, and only then, the interrogative denotes the set $\lambda p\ (p(w) \wedge (p = \phi \vee p = \neg\phi))$, where ϕ = *that John didn't give a red cent to that beggar*. No problems are expected to arise here since the NPI *a red cent* is already properly licensed in ϕ. Thus, (72a) denotes an ordinary yes/no-question.

It is relatively easy to show that the various intervening expressions in the remaining cases (i.e. the examples in 69) cannot outscope the 'negative' trigger either. This scopal deficiency is an instance of the fact that Q-NPs in general cannot take 'inverse' scope over a negative expression which c-commands them, as observed for example by Beghelli & Stowell (1997). This fact is illustrated in (78) below, where *S* stands for the subject and *IO* for the indirect object.[28]

(78) a No teacher gave at most/fewer than/less than three students homework (✓S > IO, *IO > S)

S > IO: *There isn't any teacher who gave at most/fewer than/less than three students homework*

IO > S: **At most/fewer than/less than three students are such that no teacher gave them homework*

b No teacher gave exactly/precisely three students homework (✓S > IO, *IO > S)

c No teacher gave at least/more than three students homework (✓S > IO, *IO > S)

d No teacher gave most students homework (✓S > IO, *IO > S)

e No teacher gave every student homework (✓S > IO, *IO > S)

We will not attempt to provide an explanation for facts such as those in (78), as this would fall properly outside the scope of our present concerns. Suffice it to say that whatever accounts for these facts, the generalization which is exemplified by them allows us to treat the WI effects on NPI licensing on a par with those on What For-split. This will be demonstrated in the next subsection.

3.3.3.2 Existential Disclosure and Weak Island Effects on Negative Polarity

[28] The scopal deficiency illustrated in (78a-d) is just an instance of the more general fact that the relevant Q-NPs cannot outscope any expression which c-commands them (cf. Beghelli 1993; Ben-Shalom 1993; and Beghelli & Stowell 1997). As for (78e), even though universal distributive Q-NPs in English can easily take 'inverse' scope in the normal case, it has been observed by a number of authors that they cannot do so in case of a c-commanding negative Q-NP. Along with Beghelli & Stowell (1997), we might speculate that the latter observation follows from the fact that negative quantifiers cannot function as a key for distributive quantification, as suggested by the ill-formedness of *The boys read no papers each.*

We already observed above that for a 'negative' trigger to license an NPI, we must disclose the (restricted) existential quantifier denoted by the NPI by means of ED so as to be able to compute entailment relations between alternative propositions. We may recall from our discussion of What For-split that ED in general does not output a semantically sensible result if the existential quantifier which is in need of disclosure is properly contained at LF in an inaccessible domain for dynamic anaphora. Since all WI inducing expressions also create inaccessible domains for dynamic anaphora, we can account for the WI sensitivity of Negative Polarity in terms of the same principles of Dynamic Semantics that derive inaccessibility. In what follows, we will apply this line of reasoning to account for the ill-formedness of (69a) above, which will be taken to be representative of the whole gamut of WI effects on NPI licensing reviewed in section 3.3.2. For ease of reference, (69a) has been repeated in (79a) below. In line with what we observed in the preceding subsection, we may take its LF to be as in (79b).

(79)
a *Nobody gave at most three beggars a red cent (cf. 69a)

b $[_{\text{AgrSP}}$ Nobody$_x$ $[_{\text{AgrIOP}}$ at most three beggars$_z$ $[_{\text{AgrOP}}$ $[\text{a}_y$ red cent$]_{y'}$ $[_{\text{VP}}$ e_x gave e_z $\text{e}_{y'}]]]]$

c $[\![\text{AgrIOP}']\!]^f = \{\{a\text{: }\{c\text{: }\{b\text{: }\langle a,b,c\rangle \in [\![\text{gave}']\!]\} \in [\![\text{At Most Three}']\!]([\![\text{beggar}']\!])\} \in Q\}\text{: } Q \in \text{L}_{\text{RED CENT}}\}$

As explained in section 3.3.1, the NPI *a red cent* is appropriately licensed in (79a) if this sentence entails all alternative propositions in $[\![(79a)']\!]^f$ and therefore counts as the most informative statement when compared to these alternatives. Each alternative proposition p in $[\![(79a)']\!]^f$ is the result of applying the Generalized Quantifier denoted by *nobody* to some property P in $[\![\text{AgrIOP}']\!]^f$, where the latter set is defined in terms $[\![\text{a-red-cent}']\!]^f = \mathbf{L}_{\text{RED CENT}}$ as indicated in (79c). Thus, each P in (79c) in turn is to be obtained by plugging in some $Q \in \text{L}_{\text{RED CENT}}$ in the position of the NPI. That is, each P in $[\![\text{AgrIOP}]\!]^f$ is the result of applying the function in (80) to some $Q \in \text{L}_{\text{RED CENT}}$.

(80) $\lambda Q \lambda x\ (Q\ (\lambda z\ (\text{At Most Three}'(\lambda y\ (\text{beggar}'(y)))(\lambda y\ (\text{red-cent}'(z) \wedge \text{gave}'(x,y,z))))))$

By assumption, in order to abstract over the position occupied by the NPI in the way indicated in (80), we must apply ED. Let us see whether this gives us the intended result.

(81) a $\lambda Q \lambda x\ (Q\ (\downarrow \underline{\lambda} z\ (\mathscr{At\ Most\ Three}\ (\ \lambda y\ (\uparrow \text{beggar}'(y)))(\ \lambda y\ \mathfrak{E} z\ (\uparrow \text{red-cent}'(z) \mathbin{\underline{\wedge}} \uparrow \text{gave}'(x,y,z))))))$

b $\lambda Q \lambda x\ (Q\ (\downarrow \lambda z'\ (\uparrow \text{At Most Three}'(\lambda y\ (\text{beggar}'(z)))(\lambda y \exists z\ (\text{red-cent}'(z) \wedge \text{gave}'(x,y,z))) \mathbin{\underline{\wedge}} \uparrow \underline{z} = z')))$ (def. of $\mathfrak{E}$, $\underline{\wedge}$ and ED, def. 2.36)

In the by now familar way, (81a) can be reduced to (81b). It is easy to see that

(81b) is not equivalent to (80). The reason is that the variable z that has been introduced by ED (i.e. the underlined occurrence of z in 81b) is not bound by the existential quantifier denoted by the NPI. This is a direct consequence of the inaccessible domain for dynamic anaphora created by the externally static quantifier denoted by *at most three beggars* in (79a). More generally, no proper set of alternative propositions ordered by entailment can be constructed on the basis of (81), as desired. Given that dynamic abstraction through ED over $\mathfrak{E}z$ will result in a free occurrence of the variable z, no proper $[\![\text{AgrIOP}']\!]^f$ set, and therefore no proper set of alternative propositions $[\![(79a)']\!]^f$, can be constructed on account of Fact (25). As (79a) cannot generate the appropriate scalar implicatures, the NPI *a red cent* is not properly licensed.

The remaining WI cases discussed in section 3.3.2 can be dealt with in essentially the same fashion. Consider again the ill-formedness of (73a), repeated below as (82a). As was already discussed in some detail in the above (cf. our discussion surrounding 77), on our implicature-based approach to (strong) NPIs in interrogative contexts, the question whether the NPI is licensed in (82a) reduces to the question whether the NPI is appropriately licensed in its would-be implicature (82b).

(82) a *Did John always give a red cent to that beggar? (cf. 73a)

b ¬(that John always gives a red cent to that beggar)

According to our present assumptions with respect to the semantics of NPI licensing, for the negation to license the NPI in (82b), this proposition must represent the most informative statement with respect to all alternative propositions in $[\![(82b)']\!]^f$. In order to calculate entailment relations between these alternative propositions, we must abstract over the position of the NPI through ED in the way indicated in (83a). However, note that the restricted existential quantifier denoted by *a red cent* does not bind the appropriate variable introduced by ED (i.e. the underlined occurrence of z in 83b). Again, this is due to the inaccessible domain for dynamic anaphora created by *always*, which denotes an externally static quantifier over events (cf. section 2.3.3).[29] Thus, on a par with what we observed with respect to (81) above, given that free variables such as z in (83b) cannot be assigned any value in Dynamic Semantics (cf. 25), no proper $[\![(82b)']\!]^f$ set can be constructed on the basis of (83). As (82b) cannot give rise to the appropriate scalar implicatures, the NPI *a red cent* is not properly licensed in (82a), as desired.

(83) a $\lambda Q\,(Q\,(\downarrow \underline{\lambda z}\,(\subset\!\mathscr{A} e\,(\mathfrak{E}z\,(\uparrow\text{red-cent}'(z) \underline{\wedge} \uparrow\text{gave}'(\text{john}',\text{that-beggar}',z,e))))))$

b $\lambda Q\,(Q\,(\downarrow \lambda z'\,(\uparrow\forall e\,(\exists z\,(\text{red-cent}'(z) \wedge \text{gave}'(\text{john}',\text{that-beggar}',z,e))) \underline{\wedge} \uparrow \underline{z} = z')))$ (def. of $\subset\!\mathscr{A}$, $\mathfrak{E}$, $\underline{\wedge}$ and ED)

Our dynamic approach to the WI sensitivity of Negative Polarity also

[29] In (83), we have left out an appropriate restriction on the universal quantifier over events in order not to complicate matters.

explains why proper names, definite descriptions and 'simple' indefinites may freely intervene between trigger and NPI, provided that plural definite descriptions and 'simple' indefinites receive a collective construal (cf. the examples in 74 and 75 above). Crucially, these types of expressions never induce inaccessible domains for dynamic anaphora. From a dynamic point of view, the latter property is of course as expected: the relevant expressions either denote a (singular or plural) individual, or they denote an externally dynamic quantifier. Therefore, since these expressions do not block dynamic anaphora, they do not prevent dynamic abstraction over an indefinite NPI inside their scope either.

We have thus arrived at a completely unified dynamic account of the WI effects on What For-split and Negative Polarity. In fact, the analysis we just provided is essentially identical to our story on What For-split, barring some minor differences that arise from the fact that NPIs are not dynamically bound by their 'negative' trigger. In general, principles of parsimony will deem such a unified analysis as more attractive than alternative accounts that cover one set of facts, but leave the other one unattended. However, before we confidently sit back and relax, we should realize that this unification was made possible by our characterization of Negative Polarity as a split construction (broadly understood). As was already observed in section 3.3.1, this characterization presupposes that all NPIs denote (restricted) existential quantifiers. We will see in the next section that this assumption can be challenged.

3.3.4 Problems with Definite and Modal Negative Polarity Items

Despite the fact that the vast majority of NPIs can be analyzed as denoting (restricted) existential quantifiers, there are at least two types of NPIs the semantics of which seems to resist such an explication. First, there are the modal NPIs such as *hoeven* in Dutch, *brauchen* in German and *need* (when combining with a bare infinitive) in English. The semantics of these modal NPIs must involve universal quantification over possible worlds, since they express deontic necessity. For example, (84b) below adequately represents the truth-conditions of (84a), where *M* refers to the appropriate modal base with respect to which the modal NPI is evaluated. If instead we were to represent the semantics of *need* in terms of existential quantification over possible worlds, as in (85b), we would predict that (84a) and (85a), the natural language paraphrase of (85b), mean the same thing. Of course, they do not.

(84) a John need not go to the doctor
b $\neg\forall w \in M$ (go-to$'_w$(john$'$,ιy (doctor$'_w$(y))))

(85) a John should not go to the doctor
b $\neg\exists w \in M$ (go-to$'_w$(john$'$,ιy (doctor$'_w$(y))))

If indeed modal NPIs express universal rather than existential quantification over possible worlds, it follows that we can no longer characterize constructions involving these NPIs as split constructions (broadly understood; cf. section 3.3.1).

A possible solution to this problem might be found in the observation that there exists a close variant of constructions such as (84a) with the indefinite NPI *any need*. Thus, (84a) for example is very similar in meaning to (86) below. Now, it should be clear that, given that *any need* is a 'simple' indefinite, if all 'simple' indefinites denote (restricted) existential quantifiers, *any need* must denote a (restricted) existential quantifier as well. This holds even independently of any theoretical predilections with respect to the proper treatment of (84a).

(86) There isn't any need for John to go to the doctor

As (86) corresponds closely in meaning to (84a), it is not implausible to assume that (86) reflects the base order from which the structure underlying (84a) is syntactically derived.[30] That is, we might speculate that the modal auxiliary *need* qua NPI is derived from a nominal base through a process of syntactic incorporation. If so, we can interpret the modal NPI *need* in terms of existential quantification in such a way that the meaning of (84a) as a whole still comes out as equivalent to that represented by (84b). Thus, *need* need not constitute a counterexample to our claim that all NPIs denote (restricted) existential quantifiers.

The second class of NPIs that appears to counterexemplify our claim that all NPIs denote (restricted) existential quantifiers consists of definite NPIs such as *the slightest interest*, *the faintest idea* etc. If definite descriptions support cross-sentential anaphora not through binding but through coreference, as seems reasonable, then any attempt to disclose a definite NPI must lead to semantic ill-formedness on account of (25).[31] There are good reasons to believe, however,

[30] Cf. Jackson (1994) for a similar suggestion.

[31] Something along these lines must be assumed in any event if we want to exclude definite descriptions as potential remnants of What For-split (cf. 9) on the same grounds on which we ruled out the constructions in (21) above.

that definite NPIs should not be analyzed as ordinary definite descriptions. First of all, definite NPIs intuitively do not refer to discrete objects in the sense that ordinary definite descriptions do. For example, *the man* refers to some unique object with the property of being a man, which can be distinguished from another object with the same property (i.e. *the other man*), and *the two ounces of gold* refers to some unique portion of matter with the right weight and chemical structure (symb. *Au*, element 79 in the periodic table), which can be distinguished from some other portion of matter with the same properties (i.e. *the other two ounces of gold*). But the definite NPI *the faintest idea* does not seem to refer to some unique object with well-identifiable properties (which might be abstract, such as degree of intensity), which can be distinguished from another object with the same properties (i.e. ??*the other faintest idea*). Instead, it just refers to *some* (minimal) amount of awareness which goes proxy for any number of 'concrete' instances of awareness with the same minimal degree of intensity. In this intuitive sense, definite NPIs thus seem to have more semantic properties in common with ordinary indefinites than with ordinary definite descriptions.

A second, more important reason not to analyze definite NPIs on a par with ordinary definite descriptions relates to the fact that the former can occur in syntactic environments where the latter are excluded. Consider for instance the contrast in (87). As is well-known, definite descriptions, as opposed to indefinite expressions, cannot occur in existential *there*-sentences, as demonstrated in (87a) (cf. Milsark 1974; Barwise & Cooper 1981; Keenan 1987, among many others). If definite NPIs are nothing but a special type of definite description, their licit occurrence in existential *there*-sentences, as illustrated in (87b), should come as a complete surprise.

(87) a Nobody thought there was *the/a book on Dynamic Semantics
b Nobody thought there was the slightest interest in Dynamic Semantics

Furthermore, definite descriptions which occur in the object position of (possessive) *have*-sentences must receive an 'alienable' interpretation, again unlike ordinary indefinites. This is shown by the marked status of (88a) below when *nose* is preceded by the definite article. Interestingly enough, even though a definite NPI such as *the faintest idea* clearly counts as an inalienable expression, it can freely occur in the object position of a (possessive) *have*-sentence, as shown in (88b).

(88) a John doesn't have ??the/a nose
b John doesn't have the faintest idea

In both types of constructions therefore, definite NPIs pattern more like ordinary indefinites rather than definite descriptions. It is especially this latter finding which suggests that the semantics of definite NPIs may in fact be susceptible to

an analysis in terms of existential quantification, despite initial appearances. All in all then, I hope that our discussion of modal and definite NPIs has made it clear that the mere existence of these types of NPIs does not force us to retreat from our general claim that all NPIs denote (restricted) existential quantifiers.

3.3.5 Weak Islands and the Preservation of Boolean Properties under Function Composition

The dynamic account of the WI sensitivity of Negative Polarity is certainly not without its rivals. An important alternative approach can be grounded in the assumption that for an NPI to be licensed, it takes more than just occurring inside the scope of a (atomic) trigger with the requisite Boolean properties. Instead, an NPI is licensed just in case it is the argument of a (composite) function with the appropriate properties. This means that in cases where there is a potential trigger *f* in the sentence for the NPI, we must ask ourselves whether *f* can be composed into $f \circ ... \circ g$ (where '$\circ$' denotes function composition) in such a way that the NPI is the argument of $f \circ ... \circ g$, and $f \circ ... \circ g$ preserves the appropriate Boolean properties of *f*. Since some of these Boolean properties may not be preserved under function composition, it is predicted that some intervening expressions disrupt the licensing of NPIs. Let us look at a concrete example to see what is at stake here. Consider (89a), based on an example discussed by Zwarts (1991).

(89) a John didn't see anything

b

JOHN	NOT	SEE	ANYTHING	
⟨⟨e,t⟩,t⟩:*mon*↑	⟨⟨e,t⟩,⟨e,t⟩⟩:*mon*↓	⟨gq,⟨e,t⟩⟩:*mon*↑	*gq*	
	⟨gq,⟨e,t⟩⟩:*mon*↓			**Comp**
⟨gq,t⟩:*mon*↓				**Comp**
t				**Appl**

In (89a), there is a potential trigger for the weak NPI *anything*, viz. *not*. In line with what was said in the above, the question we must now face is whether the function denoted by *not* (i.e. Boolean NOT) can be composed in such a way that the composite function takes the (denotation of the) NPI as argument while retaining the Boolean property to which the weak NPI is responsive, viz. downward monotonicity *mon*↓. Consider now the following elementary calculus on the basis of which we can compute the monotonicity properties of the result ($f \circ g$) of composing a given monotone function *g* with another monotone function *f* (cf. also Zwarts 1986), where *mon*↑ stands for monotone increasing:

(90) *Monotonicity Calculus (MC)*
a f:*mon*$\uparrow$ and g:*mon*$\uparrow$ $\Rightarrow$ $f \circ g$:*mon*$\uparrow$
b f:*mon*$\uparrow$ and g:*mon*$\downarrow$ $\Rightarrow$ $f \circ g$:*mon*$\downarrow$
c f:*mon*$\downarrow$ and g:*mon*$\uparrow$ $\Rightarrow$ $f \circ g$:*mon*$\downarrow$
d f:*mon*$\downarrow$ and g:*mon*$\downarrow$ $\Rightarrow$ $f \circ g$:*mon*$\uparrow$

Assuming the MC, consider (89b), where an expression in capitals designates its model-theoretic interpretation, where $gq = \langle\langle e,t\rangle,t\rangle$, and where **Comp** stands for function composition, and **Appl** for functional application. In (89b), we see that there exists a semantic derivation in which NOT is composed into (JOHN$\circ$ (NOT $\circ$ SEE)), which is monotone decreasing and takes ANYTHING as an argument.

Let us now turn to the question how this monotonicity-based approach sheds light on the WI effects on the licensing of NPIs. The approach will be illustrated by means of the example in (93a) below. But first, we must define the notion of *multiplicativity*, as it is this Boolean property which blocks the transmission of the relevant semantic feature to which a strong NPI such as *a red cent* is responsive, viz. anti-additivity. Multiplicativity can be defined as in (91).

(91) A function f is *multiplicative* just in case
$f(A \wedge B) \Leftrightarrow f(A) \wedge f(B)$

where $\wedge$ is the Boolean meet. We can easily show that universal distributive Q-NPs denote multiplicative functions. For instance, since (92a) and (92b) entail each other, we know that *every beggar* denotes a multiplicative function.

(92) a Every beggar (is poor and has a drinking problem) $\Leftrightarrow$
b Every beggar (is poor) and every beggar (has a drinking problem)

Furthermore, given that strong NPIs are sensitive to anti-additivity rather than mere downward monotonicity, we need to extend the MC in (90) so that we can compute the semantic properties of the result of composing more fine-grained classes of Boolean functions. Kas (1993), building on Szabolcsi & Zwarts's (1990) Revised Monotonicity Calculus, has developed such a calculus, called the Extended Monotonicity Calculus (EMC). Unfortunately, due to reasons of space, we will not be able to present and discuss this system in all its fine details. Nor is there any reason to do this: for our purposes, it suffices to note that according to the EMC, the result of composing g with f ($f \circ g$), where f is anti-additive (*anti-add*) and g is multiplicative (*mult*), is monotone decreasing. Given this much, we may now turn to (93a).

(93) a *Nobody gave every beggar a red cent

b NOBODY GAVE $\circ$ EVERY BEGGAR A RED CENT

⟨⟨e,t⟩,t⟩:*anti-add*	⟨gq,⟨e,t⟩⟩:*mult*	*gq*
⟨gq,t⟩:*mon*↓		**Comp**
		Appl

*

Assuming that the composition of EVERY BEGGAR and GAVE (GAVE ○ EVERY BEGGAR) preserves the multiplicativity of EVERY BEGGAR, we see in (93b) that (NOBODY ○ (GAVE ○ EVERY BEGGAR)) is just *mon*↓, and therefore not a suitable trigger for A RED CENT. This is so since according to Kas's EMC, composing a multiplicative function with an anti-additive one results in a downward monotone function. As there is no other way of composing NOBODY into an anti-additive function which takes A RED CENT as an argument, Kas correctly captures the ill-formedness of (93a).

It goes without saying that Kas's approach has a strong appeal to it. From the assumption that NPIs want to be an argument of a (composite) function which is at least monotone decreasing, various intervention effects on the licensing of NPIs automatically follow. Contrast this with our own dynamic analysis in which the WI effects on Negative Polarity were derived from (dynamic) principles that in themselves do not relate in any way to the fact that NPIs require a monotone decreasing function as trigger. Despite its strong initial appeal, however, there are two serious objections that may be leveled against a Boolean account such as the one advocated by Kas, one empirical and one theoretical. We will conclude this section by discussing these two objections in turn.

Firstly, on a Boolean approach to the WI sensitivity of Negative Polarity, it should be a complete mystery why the same set of harmful interveners is involved in the licensing of both weak and strong NPIs. After all, weak NPIs are merely interested in the preservation of downward monotonicity under function composition, whereas strong NPIs demand the preservation of the much stronger property of anti-additivity. A Boolean analysis would therefore predict that weak and strong NPIs are sensitive to different types of interveners, *quod non*. For example, consider again (93a). Replacing the strong NPI *a red cent* with the weak *anything* does not alter the grammatical status of this structure, as shown in (94a) below (cf. also 69e). This is rather unexpected under Kas's approach, for we already observed above that composing a multiplicative function with an anti-additive one results in a monotone decreasing function. Thus, as shown in (94b), there exists a semantic derivation in which a monotone decreasing function takes ANYTHING as argument.

(94) a *Nobody gave every beggar anything

b

NOBODY	GAVE ○ EVERY BEGGAR	ANYTHING

⟨⟨e,t⟩,t⟩:*anti-add* ⟨gq,⟨e,t⟩⟩:*mult* *gq*
---------- **Comp**
⟨gq,t⟩:*mon*↓
---------- **Appl**
t

Secondly, Kas (1993) suggests at different points in his thesis that the EMC may also be fruitfully applied to other types of WI constructions, such as What For-split. His optimism was based on the seminal work of Szabolcsi & Zwarts (1990), who exploited the resources of their Revised Monotonicity Calculus to provide a semantic explanation for WIs. Now, Szabolcsi & Zwarts (1993) discuss a number of reasons for their dissatisfaction with their earlier approach. On the empirical side, they observe that some upward monotone expressions do create WIs, an observation that should come as a surprise for their earlier monotonicity-based account. And on the theoretical side, they note as a problem that it is not entirely clear why WI-sensitive expressions should be interested in the preservation of their partial order, as required on their (1990) analysis. It seems that both these problems render Kas's optimism concerning the potential of his EMC unfounded as well. For we might get rid of most of the empirical problems by stipulating that What For-split interrogatives for example are interested in the preservation of anti-additivity. But such a stipulation would raise the even more difficult theoretical problem why WI-sensitive expressions might be interested in the preservation of anti-additivity in the first place. For one thing, most of the WI-sensitive expressions I know of certainly do not denote anti-additive functions. Thus, the conclusion seems warranted that Kas's approach cannot be extended to other types of WI constructions, not even in principle.

3.4 Conclusions: On Selective Binding and the Intervention Generalization

Given our dynamic account of the WI sensitivity of What For-split and Negative Polarity as presented in the preceding sections, it should not be too hard to see now how the Intervention Generalization in general can be straightforwardly derived from the system of assumptions set us thus far. The Intervention Generalization has been repeated in (95) for our convenience:

(95) *The Intervention Generalization*
*... $[_{\Phi}\ Q_i$ ... $[_{\text{Weak Island}}$ Operator ... $[_{\text{indefinite}}\ D_i$ NP] ...] ...] ...

In order to interpret the indefinite DP as a property restricting the range of the variable quantified over by *Q*, we must apply ED roughly in the way indicated in (96a). Recall now claim (5), according to which the class of those expressions

which induce WIs exactly coincides with the class of those expressions which create inaccessible domains for dynamic anaphora. In terms of the system of Dynamic Semantics presented in Chapter 2, this means that *Operator* in (95) translates into an externally static function λX (↑Operator´ (↓X)), as indicated in (96a) as well. Thanks to the definition of ED, (96a) reduces to (96b).

(96) a $\mathcal{Q}(\ \underline{\lambda i}\ (\ ...\ (\uparrow \text{Operator}'(\downarrow \lambda k\ \mathcal{E} i\ (\Psi)))))$

b $\mathcal{Q}(\ \lambda j\ (\ ...\ (\uparrow \text{Operator}'(\lambda k \exists i\ (\psi))) \mathbin{\underline{\wedge}} \uparrow \underline{i} = j))$ (def. of ED)

Given that the underlined occurrence of the variable *i* in (96b) is not bound by the existential quantifier $\exists i$ denoted by the indefinite DP in (95), we know that ED has failed to deliver a reading of (95) on which the indefinite is construed as a property restricting the range of the variable *j* quantified over by *Q*. Moreover, since the underlined occurrence of *i* in (96b) is free, and given that free variables are not assigned any semantic value in Dynamic Semantics (cf. again 25), (96) fails to express a well-defined reading. Along these lines then, we can reduce the Intervention Generalization to general semantic principles governing the distribution of dynamic anaphora.

So far, we have illustrated the Intervention Generalization by means of various constructions (i.e. the split constructions reviewed in section 1.5) in which an indefinite must be dynamically bound by some operator in order for it to be licensed. We may refer to this type of dynamic binding as *selective binding* to reflect the fact that the operator selects a particular indefinite to quantify over. But what about those cases that have been argued to involve *unselective binding*, most notably those involving Q-adverbs? Doesn't the Intervention Generalization imply with respect to these cases as well that the Q-adverb cannot dynamically bind an indefinite across a WI? To answer this question, let us first review two major arguments that have been adduced in the literature in support of the idea that Q-adverbs can function as unselective binders (or, equivalently, have a variable adicity).

Firstly, it is undeniable in the face of examples such as (97a) below that Q-adverbs can denote (generalized) quantifiers over events or situations. That is, adopting de Swart's (1991,1995) Generalized Quantifier approach to Q-adverbs which was briefly discussed in section 2.3.3, the truth-conditions of (97a) can be adequately represented as in (97b).

(97) a When Pavarotti sings, I am always happy

b Every´(λe (sings´(pavarotti´,e)))(λe (happy´(I´,e)))

However, examples such as (98a) do seem to indicate that Q-adverbs can sometimes be taken to quantify over individuals or objects as well. Intuitively,

this sentence is not about events or situations in which a quadratic equation has more than two solutions. Rather, it expresses a distinctly atemporal type of quantification on which the property of having more than two solutions is predicated of no quadratic equation. Thus, the static meaning of (98a) should be analyzed along the lines of (98b). To obtain this interpretation, the Q-adverb *never* must 'unselectively' bind the indefinite *a quadratic equation*, a position which was first advanced by Lewis (1975) and subsequently worked out most thoroughly by Heim (1982).

(98) a A quadratic equation never has more than two solutions (cf. Lewis 1975)
b No´(λ*x* (quadratic-equation´(*x*)))(λ*x* (More-than-two´(λ*y* (solution´(*y*)))(λ*y* (has´(*x*,*y*)))))

Kratzer (1988) argues on the basis of the paradigm in (99) below that atemporal predication involving so-called *individual-level* predicates such as *know*, *be intelligent*, (possessive) *have* etc. cannot be analyzed in terms of quantification over events, as this would leave the contrast between (99c) and (99d) unaccounted for.[32] Specifically, this contrast suggests that *stage-level* predicates such as *speak*, *work*, *play* etc. have an extra argument position for events, which can be quantified over by Q-adverbs, whereas individual-level predicates lack such a Davidsonian argument.

(99) a When Mary knows a language, she always knows it well
b When a Moroccan knows French, she always knows it well
c *When Mary knows French, she always knows it well
d When Mary speaks French, she speaks it well

The remaining contrast between (99a-b) and (99c) can then be accounted for rather straightforwardly if we assume that Q-adverbs can quantify over indefinites by 'unselectively' binding them, as illustrated for (99a) in (100).

(100) Every´(λ*x* (language´(*x*) ∧ knows´(mary´,*x*)))(λ*x* (knows-well´(mary´,*x*)))

A second important argument in favor of the hypothesis that Q-adverbs have a variable adicity concerns the behavior of so-called *symmetric* predicates such as *meet* in conditional Q-adverb constructions. If the truth-conditions of (101a) for example would be analyzed in terms of quantification over events or situations, we would wrongly predict that for each event which involves one cardinal meeting another, there is only one corresponding event of blessing, rather than two. On the other hand, we would obtain the correct reading if we

[32] The distinction between *individual-level* and *stage-level* predicates was first discussed in connection to existential *there*-sentences by Milsark (1977). Cf. Carlson (1977) and Diesing (1992) among others for further discussion of how this distinction ties in with genericity.

permit the Q-adverb *always* to 'unselectively' bind both indefinites in its restriction, as shown in (101b).

(101) a If a cardinal meets another cardinal, he always blesses him
b Every´(λ*x*λ*y* (cardinal´(*x*) ∧ cardinal´(*y*) ∧ *x* ≠ *y* ∧ meets´(*x*,*y*)))(λ*x*λ*y* (blesses´(*x*,*y*)))

If indeed the Q-adverbs *never* and *always* bind the relevant indefinites in (98a), and (99a-b) and (101a) respectively, then we must apply ED to these indefinites in order to derive the desired readings represented in (98b), (100) and (101b) in a dynamic setting.[33] But then, given the Intervention Generalization, we would expect in general that those Q-adverb constructions that involve 'unselective' binding are as sensitive to WIs as What For-split or Negative Polarity licensing. However, de Swart (1991,1995) questions the strength of the two arguments for postulating a variable adicity for Q-adverbs reviewed above. Starting with the second argument concerning the behavior of symmetric predicates in conditional Q-adverb constructions, de Swart observes that the truth-conditions of (101a) for example might equally well be represented as in (102a) below. This logical representation correctly entails that for each event of a cardinal meeting another cardinal, there is a corresponding event of the two cardinals blessing each other. Given that (102a) and (102b) are equivalent, we would obtain the desired reading for (101a) if we used the strong definition of Every rather than the weak one.[34]

(102) a Every´(λ*e*∃*x*∃*y* (cardinal´(*x*) ∧ cardinal´(*y*) ∧ *x* ≠ *y* ∧ meets´(*x*,*y*,*e*)))(λ*e*∀*x*∀*y* (cardinal´(*x*) ∧ cardinal´(*y*) ∧ *x* ≠ *y* ∧ meets´(*x*,*y*,*e*) → blesses´ (*x*,*y*,*e*)))
b Every´(↓ λ*e* ∃*x* ∃*y* (↑cardinal´(*x*) ⩓ ↑cardinal´(*y*) ⩓ ↑*x* ≠ *y* ⩓

[33] This is by no means necessary, however, as the analysis developed by Chierchia (1990) shows. On this approach, Q-adverbs together with their restriction denote Generalized Quantifiers over 'cases', where a case is a singleton-set of assignments to variables. This analysis would assign (99a) the meaning represented in (i).

(i) Most´(λ*c*∃*y* (language´(*y*) ∧ knows´(mary´,*y*) ∧ ˇ*c*))(λ*c*∃*y* (language´(*y*) ∧ knows-well´(mary´,*y*) ∧ ˇ*c*))

Note that quantifying over singleton-sets of assignments $c = \{g[y/u]\}$, where *u* is a language that Mary knows, yields the same result as quantifying directly over languages that Mary knows. The restriction on Most´ in (i) can be compositionally retrieved from the CCP in (ii) by the operation ! as defined in (iii).

(ii) λ*p*∃*y* (language´(*y*) ∧ knows´(mary´,*y*) ∧ ˇ*p*)

(iii) $!\Phi =_{def} \lambda c\ (\Phi(c))$

where CS(*c*) and CS = λ*p* (*p* ≠ (*x* ≠ *x*) ∧ ∀*q* (*q* ⊆ *p* → (*p* = *q* ∨ *q* = (*x* ≠ *x*)))) (i.e. CS is the set of all cases). For pertinent discussion of Chierchia's (1990) approach, cf. de Swart (1991).

[34] Cf. section 2.3.2 for discussion on a weak versus strong definition of dynamic quantificational determiners.

$\uparrow$meets´(x,y,e))) ($\downarrow$ λe ($\mathfrak{E}x$ $\mathfrak{E}y$ ($\uparrow$cardinal´(x) $\underline{\wedge}$ $\uparrow$cardinal´(y) $\underline{\wedge}$ $\uparrow x \neq y$ $\underline{\wedge}$ $\uparrow$meets´ (x,y,e)) $\underline{\rightarrow}_{\forall}$ $\uparrow$blesses´(x,y,e)))

Furthermore, de Hoop & de Swart (1989) and de Swart (1991) argue that the paradigm in (99) is not specific to individual-level predicates, but applies to so-called *'one-time-only'* predicates such as *die* as well, as shown in (103). Even though it is intuitively plausible to assume that individual-level predicates lack a Davidsonian argument, as Kratzer (1988) does, it is quite implausible to assume that 'one-time-only' predicates have a similarly defective argument structure.

(103) a When a man dies, his wife always inherits his debts
b *When John dies, his wife always inherits his debts

Since 'one-time-only' predicates express a bi-unique relation between events and objects, de Hoop & de Swart (1989) and de Swart (1991) observe that (103b) can be immediately ruled out by what they refer to as the Plurality Condition.[35] According to this condition, it is presupposed in general that the restriction on any given operator can be true of more than one individual. The impeccable status of (103a) then follows from the fact that the presence of the indefinite now guarantees that there will be as many events of dying as there are men, which is not necessarily less than two. They furthermore note that the paradigm in (99) can be explained along the same lines if it is assumed that individual-level predicates form a particular subspecies of 'one-time-only' predicates. This assumption is not unreasonable in view of the fact that both individual-level and 'one-time-only' predicates describe situations that have '... a unique location in the life of an individual' (cf. de Swart: p. 59).

Finally, following Schubert & Pelletier (1987), de Swart (1991) notes that notwithstanding the fact that the quantification expressed in (98a) does have a distinctly atemporal flavor, it remains nevertheless true that from a linguistic point of view, the semantic evaluation of a tensed sentence is tied somehow to a particular time index. Thus, the fact that (98a) seems to express an atemporal type of quantification does not in itself preclude the possibility of analyzing sentences such as (98a) in terms of quantification over events or situations.

I will thus tentatively side with de Swart (1991,1995) in assuming that, in the absence of any convincing evidence to the contrary, Q-adverbs always denote relations between two sets of events. That is, there is no reason to assume a variable adicity for Q-adverbs.[36] Should we conclude from this that we should

[35] Note that 'one-time-only' predicates are just the non-iterable predicates, discussed in II in the Appendix to Chapter 1.

[36] Chierchia (1995) points out that in order to obtain *asymmetric* readings of Q-adverb constructions, an event (or situation)-based approach to Q-adverbs such as de Swart's (1991)

not inquire into Q-adverb constructions if we want to assess the strength of the Intervention Generalization? To my mind, a definite answer to this question requires a serious investigation of some basic issues involved in event semantics. I will conclude this chapter by pointing out some of these. To begin with, we must be explicit concerning the source of the existential quantifier over events conventionally postulated for simple sentences of the type in (104a), whose corresponding CCP can be represented as in (104b). Let us assume along with Dekker (1993b) that all eventive verbs have their event argument existentially quantified over in their lexical representation. On that assumption, the dynamic property denoted by *sing* for example can be represented as $\lambda x\, \exists e\, (\uparrow \mathrm{sing}'(x,e))$.

(104) a Pavarotti sang in the bathtub
b $\exists e\, (\uparrow \mathrm{sang}'(\mathrm{pavarotti}',e) \mathbin{\underline{\wedge}} \uparrow \mathrm{in}'(\iota x\, (\mathrm{bathtub}'(x)),e))$

Thus, it seems that for a Q-adverb to quantify over events in relatively simple cases such as (97a) above, repeated below in (105a), we must apply ED in the way indicated in (105c). The latter representation can be compositionally obtained on the basis of the LF in (105b), where coindexing the Q-adverb with the eventive verb will see to it that the event variable which is bound by an

must be developed in such a way that it becomes virtually isomorphic to an unselective binding approach. Consider for example (i) below. This sentence admits of a symmetric reading on which it entails that most pairs of painters *p* and villages *v* that are inhabited by *p* are such that *v* is pretty. In addition, it admits of an 'object'-asymmetric reading on which it entails that most villages that are inhabited by a painter are pretty. How do we get these different readings if Q-adverbs can only quantify over events or situations? On the unselective binding approach, life is easy. To derive the 'object'-asymmetric reading, the Q-adverb *usually* 'unselectively' binds *a village*, yielding (iia) as the paraphrase of the 'object'-asymmetric reading of (i). On an event/situation-based approach to Q-adverbs, we must resort to an analysis on which the 'object'-asymmetric reading of (i) is paraphrased as in (iib). If the latter analysis is to work, we must construct minimal situations in such a way that they bi-uniquely correspond to villages inhabited by a painter.

(i) When a painter lives in a village, it is usually pretty
(ii) a Most villages in which a painter lives are pretty
b Most minimal situations *s* which contain a village inhabited by a painter are situations where the village in *s* is pretty

Of course, the fact that Q-adverb constructions can give rise to readings with respect to which we can no longer distinguish between situational and objectual quantification does not in itself invalidate an event/situation-based approach to Q-adverbs. de Swart's point still stands that while it is unquestionable that some Q-adverbs involve quantification over events or situations, there is as of yet no solid proof that Q-adverbs sometimes quantify over individuals as well.

existential quantifier will be dynamically abstracted over through ED.[37] On Dekker's (1993b) proposal then with respect to the source of existential quantification over events, it follows that even on the assumption that Q-adverbs never 'unselectively' bind any indefinites in their restriction, we still need ED to obtain quantification over events. Therefore, in view of the fact that Q-adverb constructions are now analyzed as split constructions as well (at some level of abstraction), we are again led to predict that they must be sensitive to intervention effects.

(105) a When Pavarotti sings, I am always happy
b $[_{\text{AgrSP}}$ always$_e$ $[_{\text{AgrSP}}$ $[_{\text{CP}}$ when Pavarotti sings$_e$] $[_{\text{AgrSP}}$ I am happy]]]
c $\mathcal{E}very$ ($\underline{\lambda}e$ $\mathcal{E}e$ (↑sings´(pavarotti´,e)))(λe´ (↑happy´(I´,e)))

Unfortunately, the above prediction is of limited heuristic value. For example, the fact that (106a) below is perfectly well-formed, even though the negation here clearly intervenes between the Q-adverb *always* and the existential quantifier over events with which *sing* is associated, does not itself invalidate the approach to Q-adverbs presently under consideration. The reason is that we might analyze the truth-conditions of (106a) as in (106b), where the Q-adverb binds a restriction on the existential quantifier over (atomic) events of Pavarotti singing. That is, we might paraphrase the (static) meaning of (106a) as *Every event E such that no atomic part of E is an event of Pavarotti singing is an event E at which I am depressed.*

(106) a When Pavarotti doesn't sing, I am always depressed
b Every´(λE ($\neg\exists e \subseteq E$ (sings´(pavarotti´,e))))(λE (depressed´(I´,E)))

Note that quantification over events must be assumed to be restricted in any event. A sentence such as *Pavarotti didn't sing* doesn't mean that there was no event of Pavarotti singing in the past. Rather, it means that given some contextually determined event interval *E* prior to the speech time, there was no atomic part of *E* at which Pavarotti was singing. Now, I think it is fair to say that at present, there is not a sufficient understanding of this particular area of event semantics on the basis of which we can draw firm conclusions with respect to what counts as a possible restriction on quantification over events, how this information is structurally encoded and under what conditions such restrictions can be bound by other operators. Given this state of affairs then, it is no easy

[37] A couple of remarks may be in order here. Firstly, in order not to complicate matters, we have abstracted away from the issue whether 'constructing' the dynamic property of events corresponding to the second argument of Every involves ED as well. Secondly, it should be noted that also Chierchia (1995) assumes that quantification over events by means of a Q-adverb involves ED. Finally, the reader is referred to Chierchia (1995) for interesting proposals with respect to the LF syntax of left-adjoined *if/when* clauses.

matter to decide what exactly our dynamic approach to the Intervention Generalization entails with respect to Q-adverb constructions.

Appendix to Chapter 3

I A Compositional Semantics for *Wh*-Interrogatives

We will show here how Karttunen-style denotations for *wh*-interrogatives can be built up compositionally. Consider for instance the *wh*-interrogative in (1a), whose LF is given in (1b). On Karttunen's analysis, (1c) represents its meaning.

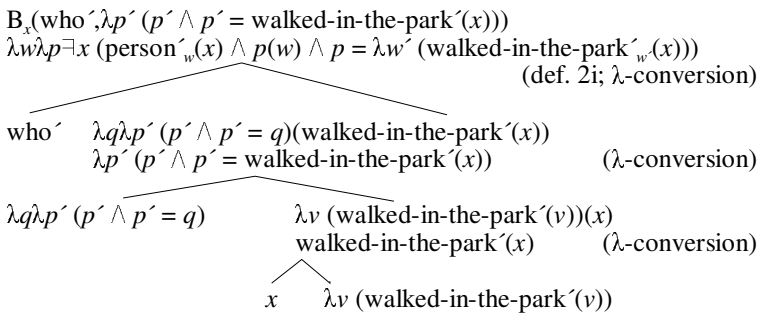
(1)
a Who walked in the park?
b $[_{CP}$ who$_x$ $[_{C'}$ C^0 $[_{AgrSP}$ e_x walked in the park]]]
c $\lambda p \exists x$ (person´$_w$(x) $\wedge$ $p(w)$ $\wedge$ $p = \lambda w$ (walked-in-the-park´(x)))

There are three things that need to be clarified before we can compositionally translate (1b) into (1c). Firstly, we need to define a static version of Binding-In. This is simple: replace the dynamic type *cc* in Definition 75 of Chapter 2 by the static type *p*. We then obtain the definition in (2), where FA stands for functional application; i.e. FA(α,β) = $\alpha(\beta)$ or $\beta(\alpha)$.

Definition: Binding-In

(2)
i. $B_x(XP´,\phi) =_{def} FA(XP´,\lambda x\ (\phi))$, where ϕ is of type *p*;
ii. $B_x(XP´,\chi) =_{def} \lambda v\ (B_x(XP´,\chi(v)))$, where χ is of a type that ends in *p*.

(3)



Secondly, assume that (2) carries over to indexed *wh*-phrases in such a way that (2i) reads as follows: $B_x(Wh´,\phi) =_{def} \lambda w\lambda p\ (FA(Wh´,\lambda x\ (\phi(p)))(w))$, where ϕ is of type $\langle p,p\rangle$. Finally, the meaning of C^0 can be represented as $\lambda q\lambda p\ (p \wedge p = q)$ (type $\langle p,\langle p,p\rangle\rangle$), whereas the meaning of *who* can be represented similarly to the meaning of *a person*: $\lambda P\exists x$ (person´(x) $\wedge$ $P(x)$) (type $\langle\langle e,p\rangle,p\rangle$). On these assumptions, the LF in (1b) can be compositionally translated into (1c) (assuming that the main function λw (...) in the last line annotating the top node in 3 is evaluated in the actual world *w*), as demonstrated by the analysis tree in (3). Recall that for any *n*-place relation *R´*, $R´ = \lambda x_1,...,x_n \lambda w\ (R´_w(x_1,...,x_n))$.

II A Digression on Dynamic Questions

In this part, we will sketch a dynamic semantics for questions which is directly based on Karttunen's approach according to which a question (in a world *w*) is a set of propositions. First, we must shift the (extensional) type ⟨p,t⟩ that is assigned to a question on a 'standard' Karttunen-semantics to a higher type so as to reflect the fact that we are now dealing with dynamic meanings, instead of static ones. The simplest way to proceed is to assume that a dynamic question is a set of ('intensions' of) CCPs. Consequently, the new type that we will assign to a question on a dynamic Karttunen-semantics is $dq = \langle\langle s,cc\rangle,t\rangle$. Now, assigning a new dynamic type to questions is one thing, but assigning the right dynamic meaning in that type to interrogatives is quite another.

Our proposal with respect to the issue of what kind of dynamic question to assign to an interrogative sentence boils down to this: we will analyze the *wh*-determiner as a dynamic quantificational determiner in the sense of Definition 36 of Chapter 2. That is, we will define $\mathcal{Wh}$ in terms of **Wh´** in the same way in which we defined $\mathcal{Every}$ or $\mathcal{Most}$ in terms of their static counterparts. As will be recalled from the previous chapter, such a proposal will have the effect of turning all *wh*-determiners into externally static, but internally dynamic operators. I know of no facts which prove these predictions to be incorrect. For example, the *wh*-phrase in (1a) does not seem to be able to bind the pronoun in the second sentence. That is, the meaning of (1a) cannot be paraphrased as in (1b). Furthermore, the well-formedness of the anaphoric dependency in (2) was already discussed by Higginbotham (1980). However, it is fair to say that both facts do not significantly support our treatment of *wh*-determiners either, as they can probably be accounted for on an alternative analysis as well. The usefulness of setting things up in the way we proposed will become apparent as we proceed.

(1) a *Who$_x$ went to school today? And didn't you tell him$_x$ the teacher was ill?

b For which person *x*, *x* went to school today and you didn't tell *x* that the teacher was ill?

(2) Which farmer who owns a$_x$ donkey beats it$_x$?

To illustrate our approach to dynamic questions, consider again the *wh*-interrogative in (3a). As before, we may take its LF to be as in (3b). On our present assumptions concerning the dynamics of questions, we are led to assign (3a) the meaning as represented in (3c), where π is a variable ranging over functions of type ⟨s,cc⟩ and *w* stands for the actual world.

(3) a Who walked in the park?

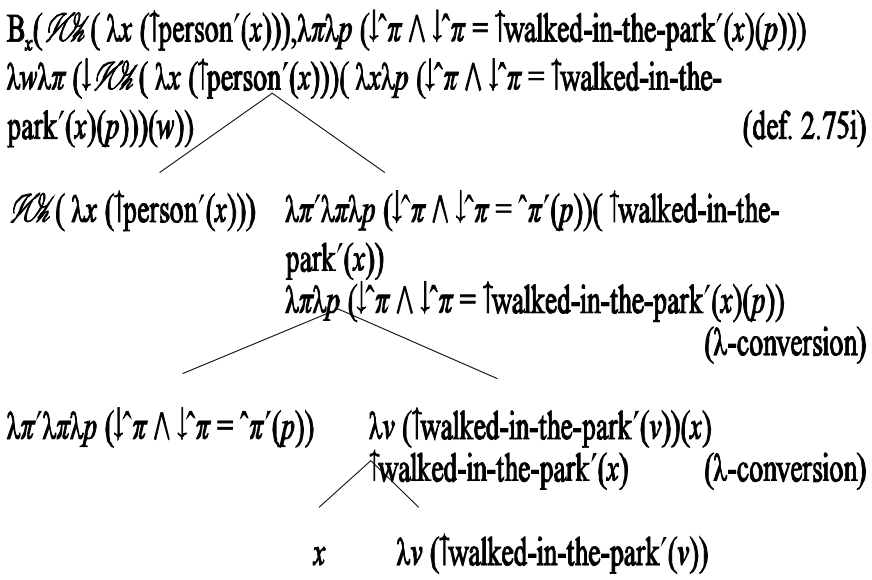
b $[_{CP}$ who$_x$ $[_{C'}$ C^0 $[_{AgrSP}$ e$_x$ walked in the park]]]

c $\lambda\pi(\downarrow\mathcal{W}\mathcal{h}(p))\lambda w)(\uparrow$person´$(x)))(\ \lambda x\lambda p\ (\downarrow^{\vee}\pi \wedge \downarrow^{\vee}\pi = \uparrow$walked-in-the-park´$(x)(p)))(w))$

The analysis tree in (4) shows that by employing essentially the same techniques

that were introduced in I of this Appendix, the LF in (3b) can be compositionally translated into (3c) (again, assume that the main function λw (...) in the last line annotating the top node in 4 is evaluated in the actual world *w*).

(4)



In (4), it was assumed that our dynamic version of Binding-In, as defined in 75 in the previous chapter, applies to indexed *wh*-phrases in such a way that $B_x(\mathcal{K},\Psi) =_{def} \lambda w\lambda\pi\,(\downarrow FA(\mathcal{K},\lambda x\,(\Psi(\pi)))(w))$, where Ψ is of type $\langle\langle s,cc\rangle,cc\rangle$. Cf. also I in this Appendix for similar assumptions with respect to the way our static version of Binding-In applies to indexed *wh*-phrases.

We will now show that by applying the various definitions of the operators and conventions introduced in the previous chapter, (3c) can be reduced to the more transparent (5). Note that in each world *w*, (5) denotes a set of CCPs, as desired.

(5) $\lambda w\lambda\pi\exists x\,(\text{person}'_w(x) \wedge \downarrow^{\vee}\pi(w) \wedge \downarrow^{\vee}\pi = \lambda w'\,(\text{walked-in-the park}'_{w'}(x)))$

The reductions in (6) essentially follow from the definition of dynamic quantificational determiners in Chapter 2. A note of clarification: **Wh**′ stands for $\lambda P\lambda Q\exists x\,(P(x) \wedge Q(x))$.

(6) a $\lambda w\lambda\pi\,(\downarrow\mathcal{K}\mathcal{K}\,(\,\lambda x\,(\uparrow\text{person}'(x)))(\,\lambda x\lambda p\,(\downarrow^{\vee}\pi \wedge \downarrow^{\vee}\pi = \uparrow\text{walked-in-the-park}'(x)(p)))(w))$

b $\lambda w\lambda\pi\,(\downarrow\uparrow\mathbf{Wh}'(\downarrow\lambda x\,(\uparrow\text{person}'(x)))(\downarrow\lambda x\,(\uparrow\text{person}'(x))\,\underline{\wedge}\,\lambda x\lambda p\,(\downarrow^{\vee}\pi\wedge\downarrow^{\vee}\pi = \uparrow\text{walked-in-the-park}'(x)(p)))(w))$ (def. 2.36i)

c $\lambda w\lambda\pi\,(\mathbf{Wh}'(\downarrow\lambda x\,(\uparrow\text{person}'(x)))(\downarrow\lambda x\,(\uparrow\text{person}'(x)\,\underline{\wedge}\,\lambda p\,(\downarrow^{\vee}\pi\wedge\downarrow^{\vee}\pi = \uparrow\text{walked-in-the-park}'(x)(p))))(w))$ (def. 2.36iii, $\downarrow\uparrow$-cancellation)

d $\lambda w\lambda\pi\,(\mathbf{Wh}'(\downarrow\lambda x\,(\uparrow\text{person}'(x)))(\downarrow\lambda x\lambda p\,(\text{person}'(x) \wedge \downarrow^{\vee}\pi \wedge \downarrow^{\vee}\pi = \text{walked-in-the-park}'(x) \wedge {}^{\vee}p))(w))$ (def. of $\underline{\wedge}$ and $\uparrow$)

e $\lambda w\lambda\pi\,(\mathbf{Wh}'(\lambda x\,(\text{person}'(x)))(\lambda x\,(\text{person}'(x) \wedge \downarrow^{\vee}\pi \wedge \downarrow^{\vee}\pi = \text{walked-in-}$

the-park´(*x*)))(*w*)) (def. 2.36ii)

f $\lambda w \lambda \pi$ ($\exists x$ (person´(*x*) $\wedge$ person´(*x*) $\wedge \downarrow^{\vee} \pi \wedge \downarrow^{\vee} \pi$ = walked-in-the-park´(*x*))(*w*)) (def. of **Wh**´)

g $\lambda w \lambda \pi \exists x$ (person´$_w$(*x*) $\wedge \downarrow^{\vee} \pi(w) \wedge \downarrow^{\vee} \pi = \lambda w´$ (walked-in-the-park´$_{w´}$(*x*))) (elementary logic, R´ = $\lambda x_1 ... \lambda x_n \lambda w$ (R´$_w$(x_1,...,x_n)), I in the Appendix to Chapter 2)

This concludes our digression on an alternative dynamic semantics for questions.

4 Algebraic versus Dynamic Perspectives on Weak Islands

4.1 Introduction

In the previous chapter, we saw that Dynamic Semantics has fruitful applications outside the realm of dynamic anaphora. We argued there that the Intervention Generalization can be derived from the same principles of Dynamic Semantics that govern dynamic anaphora. Recall that the Intervention Generalization stated that in split constructions, no Weak Island may intervene between a quantifier and its indefinite restriction. The empirical generalization expressed by the Intervention Generalization is quite substantial: What For-split, Negative Polarity, What On-split and partial *wh*-movement in German can all be analyzed as split constructions. Apart from these, it is tempting to consider *wh*-in-situ, head-internal relative constructions, and *quoi d'interessant*-split and *combien*-extraction in French as split constructions as well. If correct, their sensitivity to intervention effects, as observed by various scholars, would immediately fall under the umbrella of the Intervention Generalization.[1] However, before Dynamic Semantics can claim such a substantive empirical generalization to its credit, we must first determine whether the Intervention Generalization can be subsumed under a more general theory of Weak Islands.

The most powerful and influential approach to Weak Islands to date is the lattice-algebraic theory advocated by Szabolcsi & Zwarts (1993), which we have extensively reviewed in Chapter 1. If the Intervention Generalization cannot be derived from this theory, then the next question should be whether the various generalizations that follow from Szabolcsi & Zwarts's algebraic account might in fact be reduced to the Intervention Generalization. If so, we would have a theory of meaning at our disposal from which we can deduce the somewhat surprising statement that Weak Islands reflect general constraints on dynamic anaphora. To settle these issues, we will investigate in this chapter the precise relationship between a dynamic and an algebraic approach to Weak Islands, both in empirical as well as in theoretical terms.

[1] Cf. for example Beck (1996) on *wh*-in-situ, Williamson (1987) on head-internal relative constructions in Lakhota, and de Swart (1992) on *quoi-d'interessant*-split and *combien*-extraction in French.

4.1.1 The Plan

A theory of Weak Islands faces three tasks, two descriptive and one analytical. Firstly, it must provide a uniform characterization of the class of expressions that are sensitive to Weak Islands. Secondly, it must provide a uniform characterization of *bad interveners*, i.e. those expressions that create Weak Islands. Thirdly, it must explain why expressions of the first type cannot be combined in the required way with expressions of the second type. If all is well, one can predict the way in which the analytical problem will be dealt with on the basis of the solutions offered for the first two descriptive problems. Therefore, the most direct way to explore the relationship between two theories of Weak Islands is to compare the answers they provide to the descriptive problems.

A dynamic approach to Weak Islands characterizes island-sensitive expressions as those 'split' constituents in which a quantifier is separated from its indefinite restriction. As will be recalled from Chapter 1, in Szabolcsi & Zwarts's (1993) algebraic theory of Weak Islands, island-sensitive expressions are characterized as those elements whose denotation domains are impoverished in that certain Boolean operations cannot be executed in these domains. Logically speaking then, there are three ways in which these two notions of island-sensitive expressions might relate to each other:

Possibility I. All 'split' constituents in which a quantifier is separated from its indefinite restriction range over algebraically impoverished domains. If so, then our dynamic account of the Intervention Generalization might be reformulated in algebraic terms, assuming Szabolcsi & Zwarts's (1993) characterization of bad interveners to be empirically correct.

Possibility II. Some 'split' constituents in which a quantifier is separated from its indefinite restriction range over algebraically impoverished domains, but not all of them. If so, and if furthermore both the algebraic and the dynamic characterizion of bad interveners yields the right empirical results, then there are cases of Weak Islands that might be accounted for either dynamically or algebraically.

Possibility III. All expressions that range over algebraically impoverished domains are (at some level of grammar) 'split' constituents in which a quantifier is separated from its indefinite restriction. If so, then the various generalizations that Szabolcsi & Zwarts (1993) account for in algebraic terms might be subsumed under a dynamic approach to Weak Islands, assuming the dynamic characterization of bad interveners to be empirically correct.

These three possibilities will be systematically investigated on the basis of a number of specific case-studies in section 4.2-4.4 respectively. To anticipate the

outcome of that discussion, we will conclude that only possibility II squares with observation. Thus, there are cases of Weak Islands than can be explained either dynamically or algebraically, in addition to those cases that can only be accounted for dynamically or algebraically. Neither an algebraic nor a dynamic theory alone can therefore uniformally derive all Weak Islands effects. In the last section of this chapter, we will consider in the light of our discussion in section 4.7 the question whether a general theory of Weak Islands can be constructed in which the essential insights of both approaches are integrated.

As for the two distinct characterizations of the notion of bad intervener, recall that on our dynamic approach, the opacity effects induced by certain interveners are attributed to their externally static semantics. On Szabolcsi & Zwarts's (1993) account, on the other hand, these effects are attributed to specific algebraic properties of the relevant interveners, viz. that they require the execution of certain Boolean operations (such as Boolean meet and complement) that are not defined on the impoverished denotation domain of island-sensitive expressions. In sections 4.5 and 4.6, we will first discuss the (essential) dynamic and algebraic properties of interrogative and presuppositional verbs, something we haven't done up to this point. On the basis of that discussion, it will become clear that the application of both the dynamic as well as the algebraic notion of bad interveners to *Wh*-Islands and Presupposition Islands is not as straightforward as one would like. However, in the case of Scope Islands, both notions of bad interveners essentially single out the same, empirically correct set of expressions, a fact that was already recorded in (2) of Chapter 3. In section 4.7, we will speculate on the reasons why the algebraic and dynamic approach to Weak Islands (almost) converge on the same class of bad interveners. Specifically, we will try to develop a relatively simple but highly effective procedure which enables us to compute the dynamic properties of a given expression on the basis of its Boolean properties. Along these lines then, we may hope to find a unified theory of Weak Islands which combines the essential features of both the algebraic and the dynamic approach.

4.2 The Denotational Properties of Split *Wh*-Phrases

To repeat, our dynamic approach to Weak Islands (WIs) identifies island-sensitive expressions in more ore less syntactic terms. That is, they are characterized as those 'split' constituents in which a quantifier is separated from its indefinite restriction. This should be contrasted with Szabolcsi & Zwarts's (1993) (henceforth Sz&Z) algebraic definition of island-sensitive expressions. On their account, island-sensitive expressions range over algebraically impoverished domains in that certain Boolean operations are not defined on them. Consider for instance the case of the island-sensitive *wh*-operator *how*,

which ranges over manners. As was already discussed in Chapter 1, the domain of manners is structured in a (proper) join semilattice: a partially ordered set which is closed under Boolean join, but not under Boolean meet or complement. In principle then, there are three ways in which the dynamic and algebraic notion of island-sensitive expressions might relate to each other. These possibilities were listed above in section 4.1.1. In this section as well as the next two sections, we will discuss these possibilities in turn.

According to Possibility I, all 'split' constituents in which a quantifier is separated from its indefinite restriction range over algebraically impoverished domains. If so, the Intervention Generalization would simply follow from Sz&Z's account, assuming their algebraic characterization of bad interveners to be empirically correct. Hence, the dynamic approach we presented in the previous chapter would become redundant as its effects would be subsumed by a much more general theory of WIs. Still, the dynamic account of the Intervention Generalization would have some theoretical interest. The mere fact that the Intervention Generalization can be explained in dynamic terms immediately brings to the fore certain questions concerning the exact formal relationship between the Boolean properties of a given expression and its dynamic potential (cf. section 4.7 below). However, I believe there is conclusive evidence which shows that the Intervention Generalization cannot be accounted for on Sz&Z's algebraic approach.

Recall that some of the split constructions we discussed in Chapters 1 and 3 had a non-split variant, i.e. What For-split and German partial *wh*-movement. Crucially, the non-split variant of both types of constructions expresses the same meaning as the split version. Let us first consider the case of What For-split. Thus, the What For-split construction in (1a) poses the same question as its non-split variant in (2a). This is expressed by the (static) Karttunen-style representations in (1b) and (2b) which determine the same set of true answers. It thus follows that a non-split What For-phrase has the same range of meanings as a split What For-phrase.[2]

(1) a Wat voor boek wil jij lenen?
"What kind of book do you want to borrow?"
b $\lambda p \exists \kappa\, (\forall x \forall w' \sim w\, (\mathrm{R}_{w'}(x, \kappa) \rightarrow \mathrm{book}'_{w'}(x)) \wedge p(w) \wedge p = \lambda w''\, (\text{want-to-borrow}'_{w''}(\text{you}', \kappa)))$

(2) a Wat wil jij voor boek lenen?
"What kind of book do you want to borrow?"
b $\lambda p \exists \kappa\, (p(w) \wedge p = \lambda w'\, (\forall x \forall w'' \sim w\, (\mathrm{R}_{w'}(x, \kappa) \rightarrow \mathrm{book}'_{w'}(x)) \wedge \text{want-to-borrow}'_{w'}(\text{you}', \kappa)))$

[2] The issue whether the indefinite restriction *voor boek* in (2a) can also be interpreted *in situ* is irrelevant from the present perspective; cf. also section 3.2.1. The same applies *mutatis mutandis* to (7) in the main text.

The fact that a non-split What For phrase exhibits exactly the same range of readings as its split variant makes it difficult to account for the WI sensitivity of What For-split by algebraic means. We already observed in Chapter 1 that non-split What For-interrogatives do not evidence any sensitivity to WIs, as indicated by the contrast in (3) below.

(3) a Wat voor boek wil jij niet lenen?
"What kind of book do you not want to borrow?"
b *Wat wil jij niet voor boek lenen?

Now, suppose we want to account for the ill-formedness of (3b) along the lines of Sz&Z's approach to WIs.[3] Then we might venture the claim that the denotation domain of the *wh*-operator in What For-split constructions, which ranges over (sub)kinds, forms a (proper) join semilattice. The presence of sentence negation in (3b) will force us to perform Boolean complement in the denotation domain of the *wh*-operator *wat*. But since this domain has the algebraic structure of a (proper) join semilattice, complement cannot be performed in the denotation domain of *wat*. Hence, (3b) cannot receive a proper interpretation, which explains its ill-formedness. This reasoning, however, leaves us completely in the dark as to why (3a) is grammatical. We already saw that non-split What For-interrogatives express the same meaning as their split variants. This means that the *wh*-operator here too ranges over (sub)kinds, and therefore its denotation domain constitutes a (proper) join semilattice as well. By parity of reasoning then, the presence of sentence negation in (3a) will likewise force Boolean complement to be performed in the denotation domain of *wat*. Thus, it seems that contrasts such as the one in (3) cannot possibly be accounted for on Sz&Z's approach.

It is hard to avoid this conclusion. For example, we might hypothesize that the denotation domain of non-split What For-phrases can be individuated through contextual means (such as D-linking), whereas we cannot avail ourselves of this process of individuation (for unclear reasons) in the case of split What For-phrases. We will recall from Chapter 1 that Sz&Z use the term *individuation* in a technical sense to refer to a process through which one abstracts over the partial ordering of a given domain, thus turning the elements of such a domain into discrete, 'singular' entities. Sz&Z (1993: ex. 65a) discuss this process by means of the following example (cf. also our discussion surrounding example 22 in Chapter 1).

(4) What don't we have good supplies of? Just bread and juice.

With respect to (4), Sz&Z (p. 256) remark that "contextualization is not only

[3] For a more detailed exposition of Sz&Z's approach to WIs, cf. Chapter 1.

necessary to exclude, say, fire engines and phlogiston from consideration, but also to free us from listing supercategories and subcategories of bread and juice that we don't have good supplies of. Here contextualization saves a potentially unanswerable question." Thus, contextualization facilitates individuation here, since discarding super- and subcategories of bread and juice simply means we are abstracting over the partial ordering exhibited by the domain of bread and the domain of juice. If properly individuated, we can certainly perform complement in the denotation domain of the *wh*-phrase in (4) as all Boolean operations are defined on sets of individuals.

Thus, if only the denotation domain of non-split What For-phrases can be individuated, the contrast in (3) automatically follows on the further (not implausible) assumption that (3a) requires an individuating context; say, a context in which the school librarian has a fixed list containing a small selection of kinds of books at least one of which must be read by any student for his final exam. However, the initial premiss that only the denotation domain of non-split What For-phrases can be individuated appears to be incorrect. On its most natural interpretation, it suggests that the school librarian cannot utter (2b) above for example in the individuating context we just contemplated. But, as (5a) indicates, this is patently wrong. Suppose furthermore that the school librarian is required to fill in on this list the name of each student with the type of book he has borrowed a copy of, and that there are no names of students in the historical novels section. Crucially, note now that not even in this highly individuating context can we utter (5b) to the librarian.

(5) *Bibliothecaris*: Op deze lijst staan historische romans, psychologische romans en thrillers. (*Librarian*: "There are historical novels, psychological novels and thrillers on this list.")

a Wat wil jij voor boek lenen?
"What kind of book do you want to borrow?"

b *Wat wil geen enkele student voor boek lezen?
"What kind of book does no student want to read?"

Now, one might object that we do not know for sure that the denotation domain of *wat* has been properly individuated by the context sketched in (5), and that the ill-formedness of (5b) when uttered in that context shows just that. But then, obviously, we are begging the question: the assumption that only non-split What For-phrases allow their denotation domain to be individuated through contextual means is only motivated here by the phenomenon it was invoked to explain, viz. the fact that (3a) is grammatical whereas (3b) and (5b) are not. We therefore conclude that the WI sensitivity of What For-split cannot be accounted for by Sz&Z's algebraic theory. Consequently, the Intervention Generalization cannot be subsumed under Sz&Z's approach to WIs in general.

The same point can be made on the basis of partial *wh*-movement in German, and, I believe, more forcefully so. Again, the crucial observation here is that

German partial *wh*-movement constructions mean the same thing as their non-split counterparts. For example, as indicated by the Karttunen-style representations in (6b) and (7b), both (6a) and (7a) denote the same set of true answers.

(6) a Mit wem glaubt Hans daß Jakob jetzt spricht?
"With whom does Hans think that Jakob is talking now?"
b $\lambda p \exists x$ (person´$_w$(x) $\wedge$ $p(w)$ $\wedge$ p = λw´ (think´$_w$(hans´,λw´´ (talks-now´$_{w´}$(jakob´,x)))))

(7) a Was glaubt Hans mit wem Jakob jetzt spricht?
"With whom does Hans think that Jakob is talking now?"
b $\lambda p \exists x$ ($p(w)$ $\wedge$ p = λw´ (think´$_w$(hans´,λw´´ (person´$_w$(x) $\wedge$ talks-now´$_{w´}$(jakob´,x)))))

The fact that (6) and (7) express the same question means we cannot attribute the WI sensitivity of (7) to any special algebraic properties of the denotation domain of the *wh*-operator. For then, by parity of reasoning, we would expect its non-split variant in (6) to be sensitive to WIs as well, *quod non*. The case of German partial *wh*-movement is more convincing in that we can no longer respond to the latter problem by claiming that only the denotation domain of non-split *wh*-phrases can be individuated. As a matter of fact, the denotation domain of the split *wh*-phrase in (7) is already inherently individuated, as it ranges over discrete entities. Note that this observation in itself shows even more clearly that we cannot possibly ascribe the sensitivity of (7) to WIs to the fact that the split *wh*-phrase ranges over elements in an algebraically impoverished domain.

Given the properties then of those split constructions that have a non-split counterpart, such as What For-split and partial *wh*-movement, we conclude that the Intervention Generalization does not follow from Sz&Z's algebraic approach to WIs in general. This holds even independently of whether or not their theoretical description of the class of *bad interveners* is empirically correct. Hence, in the light of our own dynamic account of the Intervention Generalization as presented in the previous chapter, we may now praise Dynamic Semantics for providing us with the tools to derive this substantive generalization.

4.3 Algebraic versus Dynamic Perspectives on Event-Related Readings

Suppose that some 'split' constituents in which a quantifier is separated from its indefinite restriction range over algebraically impoverished domains, but not

all of them. Assuming that Sz&Z's algebraic characterization of the class of bad interveners is factually correct as well as our own, it follows that there are WI phenomena that can be accounted for either dynamically or algebraically. Normally, when one faces a situation in which two theories can explain a certain phenomenon equally satisfactorily, one feels compelled to choose one theory to the exclusion of the other. According to the familiar scenario, the choice will then be made on the basis of a number of additional criteria, such as the empirical yield of the two theories, the number of assumptions needed in both theories, the elegance with which both theories account for their respective paradigmatic cases, and so on. The rationale behind this methodological practice seems clear. If one can account for a particular fact on the basis of one theory alone, then leaving room for another theory to account for the same fact would amount to embracing a view on the phenomenal world according to which it is essentially inefficient in that its underlying mechanisms can sometimes independently produce the same effect. However, it is evident that if none of these additional criteria discriminate between any two given theories, there is simply no choice to be made. And as for 'phenomenological inefficiency', if the two theories are concerned with clearly distinct parameters within some empirical domain, one would actually expect that if the description of some phenomenon within that domain involves both parameters, its properties might be accounted for either way.

How does all this apply to the hypothetical case we are presently considering? Consider the abstract situation represented in (8), assuming that the subscript *i* here will be translated into a variable *x* which ranges over elements that are structured in a (proper) join semilattice.

(8) $^{*}Q_i$ [*not* [$_{\phi}$ V [$_{\text{indefinite}}$ D_i NP]]]

If we take the indefinite in (8) to denote a (restricted) existential quantifier, we must apply Existential Disclosure (ED) to it since the indefinite should be interpreted as a property restricting the range of the quantifier *Q*. However, for reasons which we detailed in the preceding chapter, ED does not output a sensible interpretation in contexts such as (8), due to the intervening externally static function denoted by sentence negation. On the other hand, if we take the indefinite to be a property denoting expression, we cannot perform Boolean complement in the scope of *Q*. This is due to the fact that this operation is not defined in a (proper) join semilattice. Thus, on both assumptions concerning the semantics of the indefinite DP in (8), its ill-formedness follows equally naturally and equally forcefully from general, independently motivated principles concerning fundamentally different facets of meaning, viz. the dynamics versus the algebraics of meaning. In principle, one might discriminate between the two theories by assessing the relative merits of their respective assumptions regarding the semantics of the indefinite. However, this issue is bound to be decided on the basis of very general and abstract considerations, such as those

relating to Compositionality, since both theories acknowledge (either directly or indirectly) that the indefinite in (8) provides a restriction on the range of the quantifier *Q*.

To appreciate more fully the issues that are involved here, we will inquire in the next subsections into the phenomenon of *Event-related Readings*. Our interest in these readings derives mainly from the fact that they are conditioned by WIs. We will see that this fact can be explained either dynamically or algebraically along the lines indicated in the previous paragraph.

4.3.1 Event-related Readings and Weak Islands[4]

Event-related Readings were first discussed by Krifka (1990), who observed that sentences such as (9a) systematically allow for the two readings paraphrased in (9b) and (9c).

(9) a Exactly 4,000 ships passed through the lock last night
b Object-related Reading (OR): *There are exactly 4,000 ships each of which passed through the lock last night*
c Event-related Reading (ER): *There were exactly 4,000 events in which a ship passed through the lock last night*

Be sure that the two readings paraphrased in (9b) and (9c) are truth-conditionally distinct. That is, we can imagine situations in which (9a) would represent a true statement on its OR, but a false statement on its ER, and vice versa. For example, imagine a situation in which 3,999 ships passed through the lock only once last night, while The Flying Dutchman traversed the lock twice last night. This situation therefore verifies (9a) on its OR, but falsifies it on its ER. On the other hand, a situation in which only 2,000 ships went through the lock to and fro last night would render the same sentence false on its OR, but true on its ER. Thus, the distinctive feature of ERs resides in the fact that it allows for what we might call *recycling* of individuals. If some ship passed through the lock last night on more than one occasion, the ER requires that we distinguish the ship as it passed through the lock on one occasion from the same ship as it passed through the lock on another occasion.

Some brief remarks on the relationship between OR and ER may be in order here, as for different choices of numerical expression in sentences such as (9a), the truth-conditional difference between OR and ER may be harder to perceive. Thus, if we substitute the monotone increasing *at least four thousand ships* for the subject in (9a), any situation which would verify the resulting sentence on its OR would verify it on its ER as well (but not vice versa). If instead we

4 This section draws on work that was done in collaboration with Jenny Doetjes, as reported in Honcoop & Doetjes (1996) and Doetjes & Honcoop (1997).

substitute the monotone decreasing *at most four thousand ships* for the subject in (9a), the entailment relation would be reversed: the set of situations which verify the resulting sentence on its ER is now included in the set of situations which verify it on its OR (but not vice versa). Of course, we should not conclude from these inclusion relations that either the OR or ER must be taken as basic, for such a decision would obscure the fact that the above entailment patterns can be predicted on the basis of the monotonicity properties of the subject quantifier.

Disregarding intensions, we might represent the ER of (9a) as in (10) below, where the quantifier corresponding to the numeral *4,000* quantifies over ordered pairs of events and objects. (10) adequately captures the property of *recycling* which is so distinctive of ERs: whenever a particular ship passed through the lock last night more than once, we will have just as many ⟨event,object⟩ pairs that satisfy the argument expression in (10).

(10) $4{,}000'(\lambda e,x\ (\text{ship}'(x) \wedge \text{passed-through}'(e,x,\iota y\ (\text{lock}'(y))) \wedge \text{last-night}'(e)))$

The following discussion will proceed on the assumption that a pair-quantificational approach to ERs is essentially correct. The reader is referred to Honcoop & Doetjes (1996) and Doetjes & Honcoop (1997) for detailed argumentation in support of this contention.

As for WIs, note that there is a marked contrast between the sentences in (11) and those in (12) and (13).[5] Whereas the former display both OR and ER, the ER for the sentences in (12) and (13) is absent.

(11) a 4,000 people visited the Rijksmuseum last year (✓OR/✓ER)
OR: *There are 4,000 people each of whom visited the Rijksmuseum last year*
ER: *There were 4,000 events in which a person visited the Rijksmuseum last year*
b 4,000 people visited the (three) museums last year (✓OR/✓ER)
c 4,000 people visited a museum last year (✓OR/✓ER)
d 4,000 people visited three museums last year (✓OR/✓ER)

(12) 4,000 people didn't visit the Rijksmuseum last year (✓OR/*ER)
OR: *There are 4,000 people each of whom did not visit the Rijksmuseum last year*
ER: **There were 4,000 events in which a person did not visit the Rijksmuseum last year*

(13) a 4,000 people visited no museum last year (✓OR/*ER)
OR: *There are 4,000 people each of whom visited no museum last*

[5] These observations are taken over from Doetjes & Honcoop (1997).

year
ER: **There were 4,000 events in which a person visited no museum last year*

b 4,000 people visited at most three museums last year (✓OR/*ER)
c 4,000 people visited exactly three museums last year (✓OR/*ER)
d 4,000 people visited at least three museums last year (✓OR/??ER)

In the coming subsections, we will explore both an algebraic account of the contrast observed between (11) and (12-13) as well as a dynamic account. A variant of the algebraic theory which we will present in the next section has been worked out in Doetjes & Honcoop (1997). Finally, the two explanations for the WI sensitivity of ERs will be compared with each other in section 4.3.4 on the basis of their allegiance to Compositionality.

4.3.2 An Algebraic Approach

In chapters 1 and 2, we saw that certain elementary observations concerning aspectual properties of verbs, plural reference and discourse anaphora might be accounted for if we assume that the domain of objects D_e and events D_o have a similar algebraic structure, viz. the structure of a complete, atomic, free (proper) join semilattice. Since we are now pursuing an analysis of ERs in terms of pair-quantification over ordered pairs of events and objects, we might wonder whether these ordered pairs should be assembled in such an algebraic structure as well. An interesting observation that can be made in this respect concerns the existence of what we might call a *cumulative* variant of the ER. Consider for example (14a) below, the ER of which may be paraphrased as in (14b).

(14)
a Five people visited three museums last year
b ER: *There were (altogether) 5 events in which a person visited any one of three museums last year*

A proper semantics for cumulative readings in general requires quantification over plural entities which exhibit some partial ordering, such as sets of objects simpliciter as proposed in Scha (1981). If so, then a cumulative ER involves quantification over 'plural ⟨event,object⟩ pairs', where a 'plural ⟨event,object⟩ pair' is just a set of ordered pairs of events and objects. The cumulative ER of (14a) may then be represented as in (15).

(15)
$\exists\langle E,X\rangle\exists Y\,(|\langle E,X\rangle| > 5 \wedge |Y| > 3 \wedge \Sigma^{X}\text{people}'(X) \wedge \Sigma^{Y}\text{museums}'(Y) \wedge$
$\text{visited}'(E,X,Y) \wedge \Sigma^{E}\text{last-year}'(E))$

To see that (15) represents the truth-conditions of the cumulative ER of (14a) correctly, let us first fix the interpretation of $\exists\langle E,X\rangle$ ($|\langle E,X\rangle| > n \wedge \phi$).

(16) $[\![\exists\langle E,X\rangle\ (|\langle E,X\rangle| > n \wedge \phi)]\!]^{M,g} = 1$ *iff* for some $R \subseteq \mathrm{AT}(D_o) \times \mathrm{AT}(D_e)$, $|R| > n$ and $[\![\phi]\!]^{M,g[E/\cup \mathrm{Dom}(R)],[X/\cup \mathrm{Ran}(R)]} = 1$

where for any X, 'AT(X)' stands for the set of atoms in X and where 'Dom(R)' and 'Ran(R)' represent the domain and range of R respectively. Consider now the following situation. John went to the Rijksmuseum last year at occasion $\{e_1\}$, after which he decided to visit the Stedelijk Museum at occasion $\{e_2\}$. Carl visited the Rijksmuseum last year at occasion $\{e_3\}$, whereas his best friend Frank, with whom he traveled to Amsterdam by train, went to the Van Gogh Museum at occasion $\{e_4\}$ instead. Finally, Carl visited the Rijksmuseum again last year at occasion $\{e_5\}$. This situation verifies (14a) on its cumulative ER. But does it also verify (15)? It does, since there is a set R of ordered pairs $\{\langle\{e_1\},\{j\}\rangle, \langle\{e_2\},\{j\}\rangle,\langle\{e_3\},\{c\}\rangle,\langle\{e_4\},\{f\}\rangle,\langle\{e_5\},\{c\}\rangle\}$ which has at least 5 ⟨event,object⟩ pairs as members, and there is a set of museums {rm,sm,vgm} which has at least three members. Finally, $\langle\{e_1,e_2,e_3,e_4,e_5\},\{j,c,f\},\{rm,sm,vgm\}\rangle \in I$(visited´), where $\{e_1,e_2,e_3,e_4,e_5\} = \cup\mathrm{Dom}(R)$ and $\{j,c,f\} = \cup\mathrm{Ran}(R)$ is a set of people, if we assume *summativity* for eventive predicates. Summativity can be defined as in (17) (cf. Krifka 1989,1990 and II in the Appendix to Chapter 1).

(17) *Definition: Summativity*

$\forall e\forall e'\forall x\forall x'\forall y\forall y'\ (R(e,x,y) \wedge R(e',x',y') \rightarrow R(e \cup e',x \cup x',y \cup y'))$

Thus, the existence of cumulative ERs points to the need of quantifying over 'plural ⟨event,object⟩ pairs', where a 'plural ⟨event,object⟩ pair' is but a set of ordered pairs of events and objects. In fact, if we assume in general that eventive predicates relate events to their 'actors' by means of Θ-roles and that these roles denote (partial) functions from events to objects (cf. again II in the Appendix to Chapter 1), it follows that the sets of ordered pairs of events and objects that concern us here are *(partial) functional relations* over $D_o \times D_e$.[6] [7] In

[6] Note that in event semantics, the assumption that eventive predicates relate events to their participants by means of Θ-roles such as *agent*, *patient* or what have you is certainly not unprecedented. On that account, the truth-conditions associated with *John beat Mary* for example are more accurately represented by $\exists e$ (beat´(e) $\wedge$ $\Theta_{\mathrm{Agent}}(e)$ = john´ $\wedge$ $\Theta_{\mathrm{Patient}}(e)$ = mary´). Furthermore, our assumption that Θ-roles denote functions from events to objects is just an alternative (but equivalent) formulation of a claim made by Carlson (1984) and Schein (1993) among others according to which Θ-roles observe the property of *thematic uniqueness*. Thematic uniqueness requires that one and the same event cannot have two distinct objects as agent, patient, theme and so on.

7 We will call a relation R *functional* iff $\forall x \in \mathrm{Dom}(R)\exists y\ (R(x,y) \wedge \forall y'\ (R(x,y') \rightarrow y = y'))$. We will furthermore call a functional relation R *partial* just in case $\Diamond\neg\forall x\ (x \in \mathrm{Dom}(R))$.

the following, we will find it useful to talk of any functional relation $R \subseteq D_o \times D_e$ in terms of its corresponding (partial) function $M(R) \in [D_o \rightarrow D_e]$, where $[D_o \rightarrow D_e]$ is the set of all partial functions from D_o into D_e and $M(R) = \lambda e\ (\iota x\ (R(e)(x)))$. This way of talking about R is perfectly innocent since M is clearly a one-to-one correspondence. To see that, note first that M is *onto* in that each function $f \in [D_o \rightarrow D_e]$ is the value of M on some functional relation R (just take R to be $\lambda e \lambda x\ (f(e) = x)$). Furthermore, the i*nverse* of M (i.e. $M^{-1} = \lambda f \lambda e \lambda x\ (f(e) = x)$) is also a function. We will now ponder the question what type of lattice-algebraic structure should be associated with the set of all partial functions from D_o into D_e (cf. our discussion of lattices in I in the Appendix to Chapter 1). Consider first the relation $\leq$ and the operation $\vee$ on $[D_o \rightarrow D_e]$ as defined below:

(18) *Definitions*.

For any f and g in $[D_o \rightarrow D_e]$, and for any $e \in \mathrm{Dom}(f) \cup \mathrm{Dom}(g)$:

a $f \leq g$ just in case $\mathrm{Dom}(f) \subseteq \mathrm{Dom}(g)$ and for any $e' \in \mathrm{Dom}(f)$, $f(e') \subseteq g(e')$;

b $(f \vee g)(e) = \begin{cases} f(e) \cup g(e) & \text{if } e \in \mathrm{Dom}(f) \cap \mathrm{Dom}(g), \text{ or} \\ f(e) & \text{if } e \in \mathrm{Dom}(f) - \mathrm{Dom}(g), \text{ or} \\ g(e) & \text{if } e \in \mathrm{Dom}(g) - \mathrm{Dom}(f). \end{cases}$

On the basis of these definitions, it is not hard to see that the facts in (19) below must hold (cf. I in the Appendix to this chapter for simple proofs).

(19) *Facts*.

a $\langle [D_o \rightarrow D_e], \leq \rangle$ is a join semilattice;

b $\langle [D_o \rightarrow D_e], \leq \rangle$ does not have a bottom element, i.e. $\neg \exists f \forall g: f \leq g$.

Since $\langle [D_o \rightarrow D_e], \leq \rangle$ is a join semilattice which lacks a bottom element, it must be the case that $\langle [D_o \rightarrow D_e], \leq \rangle$ is *not* closed under meet or complement. To see that, note that the top element of $[D_o \rightarrow D_e]$ $f_\top$ $(= \bigvee [D_o \rightarrow D_e]$; that function which maps every e in D_o to $\cup D_e$) does not have a (unique) complement, and for any two atoms f and g in $[D_o \rightarrow D_e]$, $f \wedge g$ does not exist in $[D_o \rightarrow D_e]$. Thus, given the facts in (19), it follows that $\langle [D_o \rightarrow D_e], \leq \rangle$ is a *proper* join semilattice. This fact is recorded in (20) for ease of reference.

(20) *Fact*. $\langle [D_o \rightarrow D_e], \leq \rangle$ is a *proper* join semilattice.

In the light of Fact (20), and in view of the fact that $\langle [D_o \rightarrow D_e], \leq \rangle$ and the set of all (partial) functional relations over $D_o \times D_e$ are isomorphic (thanks to M), it is now relatively easy to account for the absence of ERs in (12-13) along the lines of Sz&Z. We already remarked in section 3.3.3.1 that Q-NPs in general (apart from universal, distributive Q-NPs which will be discussed shortly) cannot take 'inverse' scope over any expression which c-commands them. To this, we may add that sentence negation cannot outscope a c-commanding expression either. Recall now Sz&Z's principle, as discussed in (12) of Chapter

1, according to which the Boolean operations associated with a scopal element *SE* must be performed in the denotation domain of a quantificational expression *Q* if *Q* takes scope over *SE*. With respect to the cases in (12) and (13) then, this principle, in conjunction with the aforementioned observation concerning the scopal deficiency of sentence negation and Q-NPs, entails that the Boolean operations associated with sentence negation in (12) and the object Q-NPs in (13) (meet and/or complement) must be performed in the denotation domain of the subject *4,000 people*. However, if the relevant sentences are to receive an ER, the numeral *4,000* must range over entities that are structured in a (proper) join semilattice, viz. (singleton) sets of ordered pairs of events and objects. As meet and complement are not defined on a (proper) join semilattice, we have accounted for the fact that the ER is lacking in (12-13).

Concluding this section, we note that the account just offered for the lack of ERs in (12-13) makes an important prediction. If we can move both sentence negation in (12) and the object Q-NPs in (13) into a position in which these SEs can take scope over the subject *4,000 people*, we no longer need to perform their associated Boolean operations in the denotation domain of the subject. In such a situation, we would predict that the resulting structures do admit of ERs. This prediction is verified by the passive counterparts of the sentences in (12) and (13) as presented in (21) and (22) below respectively. In these passive constructions, both sentence negation as well as the 'promoted' object Q-NPs of (13) can clearly take scope over the 'demoted' subject *4,000 people*.

(21) The Rijksmuseum wasn't visited by 4,000 people last year (✓OR/✓ER)
OR: *It is not the case that there are 4,000 people each of whom visited the Rijksmuseum last year*
ER: *It is not the case that there were 4,000 events in which a person visited the Rijksmuseum last year*

(22) a No museum was visited by 4,000 people last year (✓OR/✓ER)
OR: *No museum is such that 4,000 people visited it last year*
ER: *No museum is such that there were 4,000 events in which a person visited it last year*

b At most three museums were visited by 4,000 people last year (✓OR/✓ER)

c Exactly three museums were visited by 4,000 people last year (✓OR/✓ER)

d At least three museums were visited by 4,000 people last year (✓OR/✓ER)

Likewise, our current analysis leads us to expect that a universal distributive object Q-NP need not be incompatible with an ER. The reason is that even though the meaning of universal distributive Q-NPs is explicated in terms of Boolean meet, they are the only Q-NPs that can take inverse scope over a c-commanding expression (cf. especially Beghelli & Stowell 1997). Hence, the

fact that sentences such as (23) below admit of an ER only if the object Q-NP *every museum* takes inverse scope over the subject *4,000 people* directly supports the algebraic approach presently under consideration. The only way in which we can avoid having to carry out the impossible task of performing Boolean meet in $\langle [D_o \rightarrow D_e], \leq \rangle$ is by assigning wide scope to *every museum*. On such a construal, meet must be performed in the truth-value algebra {0,1}, as indicated in (23b). Since {0,1} is the Boolean algebra *par excellence*, this is without problems.

(23) a 4,000 people visited every museum last year (✓OR/✓ER)
ER: *Every museum is such that there were 4,000 events in which a person visited it last year*
b $\bigwedge_{m \in \text{MUSEUM}}$ (4,000´($\lambda e \lambda x$ (person´(x) $\wedge$ visited´(e,x,m) $\wedge$ last-year´(e))))

In the next section, we will explore the possibility of providing a dynamic account for the contrast between (11) and (12-13).

4.3.3 A Dynamic Approach

On a pair-quantificational analysis of ERs, the difference between these readings and ORs can be characterized simply as follows. Either the event-variable is existentially quantified over in the Nuclear Scope of the lowest quantifier present in the sentence, yielding the OR as indicated in (24b) below. Or the event-variable is bound by some determiner instead, yielding the ER as shown in (24c).

(24) a Exactly 4,000 people visited the Rijksmuseum last year
b OR: 4,000´(λx (person´(x)))($\lambda x \exists e$ (visited´(e,x,rm´) $\wedge$ last-year´(e)))
c ER: 4,000´($\lambda e \lambda x$ (person´(x) $\wedge$ visited´(e,x,rm´) $\wedge$ last-year´(e)))

Within the framework of Dynamic Semantics, both readings can be compositionally obtained in a way which is compatible with a rather minimal assumption concerning the source of the existential quantifier over events: all eventive verbs have their event-argument existentially quantified over in their lexical representation (cf. also Dekker 1993b and section 3.4). On that assumption, the lexical meaning of the verb *visit* for example will be represented as $\lambda y \lambda x \exists e$ ($\uparrow$visit´(e,x,y)). The LF in (25a) will then unambiguously determine an OR, as indicated roughly in (25b-c), given the procedures we already assumed for determining the translation of a complex expression [$_X$ Y Z] on the basis of the translations of its constituent parts *Y* and *Z* (cf. also Chapter 2). By wiping out the slot *p* for admissible continuations in (25c) by means of the $\downarrow$-operator, we obtain the equivalent of (24b) above.

(25) a $[_{AgrSP}$ exactly 4,000 people$_x$ $[_{AgrOP}$ the Rijksmuseum$_y$ $[_{VP}$ e$_x$ visited e$_y$ last year]]]

b $4{,}000$ (λx ($\uparrow$person´(x)))(λx $\&e$ ($\uparrow$visited´(e,x,rm´) $\underline{\wedge}$ $\uparrow$last-year´(e)))

c λp (4,000´(λx (person´(x)))($\lambda x \exists e$ (visited´(e,x,rm´) $\wedge$ last-year´(e))) $\wedge$ $\check{}p$) (def. 2.36)

As for the ER, let us start with identifying two essential properties that an LF must have to facilitate compositional translation into representations of the type specified in (24c). Firstly, there is an apparent conflict between the assumption that ERs involve pair-quantification over ⟨event,object⟩ pairs and the assumption that eventive verbs have their event-argument existentially quantified over in their lexical representation. The way to resolve this dilemma must be familiar by now: Existential Disclosure (ED). With this tool, we can (so to speak) abstract over a variable which is existentially quantified over. To trigger an application of ED, we had tacitly adopted the convention of coindexing a quantifier with an indefinite if we intended the former to dynamically bind the latter. In keeping with this convention then, we will henceforth coindex a determiner *D* with an eventive verb *V* using the subscript *e* if we want *D* to dynamically bind *V*'s event-argument. Note that we employed a similar strategy in our representation of Q-adverb constructions (cf. section 3.4). Since the event-argument is existentially quantified over, such coindexing will effectively force the application of ED (cf. II in the Appendix to this chapter for discussion on how this can be accomplished by means of so-called *state-switchers*).

Secondly, we have represented the truth-conditional content of ERs through *unrestricted* pair-quantification over ⟨event,object⟩ pairs. That is, the general structure of our representations of the semantics of ERs can be rendered as Q´($\lambda e \lambda x$ (NP´(x) $\wedge$ ϕ)). Given the examples discussed thus far, we can see two reasons that make an alternative analysis in terms of *restricted* pair-quantification over ⟨event,object⟩ pairs infeasible. Consider for instance (24a) above. First of all, it seems impossible to syntactically identify (at Spell-Out, or at LF) a suitable restriction on the range of the determiner 4,000´ when the latter quantifies over ⟨event,object⟩ pairs. In this respect, the situation in (26a) below is quite different. Here, the NP *ships that passed through the lock* can denote a set of ordered pairs of events and objects which, when combined with the determiner MOST, will yield a Generalized Quantifier over ⟨event,object⟩ pairs (i.e. a set of sets of ordered pairs of events and objects). This is indicated in (27). Therefore, this NP can provide a suitable restriction on the range of MOST when the latter is taken to quantify over ⟨event,object⟩ pairs.

(26) a Most ships that passed through the lock transported radioactive waste (✓OR,✓ER)

b OR: *Most ships that passed through the lock are such that each transported radioactive waste*

c ER: *Most events in which a ship passed through the lock were events*

(27) *in which it transported radioactive waste*
Most´($\lambda e \lambda x$ (ship´(x) $\wedge$ passed-through´(e,x,ιy (lock´(y)))))($\lambda e \lambda x$ (transported-radioactive-waste´(e,x)))

Moreover, suppose we want to represent the ER of (24a) above as 4,000´(λx (person´(x)))($\lambda e \lambda x$ (visited´(e,x,rm´) $\wedge$ last-year´(e))). Thus, thinking about determiners as relations between sets, 4,000´ would have to express a relation here between the property denoted by λx (person´(x)) and the relation denoted by $\lambda e \lambda x$ (visited´(e,x,rm´) $\wedge$ last-year´(e)). But such a relation cannot be straightforwardly expressed in terms of standard set-theoretic operations since the property and relation involved are of unequal type. In view of these two considerations, we are led to represent the ER of (24a) in terms of unrestricted quantification over ⟨event,object⟩ pairs, as illustrated in (24c). However, this requires an LF in which *people* and *visited the Rijksmuseum last year* form a constituent so that their meanings can be composed before the result combines with the determiner 4,000´ to yield (24c).

In view of the above, we will assign the ER of (24a) the LF in (28a), where the complex numeral *exactly 4,000* has been subextracted and adjoined to AgrSP. This yields an LF where the NP *people* and the AgrOP *the Rijksmuseum*$_y$ *visited* e_y *last year* form a constituent, as desired. Let us now assume that any NP wich does not form a constituent with its corresponding determiner/numeral at LF denotes a (restricted) dynamic existential quantifier.[8] Then the meaning of the NP (represented as $\lambda P \exists x$ (↑person´(x) $\underline{\wedge}$ ˇP(x))) can be simply composed with the meaning of the AgrOP (represented as $\exists e$ (↑visited´(e,x,rm´) $\underline{\wedge}$ ↑last-year´(e))) through Binding-In, as shown in (28b), where '↦ ' stands for 'translates as'. The fact that the numeral *exactly 4,000* shares an index with the NP *people* and the verb *visited* will then have the effect that both $\exists x$ and $\exists e$ will be abstracted over through ED at the point where the meaning of the numeral and that of the rest of the sentence are combined to yield a CCP.[9] This

[8] In fact, we could assume that all NP-complements of determiners are interpreted as (restricted) dynamic existential quantifiers, i.e. $\lambda P \exists x$ (↑NP´ $\underline{\wedge}$ ˇP(x)). In the normal case, when they combine with a determiner to form a dynamic generalized quantifier, their meaning is first type-shifted into a CCP by means of the !-operator, where !$\wp =_{def} \wp(\lambda x (\uparrow x = x))$ (cf. Chierchia 1995). This is subsequently type-shifted into a dynamic property (type ⟨s,⟨e,cc⟩⟩) by means of Existential Disclosure (ED). This dynamic property can then be combined in the ordinary fashion with a determiner to yield a dynamic generalized quantifier. Example: $\mathcal{Every}$ ($\underline{\lambda} x$ (!$\lambda P \exists x$ (↑man´(x) $\underline{\wedge}$ ˇP(x)))) ≡ (def. of !) $\mathcal{Every}$ ($\underline{\lambda} x$ ($\lambda P \exists x$ (↑man´(x) $\underline{\wedge}$ ˇP(x)))(λx (↑$x = x$))) ≡ (λ-conversion, ˇ-cancellation) $\mathcal{Every}$ ($\underline{\lambda} x \exists x$ (↑man´(x) $\underline{\wedge}$ ↑$x = x$)) ≡ (elementary logic) $\mathcal{Every}$ ($\underline{\lambda} x \exists x$ (↑man´(x))) ≡ (def. of ED, Fact 2.15, elementary logic) $\mathcal{Every}$ (λx (↑man´(x))).

[9] This requires a rather straightforward generalization along two dimensions of our definition of Binding-In, as originally given in (75) of Chapter 2, both to cover those cases that involve polyadic quantification (such as pair-quantification) as well as those cases where we need to dynamically abstract over a variable that is quantified over by E. The latter issue is addressed

is illustrated in (28c).

(28) a $[_{\text{AgrSP}}$ Exactly 4,000$_{x,e}$ $[_{\text{AgrSP}'}$ $[_{\text{NP}}$ people$]_x$ $[_{\text{AgrOP}}$ the Rijksmuseum$_y$ $[_{\text{VP}}$ e$_x$ visited$_e$ e$_y$ last year$]]]]$

b AgrSP´ ↦
$B_x(\lambda P \exists x\,(\uparrow\text{person}'(x) \mathbin{\underline{\wedge}} \check{}P(x)), \exists e\,(\uparrow\text{visited}'(e,x,\text{rm}') \mathbin{\underline{\wedge}} \uparrow\text{last-year}'(e)))$
$\lambda P \exists x\,(\uparrow\text{person}'(x) \mathbin{\underline{\wedge}} \check{}P(x))(\,\lambda x \exists e\,(\uparrow\text{visited}'(e,x,\text{rm}') \mathbin{\underline{\wedge}} \uparrow\text{last-year}'(e)))$
(def. 2.75i)
$\exists x\,(\uparrow\text{person}'(x) \mathbin{\underline{\wedge}} \exists e\,(\uparrow\text{visited}'(e,x,\text{rm}') \mathbin{\underline{\wedge}} \uparrow\text{last-year}'(e)))$
(λ-conversion, ˇ -cancellation)

c AgrSP ↦
$B_{x,e}(\textit{4,000}, \exists x\,(\uparrow\text{person}'(x) \mathbin{\underline{\wedge}} \exists e\,(\uparrow\text{visited}'(e,x,\text{rm}') \mathbin{\underline{\wedge}} \uparrow\text{last-year}'(e))))$
$\textit{4,000}\,(\,\underline{\lambda} x \underline{\lambda} e\,(\exists x\,(\uparrow\text{person}'(x) \mathbin{\underline{\wedge}} \exists e\,(\uparrow\text{visited}'(e,x,\text{rm}') \mathbin{\underline{\wedge}} \uparrow\text{last-year}'(e)))))$
(by a slight generalization of def. 2.75i)

Assume finally that $\textit{4,000}\,(R)$, where R is a dynamic relation (type $\langle s,\langle e,\langle e,cc\rangle\rangle\rangle$), is directly defined in terms of its static counterpart. That is, $\textit{4,000}\,(R) =_{def} \uparrow 4{,}000'(\downarrow R)$. Then (28c) can be reduced as follows (cf. Chapters 2 and 3 for the details of these reductions).

(29) a $\uparrow 4{,}000'(\downarrow \underline{\lambda} x \underline{\lambda} e\,(\exists x\,(\uparrow\text{person}'(x) \mathbin{\underline{\wedge}} \exists e\,(\uparrow\text{visited}'(e,x,\text{rm}') \mathbin{\underline{\wedge}} \uparrow\text{last-year}'(e)))))$

b $\lambda p\,(4{,}000'(\lambda e \lambda x\,(\text{person}'(x) \wedge \text{visited}'(e,x,\text{rm}') \wedge \text{last-year}'(e))) \wedge \check{}p)$
(def. of *4,000* and ED)

By subsequently applying the ↓-operator to (29), we obtain (24c) above, which is the desired result.

We now have a compositional semantics for both ORs and ERs at our disposal which suggests an alternative account of the WI sensitivity of ERs, exemplified earlier in (12) and (13) above. Within the present dynamic set-up, we can explain our observations in (12) and (13) along the lines of our earlier account in Chapter 3 of the WI sensitivity of What For-split. Consider for instance the Scope Island effect in (12), repeated here as (30a). Our compositional semantics for ERs entails that its LF reads as in (30b), which can be compositionally translated into (30c).

(30) a Exactly 4,000 people didn't visit the Rijksmuseum last year (✓OR/*ER)

b $[_{\text{AgrSP}}$ exactly 4,000$_{x,e}$ $[_{\text{AgrSP}'}$ $[_{\text{NP}}$ people$]_x$ $[_{\text{NegP}}$ not $[_{\text{AgrOP}}$ the Rijksmuseum$_y$ $[_{\text{VP}}$ visit$_e$ e$_y$ last year$]]]]]$

c $\textit{4,000}\,(\,\underline{\lambda} x \underline{\lambda} e\,(\exists x\,(\uparrow\text{person}'(x) \mathbin{\underline{\wedge}} \sim(\exists e\,(\uparrow\text{visited}'(e,x,\text{rm}') \mathbin{\underline{\wedge}} \uparrow\text{last-year}'(e))))))$

(30c) can be reduced in the by now familiar way to (31).

in II in the Appendix to this chapter.

(31) $\uparrow$4,000´($\downarrow$ λx´λe´ ($\mathfrak{E}x$ ($\uparrow$person´(x) $\underline{\wedge}$ $\uparrow\neg$ ($\exists e$ (visited´(e,x,rm´) $\wedge$ last-year´(e))) $\underline{\wedge}$ $\uparrow x = x$´ $\underline{\wedge}$ $\uparrow\underline{e} = e$´)))

Due to the inaccessible domain for dynamic anaphora induced by negation, which denotes an externally static function, the variable *e* which has been introduced by ED (i.e. the underlined occurrence of *e* in 31) is not bound by the existential quantifier over events. Hence, the verb *visited* cannot possibly be interpreted as a property restricting the range of the variable *e´* in (31). Moreover, given that the underlined occurrence of *e* here is free, (31) receives no interpretation on account of the fact that free variables in general are not assigned any value in Dynamic Semantics (cf. fact 2.19). An ER for (30a) can therefore be excluded on strictly semantic grounds, as desired.

Note that our dynamic approach to ERs not only offers a principled account of the Scope Island effect observed in (30a) (= 12). It also extends to the highly similar WI effects on ERs noted in (13) and (23) above. In fact, this result is not entirely unexpected given that our LFs for ERs can be straightforwardly characterized as split constructions.

4.3.4 Quantification over Events and Compositionality

On the basis of our discussion in sections 4.3.2 and 4.3.3, we may conclude that ERs exemplify the hypothetical case considered in the introduction to this section. Both an algebraic and dynamic approach can account for the WI effects exhibited by these readings in an equally natural and explanatory way. The fact that we cannot decide between the two theories on the basis of the distribution of ERs alone should not be construed as a drawback of either theory. To the extent that both an algebraic semantics and a dynamic semantics are concerned with clearly distinct facets of meaning, and therefore define their own set of core facts they must account for, it is only to be expected that when the description of a particular phenomenon involves both aspects of meaning, its properties might be accounted for either way. Still, one could decide between the two theories on the WI sensitivity of ERs on the basis of much more general considerations, such as those relating to compositionality. More specifically, both theories assume radically different sources for existential quantification over events, where the one assumption appears to be more compatible with a strict interpretation of compositionality than the other.

The algebraic and dynamic approach to the WI sensitivity of ERs both acknowledge (directly or indirectly) that the eventive verb must be interpreted

as a property restricting the range of the event-variable quantified over by some determiner/numeral. On the dynamic account, as was discussed in the preceding section, this interpretation of the eventive verb requires the mediation of ED, since by assumption, all eventive verbs have their event-argument existentially quantified over as part of their lexical meaning. Note that on this account, the need to apply ED in order to dissolve existential quantification over events is certainly not confined to cases involving ERs. As was explained in section 3.4, ED must be applied in the context of most (if not all) Q-adverb constructions as well. Moreover, we already discussed in Chapter 2 that ED is a perfectly compositional procedure, and thus does not complicate the mapping between syntax and semantics in any intolerable way. The real advantage then of assuming that eventive verbs have their event-argument existentially quantified over as part of their lexical meaning lies in the fact that it facilitates a smooth and compositional account of ORs, as was already demonstrated in (25) above.

Compare this with the algebraic approach to the WI sensitivity of ERs. Here, the event-argument of an eventive verb is not existentially quantified over in the lexical representation of its meaning. Instead, it is waiting to be bound by some operator, such as a Q-adverb or, in the case of ERs, some determiner/numeral. Now, in case no Q-adverb or determiner/numeral in a given sentence binds the event-argument, the sentence clearly receives an interpretation on which the event-variable is existentially quantified over. For example, consider again the OR of (24a) above, repeated here as (32a). The truth-conditions of this reading can be represented as in (32b).

(32)
a Exactly 4,000 people visited the Rijksmuseum last year

b $4{,}000'(\lambda x\,(\text{person}'(x)))(\lambda x \exists e\,(\text{visited}'(e,x,\text{rm}') \wedge \text{last-year}'(e)))$

To account for this 'residual' existential interpretation, it is usually assumed that an operation of Existential Closure applies by default to bind the event-variable. By definition, a default interpretation rule applies when the standard compositional interpretation procedures have not completely determined every relevant aspect of meaning. For example, in the case at hand, the compositional interpretation procedures have failed, in the absence of any trigger in the structure, to see to it that the event-argument of *visited* and *last year* is properly existentially quantified over in the scope of the subject. Existential Closure must then apply by default to fix this remaining aspect of the meaning of (32a). On this view then, the meaning of a complex expression is not always exhausted by the meanings of its parts and the way in which they are combined.[10]

On the basis of a strict interpretation of the principle of compositionality, a dynamic approach to the WI sensitivity of ERs should therefore be preferred over an algebraic one. However, it is perfectly well conceivable that there are

[10] Cf. Dekker (1993b) for more discussion of the issues involved here.

more relaxed interpretations of the principle of compositionality on the basis of which we could no longer distinguish between a dynamic and an algebraic account of the WI effects exhibited by ERs.

4.4 Semantic Relativized Minimality

According to the third possible way in which an algebraic characterization of WI-sensitive expressions might relate to a dynamic one, mentioned in section 4.1.1, all expressions that range over algebraically impoverished domains might be analyzed (at some level of grammar) as 'split' constituents in which a quantifier is separated from its indefinite restriction. If true, all cases of WIs that Sz&Z account for by algebraic means can actually be subsumed under the dynamic approach to WIs. Unfortunately, there are facts that clearly show that there are at least some expressions that range over algebraically impoverished domains that cannot be analyzed as a split constituent at any level of representation. Consider for instance the most famous of all WI sensitive expressions, the *wh*-adverb *how*. It seems pretty much impossible to represent (33) below at LF in such a way that *how* wants to dynamically bind some indefinite expression with which it does not form a constituent.

(33) *How didn't John behave?

Now, there is in principle no upper bound on the number of analyses that one might want to pursue with respect to *how*-extraction, where some of them would in fact characterize (33) as a split construction at LF. For example, we could claim that *how* needs to quantify over the eventive argument of *behave* in (33). If all eventive verbs have their event-argument existentially quantified over as part of their lexical meaning, we are forced to apply ED to derive a proper semantics for (33). Assuming that manner adverbs can indeed be analyzed as denoting properties of events, the ill-formedness of (33) can be accounted for in the same fashion as the similar Scope Island effects on What For-split.[11]

What we need then is a more direct proof that an algebraic theory of WIs cannot possibly be subsumed under a dynamic theory. On Sz&Z's account, it is predicted that different extractees are sensitive to different interveners (cf.

11 Alternatively, we might analyze *how* as *in what manner*, where the latter is split at the level of LF (Anna Szabolcsi p.c.). However, both possibilities for analyzing *how*-interrogatives on a par with split constructions will not be further pursued here. It seems to me that one major problem that such an approach would face resides in the fact that even though the WI sensitivity of *how*-extraction is lifted in those special contexts which provide lists of alternative manners (cf. section 1.3.2 for a general discussion concerning the relevance of context), the WI sensitivity of split constructions cannot likewise be suspended, as observed in section 4.2.

also section 1.3.2). That is, if *A* ranges over a (proper) join semilattice, *A* cannot scope over any expression that is semantically associated with Boolean meet or complement. However, if *A* would range over a (proper) lattice instead, the only expressions *A* could not scope over are those that are semantically associated with Boolean complement. If such semantic 'Relativized Minimality' effects (to borrow a phrase from Sz&Z) can in fact be attested, it can be straightforwardly accomodated on an algebraic approach to WIs. However, not so on a dynamic account, since a dynamic theory partitions the class of interveners into two equivalence classes: the class of those interveners that denote (externally) dynamic functions, and the class of those interveners that denote (externally) static functions.

Consider in this light the *how*-interrogative in (34) below. With respect to this type of construction, Sz&Z observe (following Kiss 1992) that the universal distributive Q-NP cannot receive a narrow scope construal.[12] This follows immediately from their account since meet, the Boolean operation with which universal distributive Q-NPs are associated, cannot be performed in a (proper) join semilattice, the algebraic structure into which manners are assembled (cf. also Chapter 1).

(34) How did everyone behave? (**wh* > ∀, ✓∀ > *wh*)
  a *wh* > ∀: **For what manner, everyone behaved in that manner?*
  b ∀ > *wh*: *For every person, how did he behave?*

As was already remarked above, if manner adverbs can indeed be analyzed as predicating properties over events, one might even contemplate a dynamic account of the missing narrow scope universal reading in (34). This observation could then be handled in the same way in which we ruled out narrow scope universal readings in What For-split in Chapter 3 (but cf. footnote 11).

Interestingly, Sz&Z observe that *how many*-interrogatives can receive two readings that display different patterns of sensitivity to different interveners. One reading is the so-called 'amount' reading which exhibits the same type of sensitivity to the same class of interveners as *how*-interrogatives.[13] The other

[12] As originally pointed out by Kiss (1992) (cf. also section 1.3.2), the unavailable a-reading in (34) should not be confused with the superficially similar 'presupposed uniformity' reading, according to which (34) may be paraphrased as *What was the uniform behavior exhibited by everyone?*.

[13] The 'amount' reading of *how many*-interrogatives is most easily discerned in modal contexts. Thus, consider (i) which can have the 'individual-type' reading glossed in (ia) and the 'amount' reading paraphrased in (ib).
(i) How many books should John read?
  a For what number *n*, there are *n* many books *y* such that John should read *y*?
  b For what number *n*/amount, John should read *n* many/that amount of books?
The sensitivity of the b-type reading to WIs is discussed at lenght by Cresti (1995). She

reading is the so-called 'number' reading which is again filtered out by the same type of interveners that block *how*-extraction, *save* for one: narrow scope universals. Thus, even though the absence of the number reading in (35a) patterns with the impossibility of extracting *how* across negation (cf. 33), the availability of the number reading in (35b), even when the universal distributive Q-NP takes narrow scope, contrasts with the impossibility of assigning a narrow scope universal reading to (34) (35b has been taken over from Sz&Z: ex. 86). Therefore, the contrast between (34) and (35b) provides evidence for the existence of semantic 'Relativized Minimality' effects.

(35) a *(At least) How many laps hasn't John covered by now?
Number Reading: **For what number* n, *John hasn't covered at least* n *many laps by now?*

b (At least) How many laps has every swimmer covered by now? ($wh > \forall$)
Number Reading: *For what number* n, *every swimmer covered at least* n *many laps?*

Sz&Z argue that the compatibility of a narrow scope universal reading of (35b) with a 'number' reading of the pertinent *how many*-phrase follows automatically from their account on the assumption that on its 'number' reading, a *how many*-phrase ranges over the natural numbers. The natural numbers form a (proper) lattice (or chain), and (proper) lattices are closed under join ànd meet. However, there is no way that a dynamic approach to WIs could account for the relevant contrast between (34) and (35). The problem is simply that a universal distributive Q-NP denotes an externally static function. It is thus predicted to always block dynamic binding. More generally then, semantic 'Relatived Minimality' effects point to the fact that the semantics of an extractee determines the type of interveners it is sensitive to. This is as predicted on an algebraic approach to WIs but comes as a complete surprise on a dynamic approach. The reason is that the latter approach partitions the class of interveners into two equivalence classes: one which contains all those expressions that denote (externally) static functions, and one which contains all those expressions that denote (externally) dynamic functions. This approach cannot possibly deal with a situation in which an extractee on one interpretation is sensitive to exactly those interveners that denote static functions, whereas on another interpretation it is sensitive to a proper subset of the static interveners.

To conclude the discussion in this section and the two preceding ones, we have looked at the three possible ways in which an algebraic characterization of island-sensitive expressions might relate to a dynamic characterization of these

argues that the two readings distinguished in (i) are determined by the position in which *n many books* is interpreted relative to the position in which the modal is interpreted . That is, she assumes that the two readings of (i) can be traced back to a scopal ambiguity, rather than an inherent ambiguity of the *how many*-phrase itself. I will not take a position here with respect to whether all 'amount' readings can be reduced in this way to scopal ambiguities.

expressions. Our findings with respect to Event-related Readings suggest that at least some 'split' constituents in which a quantifier is separated from its indefinite restriction range over semantically impoverished domains. However, not all of them, and not all expressions that range over semantically impoverished domains can be analyzed (at some level of representation) as split constituents. This means that Sz&Z's algebraic approach to WIs cannot be subsumed under a dynamic approach to WIs, nor can the dynamic approach be reduced to the algebraic one. Consequently, we must acknowledge that there are cases of WIs that can only be explained dynamically or algebraically, in addition to those cases that could be accounted for either way. We may thus conclude that neither theory alone can account for the full range of facts. In itself, this is not as disappointing as it may sound. As was already observed, to the extent that both theories are concerned with clearly distinct aspects of meaning, the aforementioned conclusion is in fact the expected one. However, we will see in section 4.7 that there is ample reason to suspect that the dynamic potential of an expression is intimately related to its Boolean properties. If so, then that suggests there is a more general theory, combining the essential features of both the dynamic and algebraic approach to WIs, that does account for the full range of facts. But before we will come to discuss these issues more fully, we will first compare from an empirical point of view the relevant two theories in terms of their characterization of bad interveners in the next two sections.

4.5 The Essential Algebraic and Dynamic Properties of Interrogative Complements

We already observed in (2) of the preceding chapter that the notion of a bad intervener in Dynamic Semantics is (almost) coextensional with Sz&Z's notion of a bad intervener in WI constructions. However, up to this point, this observation is solely based on the algebraic and dynamic properties of sentence negation, Q-NPs and Q-adverbs. In this section as well as the next one, we will address the (essential) algebraic and dynamic properties of interrogative complements and presuppositional verbs. On the basis of that discussion, it will become clear that *Wh*-Islands and Presupposition Islands can be characterized in terms of either an algebraic or dynamic notion of bad interveners, although not as straightforwardly perhaps as one would like.

Thus, let us first consider the question whether contrasts such as the one observed in (36) (taken over from Cinque 1990) can be subsumed under an algebraic approach to WIs.

(36) a ?To whom didn't they know when to give their present?
b *How did they ask you who behaved?

As pointed out by Sz&Z, to answer the above question, it suffices to look for at least one operation in the set of Boolean operations that characterize the

denotation of complement interrogatives that cannot be executed in the denotation domain of *how*. Given that the denotation domain of this *wh*-adverb constitutes a (proper) join semilattice, the contrast in (36) would automatically follow from Sz&Z's account if the denotation of complement interrogatives can be partially characterized in terms of Boolean meet. Sz&Z (1997: p. 248, added footnote) argue that this is indeed the case if Groenendijk & Stokhof's (1984) semantics for interrogatives is adopted. According to their analysis, the intension of an interrogative $?\phi$ is a function from possible worlds w to sets of possible worlds w' in which ϕ has the same extension (i.e. a truth-value, a set of individuals, a set of ordered pairs and so on) as in w. To put the same point somewhat differently, Groenendijk & Stokhof (1984) argue that the intension of an interrogative $?\phi$ is an equivalence relation which partitions the set of possible worlds into mutually exclusive but jointly exhaustive subsets of worlds in which ϕ has the same extension. A possible answer to $?\phi$ then is that answer which reduces the interrogator's ignorance as to which of the equivalence classes induced by $?\phi$ the actual worlds w belongs to, or, equivalently, what ϕ's extension is in w. On this analysis, the meaning of (37) for example when uttered in a world w is the set of possible worlds w' represented in (37a).

(37) Who behaved rudely?

a $\lambda w' (\lambda x' (\text{behaved-rudely}'_{w'}(x')) \equiv \lambda x (\text{behaved-rudely}'_{w}(x)))$

b $\lambda w \forall x (\text{behaved-rudely}'_{w}(x) \leftrightarrow x = \text{john}' \vee x = \text{mary}')$

Along with Groenendijk & Stokhof (1984), Sz&Z observe that this analysis of the semantics of interrogatives entails that *wh*-phrases have universal force. To see that, suppose that the people that actually behaved rudely are John and Mary, and that no one else behaved rudely. On that assumption, (37a) (the extension of 37 in the actual world w) is equivalent with (37b), since $[\![\lambda x (\text{behaved-rudely}'_{w}(x))]\!] = \{\text{John,Mary}\}$. Since universal quantifiers are associated with Boolean meet, (36b) is expected to be at least as bad as (34) above on a narrow scope universal reading, an observation which is repeated in (38) for ease of reference.

(38) How did everyone behave? (*$wh > \forall$, ✓$\forall > wh$; cf. also 34 above)

a $wh > \forall$: **For what manner, everyone behaved in that manner?*

b $\forall > wh$: *For every person, how did he behave?*

This account is somewhat unsatisfying, though. Firstly, it predicts that a *how many*-phrase on its number reading (cf. section 4.4) can be extracted across a *Wh*-Island. However, the grammaticality of (35b) above stands in sharp contrast with the ungrammaticality of (39).

(39) *(At least) How many laps do you wonder who has covered by now?

Secondly, and more importantly, Groenendijk & Stokhof's (1984) approach to the semantics of interrogatives would not ascribe a similar universal force to

whether. That is, assuming that you behaved in a rude way in the actual world *w*, there is no ϕ such that $\lambda w'$ (behaved-rudely$'_{w'}$(you$'$) ≡ behaved-rudely$'_{w}$ (you$'$)) (the extension of *whether you behaved* in *w*) is equivalent with $\lambda w' \forall x$ (ϕ ↔ 1). But then, Sz&Z cannot account for the fact that *whether*-clauses too induce WIs, as shown by the contrast in (40).

(40) a Which man are you wondering whether to invite?
b *How are you wondering whether to behave?

It seems that a dynamic approach to WIs is in a considerably better shape in this respect. Embedded *wh*-interrogatives and *whether*-clauses alike induce inaccessible domains for dynamic anaphora, as (41) demonstrates.

(41) a *I wonder who has a_x VCR. The shop has sold it_x yesterday.
b *I wonder whether John has a_x VCR. The shop has sold it_x yesterday.

The fact that *Wh*-Islands create inaccessible domains for dynamic anaphora can be easily explained on the basis of our approach to dynamic questions presented in II of the Appendix to Chapter 3. We argued there that the simplest way to implement a Kartunnen-semantics for interrogatives in a dynamic setting would be to assume that the intension of an interrogative is a function from possible worlds to sets of CCPs (type $\langle w,\langle\langle s,cc\rangle,t\rangle\rangle$). This entails that the meaning of the first sentence in (41b) for example be represented as in (42).

(42) $\uparrow$wonder$'$(I$'$,$\lambda w \lambda \pi$ ($\downarrow^{\vee} \pi(w) \wedge \downarrow^{\vee} \pi = \exists x$ (VCR$'(x) \wedge$ has$'$(john$'$,x))))

Given that $\exists x$ in (42) has lost its dynamics, it cannot possibly bind an occurrence of *x* outside the scope of wonder$'$. In the light of our dynamic account of the Intervention Generalization in Chapter 3, this result means that the explanation of our earlier observation that split constructions are sensitive to *Wh*-Islands as well (cf. section 1.5) can follow its familiar course.

To conclude, assuming for now that the problems that were observed in connection with (39) and (40) can be settled in a way which is consistent with Sz&Z's account, it is quite remarkable that the algebraic and dynamic approach to WIs agree on at least a significant subset of the *Wh*-Island cases. This again raises the issue whether both types of explanation can be related to each other in a way that would make their empirical ties non-accidental. As promised, this issue will be explored in section 4.7.

4.6 The Essential Algebraic and Dynamic Properties of Presuppositional Verbs[14]

It is time to reflect on Presupposition Islands. As was already discussed in Chapter 1, presuppositional verbs come in two flavors: Cattell's (1978) *non-stance* verbs, typical examples of which are *regret* and *know*, and *response stance* verbs, representative examples of which are the verb *deny* and *confirm*. To remind ourselves of the fact that Presupposition Islands form a special class of WIs, consider again the contrast in (43) (these observations are repeated from Chapter1).

(43) a Which man did you [regret/know/realize ... that you invited _]?
b Which man did you [deny/verify/agree ... that Peter invited _]?
c *How did you [regret/know/realize ... that you behaved _]?
d *How did you [deny/verify/agree ... that Peter behaved _]?

Let us first find out whether the content of presuppositional complement CPs can be at least partially characterized in terms of one of the Boolean operations which cannot be executed in the denotation domain of *how*, viz. meet. Building on work reported in Dukes (1992), Sz&Z note that non-stance and response stance predicates allow for the following types of paraphrases:

(44) a I regret that John behaved badly
a´ *regret*(*I*,*that John behaved badly*) ∧ *fact*(*that John behaved badly*)
b I deny that John behaved badly
b´ *deny*(*I*,*that John behaved badly*) ∧ *assumption*(*that John behaved badly*)

Sz&Z furthermore observe that volunteered stance verbs like *think* and *believe* at best only allow for paraphrases that involve tautological cognates (i.e. *thought*, *belief* etc.). The differential behavior of volunteered stance verbs versus non-stance and response stance verbs *vis a vis how*-extraction can then simply be related to the fact that only the meanings of the latter types of verbs can be partially explicated in terms of Boolean conjunction, where conjunction ∧ corresponds to meet in the truth-value algebra. Before we will turn in the next subsection to the question whether Presupposition Islands constitute a natural class within a dynamic perspective on WIs as well, it should be pointed out that it is in virtue of the presuppositions associated with non-stance and response stance verbs that we are able to paraphrase their meanings by means of Boolean conjunction. That is, *regret* and *know* presuppose the truth of their complements and *deny* and *confirm* presuppose that their complements express assumptions or claims held by someone possibly other than the speaker which are part of the common ground (cf. also Chapter 1). In general, presuppositions cannot be

14 Parts of the material covered in this section appeared as Honcoop (1997b).

represented as conjuncts. Otherwise, we would wrongly predict that *I didn't regret that John behaved badly* is true in a situation where in fact John did not behave badly, even though I believed he did and was sad about that. Sz&Z (1997: p. 249, added footnote) suggest that this problem might be circumvented by adopting Moltmann's (1994) event-based analysis of attitude reports. Future research should decide whether this suggestion can also meet more general objections that can be leveled against representing presuppositions in the semantics proper.

In the remainder of this section, we will explore a dynamic approach to Presupposition Island effects.

4.6.1 A Dynamic Perspective on Presupposition Islands

What then is the performance of a dynamic approach *vis à vis* Presupposition Islands? Very poor, judging from the small sample of data presented in (45) below. From a dynamic point of view, we would expect volunteered and response stance verbs to create WIs, rather than response stance and non-stance verbs, since only the former types of verbs induce inaccessible domains for dynamic anaphora (the judgments concern *de dicto* construals of the pertinent indefinites).

(45) a *John thought he met a_x photomodel yesterday. She_x smiled at him.
b *John denied that he met a_x photomodel yesterday. She_x smiled at him.
c John is happy that he met a_x nice girl yesterday. She_x smiled at him.

Before we provide an explicit characterization of the problems (45) poses for a dynamic approach to WIs, observe first that the ill-formedness of the anaphoric dependency depicted in (45a) and, likewise, the one displayed in (45b) would automatically follow if we assume that volunteered stance and response stance verbs denote externally static functions. That is, we might assume that the main verb of the first sentence in (45a) combines with its arguments in the way indicated roughly in (46). A note of clarification may be in order here. In (46), the more or less classical analysis of *think/believe* has been adopted according to which think´/believe´(α,ϕ) holds in *w* just in case ϕ holds in all worlds *w´* that are *doxastically accessible* to *w* for α (that is, that are compatible with what α thinks/believes in *w*). In short: think´$_w$/believe´$_w$(α,ϕ) $\leftrightarrow$ $\forall w' \sim w$ (DOX(α,*w´*) $\rightarrow$ ϕ(*w´*)).[15]

[15] In philosophical parlour, these verbs are also referred to as *propositional attitude verbs*. To avoid possible misunderstandings, however, we will stick to Cattell's terminology thoughout this chapter.

(46) a $\lambda\pi\lambda x\ (\lambda p\lambda w\ (\forall w' \sim w\ (\textsc{Dox}(x,w') \rightarrow \downarrow^{\vee}\pi(w')) \wedge {}^{\vee}p(w)))(\ \&_x\ (\uparrow\text{photomodel}'(x) \underline{\wedge} \uparrow\text{met-yesterday}'(\text{john}',x)))(\text{john}')$

b $\lambda p\lambda w\ (\forall w' \sim w\ (\textsc{Dox}(\text{john}',w') \rightarrow \exists x\ (\text{photomodel}'_{w'}(x) \wedge \text{met-yesterday}'_{w'}(\text{john}',x))) \wedge {}^{\vee}p(w))$

(λ-conversion, ${}^{\vee}$-cancellation, $R' =_{def} \lambda x_1 \ldots \lambda x_n \lambda w\ (R'_w(x_1,\ldots,x_n))$)

Since the place-holder for possible continuations *p* falls outside the scope of $\forall w' \sim w$, $\exists x$ cannot possibly bind any occurrence of *x* outside the scope of this modal operator, as desired. However, note that this analysis also effectively undermines the possibility of providing a dynamic account of the sensitivity of split constructions to Presupposition Islands, as exemplified by the contrasts in (47-48). That is, by ascribing an externally static semantics to volunteered stance verbs, we can no longer sensibly apply ED in (47a) and (48a) if we interpret the indefinite remnant/partially moved *wh*-phrase *de dicto*.

(47) a Wat denk jij dat Peter voor een boek/aan boeken heeft gelezen?
"What kind of book/What books do you think that Peter read?"

b *Wat ontken jij dat Peter voor een boek/aan boeken heeft gelezen?
"What kind of book/What books do you deny that Peter read?"

c *Wat betreur jij dat Peter voor een boek/aan boeken heeft gelezen?
"What kind of book/What books do you regret that Peter read?"

(48) a Was glaubst du mit wem Jakob jetzt spricht?
"With whom do you think that Jakob is talking now?"

b *Was verweigerst du mit wem Jakob jetzt spricht?
"With whom do you deny that Jakob is talking now?"

c *Was bedauerst du mit wem Jakob jetzt spricht?
"With whom do you regret that Jakob is talking now?"

Summarizing our findings thus far, a dynamic approach to WIs faces two major problems when confronted with our observations in (45) and (47-48):

(49) *Problem I*. There are apparently some WI contexts that do not constitute inaccessible domains for dynamic anaphora (cf. 45c versus 47c and 48c).

(50) *Problem II*. Conversely, there are apparently some inaccessible contexts for dynamic anaphora that do not create WIs (cf. 45a versus 47a and 48a).

Since both problems directly contradict our claim in (5) of Chapter 3, according to which the class of expressions which induce WIs exactly coincides with the class of expressions that create inaccessible domains for dynamic anaphora, our dynamic account of the Intervention Generalization is in immediate danger. The

second problem is in fact much more serious than what the facts as discussed up to this point already indicate. As is well-known, all the classical intensional (or opaque) contexts (i.e. all those contexts where the principle of Extensionality does not hold) induce inaccessibility effects. However, it is almost equally well-known that none of these contexts create WIs.[16]

This situation recalls a point made by Sz&Z (1993: p. 269) in connection with *intentional* verbs such as *want* and *seek*. They observe that, intuitively, the scopal properties of these verbs are not Boolean in nature. Intentional verbs are therefore not expected to create WIs, as desired. Sz&Z furthermore point out that any theory which treats scope as primitive cannot make the correct distinctions. It seems to me that the problem a dynamic theory of WIs faces with intensionality can ultimately be traced back to the fact that scope does seem to be taken as a primitive in this theory. That is, it cannot be accidental that the operators $\mathcal{Q}$ that do not induce inaccessibility effects (i.e. 'referential' expressions and externally dynamic operators) are those for which the following holds: $\mathcal{Q}(\mathcal{E}x\,(\Phi)) \equiv \mathcal{E}x\,(\mathcal{Q}(\Phi))$. The challenge then is to elaborate the dynamic theory in a such a way that a solution to the two problems mentioned above becomes feasible. Specifically, we must look for a modification of our original formulation of the operation that was so pivotal in our dynamic account of the Intervention Generalization, viz. ED, that will enable us to disclose simple indefinites across intensional domains, but not across the presuppositional domains created by response stance and non-stance verbs. Of course, this modification should preserve the results that have already been achieved in the preceding chapter.

The remainder of this section will be organized as follows. In the next subsection, we will first see that anaphoric dependencies that cross intensional domains can be saved if there is an appropriate additional intensional operator which scopes over the pronoun. This phenomenon is called *modal subordination*. We will then discuss Groenendijk & Stokhof's (1989) compositional approach to modal subordination. Assuming their analysis, we might expect that ED can be sensibly applied across the intensional domains represented in (47a) and (48a) if we make two further assumptions: i) the proper definition of ED involves a suitably parametrized intensional operator; ii) volunteered stance verbs introduce the CCP denoted by their complement as a 'discourse referent'. This suggestion will be systematically worked out in section 4.6.3. We will also briefly discuss there how this solution might be extended to other intensional domains. In section 4.6.4, we will discuss the essential dynamics of response stance and non-stance verbs. Recall that non-stance verbs presuppose that the proposition *p* expressed by their complement clause is part of the common ground, whereas response stance verbs presuppose that the assumption or claim (held by someone possibly other than the speaker)

[16] Thanks to Gennaro Chierchia (p.c.) who was the first one to point out this problem to me.

that *p* is the case is part of the common ground. In view of their presuppositional nature, it seems natural to assume that both these types of verbs do not introduce the CCPs denoted by their complements as 'discourse referents'. Therefore, an intensional version of ED will not have the unwanted effect of ruling in the ungrammatical cases in (47) and (48). We will show that modal subordination involving response stance and non-stance verbs can be straightforwardly analyzed in terms of the E-type strategy along the lines of Heim (1992).

4.6.2 A Compositional Approach to Modal Subordination

As was already anticipated in the above, dynamic anaphora can access an indefinite antecedent in an intensional context only if there is an additional intensional operator present which scopes over the relevant pronoun. This phenomenon of modal subordination (cf. Roberts 1987) is illustrated in (51) (the example in 51a has been taken over from Groenendijk & Stokhof 1989).

(51)
a A_x tiger might come in. It_x would eat you first.
b John thinks he has a_x dollar in his wallet. He wants to give it_x to the beggar.

The meaning of the first pair of sentences in (51) can be paraphrased as indicated in (52a). Closely following Heim's (1992) semantics for *want*, we can paraphrase the meaning of the second pair of sentences in (51) as indicated roughly in (52b). Abstracting away from some superficial differences, both instances of modal subordination require identifying (part of) the first argument of the second intensional operator with the second argument of the first intensional operator. In the following, we will discuss Groenendijk & Stokhof's (1989) proposal for a compositional procedure by means of which this identification can be accomplished for (51a). I will just assume that, *mutatis mutandis*, this procedure can be carried over to account for the anaphoric dependency in (51b) as well.

(52)
a $\exists w' \sim w$ (a tiger comes in in w'), and $\forall w'' \sim w$ (if a tiger comes in in w'', it eats you first in w'')
b $\forall w' \sim w$: DOX(John,w') (John has a dollar in his wallet in w'), and $\forall w'' \sim w$: DOX (John,w'') (if John has a dollar in his wallet in w'', (John gives it to the beggar in w'') is more desirable to John in w than (John does not give it to the beggar in w''))

Groenendijk & Stokhof (1989) observe that we can account for the anaphoric dependency in (51a) in a compositional fashion if we assume i) that the first sentence introduces a semantic object (say, to use DRT terminology, a 'discourse referent') which is the meaning of *A tiger comes in*, and ii) that the

restriction of the modal *would* is an empty anaphor which picks up this discourse referent. The meaning of the second sentence in (51a) can then be represented as follows, where D is a variable of type ⟨s,cc⟩.

(53) $\lambda p \lambda w\ (\forall w'' \sim w \downarrow(\check{}D \underline{\rightarrow} \uparrow\text{eats-first}'(x,\text{you}'))(w'') \wedge \check{}p(w))$

How do we model the introduction of a discourse referent? Groenendijk & Stokhof suggest we do this by means of so-called *state-switchers*. Prefixing an expression β with a state-switcher $\{\alpha/d\}$ has the following semantic effect: the interpretation of $\{\alpha/d\}\beta$ with respect to a *state s* (an assignment to distinguished variables, called *discourse markers*) is given by the interpretation of β with respect to state s' which differs from s at most in this respect that the denotation of the discourse marker d in s' is the object denotated by α in s. For a more thorough discussion of state-switchers and the concomitant notions of states and discourse markers, cf. II in the Appendix to this chapter. For the purposes of the present discussion, we may simply think of state-switchers as the semantic analogue of the syntactic substitution operator $[\alpha/d]$. The assumption that the first sentence in (51a) introduces the meaning of *A tiger comes in* as a discourse referent, can now be formally implemented as follows.

(54) $\lambda p \lambda w\ (\exists w' \sim w\ (\exists x\ (\text{tiger}'_{w'}(x) \wedge \text{comes-in}'_{w'}(x))) \wedge \{\ \mathcal{E}x\ (\uparrow\text{tiger}'(x)\ \underline{\wedge}\ \uparrow\text{comes-in}'(x))/D\}\check{}p(w))$

By dynamically conjoining the meaning of the first sentence in (51a), as represented in (54), with that of the second one, as represented in (53), we obtain the following representation of the discourse as a whole.

(55) a $\lambda p \lambda w\ (\exists w' \sim w\ (\exists x\ (\text{tiger}'_{w'}(x) \wedge \text{comes-in}'_{w'}(x))) \wedge \{\ {}^\wedge\mathcal{E}x\ (\uparrow\text{tiger}'(x)\ \underline{\wedge}\ \uparrow\text{comes-in}'(x))/D\}\check{}p(w))\ \underline{\wedge}\ \lambda p \lambda w\ (\forall w'' \sim w \downarrow(\check{}D \underline{\rightarrow} \uparrow\text{eats-first}'(x,\text{you}'))(w'') \wedge \check{}p(w))$

b $\lambda p \lambda w\ (\exists w' \sim w\ (\exists x\ (\text{tiger}'_{w'}(x) \wedge \text{comes-in}'_{w'}(x))) \wedge \{\ {}^\wedge\mathcal{E}x\ (\uparrow\text{tiger}'(x)\ \underline{\wedge}\ \uparrow\text{comes-in}'(x))/D\}(\forall w'' \sim w \downarrow(\check{}D \underline{\rightarrow} \uparrow\text{eats-first}'(x,\text{you}'))(w'') \wedge \check{}p(w)))$

(def. of $\underline{\wedge}$)

At this point, the state-switcher can be pushed inside, substituting the discourse referent $\mathcal{E}x\ (\uparrow\text{tiger}'(x)\ \underline{\wedge}\ \uparrow\text{comes-in}'(x))$ for each occurrence of the discourse marker D, until it hits $\check{}p(w)$, from where it cannot be moved any further (cf. II in the Appendix to this chapter).[17] We thus obtain (55c).

17 It goes without saying that the seemingly 'derivational' terms *push* here as well as *move* below should be interpreted metaphorically, rather than literally. That is, it is not that we have a choice with respect to whether we 'push' a state-switcher inside or not.

(55) c $\lambda p\lambda w\,(\exists w´\sim w\,(\exists x\,(\text{tiger´}_{w´}(x) \wedge \text{comes-in´}_{w´}(x))) \wedge \forall w´´\sim w \downarrow(\mathcal{E}x\,(\uparrow\text{tiger´}(x) \underline{\wedge} \uparrow\text{comes-in´}(x)) \underline{\rightarrow} \uparrow\text{eats-first´}(x,\text{you´}))(w´´) \wedge \{\hat{}\mathcal{E}x\,(\uparrow\text{tiger´}(x) \underline{\wedge} \uparrow\text{comes-in´}(x,\text{you´}))/D\}\check{}\,p(w))$ (def. of state-switchers, $\check{}$ -cancellation)

In (55c), there is a dynamic existential quantifier in the antecedent of a dynamic conditional. We will recall from Chapter 2 that since dynamic implication is internally dynamic, an active occurrence of $\mathcal{E}x$ in its antecedent can bind occurrences of x in its consequent. This is shown in (55d-e).

(55) d $\lambda p\lambda w\,(\exists w´\sim w\,(\exists x\,(\text{tiger´}_{w´}(x) \wedge \text{comes-in´}_{w´}(x))) \wedge \forall w´´\sim w \downarrow\uparrow\,(\exists x\,(\text{tiger´}(x) \wedge \text{comes-in´}(x)) \rightarrow \exists x\,(\text{tiger´}(x) \wedge \text{comes-in´}(x) \wedge \text{eats-first´}(x,\text{you´})))(w´´) \wedge \{\hat{}\mathcal{E}x\,(\uparrow\text{tiger´}(x) \underline{\wedge} \uparrow\text{comes-in´}(x,\text{you´}))/D\}\check{}\,p(w))$ (def. of $\underline{\rightarrow}$, $\mathcal{E}$ and $\underline{\wedge}$)

e $\lambda p\lambda w\,(\exists w´\sim w\,(\exists x\,(\text{tiger´}_{w´}(x) \wedge \text{comes-in´}_{w´}(x))) \wedge \forall w´´\sim w\,(\exists x\,(\text{tiger´}_{w´´}(x) \wedge \text{comes-in´}_{w´´}(x)) \rightarrow \exists x\,(\text{tiger´}_{w´´}(x) \wedge \text{comes-in´}_{w´´}(x) \wedge \text{eats-first´}_{w´´}(x,\text{you´}))) \wedge \{\hat{}\mathcal{E}x\,(\uparrow\text{tiger´}(x) \underline{\wedge} \uparrow\text{comes-in´}(x,\text{you´}))/D\}\check{}\,p(w))$
($\text{R´} =_{def} \lambda x_1 \ldots \lambda x_n \lambda w\,(\text{R´}_w(x_1,\ldots,x_n))$, $\downarrow\uparrow$-cancellation)

By applying the $\downarrow$-operator to (55e), we can see what truth-conditional content we are led to assign to (51a). The result reduces to (56), which captures the static meaning of (51a), as paraphrased above in (52a), reasonably well (assuming a weak definition of dynamic implication; cf. Chapter 2).

(56) $\lambda w\,(\exists w´\sim w\,(\exists x\,(\text{tiger´}_{w´}(x) \wedge \text{comes-in´}_{w´}(x))) \wedge \forall w´´\sim w\,(\exists x\,(\text{tiger´}_{w´´}(x) \wedge \text{comes-in´}_{w´´}(x)) \rightarrow \exists x\,(\text{tiger´}_{w´´}(x) \wedge \text{comes-in´}_{w´´}(x) \wedge \text{eats-first´}_{w´´}(x,\text{you´}))))$

Observe that the assumption that that an intensional operator can introduce a CCP as discourse referent does not entail that the first sentence in (51a) for example can be continued with *It$_x$ eats you first*, as desired. Since the latter sentence does not contain an intensional operator itself, there is hence no anaphoric restriction that can be resolved to the relevant CCP-level discourse referent.

4.6.3 An Intensional Version of Existential Disclosure

One might expect that if we formulate a suitably intensionalized version of ED, i.e. one that involves an intensional operator which is similarly parametrized as the modal *would* on Groenendijk & Stokhof's (1989) account, we can sensibly apply this operation across intensional domains, thus solving the second problem noted in (50) above. Consider the following version of ED, where D is of type $\langle s,\langle cc\rangle\rangle$.

(57) *Definition: Intensional Existential Disclosure (IED)*

$$\underline{\lambda}x\,(\Phi) =_{def} \lambda x'\,(\Phi \mathbin{\underline{\wedge}} \uparrow\lambda w\forall w' \sim w\,(\downarrow\,(\check{}D \mathbin{\underline{\rightarrow}} \uparrow x = x')(w')))$$

(where x' is not free in Φ)

It is not difficult to see that IED, just like the old ED, enables us to deactivate a dynamic existential quantifier on the following assumptions (where the first two are relatively uncontroversial; cf. Gamut 1991): i) the domain of individuals E is the same for all worlds, ii) '=' denotes $\{\langle a,a\rangle: a \in E\}$ in all worlds, and iii) $\downarrow\check{}$D is true of at least one world. This can be illustrated by means of the following example.

(58) a $\underline{\lambda}x\,\&x\,(\uparrow\text{man}'(x))$

b $\lambda x'\,(\&x\,(\uparrow\text{man}'(x)) \mathbin{\underline{\wedge}} \uparrow\lambda w\forall w' \sim w\,(\downarrow\,(\check{}D \mathbin{\underline{\rightarrow}} \uparrow x = x')(w')))$ (def. of IED)

c $\lambda x'\,(\&x\,(\uparrow\text{man}'(x) \mathbin{\underline{\wedge}} \uparrow\lambda w\forall w' \sim w\,(\downarrow\,(\check{}D \mathbin{\underline{\rightarrow}} \uparrow x = x')(w')))$ (def. of & and $\underline{\wedge}$)

d $\lambda x'\,(\&x\,(\uparrow\text{man}'(x) \mathbin{\underline{\wedge}} \uparrow\lambda w\forall w' \sim w\,(\downarrow\uparrow\,(\downarrow\check{}D \rightarrow x = x')(w')))$ (def. of $\underline{\rightarrow}$)

e $\lambda x'\,(\&x\,(\uparrow\text{man}'(x) \mathbin{\underline{\wedge}} \uparrow\lambda w\forall w' \sim w\,(\downarrow\check{}D(w') \rightarrow x = x')))$

($\downarrow\uparrow$-cancellation, $\text{R}' =_{def} \lambda x_1 \ldots \lambda x_n \lambda w\,(\text{R}'_w(x_1,\ldots,x_n))$)

Given the three assumptions discussed above, it follows that (58e) is equivalent to (58f) below.[18] Finally, the equivalence of (58f) and (58g) was already at the heart of our older version of ED.

(58) f $\lambda x'\,(\&x\,(\uparrow\text{man}'(x) \mathbin{\underline{\wedge}} \uparrow x = x'))$

g $\lambda x'\,(\uparrow\text{man}'(x))$ (elementary logic)

Thus, in 'ordinary' extensional contexts, ED and IED yield the same semantic effects. This means that the intensional version of ED as formulated in (57) will preserve the empirical results of the preceding chapter, as desired. However, IED distinguishes itself from ED in that it, in conjunction with Groenendijk & Stokhof's (1989) compositional approach to modal subordination, provides us with the tools to account for the fact that split constructions are insensitive to the intensional domains created by (modals and) volunteered stance verbs such as *think* (cf. 47a and 48a above). Consider for example the What For-split construction in (59a) on a *de dicto* construal of the indefinite remnant *voor een monster* (which is the most salient reading).

18 Actually, something more needs to be said in view of Fact (2.19) which leaves free variables such as D uninterpreted. Note first that in the absence of any prior context, the modal base of an intensional operator is provided by the common ground CG, where CG is the set of all worlds that are consistent with the shared beliefs of the interlocutors. A natural move to make then in a dynamic set-up is to codify this contextual dependency of modal operators in the initial assignment g. Let us therefore assume then that (58) is not interpreted relative to $\varnothing$ (the empty assignment), but rather relative to $g[D/\uparrow\text{CG}']$. The equivalence of (58e) and (58f) now follows, independently of what set of worlds CG′ is taken to denote.

Assume that the main verb *thinks* here introduces the CCP denoted by its complement (as restricted to the believe-worlds of its subject) as a discourse referent. On this assumption, the meaning of *thinks* can be represented as in (59b), where $\textsc{Dox}'(x) = \lambda w\ (\textsc{Dox}(x,w))$.[19] To keep the following discussion maximally simple, we will just assume that on their static reading, *wh*-interrogatives denote functions from individuals into propositions (and correspondingly, on their dynamic reading, functions from individuals into CCPs; cf. II in the Appendix to Chapter 3 for a more conventional approach to the meaning of *wh*-interrogatives). The dynamic meaning of (59a) will then be represented as in (59c) (recall from Chapter 3 that kind-of-monster$'$ = $\lambda\kappa\lambda w\forall x\ \forall w'\sim w\,(\mathrm{R}_{w'}(x,\kappa) \rightarrow \text{monster}'_{w'}(x))$, where *R* is Carlson's 1977 realization-relation holding between individuals and kinds).

(59)
a Wat denkt Jan dat Peter voor een monster heeft gezien?
"What kind of monster does Jan think that Peter saw?"

b *thinks* $\mapsto$ (translates as) $\lambda\pi\lambda x\lambda p\lambda w\ (\forall w'\sim w\ (\textsc{Dox}(x,w') \rightarrow \downarrow\hat{}\pi(w')) \wedge \{ \uparrow\textsc{Dox}'(x) \mathbin{\underline{\wedge}} \hat{}\pi/D\}\hat{}p(w))$

c $\underline{\lambda}\kappa\ (\lambda p\lambda w\ (\forall w'\sim w\ (\textsc{Dox}(\text{jan}',w') \rightarrow \exists\kappa\ (\text{kind-of-monster}'_{w'}(\kappa) \wedge \text{saw}'_{w'}(\text{peter}',\kappa))) \wedge \{ \uparrow\textsc{Dox}'(\text{jan}') \mathbin{\underline{\wedge}} \mathfrak{E}\kappa\ (\uparrow\text{kind-of-monster}'(\kappa) \mathbin{\underline{\wedge}} \uparrow\text{saw}'(\text{peter}',\kappa))/D\}\hat{}p(w)))$

We will now prove the following fact, where (60b) (by assumption) adequately captures the truth-conditional content of (59a).

(60) *Fact. If* $\forall w'\sim w\ (\textsc{Dox}(\text{jan}',w') \rightarrow \exists\kappa\ (\text{kind-of-monster}'_{w'}(\kappa') \wedge \text{saw}'_{w'}(\text{peter}',\kappa)))$*, then a (=* ↓59c*) and b below are equivalent.*

a $\downarrow\underline{\lambda}\kappa\ (\lambda p\lambda w\ (\forall w'\sim w\ (\textsc{Dox}(\text{jan}',w') \rightarrow \exists\kappa\ (\text{kind-of-monster}'_{w'}(\kappa) \wedge \text{saw}'_{w'}(\text{peter}',\kappa))) \wedge \{ \uparrow\textsc{Dox}'(\text{jan}') \mathbin{\underline{\wedge}} \mathfrak{E}\kappa\ (\uparrow\text{kind-of-monster}'(\kappa) \mathbin{\underline{\wedge}} \uparrow\text{saw}'(\text{peter}',\kappa))/D\}\hat{}p(w)))$

b $\lambda\kappa\ (\lambda w\forall w'\sim w\ (\textsc{Dox}(\text{jan}',w') \rightarrow \text{kind-of-monster}'_{w'}(\kappa) \wedge \text{saw}'_{w'}(\text{peter}',\kappa)))$

Observe first that by the assumption mentioned in (60), (60a) is equivalent to (61a) below. Then, given the definition of IED in (57), we know that (61a) is equivalent to (61b) below. (61b) in its turn can subsequently be reduced to (61c)

[19] Note that it is assumed for (59b) that the dynamic conjunction of the first and second argument of a modal operator can be introduced as a discourse referent as well. On Groenendijk & Stokhof's (1989) approach to modal subordination, this possibility must be assumed in any event (cf. also Roberts 1995). Consider for instance the discourse in (i).

(i) If you step inside the cage with a piece of meat, a tiger might attack you. It would eat the meat first, and then both your legs.

Here, the modal *would* does not indiscriminately quantify over all worlds in which a tiger attacks you, but only over those worlds in which you first stepped inside the cage with a piece of meat.

by applying essentially the same techniques that were discussed in connection with (55) above.

(61)
a $\downarrow\underline{\lambda}\kappa\ (\lambda p\lambda w\ (\{\ \uparrow\textsc{Dox}'(\text{jan}')\ \underline{\wedge}\ \mathfrak{E}\kappa\ (\uparrow\text{kind-of-monster}'(\kappa)\ \underline{\wedge}\ \uparrow\text{saw}'(\text{peter}',\kappa))/D\}\hat{}p(w)))$ (by assumption)

b $\downarrow\lambda\kappa'\ (\lambda p\lambda w\ (\{\ \uparrow\textsc{Dox}'(\text{jan}')\ \underline{\wedge}\ \mathfrak{E}\kappa\ (\uparrow\text{kind-of-monster}'(\kappa)\ \underline{\wedge}\ \uparrow\text{saw}'(\text{peter}',\kappa))/D\}\hat{}p(w))\ \underline{\wedge}\ \uparrow\lambda w\hat{}\forall w''\sim w'\ (\downarrow(\hat{}D\ \underline{\rightarrow}\ \uparrow\kappa = \kappa')(w''))$ (by def. of IED)

c $\downarrow\lambda\kappa'\ (\lambda p\lambda w\ (\forall w''\sim w\ (\textsc{Dox}(\text{jan}',w'')\ \wedge\ \exists\kappa\ (\text{kind-of-monster}'_{w''}(\kappa)\ \wedge\ \text{saw}'_{w''}(\text{peter}',\kappa))\rightarrow\exists\kappa\ (\text{kind-of-monster}'_{w''}(\kappa)\wedge\text{saw}'_{w''}(\text{peter}',\kappa)\wedge\kappa=\kappa'))\ \wedge\ \{\ \uparrow\textsc{Dox}'(\text{jan}')\ \underline{\wedge}\ \mathfrak{E}\kappa\ (\uparrow\text{kind-of-monster}'(\kappa)\ \underline{\wedge}\ \uparrow\text{saw}'(\text{peter}',\kappa))/D\}\hat{}p(w)))$ (cf. 55 above)

Since in general, if $\forall x\ (\varphi\rightarrow\chi)$, then $\forall x\ (\varphi\wedge\chi\rightarrow\psi)$ and $\forall x\ (\varphi\rightarrow\psi)$ are logically equivalent, (61c) is logically equivalent to (62a). Let us generalize the $\downarrow$-operator to any function Φ into CCPs as follows: $\downarrow\Phi_{\langle X,\text{cc}\rangle} = \lambda V_X\ (\downarrow\Phi(V))$. Thus, (62a) reduces to (62b).

(62)
a $\downarrow\lambda\kappa'\ (\lambda p\lambda w\ (\forall w''\sim w\ (\textsc{Dox}(\text{jan}',w'')\ \rightarrow\ \exists\kappa\ (\text{kind-of-monster}'_{w''}(\kappa)\ \wedge\ \text{saw}_{w''}(\text{peter}',\kappa)\wedge\kappa=\kappa'))\wedge\{\ \uparrow\textsc{Dox}'(\text{jan}')\ \underline{\wedge}\ \mathfrak{E}\kappa\ (\uparrow\text{kind-of-monster}'(\kappa)\ \underline{\wedge}\ \uparrow\text{saw}'(\text{peter}',\kappa))/D\}\hat{}p(w)))$ (by assumption)

b $\lambda\kappa\hat{}\lambda w\forall w'\sim w\ (\textsc{Dox}(\text{jan}',w')\rightarrow\exists\kappa\ (\text{kind-of-monster}'_{w'}(\kappa)\wedge\text{saw}'_{w'}(\text{peter}',\kappa)\wedge\kappa=\kappa'))$ (def. $\downarrow$; variable-renaming)

And of course, it is not difficult to see that (62b) is equivalent to (60b) above. Thus, if $\forall w'\sim w\ (\textsc{Dox}(\text{jan}',w')\rightarrow\exists\kappa\ (\text{kind-of-monster}'_{w'}(\kappa)\wedge\text{saw}'_{w'}(\text{peter}',\kappa)))$ is true, we have the desired equivalence of (60a) and (60b). This account therefore predicts that the question in (59a) only makes sense if it is presupposed that in all of Jan's believe worlds, there is a kind of monster that Peter saw. Interestingly enough, the split *wh*-interrogatives in (47a), (48a) and (59a) do seem to carry this type of existential presupposition. That is, (59a) does seem to be felicitous only in those contexts where it is presupposed that Jan thought that Peter saw a kind of monster.

Given the discussion in this section, we conclude that an intensional version of ED in tandem with Groenendijk & Stokhof's (1989) compositional approach to modal subordination can account for the fact that split constructions are insensitive to the intensional domains created by (modals and) volunteered stance verbs. This solves one of the second major problem noted in connection with (47-48) above. The other problem in (49), viz. why some WI contexts do not appear to correspond to inaccessible domains for dynamic anaphora (cf. the contrast between 45c and 47c/48c), will be addressed in the next subsection. This section will be concluded with a brief discussion on how IED might be put to use when attempting to disclose an indefinite across other intensional domains, most notably those created by intentional verbs such as *want* and *seek*. The following examples show that these verbs do not constitute bad interveners for What For-split on either the *de dicto* or *de re* construal of the indefinite

remnant.

(63) a Wat wil Jan voor een meisje?
"What kind of girl does Jan want?"
b Wat zoekt Jan voor een meisje?
"What kind of girl is Jan looking for?"

Note first of all that the meaning of *want DP* and *seek DP* can be paraphrased as *want to have DP* (or some other verb which denotes a relation which can be considered canonical with respect to the object DP) and *try to find DP* respectively. Secondly, the sequence *intentional verb + object DP* and its paraphrase *intentional verb + infinitival complement* can both license discourse anaphora under modal subordination, where the quantification of the second intensional operator appears to be similarly restricted. This is illustrated in (64), where (64a-b) and (64c-d) more or less express the same meaning (again, the judgments here concern the *de dicto* reading of the indefinite).

(64) a John wants a_x nice girl. *She_x is blond/She_x must be blond.
b John wants to have a_x nice girl. *She_x is blond/She_x must be blond.
c John seeks a_x nice girl. *She_x is blond/She_x must be blond.
d John tries to find a_x nice girl. *She_x is blond/She_x must be blond.

These data therefore suggest that intentional verbs which combine with object DPs introduce a discourse referent which is (essentially) the CCP denoted by the infinitival complement in their paraphrases. If correct, our intensional version of ED will enable us to disclose the indefinite in sentences such as (63) in the same way in which it was used earlier to disclose the indefinite in (59a).[20]

4.6.4 Presuppositional Verbs and Dynamic Semantics

Recall the first problem for a dynamic approach to WIs noted in (49) above: apparently, there are some WIs (most notably those created by non-stance verbs)

[20] It is well-known that the introduction of discourse referents through inference is severely restricted. Consider for instance (i) (an example due to Kamp & Reyle 1993), where *they* in the second sentence cannot refer to the two missing balls, even though their existence can be inferred from the first sentence.
(i) Eight of the ten balls are in the bag. They are under the sofa.
Therefore, if we want to account for the similarity in meaning between *seek DP* and *try to find DP* by means of meaning postulates, as in Montague's PTQ, we must explain the difference between (i) on the one hand and (64a) and (64c) on the other, given that in all three cases the required discourse referent must be inferred. If instead we adopt den Dikken *et al.*'s (1997) approach according to which intentional verbs such as *want* and *seek* always subcategorize for a clausal complement, these problems would of course not arise.

that do not correspond with inaccessible domains for dynamic anaphora. In fact, this problem becomes even more serious if we opt for an intensional version of ED, as proposed in the preceding subsection. Since both non-stance and response stance verbs can support modal subordination too, as shown in (65) below, we should be able to disclose an indefinite across both classes of verbs by means of IED. But then, it would seem that a dynamic explanation of the fact that split constructions are sensitive to Presupposition Islands is no longer feasible.

(65) a John knows that Bill bought *a scarf*. He thinks *it* will keep him warm in winter.
b Robin confirmed Batman's suspicion that the Joker planted *a bomb* under the Empire State Building. Batman also believed that the Joker got help from someone else in constructing *it*.

In the next subsection, we will see that, even though response stance and non-stance verbs are like volunteered stance verbs in denoting externally static functions, there are still good reasons to believe that the anaphoric dependencies in (65) should not be treated on a par with those involving volunteered stance verbs. Thus, modal subordination involving presuppositional verbs cannot be accounted for in terms of Groenendijk & Stokhof's (1989) compositional approach, which was discussed in section 4.6.2. This effectively excludes the possibility of disclosing an indefinite across presuppositional domains, thus solving the problem noted in (49). We will then show in section 4.6.4.2 how the modal subordination effects in (65) can be straightforwardly analyzed in terms of E-type pronouns along the lines of Heim (1992).

4.6.4.1 Presuppositions and Discourse Referents

There are two important observations that suggest that modal subordination effects with presuppositional verbs should be treated in a different way from those with volunteered stance verbs, as exemplified in (51b) above and repeated here as (66a). Firstly, it was already observed in (45c) above, repeated below in (66b), that the presence of an additional intensional operator is not required for a discourse anaphor to access an indefinite inside the scope of a non-stance verb. Crucially, the latter observation cannot be accounted for by directly assigning an externally dynamic denotation to non-stance verbs, as contemplated for *be glad* in (67a). For this would imply that (67b) expresses the same meaning as (67c). Evidently, it does not. Therefore, non-stance verbs are like volunteered and response stance verbs in denoting externally static functions.

(66) a John thinks he has a_x dollar in his wallet. He wants to give it_x to the

beggar.

b John is happy that he met a$_x$ nice girl yesterday. She$_x$ smiled at him.

(67)

a $\lambda\pi\lambda x\lambda p$ (be-glad´(x,$\hat{}\pi(p)$))

b John was glad that Bill bought a rabbit. But soon, it started to eat his lattuce.

c John was glad that Bill bought a rabbit and that soon, it started to eat his lattuce

When taken together, these observations strongly suggest that the resolution of discourse anaphora that access an indefinite inside the scope of a non-stance verb does not involve binding, but some other mechanism instead.

A second, more theory-internal reason not to account for the anaphoric dependencies in (65) along the same lines as those involving volunteered stance verbs relates to the fact that in view of their presuppositional nature, it would be very odd indeed to assume that response stance and non-stance verbs introduce the CCP denoted by their complement as a discourse referent on a par with volunteered stance verbs. Recall that non-stance verbs presuppose the truth of the proposition expressed by their complement clause, whereas response stance verbs presuppose that there is a claim or assumption in the common ground (held by someone possibly other than the speaker) according to which the proposition expressed by the complement clause is true. On Groenendijk & Stokhof's (1989) approach to modal subordination, as discussed in section 4.6.2, introducing a discourse referent α by means of a state-switcher $\{\alpha/d\}$ brings about a change of state relative to which future discourse will be interpreted. For example, uttering *A tiger might come in* changes the state *s* relative to which this utterance is interpreted into another state *s´* which differs from *s* at most in this respect that the denotation of the discourse marker *D* in *s´* is the CCP denoted by *a tiger comes in* in *s*. Thus, the introduction of discourse referents crucially yields a change in our information-state concerning possible values of variables. It is clear, however, that presuppositions do not effect such a change in our information-state. On the contrary, presuppositions contribute old information that must be entailed by the common ground. It is tempting to think of the distinction between volunteered stance verbs on the one hand and the inherently presuppositional response stance and non-stance verbs on the other as being akin to that between simple indefinites and definites. As argued by Heim (1982), the former introduce new discourse referents, whereas the latter must refer back to previously established discourse referents. Therefore, on a Heimean account, definites behave more like discourse markers whose value is fixed by some previously introduced discourse referent, rather than like expressions that introduce a discourse referent by themselves by means of which the value of future discourse markers can be fixed. Moreover, a felicitous use of definites too demands that their associated presuppositions be

entailed by the common ground. Note in this respect that response stance and non-stance verbs naturally allow for paraphrases which involve definite descriptions such as *the fact* (with non-stance verbs) or *the claim/assumption* (with response stance verbs), whereas volunteered stance verbs do not allow for such paraphrases (or only for those paraphrases that involve tautological cognates). Consider (68) for illustration (cf. also the discussion surrounding 44 above).

(68) a John thought that Mary had a crush on him
a´ #John thought the thought that Mary had a crush on him
b John was glad that Mary had a crush on him
b´ John was glad about the fact that Mary had a crush on him
c John denied that Mary had a crush on him
c´ John denied the assumption that Mary had a crush on him

The above considerations lead us to conclude that modal subordination involving presuppositional verbs must be treated differently from modal subordination involving volunteered stance verbs. Specifically, presuppositional verbs do not introduce the CCP denoted by their complements as a discourse referent. As it was already established that presuppositional verbs are like volunteered stance verbs in denoting externally static functions, it follows that neither ED nor its intensional variant will enable us to disclose an indefinite inside the scope of a presuppositional verb. Given the results that were achieved in the preceding section, it is now no longer an embarrassment for a dynamic approach to WIs that split constructions are sensitive to Presupposition Islands.

This argument does raise the issue however how modal subordination involving presuppositional verbs should be treated, given that Groenendijk & Stokhof's (1989) compositional approach can no longer be called upon. In fact, if response stance and non-stance verbs denote externally static functions, and if they furthermore do not introduce the CCP denoted by their complements as a discourse referent, there is no way that the referential dependencies in (65) can be accounted for in terms of binding. Rather, they must be accounted for in terms of an alternative strategy, viz. the E-type-strategy. Let us explore the consequences of the idea that the pronouns in (65) are E-type pronouns, i.e. definite descriptions in disguise. Like definite descriptions then, E-type pronouns are associated with presuppositions. In this light, it becomes tempting to analyze modal subordination with presuppositional verbs as a byproduct of the general meachanisms governing presupposition projection. In the next subsection, we will show how this idea can be formally implemented along the lines of Heim's (1992) analysis of the semantics of propositional attitude verbs and the way it interacts with presupposition projection.

4.6.4.2 Update Functions and Modal Subordination with Presuppositional Verbs

Up to this point, our view of the dynamics of meaning has been overly restrictive in the sense in that it centered only on those cases where a sentence can be used to introduce new discourse referents which can be picked up by subsequent pronouns. These cases reflect an inherently forward-looking aspect of the dynamics of sentence meaning. But there is another aspect of the dynamics of meaning which involves *updating* the context/common ground relative to which a sentence is uttered by adding to it the information expressed by that sentence. This process then is inherently backward-looking. Obviously, presuppositionality relates to this second aspect of the dynamics of meaning, as it involves checking whether the context c (where c can be identified with the set of all worlds that are consistent with the shared beliefs of the discourse participants) in which a sentence S is uttered entails its presuppositions. If c does entail S's presuppositions, then c will be updated with the information expressed by S by subtracting those worlds from c that are incompatible with S.

We will now introduce some technical notions to facilitate discussion (cf. Chierchia 1995 for more details). Let us assume that propositions are either total or partial functions from W (the set of all worlds) into $\{0,1\}$ (the set of truth-values). For instance, a proposition will be a partial function from W into $\{0,1\}$ when the corresponding sentence contains a definite description: in some worlds $w \in W$, the presuppositions associated with the definite description will not be met. Contexts c, however, will be assumed to be total functions from W into $\{0,1\}$. Let us now represent the update function corresponding to a proposition φ as $\Uparrow\varphi$. Then $\Uparrow\varphi$ (type: $\langle p,p\rangle$) can be defined as follows:

(69) $\Uparrow\varphi =_{def} \lambda c\ (c + \varphi)$
where for any c, $c + \varphi = c \wedge \varphi$, if $c \wedge \varphi$ is total (i.e. c entails φ's presuppositions), else undefined.

To illustrate, the update function corresponding to the *believe*-sentence in (70a) can be represented as in (70b), as argued by Heim (1992) (where $B(x,w) = \lambda w' \sim w$ (DOX(x,w')) denotes the set of all worlds that are doxastically accessible to w for x).[21] Since the update function in (70b) is only defined for those contexts in whose worlds John believes that there is a (unique) king of France, this analysis correctly predicts that if φ presupposes p, α *believes* φ

[21] (70b) reflects the classical analysis of *believe*. To see that, note that if p denotes a total function (i.e. p is not associated with any presuppositions), $\lambda w\ (B(x,w) + p = B(x,w)) = \lambda w\ (B(x,w) \subseteq p)$ $(= \lambda w \forall w' \sim w\ (\text{DOX}(x,w') \rightarrow p(w')))$.

presupposes that α believes *p*.[22]

(70)
a John believes that the king of France is bald

b $\lambda c\ (c + \lambda w\ (\mathrm{B}(\mathrm{john}',w) + \lambda w'\ (\mathrm{is\text{-}bald}'_{w'}(\iota x\ (\mathrm{king\text{-}of\text{-}France}'_{w'}(x)))) = \mathrm{B}(\mathrm{john}',w)))$

The update function in (70b) will also correctly capture the presupposition projection properties of *John knows that the king of France is bald* if it is furthermore understood that (70b) is only defined for those contexts which entail that there is in fact a (unique) king of France who is bald. Of course, this extra requirement on what constitutes a proper input context for *John knows that the king of France is bald* is needed in order to accomodate the factivity of *know.*

As is the case with the CCP denoted by a complex sentence, its update function too can be compositionally built up from the update functions that correspond to its component parts and the way in which these are put together. The rules of semantic composition that correspond to the syntactic rules will then determine how the presuppositions associated with these parts, if any, will project through the sentence. I will not attempt to specify these rules here, as this would take me too far afield.[23] However, we will find it useful later on to see how the update function corresponding to a conjoined sentence can be compositionally determined on the basis of the update functions corresponding to its parts. Consider the definition of conjunction of update functions ';' in (71).

(71) $\Phi\ ;\ \Psi =_{def} \lambda c\ (\Psi(\Phi(c)))$

(71) correctly predicts that the presuppositions associated with Φ ; Ψ are the presuppositions of Φ together with the presuppositions of Ψ *unless* Φ entails the Ψ's presuppositions, in which case these are 'filtered out'. Thus, contrast *John will come to our party. Bill will come too*, which as whole presupposes nothing, with *John will come to our party too. Bill won't come* which presupposes that in addition to John, someone else will come to our party as well.

We have by now accumulated enough machinery to show that modal subordination involving presuppositional verbs can be analyzed as a byproduct of presupposition projection. In fact, this type of modal subordination should be reduced to general mechanisms governing presupposition projection if we claim, as we did before, that the anaphora in cases such as (65) are E-type

[22] Cf. Karttunen (1974) for the original observation concerning the presupposition projection properties of *believe*-contexts.

[23] But cf. Karttunen (1974) for an early attempt to define the projective properties of the propositional connectives.

pronouns. Specifically then, we will demonstrate here that the presuppositions associated with these E-type pronouns (*modulo* uniqueness) are entailed by those contexts c' which result from updating an initial context c with the information expressed by the 'antecedent' sentence, or, equivalently, that the two relevant discourses in (65) are defined for a context c just in case the relevant 'antecedent' sentence is. Consider (72), a simplified version of (65a) above.

(72) John knows that Bill bought a rabbit. He believes he spotted it once.

The update function corresponding to the 'antecedent' sentence in (72), repeated below as (73a), may be represented as in (73b), provided of course that it is understood that this function is partial: it is only defined for those contexts c which entail that Bill bought a rabbit. The latter requirement is needed to accomodate the factivity of the non-stance verb *know* (cf. also 70 above).

(73) a John knows that Bill bought a rabbit. ...
b $\lambda c\ (c + \lambda w\ (\mathrm{B}(\mathrm{john}',w) + \exists x\ (\mathrm{rabbit}'(x) \wedge \mathrm{bought}'(\mathrm{bill}',x)) = \mathrm{B}(\mathrm{john}',w)))$

On the assumption that the pronoun *it* in (72) is an E-type pronoun, the meaning of which we can roughly paraphrase as *the rabbit that Bill bought*, we may take the update function corresponding to the second sentence in (72), repeated below as (74a), to be the one represented in (74b). Again, this function is partial in that it is only defined for those contexts c which entail that John believes there is a (unique) rabbit that Bill bought.

(74) a ... He believes he spotted it/the rabbit that Bill bought once.
b $\lambda c'\ (c' + \lambda w\ (\mathrm{B}(\mathrm{john}',w) + \lambda w'\ (\mathrm{spotted\text{-}once}'_{w'}(\mathrm{john}',\iota y\ (\mathrm{rabbit}'_{w'}(y) \wedge \mathrm{bought}'_{w'}(\mathrm{bill}',y)))) = \mathrm{B}(\mathrm{john}',w)))$

The update function corresponding to (72) as a whole can then be represented as in (75a) below. Thanks to the definition of ';' in (71) above, (75a) can be reduced to (75c). It is easy to see that, *modulo* uniqueness, (75c) is defined for a context c just in case (73b) is. That is, both (73b) and (75c) can be used to update a context c just in case c entails that Bill bought a rabbit. Therefore, we have shown that the presuppositions associated with the E-type pronoun *it* in (72) (again *modulo* uniqueness) are entailed by any context c' which is the result of a successful update of an initial context c with the meaning expressed by the relevant 'antecedent' sentence, which is the desired result. As for uniqueness then, given that an update of an intial context c with the information expressed by *John knows that Bill bought a rabbit* does not immediately entail that Bill bought a unique rabbit, we predict that this uniqueness presupposition is preserved by the discourse as a whole. This prediction squares reasonably

well with intuition.

(75)
a (73b) ; (74b)

b λc ((74b)((73b)(c))) (def. of ;)

c λc ((c + λw (B(john´,w) + $\exists x$ (rabbit´(x) $\wedge$ bought´(bill´,x)) = B(john´,w))) + λw (B(john´,w) + $\lambda w'$ (spotted-once´$_{w'}$(john´,ιy (rabbit´$_{w'}$(y) $\wedge$ bought´$_{w'}$(bill´,y)))) = B(john´,w)))

This account naturally explains why anaphoric dependencies that cross the intensional domains induced by non-stance verbs do not require the presence of an appropriate additional intensional operator, as illustrated in (76) below (cf. also 66b and 67b).[24] In the absence of a second intensional operator, the existence presupposition associated with the pronoun *it* in (76) (viz. there is a rabbit that Bill bought) must hold true of all worlds in the context c' in which the relevant sentence is uttered. However, this is guaranteed if c' is the result of a successful update of some initial context c with the meaning conveyed by the 'antecedent' sentence, given that this sentence contains the non-stance/factive verb *know*. Note that by parity of reasoning, this also accounts for the impossibility of linking *it* as a description in disguise to *a rabbit* (on its *de dicto* construal) in *John thinks that Bill bought a rabbit. He spotted it once.*

(76) John knows that Bill bought a rabbit. He spotted it once.

Finally, our present analysis of modal subordination involving non-stance verbs straightforwardly carries over to the remaining cases involving response stance verbs. That is, it is not difficult to see that the presuppositions associated with *it* in (65b) (*modulo* uniqueness, which again is fairly unproblematic here)

24 Anna Szabolcsi (p.c.) informs me that (76) works so well because the second sentence explains how John came to know that Bill bought a rabbit. In this respect, (76) contrasts with (i) below, where an anaphoric dependency between *a rabbit* and *it* appears to be much more marked.

(i) #John knows that Bill bought *a rabbit*. *It* has already escaped.

What this contrast suggests is that anaphoric dependencies which cross non-stance verbs are acceptable to the extent that the information expressed by the 'second' clause can be related to the 'topical' subject of the antecedent clause. From this perspective, the contrast between (i) and (ii) below is as expected.

(ii) John knows that Bill bought *a rabbit*, but he is not aware that *it* has already escaped.

Note furthermore that the same pattern of judgments obtains when the pronoun is replaced by a suitable definite description.

(iii) #John knows that Bill bought a rabbit. The rabbit has already escaped.

(iv) John knows that Bill bought a rabbit, but he is not aware that the rabbit has already escaped.

Thus, whatever discourse principle ultimately explains the fact anaphoric dependencies across non-stance verbs are sensitive to what we might refer to as 'topical coherence', it is certainly not incompatible with an E-type analysis of the relevant pronouns.

for example are automatically entailed by any context *c´* which is the result of a successful update of an initial context *c* with the information expressed by the 'antecedent' sentence. The only notable difference between non-stance and response stance verbs in this respect is that the presuppositions triggered by the latter type of verbs require that the proposition denoted by their complement clause is true in the believe-worlds of some agent in the discourse to whom the subject of the response verb responds (i.e. Batman in 65b), rather than in the worlds contained in the context set. This is why a pronoun which is not inside the scope of a suitable additional intensional operator cannot access an indefinite inside the scope of a response stance verb, as was already shown in (45b), repeated below in (77), unlike what is the case with non-stance verbs.

(77) *John denied that he met a_x photomodel yesterday. She_x smiled at him.

To wrap up the discussion, we have argued in section 4.6.4.1 that presuppositional verbs do not introduce the CCP denoted by their complement clause as a discourse referent. This prevents a successful application of our intensional version of ED to any indefinite inside the scope of a presuppositional verb, as desired. Modal subordination involving presuppositional verbs must therefore rely on the E-type strategy, and we have shown in this subsection that this idea can be straightforwardly implemented within Heim's (1992) approach to the semantics of propositional attitude verbs and the way it interacts with presupposition projection. It should be noted, though, that the preceding discussion did not touch on some important issues that arise in connection with modal subordination, propositional attitude verbs and the general problem of presupposition projection. First of all, we have by no means provided a semantic analysis that fully covers the dynamics of propositional attitude verbs.[25] However, from our present perspective, there is no compelling reason to do so. Since we are merely concerned here with the question how a dynamic theory of WIs can cope with Presupposition Islands, it suffices to isolate and discuss those properties of the dynamics of propositional attitude verbs in terms of which this issue can be resolved. In this section, we have attempted to do just that. Secondly, our E-type approach to modal subordination involving presuppositional verbs leads us to predict that this phenomenon invariably generates unicity effects, whereas modal subordination with volunteered stance verbs does not. A careful assessment of this prediction falls outside the scope of our present discussion, however. Finally, we haven't said anything about how update functions and context change potentials should be integrated within a unified compositional theory that simultaneously deals with presupposition projection and discourse anaphora, the two key aspects of the dynamics of information flow. There are

[25] For important work on this topic, cf. Asher (1987), Heim (1992) and van Rooij (1996).

essentially two conceivable ways in which this problem might be approached. One might devise a monostratal theory of dynamic semantics in which informations states are defined in terms of ⟨world,assignment⟩-pairs, in which the world coordinate can be used to represent the presuppositions of the various discourse participants, and the assignment coordinate to keep track of which discourse referents are still active. This unitary view on the dynamics of information flow lies at the heart of Heim's (1982) File Change Semantics, and has been taken over by Beaver (1994). The other possibility then is to devise a bistratal theory of dynamic semantics in which, even though they are carefully kept apart, some communication between the two key aspects of the dynamics of meaning is possible, for instance through general type-shifting mechanisms. This is the approach advocated by Chierchia (1995). I am inclined to think that the dynamic theory of WIs defended here can be implemented along both lines, so I will leave this matter open for further debate.[26]

4.7 On the Notion of Bad Intervener: A Boolean Base for Dynamic Semantics?

Already in (2) of Chapter 3, we noted that the notion of a bad intervener in Dynamic Semantics is (almost) coextensional with Sz&Z's notion of a bad intervener in WI constructions. Recall that this claim was based on our observation that the class of those expressions that denote externally static functions almost completely overlaps with the class of those expressions whose meaning is defined in terms of Boolean meet and/or complement. Consider for instance the correlations presented in (78) below (cf. also 1 in Chapter 3), while keeping in mind the conclusions reached in Chapter 2, section 2.4 with respect to plural quantification. Whether or not we accept the conclusion reached earlier that neither the algebraic nor the dynamic approach alone can cover the full range of WI effects, it remains interesting to explore the extent in which these two seemingly unrelated notions can in fact be related to each other in a way that would make the fact they are almost coextensional non-accidental. Focusing for convenience on Q-adverbs and DPs as their Boolean and dynamic properties are most easily discerned, we will explore in the following one way in which this issue might be tackled: it might be the case that whether or not a given function is externally dynamic is a function of its Boolean properties, i.e. whether or not it is associated with Boolean meet and/or complement.[27]

[26] Cf. Chierchia (1995) for relevant discussion of the issues involved here.

[27] Cf. Chapters 1 and 2 for discussion of the Boolean and dynamic properties of various Q-adverbs and DPs.

(78) *Boolean and Dynamic Properties of Quantifiers*

	Examples	**Boolean Operations**	**Dynamic Properties**
Negation	*not*	complement	static
Universal Quantification	*every man*, *always*, ...	meet	static
Existential Quantification	*a man*, *three men*, ...	join	dynamic
Numerical Quantification	*at most/exactly/at least five men*, *most men*, *mostly*, *often*, *seldom*, ...	(at least) join and meet	static

Groenendijk & Stokhof (1989) have already pointed out that the Boolean properties of at least some quantified expressions can be directly invoked in explaining their external statics. Specifically, they observe that monotone decreasing expressions without exception denote externally static functions. They furthermore note that this property of monotone decreasing quantifiers would immediately follow if we make the following natural assumption:

(79) *Informativity Hypothesis*
The result of adding a statement φ to a discourse *D* (i.e. D ∧ φ) may not be less informative than *D* itself.

Suppose for the sake of illustration that we analyze *no man* as an externally dynamic Generalized Quantifier, i.e. that we take its meaning to be the one represented in (80a). On this analysis, we would not only predict that the anaphoric dependency in (80b) is well-formed but, moreover, that the meaning of this discourse is identical to the one expressed by (80c). However, given the Informativity Hypothesis, this is an impossible state of affairs: *No man walked in the park and whistled* is less informative than (in the sense of being entailed by) *No man walked in the park*. Therefore, the Informativity Hypothesis directly entails that all monotone decreasing expressions must denote externally static functions.

(80) a *no man* ↦ (translates as) $\lambda P \lambda p\ (\neg\exists x\ (\text{man}'(x) \wedge \hat{}P(x)(p)))$
b *No$_x$ man walked in the park. He$_x$ whistled.
c No man walked in the park and whistled

An obvious drawback of this line of inquiry is that the Informativity Hypothesis does not shed any light on why all non-monotone as well as many monotone

increasing expressions denote externally static functions too.[28] Thus, if we were to insist that the dynamic properties of an expression are a function of its Boolean properties, we had better explore a different route.

A particularly simple and much more direct way to explore the idea that the dynamic properties of a given expression can be predicted on the basis of its Boolean properties is suggested by the following observations. Consider first what it takes for some quantifier $\mathcal{Q}$ to denote an externally dynamic function: $\mathcal{Q}$ denotes an externally dynamic function just in case the CCP denoted by $\mathcal{Q}x\,(\Phi)$ can be represented as $\lambda p\,(Q'x\,(\Phi(p)))$, where Φ is of type *cc* and where Q' is the static analogue of $\mathcal{Q}$. This is an adequate definition of an externally dynamic function $\mathcal{Q}$ in the sense that it enables us to prove the (so-called *donkey*) equivalence in (81) which is so pivotal in a dynamic and compositional account of donkey-anaphora.

(81) $\mathcal{Q}x\,(\Phi) \mathbin{\underline{\wedge}} \Psi \Leftrightarrow \mathcal{Q}x\,(\Phi \mathbin{\underline{\wedge}} \Psi)$

Observe now that in $\lambda p\,(Q'x\,(\Phi(p)))$, the place-holder p for possible continuations occurs inside the scope of $Q'x$. Keeping in mind Sz&Z's point concerning the connection between scope and Boolean operations (cf. 1.12), in order to construct the appropriate semantic object denoted by $\lambda p\,(Q'x\,(\Phi(p)))$, we must perform the Boolean operations associated with Q' in the domain the elements of which the place-holder p for possible continuations ranges over. This domain is the set of all sets of assignments to variables as place-holders for possible continuations range over sets of assignments to variables. We will henceforth refer to this domain as Π. Let us assume for the moment that Π forms a (proper) join semilattice; i.e. Π is closed under join, but not under meet or complement. This assumption will be discussed in more depth at the end of this section. It then follows that for any Q' whose meaning is defined in terms of Boolean meet and/or complement, we can now no longer guarantee a proper

28 Gamut (Volume 2, Chapter 7) shows that the anaphoric dependency in (i) can be accounted for in Dynamic Semantics. Crucially, their account works in such a way that (i) correctly entails that exactly one man walked in the park. Gamut's solution is given in (ii).

(i) *Exactly one man* walked in the park. *He* whistled.

(ii) $\mathrm{E}x\,(\uparrow\mathrm{man}'(x) \mathbin{\underline{\wedge}} \uparrow\mathrm{walked\text{-}in\text{-}the\text{-}park}'(x) \mathbin{\underline{\wedge}} \mathrm{A}y\,(\uparrow\mathrm{man}'(y) \mathbin{\underline{\wedge}} \uparrow\mathrm{walked\text{-}in\text{-}the\text{-}park}'(y) \mathbin{\underline{\rightarrow}} \uparrow x = y)) \mathbin{\underline{\wedge}} \uparrow\mathrm{whistled}'(x)$

Note that the fact that the aforementioned entailment is preserved is made possible by the fact that the quantificational force of *exactly one man* is factored out in an existential part and an additional maximality condition Ay (...). Thus, the solution in (ii) is still consistent with our claim that any dynamic determiner Exactly One that faithfully interprets *exactly one* as a unit is externally static. If it were not, (i) would be predicted to mean the same as (iii), which no longer entails that exactly one man walked in the park.

(iii) Exactly one man walked in the park and whistled.

The question whether a decompositional analysis of the dynamics of determiner expressions has more general applications must be left for further research.

denotation for $\lambda p\ (Q'x\ (\Phi(p)))$ in the general case. In this way, we can exclude on strictly semantic grounds the possibility of assigning an externally dynamic denotation to a Q-NP such as *no man*, even independently of whether the same possibility could be excluded on pragmatic grounds as well, as was considered above. Note that on the same assumption concerning the algebraic structure of Π and the Boolean properties of Q´, assigning an externally static denotation to $\mathcal{Q}$ instead is perfectly consistent with its Boolean properties, as desired. On this approach, as outlined in Chapter 2, the CCP denoted by $\mathcal{Q}x\ (\Phi)$ can be represented as $\lambda p\ (Q'x\ (\downarrow\Phi) \wedge \hat{}p)$. Since the place-holder for possible continuations here no longer occurs inside the scope of Q´, the Boolean operations associated with this quantifier will not be performed in the set of all sets of assignments to variables Π.

In general then, this line of reasoning correctly predicts that all Q-adverbs and DPs whose truth-conditional meanings are defined in terms of Boolean meet and/or complement (cf. Table 78 above) denote externally static functions.[29] However, it does not predict that all Q-adverbs and DPs whose truth-conditional meanings are exhaustively defined in terms of Boolean join (e.g. *a man*, *more than zero men*, *one or more men*, *at least one man* etc., and all bare numeral indefinites) denote externally dynamic functions. The reason for this is simply that any Q-adverb and DP can denote an externally static function which is consistent with its Boolean nature. For instance, there is clearly nothing wrong with the meaning expressed by $\lambda p\ (\exists x\ (\varphi) \wedge \hat{}p)$ (for any φ of type t and x ranging over atomic or plural individuals), just as much as there is nothing wrong with the meaning expressed by $\lambda p\ (\exists x\ (\Phi(p)))$ (for any Φ of type cc and x ranging over atomic or plural individuals). This is again as it should be. Note that we were always careful in saying that the class of those expressions whose truth-conditional meaning is defined in terms of Boolean meet and/or complement *almost* coincides with the class of those expressions that denote externally static functions. The contrast between (82) and (83) below clearly shows that there are some DPs that, even though their truth-conditional force can be exhaustively characterized in terms of Boolean join, nevertheless denote externally static functions. Thus, contrary to what is the case in (82), the pronoun *they* in (83) can only refer to the maximal set of people that came to my office today. This means that even though the truth-conditional meaning of *a man* on the one hand and *more than zero men*, *one or more men* and *at least one man* on the other can be adequately captured in terms of existential quantification, and thus can be exhaustively defined in terms of

[29] One might object that the same line of reasoning would wrongly predict that $\underline{\wedge}$ is externally static. Note, however, that $\underline{\wedge}$ is not obviously Boolean, as it fails to observe the property of symmetry (i.e $(\Phi \underline{\wedge} \Psi) \nrightarrow (\Psi \underline{\wedge} \Phi)$ is not valid). The line of reasoning pursued in the main text rather precludes a truly Boolean (that is, symmetric) definition of $\underline{\wedge}$ (e.g. $\Phi \underline{\wedge} \Psi =_{def} \lambda p\ (\Phi(p) \wedge \Psi(p))$), since this would have forced us to perform meet in the set of all sets of assignments to variables.

Boolean join, only the former expression can be used to 'introduce a discourse referent'.

(82) A man came to my office today. He wanted to sell an encyclopedia.

(83) a More than zero men came to my office today. They wanted to sell an encyclopedia.
b One or more men came to my office today. They wanted to sell an encyclopedia.
c At least one man came to my office today. *He/They wanted to sell an encyclopedia.

Still, we might comtemplate the possibility that the quantificational force of the subject Q-NPs in (83) should be analyzed in terms of the Boolean compound ¬∀¬, rather than simply in terms of the existential quantifier.[30] Perhaps this could be related in some way or other to the fact that these complex numerals are syntactically structured expressions.[31] Given that on this analysis, the truth-

[30] Given our tentative conclusion in section 4.4 that the WI sensitivity of *how*-extraction is most naturally accounted for by Sz&Z's algebraic approach, we thus predict *how*-extraction across *more than zero/one or more/at least one* NP etc. to be worse than *how*-extraction across *a/some* NP. Unfortunately, this prediction is somewhat hard to check in view of the fact that i) *wh*-extraction across a singular, simple indefinite leads to somewhat marked results in general (e.g. compare *Which book did John read?* with *Which book did a student read?*), and ii) the use of *more than zero* is highly contextually constrained.

31 This suggestion is most naturally expressed within a theory according to which the types of Boolean operations with which a given expression α is associated are not only determined by the (truth-conditional) semantics of α but also by its specific syntactic properties. There are two observations that might make such a theory generally plausible. First of all, the Boolean operations which are associated with α cannot be considered a straightforward function of α's truth-conditional content. This is due to the de Morgan laws according to which meet can be defined in terms of join and complement, and *vice versa*, join can be defined in terms of meet and complement. Thus, logically speaking, any (quantificational) expression is associated with a (infinite) set of Boolean compounds of individual filters all of which are logically equivalent. Keeping in mind the contrast noted between (82) and (83), it seems natural then to assume that a quantificational expression α is associated with the smallest (in terms of the number of Boolean operations required to generate it) Boolean compound of individual filters which is compatible with α's internal syntactic structure. Furthermore, it is important to observe that in Sz&Z's account, Boolean operations are essentially conceived of as procedural instructions; i.e. instructions which inform us how to compute the semantic object denoted by some syntactic constituent. Consider now in this light Szabolcsi's (1997a) observation that depending on the syntactic position it occupies in surface syntax, a DP in Hungarian can be used to introduce a discourse referent and thereby support non-maximal anaphora (cf. i) or not (cf. ii). (The position of the verbal particle *félre* with respect to the stem *értette* unequivocally shows that *több, mint hat diákunk* "more than six of our students" occupies a position in i which is distinct from the one it occupies in ii; cf. Szabolcsi 1997a for discussion.)

conditional meaning of these complex numerals is cashed out in terms of Boolean meet and complement, we now have a complete overlap between the class of those expressions whose static meanings are defined in terms of Boolean meet and/or complement on the one hand, and the class of those expressions that denote externally static functions on the other. On this approach to the quantificational force of the subject Q-NPs in (83) then, the question does arise how we can account for the fact that all Q-adverbs and DPs whose truth-conditional meanings are exhaustively defined in terms of Boolean join denote externally dynamic functions. This issue would be immediately settled if we adopt the following principle:

(84) *The Compatibility Hypothesis*
If assigning an externally dynamic denotation $[\![f]\!]^{Dyn}$ to *f* is compatible with its Boolean properties, assign $[\![f]\!]^{Dyn}$ to *f*.

To conclude, assuming that the quantificational force of Q-NPs such as *more than zero men*, *at least one man*, *one or more men* etc. is to be represented in terms of the Boolean compound ¬∀¬, the class of those Q-adverbs and DPs whose quantificational force is defined in terms of meet and/or complement exactly coincides with the class of those Q-adverbs and DPs that denote externally static functions. The fact that these two classes are coextensional was seen to follow from the Compatibility Hypothesis and the assumption that the set of all sets of assignments to variables forms a (proper) join semilattice. But how natural are both these assumptions? Starting with the Compatibility Hypothesis, one might argue that this follows directly from a principle which can be referred to as Avoid Deictic Pronouns. Thus, only by assigning an externally dynamic denotation to A_d *man* can the pronoun He_d be interpreted as a bound variable in the classic A_d *man walked in the park.* He_d *whistled.* Avoid

(i) Több, mint hat diákunk félreértette a kérdést. Lehet, hogy még másokat is találsz.
"More than six of our students misunderstood the question. Maybe you will find others, too."

(ii) Több, mint hat diákunk értette félre a kérdést. *Lehet, hogy még másokat is találsz.
"More than six of our students misunderstood the question. *Maybe you will find others, too."

Szabolcsi (1997a) concludes from this observation as well as similar ones that we cannot predict on the basis of its denotational properties alone whether a DP can be used to introduce a discourse referent or not. While agreeing with her on this point, we might still assume that in general, specific syntactic positions in a sentence can be associated with specific procedural instructions. In fact, this assumption is directly inspired by Szabolcsi's own view on the correlation between distinct positions in Hungarian surface syntax and distinct types of verification procedures. If the procedural instructions which correspond to the syntactic positions distinguished in (i) and (ii) are at least partially Boolean in nature, the Hungarian facts do not necessarily show that we must abandon the hypothesis that the dynamic properties of a given expression are a function of its Boolean properties.

Deictic Pronouns appeals to the intuition that resolving a pronoun through standard, run-of-the-mill variable-binding mechanisms is in some sense less costly than resolving it through deictic means.

As for the assumption that the set of all sets of assignments to variables Π forms a (proper) join semilattice, note that this boils down to the following two claims: i) Π is closed under join, ii) Π lacks the bottom element $\varnothing_{\langle s,t\rangle}$ (i.e. the empty set of assignments to variables). The first claim is unproblematic: if *A* is a set of assignments to variables (i.e. a set of sets of ordered pairs of variables and their values) and *B* is a set of assignments to variables, then obviously $A \cup B$ is a set of assignments to variables as well. A conceivable way of corroborating the second claim would be to argue that nothing essential would get lost if we just identified Π with $\wp(\Omega) - \{\varnothing_{\langle s,t\rangle}\}$, where Ω is the set of all assignments to variables. That is, if a viable system of Dynamic Semantics could be grounded in $\wp(\Omega) - \{\varnothing_{\langle s,t\rangle}\}$ as well, there is no reason to insist that Π should include $\varnothing_{\langle s,t\rangle}$. Even though a full discussion of this topic must be left for future research, let me at least identify the one area where the absence of the empty set of assignments to variables will be felt most strongly. If our model does not provide for $\varnothing_{\langle s,t\rangle}$, there is no semantic object which corresponds with the 'intension' of a false proposition φ, where φ is of type *t* and contains no free variables. Consequently, for any assignment to variables *g*, there is no semantic object that can be associated with $[\![\lambda p\ (\varphi \wedge \hat{}p)]\!]^{M,g}$ either, given that $[\![\varphi]\!]^{M,g} = [\![\varphi]\!]^{M,g}(g)$ is undefined. But doesn't this just come down to the same thing as asserting that, if it is assumed that $[\![\varphi]\!]^{M,g} = \varnothing_{\langle s,t\rangle}$, $[\![\lambda p\ (\varphi \wedge \hat{}p)]\!]^{M,g}$ is identical to $\varnothing_{\langle\langle s,t\rangle,t\rangle}$? On both counts, it is predicted that $\uparrow\varphi$ does not allow for possible continuations. Thus, one might argue that from a dynamic point of view, it is immaterial whether we let the 'intension' of a false proposition φ, where φ does not contain free variables, denote the empty set of assignments to variables, or rather leave it undefined.

4.8 Conclusions: Toward a Unified Theory of Weak Islands

In this chapter, we have systematically compared Sz&Z's algebraic approach to WIs with our own dynamic account in both empirical and theoretical terms. The empirical commitments of the two theories were mainly investigated on the basis of their different characterizations of island-sensitive expressions. A number of specific case studies led us to conclude that there are instances of WIs that can be accounted for either algebraically or dynamically, as well as other cases that can only be explained on either an algebraic or dynamic approach. These studies then lead to the conclusion that neither the algebraic nor the dynamic approach to WIs alone can account for the full range of intervention effects. As was stressed time and again, this is the expected conclusion as long as it is taken for granted that both theories are concerned with clearly distinct facets of meaning.

Now, our further empirical assessment of how well the relevant notion of bad

interveners is captured by both theories lead us to inquire into the question whether indeed the two theories focus on completely independent levels of meaning. Already in (2) of Chapter 3, we observed that the notion of a bad intervener in Dynamic Semantics is (almost) coextensional with the notion of a bad intervener in Sz&Z's algebraic approach to WIs. That is, both theories can (more or less) equally successfully identify the right set of harmful interveners. However, that observation was based exclusively on the algebraic and dynamic properties of Q-adverbs, DPs and negation. In this chapter, we saw that the algebraic and dynamic approach to WIs can successfully identify the relevant set of bad interveners in *Wh*-Islands and Presupposition Islands as well, even though both theories required a small number of additional assumptions. These findings raise the question whether the algebraic and dynamic notion of bad intervener can be related to each other in a way that makes their empirical ties non-accidental. We then developed a relatively simple but effective procedure which enables us to compute the dynamic properties of a given expression on the basis of its Boolean properties. To the extent in which the assumptions on which this procedure rests can be solidified, we might have found a way in which the algebraic and dynamic approach can be integrated into a more general theory of WIs that can derive the full range of intervention effects.

Appendix to Chapter 4

I Proofs

In the following, we provide informal proofs for the two propositions in (19) in the main text. We will start with a proof for (19a), repeated below.

(1) *Proposition.* $\langle [D_o \rightarrow D_e], \leq \rangle$ is a join semilattice.

Consider first the following simple observation: given the definition of $\leq$ in (18a), we note that this relation defines a partial order on $[D_o \rightarrow D_e]$. That is, it is easy to see that the following properties must hold of $\leq$:

(2) *Fact.* $\leq$ is a partial order, i.e. for any f, g and $h \in [D_o \rightarrow D_e]$:
- a $f \leq f$ ($\leq$ is reflexive)
- b if $f \leq g$ and $g \leq f$, then $f = g$ ($\leq$ is anti-symmetric)
- c if $f \leq g$ and $g \leq h$, then $f \leq h$ ($\leq$ is transitive)

It follows that $\langle [D_o \rightarrow D_e], \leq \rangle$ is a poset. But is it a join semilattice? Note now that $\vee$ as defined in (18b) indeed yields the join of any two functions f and $g \in \langle [D_o \rightarrow D_e], \leq \rangle$. To see that, observe that $f \vee g$ is not only an upper bound for f and g (cf. 3a), but also the least upper bound for these functions (cf. 3b).

(3) *Facts.* For any f, g and $h \in \langle [D_o \rightarrow D_e], \leq \rangle$:
- a $f \leq f \vee g$ and $g \leq f \vee g$ ($f \vee g$ is an upper bound)
- b if $f \leq h$ and $g \leq h$, then $f \vee g \leq h$ ($f \vee g$ is the least upper bound)

Given the definition of join in (18b), it is not hard to see that for any two functions f and $g \in \langle [D_o \rightarrow D_e], \leq \rangle$, $f \vee g \in \langle [D_o \rightarrow D_e], \leq \rangle$. Note for example that (18b) defines the function $f_\top$ which maps every event $e \in D_o$ to $\bigcup D_e$ (the top element of D_e) to be the top element of $\langle [D_o \rightarrow D_e], \leq \rangle$, i.e. $f_\top = \bigvee [D_o \rightarrow D_e]$. We have therefore shown (1) to be true.

It is even easier to see why (4) (= 19b in the main text) must hold.

(4) *Proposition.* $\langle [D_o \rightarrow D_e], \leq \rangle$ does not have a bottom element.

Suppose that there is an $f \in \langle [D_o \rightarrow D_e], \leq \rangle$ such that for all $g \in \langle [D_o \rightarrow D_e], \leq \rangle$, $f \leq g$. According to the definition of $\leq$ in (18a), for any such g, $\mathrm{Dom}(f) \subseteq \mathrm{Dom}(g)$ and for all events $e \in \mathrm{Dom}(f)$, $f(x) \subseteq g(x)$. But this is impossible, since by assumption D_e lacks a bottom element. We have therefore shown (4) to be true as well.

II State-Switchers

In order to accomodate Groenendijk & Stokhof's (1989) *state-switchers*, we must first assume that the syntax of our dynamic logic provides us with two distinct sets of variables, viz. VAR_τ and DM_τ (d, d', ..., D, D', ...), where $\tau \in$ T (the set of types; cf. 1 below) and *DM* stands for *Discourse Marker*. We then need to revise the structure of the models assumed thus far along the following lines. Let $M = \langle\langle D,\subseteq\rangle,W,S,I\rangle$, where $\langle D,\subseteq\rangle$ is a complete, atomic, free (proper) join semilattice (cf. section 2.4.1), W the set of all posible worlds, S the set of all *states* (i.e. assignments of values to DMs), and I the interpretation function mapping any n-place predicate P into a set of n-tuples of elements in D, and any DM d of type τ into some function $I(d) \in D_\tau^S$. Accordingly, we will distinguish among the folowing semantic domains with respect to which the various expressions of our dynamic logic will be interpreted:

(1) a $D_e = D$
b $D_p = \{0,1\}^W$
c $D_{\langle a,b\rangle} = D_b^{D_a}$
d $D_{\langle s,a\rangle} = D_a^S$

In line with (1d), an expression of type ⟨s,a⟩ will no longer be interpreted as a function from assignments to objects in D_a, but rather as a function from states to objects in D_a. Consequently, '^' and ' ' represent abstraction over, and application to states, rather than ordinary assignments to variables. That is:

(2) a $[\![\varphi]\!]^{M,s,g} =_{def}$ that function $h \in D_a^S$ such that $h(s) = [\![\varphi]\!]^{M,s,g}$ for all $s \in S$, where φ is of type a
b $[\![\hat{}\varphi]\!]^{M,s,g} =_{def} [\![\varphi]\!]^{M,s,g(s)}$

The only significant difference then between the system of Dynamic Semantics presented in Chapter 2 and the one contemplated here is that plain assignments are now replaced by states (i.e. assignments to DMs) as the relevant parameter on which the interpretation of a given expression depends.

State-switchers will now be introduced in the definition of $\mathscr{E}$, and derivatively $\mathscr{A}$ (for a more thorough discussion of state-switchers and their distinctive properties, cf. Groenendijk & Stokhof 1989: section 2.2):

(3) $\mathscr{E}d\,(\Phi) =_{def} \lambda p\,(\exists x\{x/d\}(\Phi(p)))$

The semantics of state-switchers can be given as follows:

(4) $[\![\{\alpha/d\}\varphi]\!]^{M,s,g} =_{def} [\![\varphi]\!]^{M,\langle d\leftarrow[\![\alpha]\!]^{M,s,g}\rangle s,g}$

where $\langle d\leftarrow[\![\alpha]\!]^{M,s,g}\rangle s$ is the unique state s' that differs from s at most in this

respect that the denotation of the DM d in s' is the denotation of α in s. Thus, state-switchers switch the state relative to which some expression is evaluated to some uniquely determined, possibly different state.

Given (4), we may think of state-switchers as the semantic equivalent of the syntactic substitution operator $[\alpha/d]$. Consider for example the following:

(5)
a $[\![\exists x\{x/d\}(\mathrm{P}'(d))]\!]^{\mathrm{M,s,g}} = 1$ *iff*
b for some $u \in D$, $[\![\{x/d\}(\mathrm{P}'(d))]\!]^{\mathrm{M,s,g}[x/u]} = 1$ *iff*
c for some $u \in D$, $[\![\mathrm{P}'(d)]\!]^{\mathrm{M},\langle d \leftarrow [\![x]\!]^{\mathrm{M,s,g}[x/u]}\rangle\mathrm{s,g}[x/u]} = 1$ *iff*
d for some $u \in D$, $[\![d]\!]^{\mathrm{M},\langle d \leftarrow u\rangle\mathrm{s,g}[x/u]} \in [\![\mathrm{P}']\!]^{\mathrm{M},\langle d \leftarrow u\rangle\mathrm{s,g}[x/u]}$ *iff*
e for some $u \in D$, $I(d)(\langle d \leftarrow u\rangle\mathrm{s}) \in I(\mathrm{P}')$ *iff*
f for some $u \in D$, $u \in I(\mathrm{P}')$ *iff*
g $[\![\exists x\,(\mathrm{P}'(x))]\!]^{\mathrm{M,s,g}} = 1$

In general, when a state-switcher $\{x/d\}$ is prefixed to some expression φ, it can be moved inside φ until one of the following cases obtains. If it directly precedes a DM d, d will be resolved thus: $\{x/d\}d = x$. If it directly precedes a constant, a 'plain' variable or some DM $d' \neq d$, $\{x/d\}$ disappears. Finally, if it winds up in front of an expression of the form $\hat{}\beta$, it cannot be moved any further. These properties are best illustrated by considering the question how state-switchers can be put to use in a compositional treatment of our favorite example in (6).

(6) A_d man came in. He_d whistled.

Assume here that an index d on a determiner corresponds to the introduction of the DM d in the state-switcher $\{\alpha/d\}$ associated with the dynamic existential quantifier denoted by $a_d\,man$. This indexing mechanism intends to mark possible (dynamic) anaphoric dependencies between constituents. As pointed out by Groenendijk & Stokhof (1989), the use of indices to stake out possible anaphoric relationships in itself is nothing new. Groenendijk & Stokhof's interpretation of the type of indexing illustrated in (6) does bring an important technical point to light: there are anaphoric relations indicated through co-indexing that cannot be dealt with in terms of the same rule (viz. Quantifying/Binding-In) that relates quantified expressions to syntactic variables/traces. However, this point must be acknowledged by anyone who is interested in donkey-type anaphora. Having said that, let us now turn to an analysis of (6) in terms of state-switchers.

(7) a $\mathfrak{E}d\,(\uparrow\mathrm{man}'(d) \mathbin{\underline{\wedge}} \uparrow\mathrm{came\text{-}in}'(d)) \mathbin{\underline{\wedge}} \uparrow\mathrm{whistled}'(d)$
b $\lambda p\,(\exists x\{x/d\}(\mathrm{man}'(d) \wedge \mathrm{came\text{-}in}'(d) \wedge \hat{}p)) \mathbin{\underline{\wedge}} \uparrow\mathrm{whistled}'(d))$
(def. of $\mathfrak{E}$, $\underline{\wedge}$ and $\uparrow$)

At this point, we can push the state-switcher inside until it hits $\hat{}p$ from where it cannot be moved any further.

(7) c $\lambda p\,(\exists x\,(\mathrm{man}'(x) \wedge \mathrm{came\text{-}in}'(x) \wedge \{x/d\}\hat{}p)) \mathbin{\underline{\wedge}} \uparrow\mathrm{whistled}'(d)$

(def. of state-switchers)

d $\lambda p\ (\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x) \wedge \{x/d\}(\text{whistled}'(d) \wedge {}^\wedge p)))$

(def. of $\underline{\wedge}$ and $\uparrow$)

By performing the same variable-substitution trick once more, we arrive at (7e) which directly captures the anaphoric dependency depicted in (6).

(7) e $\lambda p\ (\exists x\ (\text{man}'(x) \wedge \text{came-in}'(x) \wedge \text{whistled}'(x) \wedge \{x/d\}{}^\wedge p))$

(def. of state-switchers)

To conclude, state-switchers are also useful when we want to provide an explicit semantics for those constructions in which some operator is coindexed with an indefinite determiner, a simple example of which is given in (8a). Given our earlier proposal with respect to how to interpret an index *d* on an indefinite determiner, the specific task we face in connection with (8a) is this. We need to ensure that identifying the index *d* on the determiner *a* with the index on *usually* will have the effect that the first index will be abstracted over by means of ED, as indicated in (8b).

(8) a Usually$_d$, if a$_d$ man drinks, he$_d$ gets drunk

b $\mathcal{M}ost\ (\ \underline{\lambda} d\ (\mathcal{E} d\ (\uparrow\text{man}'(d)\ \underline{\wedge}\ \uparrow\text{drinks}'(d))))(\ \lambda d\ (\uparrow\text{gets-drunk}'(d)))$

This requires a simple modification of our earlier definition of Binding-In (cf. def. 75 of Chapter 2) along the following lines:

(9) *Definition: Binding-In*

i. $B_d(XP',\Phi) =_{def}$ FA(XP′,$\lambda d\ (\Phi)$), where *d* occurs free in Φ and Φ is of type *cc*, or
FA(XP′,$\underline{\lambda} d\ (\Phi)$), where *d* is bound in Φ and Φ is of type *cc*;

ii. $B_d(XP',\Psi) =_{def}$ $\lambda v\ (B_d(XP',\Psi(v)))$, where Ψ is of a type that ends in *cc*.

The first argument of $\mathcal{M}ost$ in (8b) can now be reduced as follows.

(10) a $\underline{\lambda} d\ (\mathcal{E} d\ (\uparrow\text{man}'(d)\ \underline{\wedge}\ \uparrow\text{drinks}'(d)))$

b $\lambda d'\ (\mathcal{E} d\ (\uparrow\text{man}'(d)\ \underline{\wedge}\ \uparrow\text{drinks}'(d))\ \underline{\wedge}\ \uparrow d = d')$ (def. of ED)

c $\lambda d'\ (\lambda p\ (\exists x\{x/d\}\ (\text{man}'(d) \wedge \text{drinks}'(d) \wedge {}^\wedge p))\ \underline{\wedge}\ \uparrow d = d')$

(def. of $\mathcal{E}$, $\underline{\wedge}$, and $\uparrow$)

Again, we can push the state-switcher $\{x/d\}$ inside until it hits ${}^\wedge p$ from which point it cannot be moved any further.

(10) d $\lambda d'\ (\lambda p \exists x\ (\text{man}'(x) \wedge \text{drinks}'(x) \wedge \{x/d\}{}^\wedge p)\ \underline{\wedge}\ \uparrow d = d')$

(def. of state-switchers)

e $\lambda d'\ (\lambda p \exists x\ (\text{man}'(x) \wedge \text{drinks}'(x) \wedge \{x/d\}(d = d' \wedge {}^\wedge p)))$

(def. of $\underline{\wedge}$ and $\uparrow$)

Resolving the DM *d* by means of the state-switcher once more, we obtain:

(10) f $\lambda d'$ ($\lambda p \exists x$ (man´(x) $\wedge$ drinks´(x) $\wedge$ $x = d' \wedge$ $\{x/d\}\hat{}p$))
(def. of state-switchers)

Thus, (8b) is equivalent to (11a), which can be reduced to (11b) in the by now familiar way.

(11) a $\mathcal{M}ost$ ($\lambda d' \lambda p \exists x$ (man´(x) $\wedge$ drinks´(x) $\wedge$ $x = d' \wedge$ $\{x/d\}\hat{}p$))(λd ($\uparrow$gets-drunk´(d)))
b $\uparrow$Most´(λd (man´(d) $\wedge$ drinks´(d)))(λd (gets-drunk´(d)))

where (11b) adequately represents the intended reading of (8a).

5 Summary and Conclusions

In this thesis, we have studied the phenomenon of Weak Islands from a formal semantic perspective. Weak Islands are contexts that are transparent with respect to some, though not all quantificational dependencies that involve an operator and a variable-expression. Given contrasts such as the ones observed in (1) and (2), we thus know that *whether*-clauses and universal negative quantifiers for example constitute Weak Islands. The phenomenon of Weak Islands poses the following basic questions. Firstly, what is the proper characterization of those expressions, such as the *wh*-adverb *how*, that are sensitive to Weak Islands? Secondly, what is the proper characterization of those expressions, such as *whether* and *no mechanic*, which create Weak Islands? Finally, why is it that the first class of expressions cannot be combined in the required way with the second class of expressions?

(1) a Which man did you wonder [whether to invite _]?
b *How did you wonder [whether to fix your car _]?

(2) a Which car has [no mechanic fixed _ yet]?
b *How has no mechanic fixed my car _ yet]?

The most powerful and successful theory of Weak Islands to date is the one developed by Szabolcsi & Zwarts (1993) which is couched in the framework of algebraic semantics. As was explained in detail in Chapter 1, this theory offers the following answers to the three major issues raised by the phenomenon of Weak Islands. Firstly, the expressions that are sensitive to Weak Islands are those that range over algebraically impoverished domains. Secondly, the expressions that create Weak Islands are those that are semantically associated with at least some Boolean operations (meet or complement) that cannot be executed in the algebraic domains the elements of which island-sensitive expressions range over. Finally, the first class of expressions cannot be combined in the required way with (that is, scope over) the second class of expressions since in general, if α scopes over β, then the Boolean operations

associated with β must be executed in α's denotation domain. We concluded this chapter by observing that a substantial number of expressions that create Weak Islands also have a particular dynamic effect: any simple indefinite contained in their scope cannot bind a pronoun outside of their scope. Compare for example (1) and (2) above with (3). The phenomenon illustrated in (3) is called *inaccessibility*.

(3) a *John wonders whether this shop has a bike$_i$. He saw it$_i$ last week.
b *Nobody has a bike$_i$. It$_i$ was stolen last week.

Correlations such as these strongly suggest that in addition to the constructions discussed by Szabolcsi & Zwarts (1993), there is a significant set of Weak Island effects that are best accounted for by making use of the tools of Dynamic Semantics, as espoused by Groenendijk & Stokhof (1989,1990,1991) and Chierchia (1992,1995). The main contribution of this thesis consists in carefully developing a theory of Weak Islands which refers to dynamic aspects of meaning, rather than static algebraic ones. To set the stage for an alternative dynamic approach to Weak Islands, we presented in Chapter 2 a version of Dynamic Semantics which departs only in minor respects from Groenendijk & Stokhof's (1989,1990) Dynamic Montague Grammar and the system of Dynamic Semantics developed by Chierchia (1992,1995). Special attention was paid here to certain issues that arise in connection with quantificational adverbs, plural anaphora and collective versus distributive predication. Having thus established our point of reference, we set sail. During our dynamic excursions on Weak Islands, we came across the following three basic questions and provided the following answers:

Question I. *Why are all split constructions sensitive to Weak Islands, where split constructions are structures in which a quantificational expression must bind a simple indefinite as its restriction even though it does not form a constituent with it?*

The generalization alluded to in this question was referred to in Chapter 3 as the *Intervention Generalization*. We argued there that the various constructions covered by this generalization constitute the paradigm case for a dynamic, rather than an algebraic approach to Weak Islands. The Intervention Generalization can be stated as in (4):

(4) *The Intervention Generalization*
* ... [$_{\Phi}$ Q_i ... [$_{\text{Weak Island}}$ Operator ... [$_{\text{indefinite}}$ D_i NP] ...] ...] ...

The Intervention Generalization can be straightforwardly derived from the

system of Dynamic Semantics presented in Chapter 2. Dynamic Semantics insists that the semantics of all simple indefinites be uniformly represented in terms of existential quantification. To account for the well-known chameleontic nature of simple indefinites, Dynamic Semantics seeks refuge in an operation called Existential Disclosure (ED; cf. Dekker 1990,1993a,b). ED is a fully compositional procedure which enables us to address an indefinite as though it acts as a restricted variable in the semantics. Since the indefinite in structures which conform to (4) needs to be (dynamically) bound by Q_i, we must apply ED to it. For ED to be applied properly, the indefinite which needs to be disclosed must bind a variable which occurs outside of its syntactic scope. It is now predicted that any (semantically sensible) application of ED is conditioned by inaccessibility, a restriction which governs the well-formedness of anaphoric links between a variable expression and a non-c-commanding antecedent (cf. 3 above). By tentatively generalizing our earlier observations concerning the correlation between the class of expressions which create Weak Islands and the class of expressions which induce inaccessibility, we have explained the Intervention Generalization. Since ED cannot yield a semantically coherent interpretation for the relevant constructions, due to the inaccessible domain for dynamic anaphora created by *Operator*, the structures conforming to (4) will be ruled on semantic grounds. Along these lines, the ungrammaticality of the examples in (5) and (6) receives a natural explanation:

(5) a *Wat$_i$ hebben hoogstens drie studenten voor een$_i$ boek gelezen?
"What kind of book did at most three students read?"
b *Wat$_i$ hebben precies drie studenten voor een$_i$ boek gelezen?
"What kind of book did exactly three students read?"

(6) a *Nobody$_i$ gave at most three beggars a$_i$ red cent
b *Nobody$_i$ gave exactly three beggars a$_i$ red cent

We have thus seen that a dynamic approach offers the following answers to the three basic questions raised by Weak Islands, mentioned in the above. Firstly, the expressions that are sensitive to Weak Islands are those that need to dynamically bind an indefinite as their restriction, even though they do not form a constituent with it. Secondly, the expressions that create Weak Islands are those that induce inaccessible domains for dynamic anaphora. Finally, the first class of expressions cannot be combined in the required way with (that is, bind inside the scope of) the second class of expressions since in general, α cannot dynamically bind β if β is contained in an inaccessible domain for dynamic anaphora.

Question II. *Why do opaque or intensional contexts not constitute inaccessible domains for dynamic binding?*

A dynamic approach to Weak Islands is in trouble whenever an expression which induces an inaccessible domain for dynamic anaphora does not create a Weak Island. The following contrast, which involves the intensional verb *think*, therefore means red alarm.

(7) a Wat$_i$ dacht Jan dat hij voor een$_i$ monster had gezien?
"What kind of monster did Jan think that he had seen?"
b *John thought he saw a$_i$ photomodel yesterday. She$_i$ smiled at him.

The general problem which intensionality poses for a dynamic approach to Weak Islands is addressed in Chapter 4. We argued there that this problem ceases to exist if we opt for an intensional version of Existential Disclosure (IED) which involves a free discourse marker ranging over CCPs. As desired, IED yields the same results in extensional contexts as Dekker's (1990) original formulation. However, on Groenendijk & Stokhof's (1989) compositional approach to modal subordination, IED in addition enables us to disclose an indefinite across (non-presuppositional) opaque domains if it is assumed that intensional verbs such as *think* (Cattell's 1978 volunteered stance verbs) introduce the CCP denoted by their complement clause as a discourse referent.

Question III. *What is the relationship between the Boolean properties of a given expression and its dynamic properties?*

This question was raised in Chapter 4 as well, where we investigated more generally the precise relationship between Szabolcsi & Zwarts's (1993) algebraic theory of Weak Islands and our own dynamic approach both in empirical and in theoretical terms. We first established that our dynamic account of the Intervention Generalization cannot be subsumed under Szabolcsi & Zwarts's approach. There is sufficient evidence which shows that the Intervention Generalization in (4) holds independently of the algebraic properties of Q_i's denotation domain. We furthermore saw that Szabolcsi & Zwarts's algebraic account of various Weak Island constructions cannot be subsumed under our dynamic approach either. This becomes particularly evident when we turn to semantic 'Relatived Minimality' effects where different extractees are sensitive to different interveners. Finally, we observed that there are Weak Island effects that may be accounted for either dynamically or algebraically. When taken together, these findings point to the following conclusion: neither the algebraic nor the dynamic approach to Weak Islands can

account for the full range of intervention effects. Even though this might come as a shock at first, this is in fact the expected situation if both theories are concerned with clearly distinct aspects of meaning.

Still, the fact that virtually the same class of 'bad interveners' is singled out on both accounts strongly suggests that the two theories do not focus on completely independent levels of meaning. If so, then there should be a more general theory in which the essential features of both analyses are combined that can account for the whole gamut of Weak Island effects. It was with an eye toward this more general theory of Weak Islands that we then speculated on a relatively simple but effective procedure which enables us to compute the dynamic properties of a given expression on the basis of its Boolean properties. In general, a quantifier $\mathcal{Q}$ is called (externally) dynamic (and therefore will not induce an inaccessible domain for dynamic anaphora) just in case for any CCP Φ, $\mathcal{Q}x\,(\Phi) \equiv \lambda p \mathrm{Q}'x\,(\Phi(p))$, where Q′ is the static counterpart of Q and p ranges over propositions, or equivalently, sets of assignments to variables. Suppose that the set of all sets of assignments to variables Π constitutes a (proper) join semilattice. This would follow if we removed $\varnothing_{\langle s,t\rangle}$ (the empty set of assignments to variables) from $\wp(\Omega)$, where Ω is the set of all assignments to variables. Recalling Szabolcsi & Zwarts's point concerning the connection between scope and Boolean operations, in order to construct the set of propositions denoted by $\lambda p \mathrm{Q}'x\,(\Phi(p))$, we must therefore perform the Boolean operations associated with Q′ in $\Pi = \wp(\Omega) - \{\varnothing_{\langle s,t\rangle}\}$. If Q′ is associated with join, the denotation of $\lambda p \mathrm{Q}'x\,(\Phi(p))$ can be properly constructed. Assume furthermore the Compatibility Hypothesis: if assigning an (externally) dynamic denotation $[\![f]\!]^{\mathrm{Dyn}}$ to f is compatible with the Boolean properties associated with f, we should assign $[\![f]\!]^{\mathrm{Dyn}}$ to f. It is now correctly predicted that any expression which is associated exclusively with join denotes an (externally) dynamic function. Conversely, if Q′ is associated with meet and/or complement, we cannot construct a proper denotation for $\lambda p \mathrm{Q}'x\,(\Phi(p))$ since we assumed that Π forms a (proper) join semilattice. This correctly predicts that any expression which is associated with meet and/or complement denotes a (externally) static function. To the extent that both the Compatibility Hypothesis as well as our specific assumption with respect to the algebraic structure of Π can be solidified, we might have found a way in which the algebraic and dynamic approach to Weak Islands can be naturally integrated into a more general theory that can derive the full range of intervention effects.

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Samenvatting (Summary in Dutch)

In dit proefschrift hebben we het verschijnsel van Zwakke Eilanden bestudeerd vanuit een formeel-semantisch perspectief. Zwakke Eilanden zijn omgevingen die transparant zijn met betrekking tot sommige, doch niet alle kwantificationele afhankelijkheden waarbij een operator en een variabele-uitdrukking betrokken zijn. Gegeven contrasten zoals die in (1) en (2) kunnen we derhalve vaststellen dat zinsnegatie en universeel-negatieve kwantoren bijvoorbeeld Zwakke Eilanden vormen. Het verschijnsel van Zwakke Eilanden stelt ons voor de volgende hoofdvragen. Om te beginnen, wat is de juiste karakterisering van die uitdrukkingen, zoals het adverbiale vraagwoord *hoe*, die gevoelig zijn voor Zwakke Eilanden? Ten tweede, wat is de juiste karakterisering van die uitdrukkingen, zoals *niet* en *geen monteur*, die Zwakke Eilanden creëren? Tenslotte, waarom kan de eerste klasse van uitdrukkingen niet op de vereiste wijze gecombineerd worden met de tweede klasse van uitdrukkingen?

(1) a Welke man had je niet voor het feest _ uitgenodigd?
b *Hoe hebben we ons op het feest niet _ gedragen?

(2) a Welke auto heeft geen monteur nog _ gerepareerd?
b *Hoe heeft geen monteur nog mijn wagen _ gerepareerd?

De meest krachtige en succesvolle theorie over Zwakke Eilanden tot op heden werd ontwikkeld door Szabolcsi & Zwarts (1993). Deze theorie ligt ingebed binnen het kader van de algebraïsche semantiek. Zoals tot in detail werd uitgelegd in Hoofdstuk 1, biedt deze theorie de volgende antwoorden op de drie hoofdvragen die het verschijnsel van Zwakke Eilanden oproept. Ten eerste zijn de uitdrukkingen die gevoelig zijn voor Zwakke Eilanden die welke bereik hebben over algebraïsch verarmde domeinen. Ten tweede zijn de uitdrukkingen die Zwakke Eilanden creëren die welke semantisch geassocieerd zijn met op zijn minst één Boolese operatie (*meet* of *complement*) die niet uitgevoerd kan worden in het algebraïsche domein waarover de eilandgevoelige uitdrukking bereik heeft. Tenslotte kan de eerste klasse van uitdrukkingen niet

op de vereiste wijze gecombineerd worden met (dat wil zeggen, bereik hebben over) de tweede klasse van uitdrukkingen aangezien het meer in het algemeen zo is dat indien α bereik heeft over β, de Boolese operaties die geassocieerd zijn met β uitgevoerd dienen te worden in het domein waarin α verwijst. We besloten dit hoofstuk met de constatering dat een substantieel aantal uitdrukkingen dat Zwakke Eilanden creëert ook een specifiek dynamisch effect sorteert: een simpele indefiniet die zich binnen hun bereik bevindt, kan geen pronomen binden dat zich buiten hun bereik ophoudt. Laten we nu het verschijnsel dat (3) illustreert *ontoegankelijkheid* noemen.

(3) a *Jan heeft geen (d.w.z. *niet een*) fiets$_i$. Hij zag hem$_i$ verleden week.

b *Geen student heeft een fiets$_i$. Hij$_i$ werd verleden week gestolen.

Dergelijke verbanden doen sterk het vermoeden rijzen dat naast de constructies die besproken zijn door Szabolcsi & Zwarts (1993), er nog een belangwekkende verzameling Zwakke Eiland-effecten bestaat die het best verantwoord kan worden door gebruik te maken van het gereedschap van de Dynamische Semantiek, zoals ontworpen door Groenendijk & Stokhof (1989, 1990,1991) en verder ontwikkeld door Chierchia (1992,1995). De belangrijkste bijdrage van dit proefschrift schuilt in het zorgvuldig ontwikkelen van een theorie over Zwakke Eilanden die verwijst naar dynamische in plaats van statisch-algebraïsche aspecten van betekenis. Als fundament voor een alternatieve dynamische benadering van Zwakke Eilanden presenteerden we in Hoofdstuk 2 een versie van de Dynamische Semantiek die slechts op enkele onbeduidende punten afwijkt van Groenendijk & Stokhof's (1989,1990) Dynamic Montague Grammar en het systeem van dynamische semantiek zoals ontwikkeld door Chierchia (1992,1995). Speciale aandacht werd besteed aan bepaalde kwesties die optreden in verband met kwantificationele adverbia, plurale anaforen en collectieve versus distributieve predicatie. Met deze versie van de Dynamische Semantiek als kompas zetten we daarna koers. Tijdens onze dynamische excursies naar Zwakke Eilanden stuitten we op de volgende drie kernvragen en verschaften we de volgende antwoorden:

Vraag I. *Waarom zijn gespleten constructies gevoelig voor Zwakke Eilanden, waar gespleten constructies die structuren zijn waarin een kwantificationele uitdrukking een simpele indefiniet als restrictie moet binden, ook al vormt het er geen constituent mee?*

De generalisatie waarop in deze vraag wordt gezinspeeld, werd in Hoofdstuk 3 de *Interventie Generalisatie* genoemd. We beargumenteerden daar dat de verschillende constructies die door deze generalisatie worden afgedekt het paradigmatische geval vormen voor een dynamische in plaats van een algebraïsche benadering van Zwakke Eilanden. De Interventie Generalisatie kan als in (4) worden geformuleerd:

(4) *De Interventie Generalisatie*

* ... [$_{\varphi}$ Q_i ... [$_{\text{Zwak Eiland}}$ Operator ... [$_{\text{indefiniet}}$ D_i NP] ...] ...] ...

De Interventie Generalisatie kan eenvoudig afgeleid worden uit het systeem van dynamische semantiek dat in Hoofdstuk 2 werd gepresenteerd. De Dynamische Semantiek stelt dat de verwijzing van alle simpele indefinieten uniform weergegeven kan worden door middel van existentiële kwantificatie. Om het bekende kameleontische karakter van simpele indefinieten te kunnen modelleren, zoekt de Dynamische Semantiek zijn toevlucht tot een operatie die luistert naar de naam Existentiële Ontsluiting (EO; zie Dekker 1990, 1993a,b). EO is een volkomen compositionele procedure die ons in staat stelt een indefiniet aan te spreken als of het zich in semantisch opzicht gedraagt als een beperkte variabele. Aangezien de indefiniet in structuren die zich voegen naar (4) (dynamisch) gebonden dient te worden door Q_i, moeten we er EO op toepassen. Voor een geslaagde toepassing van EO is het echter noodzakelijk dat de indefiniet die ontsloten moet worden, een variabele bindt die zich buiten zijn syntactische bereik ophoudt. We voorspellen nu dat een (semantisch zinvolle) toepassing van EO gevoelig is voor ontoegankelijkheid, een conditie die betrekking heeft op de welgevormdheid van anaforische schakels tussen een variabele uitdrukking en een niet c-commanderend antecedent (zie 3 hierboven). Door voorlopig onze eerdere observaties met betrekking tot de samenhang tussen de klasse van uitdrukkingen die Zwakke Eilanden scheppen en de klasse van uitdrukkingen die ontoegankelijkheid oproepen, te veralgemenen, kunnen we de Interventie Generalisatie verklaren. Aangezien EO geen semantisch samenhangende interpretatie kan leveren voor de betrokken constructies, dankzij het ontoegankelijke domein voor dynamische anaforen dat geschapen is door *Operator*, zullen structuren die zich voegen naar (4) op semantische gronden uitgesloten worden. Langs deze lijnen kan voor de ongrammaticaliteit van de voorbeelden in (5) en (6) een natuurlijke verklaring gegeven worden:

(5)
a *Wat$_i$ hebben hoogstens drie studenten voor een$_i$ boek gelezen?
b *Wat$_i$ hebben precies drie studenten voor een$_i$ boek gelezen?

(6)
a *Niemand$_i$ gaf hoogstens drie zwervers ook maar een$_i$ rooie cent
b *Niemand$_i$ gaf precies drie zwervers ook maar een$_i$ rooie cent

We hebben derhalve gezien dat een dynamische benadering de volgende antwoorden geeft op de drie hoofdvragen die Zwakke Eilanden oproepen, zoals die hierboven reeds werden geformuleerd. Ten eerste zijn de uitdrukkingen die gevoelig zijn voor Zwakke Eilanden die welke een indefiniet dynamisch als restrictie moeten binden, ook al vormen zij er geen constituent mee. Ten tweede zijn de uitdrukkingen die Zwakke Eilanden scheppen die welke ontoegankelijke domeinen oproepen voor dynamische anaforen. Tenslotte kan de eerste klasse van uitdrukkingen niet op de vereiste wijze gecombineerd worden met (dat wil zeggen, dynamisch binden in het bereik van) de tweede klasse van uitdrukkingen aangezien het meer in het algemeen zo is dat α niet β dynamisch kan binden indien β bevat is in een ontoegankelijk domein voor dynamische anaforen.

Vraag II. *Waarom vormen opake of intensionele omgevingen geen ontoegankelijke domeinen voor dynamische binding?*

Een dynamische benadering van Zwakke Eilanden komt in de problemen zodra een uitdrukking die een ontoegankelijk domein voor dynamische anaforen oproept geen Zwak Eiland schept. Het volgende contrast, waarbij het intensionele werkwoord *denken* betrokken is, doet derhalve de alarmbel luiden.

(7) a Wat$_i$ dacht Jan dat hij voor een$_i$ monster had gezien?
b *Jan dacht dat hij gisteren een$_i$ fotomodel zag. Zij$_i$ lachtte naar hem.

Het algemene probleem waarvoor intensionaliteit een dynamische benadering van Zwakke Eilanden stelt, werd besproken in Hoofdstuk 4. Daar beargumenteerden wij dat dit probleem als sneeuw voor de zon verdwijnt indien wij kiezen voor een intensionele versie van Existentiële Ontsluiting (IEO) waarbij een vrije discourse markeerder betrokken is die bereik heeft over CCPs. Als gewenst levert IEO dezelfde resultaten in extensionele omgevingen als Dekker's (1990) oorspronkelijke formulering. In combinatie met Groenendijk & Stokhof's (1989) compositionele benadering van modale subordinatie stelt IEO ons daarnaast echter in staat een indefiniet over (niet-presuppositionele) opake domeinen heen te ontsluiten indien wij aannemen dat intensionele werkwoorden als *denken* de CCP waarnaar hun complementszin verwijst als discourse referent introduceren.

Vraag III. *Wat is de relatie tussen de Boolese eigenschappen van een gegeven uitdrukking en zijn dynamische eigenschappen?*

Ook deze vraag werd in Hoofdstuk 4 aan de orde gesteld, waarin wij meer in het algemeen de precieze samenhang tussen Szabolcsi & Zwarts's (1993) algebraïsche theorie over Zwakke Eilanden en onze eigen dynamische benadering zowel in empirisch als theoretisch opzicht onderzochten. We stelden eerst vast dat onze dynamische verklaring voor de Interventie Generalisatie niet uit Szabolcsi & Zwarts's benadering afgeleid kan worden. Er zijn goede gronden voor de stelling dat de Interventie Generalisatie in (4) geldig is ongeacht de algebraïsche eigenschappen van het domein waarin Q_i verwijst. We zagen verder dat Szabolcsi & Zwarts's algebraïsche verklaring van diverse Zwakke Eiland-constructies ook niet uit onze dynamische benadering afgeleid kan worden. Dit wordt met name duidelijk als we semantische *Relativized Minimality* effecten in onze beschouwingen betrekken waarbij verschillende geëxtraheerde elementen gevoelig blijken te zijn voor verschillende intervenieerders. Tot slot merkten wij op dat er Zwakke Eiland-effecten bestaan die zowel algebraïsch als dynamisch verklaard kunnen worden. Deze bevindingen leiden tot de volgende conclusie: de algebraïsche noch de dynamische benadering van Zwakke Eilanden kan alle interventie-effecten verklaren. Ook al mag dit in eerste

instantie als een schok overkomen, toch is deze situatie geheel in overeenstemming met de verwachting indien beide theorieën betrekking hebben op duidelijk verschillende aspecten van betekenis.

Het feit dat nagenoeg dezelfde klasse van 'storende intervenieerders' uitgezonderd wordt door beide verklaringen doet echter sterk het vermoeden rijzen dat beide theorieën zich niet op volkomen onafhankelijke niveaus van betekenis concentreren. Als dit het geval is, dan moet er een meer algemene theorie zijn die de wezenlijke kenmerken van beide analyses in zich verenigt en die het hele spectrum van Zwakke Eiland-effecten verklaart. Het was met het oog op deze meer algemene theorie over Zwakke Eilanden dat we vervolgens speculeerden op een betrekkelijk eenvoudige doch effectieve procedure die ons in staat stelt de dynamische eigenschappen van een gegeven uitdrukking te berekenen op basis van zijn Boolese eigenschappen. In het algemeen wordt een kwantor $\mathcal{Q}$ (extern) dynamisch genoemd (en zal daarom geen ontoegankelijk domein voor dynamische anaforen oproepen) juist in het geval dat voor elke CCP Φ, $\mathcal{Q}x\,(\Phi) \equiv \lambda p\mathrm{Q}'x\,(\Phi(p))$, waar Q´ de statische tegenhanger vormt van $\mathcal{Q}$ and p bereik heeft over proposities, d.w.z. verzamelingen van toekenningen van objecten aan variabelen. Stel dat de verzameling van alle verzamelingen van toekenningen van objecten aan variabelen Π een zogeheten (*proper*) *join semilattice* vormt. Dit zou volgen als we $\varnothing_{\langle s,t\rangle}$ (de lege verzameling van toekenningen van objecten aan variabelen) weghaalden uit $\wp(\Omega)$, waar Ω de verzameling van alle toekenningen van objecten aan variabelen is. Szabolcsi & Zwarts's punt met betrekking tot het verband tussen bereik en Boolese operaties indachtig, om de verzameling van proposities waarnaar $\lambda p\mathrm{Q}'x\,(\Phi(p))$ verwijst te construeren, moeten we derhalve de Boolese operaties die geassocieerd zijn met Q´ in $\Pi = \wp(\Omega) - \{\varnothing_{\langle s,t\rangle}\}$ uitvoeren. Indien Q´ geassocieerd is met *join* kan de verwijzing van $\lambda p\mathrm{Q}'x\,(\Phi(p))$ op de juiste wijze geconstrueerd worden. Veronderstel verder de Compatibiliteit Hypothese: indien het toekennen van een (extern) dynamische verwijzing $[\![f]\!]^{\mathrm{Dyn}}$ aan f verenigbaar is met de Boolese eigenschappen van f, ken dan $[\![f]\!]^{\mathrm{Dyn}}$ toe aan f. We doen nu de juiste voorspelling dat elke uitdrukking die uitsluitend geassocieerd is met *join* naar een (extern) dynamische functie verwijst. Omgekeerd, indien Q´ geassocieerd is met *meet* en/of *complement*, dan kunnen wij niet een geschikte verwijzing voor $\lambda p\mathrm{Q}'x\,(\Phi(p))$ construeren aangezien wij hadden aangenomen dat Π een (*proper*) *join semilattice* vormt. Dit doet de juiste voorspelling dat elke uitdrukking die is geassocieerd is met *meet* en/of *complement* naar een (extern) statische functie verwijst. Voor zover zowel de Compatibiliteit Hypothese als onze specifieke veronderstelling met betrekking tot de algebraïsche struktuur van Π onderbouwd kunnen worden, hebben we wellicht één manier ontdekt waarop de algebraïsche en dynamische benadering van Zwakke Eilanden geïntegreerd kunnen worden in een meer algemene theorie waaruit het gehele spectrum van interventie-effecten afgeleid kan worden.