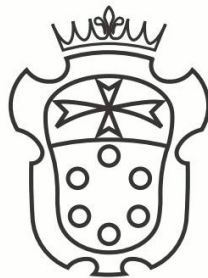


DETERMINISTIC MAPPING AND DEPENDENCIES
A SYNTAX/SEMANTICS INTERFACE ACCOUNT OF
CROSSOVER AND SPECIFICITY

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June 2010

Michelangelo Falco: *Deterministic mapping and dependencies. A syntax/semantics interface account of crossover and specificity.*
Diploma di Perfezionamento, Scuola Normale Superiore
Pisa, June 2010

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ABSTRACT

This thesis proposes an analysis of *weak crossover* (WCO) in terms of conflicting interface economy principles. These principles apply to representations resulting from a transparent mapping between Rizzi's (2001a) LF syntax for specific vs. non-specific chains and a refined version of Elbourne's (2005) semantics for traces/copies and pronouns. While pronouns are endowed with a referential index, copies of Q-phrases are devoid of it, due to their quantificational nature. In standard WCO, the underspecified index on the trace is compelled by economy to get a value, through *linking* (Higginbotham 1983), from the closest potential index-bearing element, that is the intervening WCO pronoun. This local process of valuation yields a redundancy effect with the process of mapping the underspecified copy into the same variable by a generalized version of Heim & Kratzer's (1998) *Predicate Abstraction Rule* (Delfitto & Fiorin 2009). I argue that WCO effects can be circumvented by overtly moved specific Q-phrases. In order to establish the relevance of specificity in WCO contexts systematically, a formalization of the notion of specificity and an operational definition of specificity are provided, drawing from the literature. Concerning the formalization, specificity is analyzed by enriching the syntactic representation for Q-phrases, extending Elbourne's (2005) analysis of definites: indefinites are not endowed with a referential index, but they always contain a (usually silent) NP that restricts the domain (Stanley 2000). In Elbourne's (2005) system, this restriction is of same semantic type of the definite DP index - $\langle e, t \rangle$. With respect to the operational definition, a range of constructions affected by specificity of the extracted DP are used as tests to support the claim that overtly moved Q-phrases circumvent WCO. These facts are explained as a consequence of the LF chains to which specific phrases give rise under Rizzi's (2001a) treatment, and the format for indefinites: the NP-restriction moves to a Topic position, thus, under Rizzi's (2001a) mechanism of *shrinking*, its domain restriction is set free and is made available, as a referential index, for the whole DP. It follows that the intervening WCO pronoun is irrelevant for index-valuation and no redundancy arises in this case. The restriction of covertly moved Q-phrases cannot form an independent chain, as a consequence of the very nature of covert movement. So, the embedded index of the NP-restriction is buried in its original position and the whole DP trace remains devoid of an index, leading to WCO effects.

PUBLICATIONS

Part of the material previously appeared or will appear in the following publications:

Falco, Michelangelo. 2007. Weak crossover, specificity and LF chains. In Luis Eguren & Olga Fernández-Soriano (eds.) *Coreference, Modality and Focus*, 19-44. Volume 111 of *Linguistik Aktuell*. Amsterdam: John Benjamins.

Falco, Michelangelo & Denis Delfitto. 2009. Deterministic mapping and the nature of dependencies. Manuscript.

Falco, Michelangelo. 2010. The licensing of pronominal features in WCO and OPC configurations. Volume 16.1 of *Penn Working Papers in Linguistics (PWPL)*, Proceedings of PLC 33.

ACKNOWLEDGMENTS

It is a pleasure to thank a few people who helped me in this work. First and foremost I am heartily thankful to Valentina Bianchi and to Denis Delfitto, who supervised and inspired my research at different stages of its development, and to Pier Marco Bertinetto, whose support and guidance enabled me to carry the project out.

I am grateful to Luigi Rizzi, to Ur Shlonsky, to Dominique Sportiche, and to Roberto Zamparelli, who generously discussed my research topics whenever I met them, offering insightful comments and sound advice.

I wish to thank my student colleagues met in Pisa, Siena, Los Angeles, Genève and Verona for making a stimulating and pleasant research environment in which I learnt and grew over the doctoral years. In particular, I am grateful to the members of the 'Laboratorio di Linguistica' in Pisa: Valentina Bambini, Cristina Bertocin, Basilio Calderone, Chiara Celata, Margherita Farina, Marta Ghio, and especially Emanuela Sanfelici; to Cristiano Chesi, Ida Ferrari, Irene Franco, Maria Garraffa, Nino Grillo, and Vincenzo Moscati in Siena; to Vincent Homer in Los Angeles; to Léna Baunaz and Gabriela Soare in Genève; to Gaetano Fiorin and Jacopo Torregrossa in Verona.

The Scuola Normale Superiore funded me through a three years 'perfezionamento' scholarship, while the University of Geneva and UCLA, provided exchange grants. This work would not have been possible without these resources.

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ACRONYMS

ACC	Accusative
AGR	Agreement
BV	Bound Variable
CLIT.	Clitic
GEN.	Genitive
LF	Logical Form
NOM	Nominative
OPC	Overt Pronoun Constraint
PART.	Partitive
PA	Predicate Abstraction
Q	Quantificational element
QR	Quantifier Raising
SCO	Strong Crossover
WCO	Weak Crossover

INTRODUCTION

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1.1	The challenges	1
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This dissertation deals with crossover phenomena, specificity and the mechanisms responsible for pronominal binding. It claims that referential indexes are present only when syntactically justified and proposes to look at crossover as a consequence of interface economy principles, operating on structurally rich Logical Form representations.

The proposal can be seen as the answer to three intertwined questions for the current understanding of the syntax/semantics interface, namely:

- A. Why can overtly-moved specific *wh*-elements circumvent Weak Crossover?
- B. What is specificity and how to formalize it precisely?
- C. Why should semantic binding entail syntactic binding?

In this introduction, I present each of these challenges (§1.1) and the core ideas of the solution I advance (§1.2); finally, I conclude with an outline of the following chapters (§1.3).

1.1 THE CHALLENGES

The seminal characterizations of crossover did not classify it as a quantifier-dependent phenomenon. The term *crossover* was originally introduced by Postal (1971) to describe the constructions where a *wh*-phrase, in the movement from right to left, crosses over a pronoun (1-b).¹

- | | | | |
|-----|----|---|--------------|
| (1) | a. | <i>Who t</i> said Mary kissed <i>him</i> ? | No crossover |
| | b. | * <i>Who</i> did <i>he</i> say Mary kissed <i>t</i> ? | Crossover |

Later, Wasow (1972) noticed that constructions where the base position of the *wh*-element is less embedded than the position of the pronoun (2-a) are less deviant than the constructions where this is not the case (2-b).

¹ Dependent interpretations are expressed using *italics*, instead of co-indexation, for two reasons. First, the proposal presented here advocates a syntactically and semantically motivated existence of referential indexes. Moreover, the use of indexes would be philologically incorrect, since the first works on crossover precede the advent of Binding Theory and, thus, the use of indexes.

The trace notation is used here as a descriptive device since I adopt Chomsky's (1993) copy theory of traces. Furthermore, at the time of the first proposals on crossover, traces were not standardly assumed as linguistic objects.

- (2) a. ?*Who does [his mother] love *t*? Weak crossover (WCO)
 b. *Who did he say Mary kissed *t*? Strong crossover (SCO)

To describe this difference concerning the severity of the violation, Wasow introduced the term *weak crossover* (WCO) (2-a) as opposed to *strong crossover* (SCO) (2-b).

The perspective was crucially widened by Chomsky (1976) who proved that any meaningful theory of crossover should extend to the distribution of quantifier-bound readings for pronouns. In particular, Chomsky noted that a quantifier does not allow *bound variable* (BV) readings for a pronoun to its left (3-b).

- (3) a. Everyone loves his mother. No WCO
 b. ?*His mother loves everyone.
 LF: [everyone [his mother loves *t*]] WCO at LF

The parallelism between (3-b) and cases like those in (2-a) with respect to WCO suggests that the universal quantifier moves in the derivation of LF (3-b) to create a structure similar to the one in (2-a).

Since this work, the stakes of the generative endeavor have been raised, giving crucial importance to the relation between syntactic representations and the interpretive component, and thus also to the study of the Logical Form (LF). At the same time, this move raises empirical and theoretical challenges.

Empirically, this shift, and the consequent bipartition between referential and quantificational elements, led to shelving the relevance of fine-grained differences in crossover, namely the fact that WCO is circumvented by specific *wh*-phrases (like *which NP*), as noted in the original works on crossover (Wasow 1972 a.o.). As a matter of fact, in recent literature, data concerning the role of specificity in WCO are rarely found, with the exception of the following contrast quoted from Culicover & Jackendoff 1995:²

- (4) a. Which famous senator do his constituents despise *t*? Specific *wh*-phrase
 b. ?*Who do his constituents despise *t*? Non-specific *wh*-phrase
 (Culicover & Jackendoff 1995: ex. 39)

Reviving Wasow's (1972) observation, I thoroughly show that, while WCO is systematically present with quantifiers and operators moved in covert syntax, it does not arise with overtly-moved D-linked *wh*-elements (*weaker crossover*). The problem of how to derive these fine-grained empirical distinctions arises. Putting it more directly, the following question remains unanswered: why can overtly-moved specific *wh*-elements circumvent WCO?

² Actually, as we will see in §§2.1.2, precisely this observation led Wasow (1972) to the attempt to reduce WCO to the paradigm: if a DP is a possible antecedent for an embedded pronoun to its left, the DP must be definite (i-a) vs. (i-b) (or generic).

- (i) a. The portrait of his girlfriend always depressed John.
 b. *The portrait of his girlfriend always depressed someone.
 (cf. Postal 1970 a.o.)

This question in turn raises the issue of what exactly specificity is and of how to formalize it. Since the introduction of LF and interpretive semantics, research have been carried on different aspects of specificity and this has contributed to a better understanding of the referential potential of indefinite noun phrases at the semantics-pragmatics interface. Furthermore, many studies have established a considerable body of cross-linguistic expressions and constructions that can be related to different types of specificity. However, the following fundamental question remains without a satisfactory answer: what is specificity and how to formalize it precisely?

Theoretically, from the LF perspective, we expect that crossover effects in an optimal grammar follow from the devices that encode the BV readings, but this is not the case, under current assumption. Assuming Heim & Kratzer's (1998) implementation, these devices reduce to some version of *quantifier raising* (QR) or *wh*-movement, with an index inserted in the LF-structure as a result of QR.³ The same index must be realized on the trace of the moved DP. The index produced by QR is interpreted by Heim & Kratzer's (1998) *Predicate Abstraction Rule* (PA), mapping all the elements with index i to x , with x bound by a λ -operator (5). Pronouns bearing the same index i as the Q-trace are thus mapped into the same bound variable, accounting for the BV-reading.

(5) *Predicate abstraction rule* (PA)

Let α be a branching node with daughters β and γ , where β dominates only a numerical index i . Then, for every variable assignment a , $\llbracket \alpha \rrbracket^a = \lambda x \in D . \llbracket \gamma \rrbracket^{a^{i \rightarrow x}}$. (cf. Heim & Kratzer 1998: p. 186)

By applying QR and PA, the WCO structures in (6-a) and (6-b) are correctly derived with BV readings, to the effect that their agrammaticality is completely unexpected.

- (6) a. *His mother loves everyone*
 LF: ?*[everyone] i [[his $_i$ mother] loves t_i] Quantifier raising
 b. ?*Who i did his $_i$ mother love t_i ? *Wh*-movement

I conclude, therefore, that the familiar view on semantic binding and BV-readings is not enough to derive crossover effects.

The requirement that the trace/copy of the Q-phrase c-command the pronoun in order to license a BV reading of the latter seems to correspond to a correct descriptive generalization. Basically, familiar approaches to crossover have striven to derive this fact. However, if we try to solve this problem from the point of view of optimal design, we are forced to the conclusion that these proposals fail in their search for a non-stipulative account. More straightforwardly, the following issue systematically remains unsolved: why should semantic binding entail syntactic binding?

Summarizing, crossover raises an empirical question - why can overtly-moved specific *wh*-elements circumvent WCO? - and two theoretical questions - what is specificity and how to formalize it? why should semantic binding entail syntactic binding? - of crucial importance for the syntax/semantics interface and for the issue of optimal design. In this

³ I use the Q letter to refer to both *wh*-elements and to quantifiers.

thesis, I aim at an empirically adequate and theoretically principled theory of crossover and specificity, answering the three questions.

1.2 THE FORM OF THE SOLUTION

Crossover is usually thought of as a syntactic dependency failure: for some reason, the pronoun fails to be dependent on the trace. The direction of this dependency is represented in (7) through the arrow connecting the dependent pronoun to the trace on which it depends.⁴

$$(7) \quad ?^* \lambda_i \dots [pro_i] \dots t_i \quad \text{Standard perspective}$$

However, since the accounts that have been advanced to date are unsuccessful in deriving this dependency failure in a principled way, the reason behind it remains fundamentally unknown.

I propose to look at crossover configurations from the mirror perspective: it is the Q-trace that must enter into a dependency relation with the pronoun. In itself this dependency is well-formed, but, in crossover configurations, it leads to a redundancy with PA, the interpretive mechanism at stake in these structures, as seen above.

The claim that the Q-trace is better conceived of as dependent on the pronoun follows naturally once we consider the referential indexes proper to the pronoun and to the Q-trace involved. While it is sound to assume that pronouns are endowed with a referential index, interpreted in the semantics through an assignment function, Q-traces, due to their quantificational nature, are better understood as underspecified for such an index. The subscript \emptyset adorning the trace in (8) expresses the index underspecification.

$$(8) \quad ?^* \lambda_i \dots [pro_i] \dots t_\emptyset \quad \text{New perspective}$$

Crossover can now be seen as a consequence of the process of index-valuation on the Q-trace, having two potential assigners: the intervening pronoun (through *linking*) and the predicate abstractor, through PA (9). This entails that crossover configurations yield unnecessary redundancy in the index interpretation process: *linking* of the Q-trace to a local pronoun to resolve index underspecification on the Q-trace does not affect in any way the result of the successive application of a generalized version of PA. Viewed from this perspective, crossover is a case where locality constraints interfere with optimal mapping between syntactic representations and interpretation (cf. [Delfitto & Fiorin 2009](#)).

$$(9) \quad ?^* \lambda_i \dots [pro_i] \dots t_\emptyset \quad \text{WCO as redundancy}$$

At its core, this is the simple and principled solution I provide to the theoretical challenge formulated above concerning the reason why seman-

⁴ A dotted arrow is used to indicate the dependency failure and to distinguish it from the *linking* relation denoted by a single-line arrow. Below, a dashed arrow is adopted for the dependency established by a predicate abstractor.

tic binding entails syntactic binding. However, the deepness and scope of this solution will fully emerge only from closely inspecting the nature of the empirical challenge.

From the point of view proposed, the possibility to escape WCO for specific *wh*-element reduces to the possibility of their trace/copy to be endowed with a referential index, since in that case the intervening WCO pronoun would not count as a potential antecedent and the redundancy causing WCO would not arise (10).

$$(10) \quad \checkmark \lambda_i \dots [pro_i] \dots \textcircled{t_i} \quad \text{No redundancy}$$

Intuitively, in a semantically motivated theory of referential indexes, there are two types of indexes. On the one hand we have the index on object-referring DPs denoting an entity, as standardly assumed; crucially in Q-phrases this index is underspecified and indicated with \emptyset in (11). On the other hand, it is natural to assume that an index denoting a set is present on the ‘familiar’ NP-restriction of the DPs, as in [Enç 1991](#); this index is indicated with j in (11).

$$(11) \quad [{}_{\text{DP}} Q [NP]_j]_{\emptyset}$$

It is this second NP index j that can be ‘transmitted’ to the whole DP-trace when it is a specific *wh*-element. Therefore, Q-traces are generally devoid of a referential index, but in the case of overtly-moved specific *wh*-elements, they can somehow inherit the index of their restriction. The notion of second index of [Enç’s \(1991\)](#) is neatly formalized by enriching [Elbourne’s \(2005\)](#) proposal, where indexes correspond to NPs ([Stanley 2000](#)). In this thesis, one of my aims is to contend that this basic insight can be neatly formalized refining [Elbourne’s \(2005\)](#) semantics of referential expressions - names, pronouns and definite descriptions - and specific and non-specific Q-elements, once we combine them with [Rizzi’s \(2001a\)](#) LF syntax for specific vs. non-specific chains.

Consider the abstract LF configurations in (12-a) and (12-b), where copies/traces are expressed by using the angled brackets notation. According to [Rizzi \(2001a\)](#), if the *wh*-phrase is D-linked, a chain limited to the restriction of the *wh*-element is formed, since the restriction alone is moved, due to its topical nature, to the relevant position within the left-periphery (12-a). Conversely, the non-specific *wh*-phrases form a chain which does not contain the restriction, since the restriction does not have to be interpreted in the left-periphery (12-b). [Rizzi’s](#) configurational definition of chains enforces a *shrinking* mechanism that redefines the portion of structure that counts as a trace, as illustrated in the LF representations below.

$$(12) \quad \begin{array}{ll} \text{a.} & [{}_{\text{TOP}} NP]_j \dots [Q \langle [NP]_j \rangle]_{\emptyset} \dots [pro_j] \dots \langle [Q \langle [NP]_j \rangle]_{\emptyset} \rangle \\ & \text{Specific LF chain} \\ \text{b.} & [Q \langle [NP]_j \rangle]_{\emptyset} \dots [pro_i] \dots [\langle Q \rangle [NP]_j]_{\emptyset} \\ & \text{Non-specific LF chain} \end{array}$$

In the specific configuration (12-a), the restriction coincides with the portion of structure that counts as a trace; in a sense, the specificity index is no longer embedded (it qualifies as the index of the chain), and it is thus

available as an index for the whole DP. More particularly, I propose that the index underspecification on the Q-trace is resolved ‘in-situ’ in this case, by using the index of the NP-restriction, which is directly available in the same syntactic position as an effect of *shrinking*. This explains why the presence of the WCO pronoun, potentially triggering *linking* to resolve underspecification on the Q-trace, is irrelevant with D-linked *wh*-phrases. This LF-mechanism of index-inheritance is excluded with operators moved in the covert syntax: by hypothesis, covert movement cannot consist of successive cyclic steps (Luigi Rizzi, p.c.), to the effect that *shrinking* cannot give rise to any chain only consisting in the NP-restriction of a full DP. In this way, the original insight on the indexing possibilities receives theory-internal conceptual and technical support. This is the gist of my answer to the empirical question raised by crossover.

Putting the three answers together, the overall result is that by combining a semantically motivated theory of referential indexes and specificity with a syntactically motivated chain-formation algorithm at the LF-interface, I arrive at a theoretically principled and empirically adequate theory of crossover as a conflict of fundamental interface economy principles: on the one hand, the principles governing the valuation of underspecified indexes, and on the other hand, the principles governing their interpretation at the LF-interface. This is, in a nutshell, the theoretical contribution to be fully developed in the following chapters.

1.3 CONTENTS

Apart from the present introduction and the conclusions, the dissertation is structured around five chapters devoted respectively to a critical assessment of the received view on crossover, the notion of specificity, the role of specificity in WCO, and the development of my interface account.

THE SECOND CHAPTER begins with the seminal proposal where WCO is put in relation to the paradigm of Backward Anaphora (§2.1.1). In §2.1.2, I show that Wasow (1972), while identifying the phenomenon of WCO, was the first to notice the relevance of specificity for it, too. Despite its merits, this work lacks any insights into how bound variables are obtained in natural language or the proper characterization of the notion of specificity, since they were not a concern at the time. Among the ‘prehistoric’ accounts, I describe the very first analysis by Postal (§2.1.3) since it highlighted some problems of Wasow’s (1972) proposal and inspired some of the analysis of crossover at LF.

Then, in §2.2, I describe the theories of crossover as an LF phenomenon, which tend to assume a clear-cut bipartition between quantificational and referential antecedents. Many proposals have been advanced in the literature, and I will review some of them: Leftness Condition (Chomsky 1976) (§2.2.1), Revised Leftness Condition and Accessibility Condition (Higginbotham 1980b) (§2.2.2), Accessibility Condition (Higginbotham 1983), C-command condition (Reinhart 1983, 1987) (§2.2.3), Bijection Principle (Koopman & Sportiche 1982) (§2.2.4), Parallel Constraint on Operator Binding

(Safir 1984) (§§2.2.5), and the more recent account of Safir (2004) (§§2.3). In the presentation of each proposal I highlight the empirical reasons that motivated it, and show its major shortcomings. I conclude that from the point of view of optimal design they are all stipulative.

Finally, I show that the standardly assumed semantic rules for interpreting structures undergoing QR or *wh*-movement make stipulations on the insertion of indexes that are incongruent with the copy theory of movement (cf. Chomsky 1993: ch. 3). In §2.4, I introduce the interpretive devices used in the current approaches to semantic binding, and highlight the stipulations on the use of indexes they contain. As a matter of fact, in a semantically motivated theory of indexes it is not sound to assume that Q-elements are endowed with a referential index, because of their quantificational, non-referential, nature (see especially Elbourne 2005).

THE THIRD CHAPTER is devoted to the state of the art of the notion of specificity in formal semantics and to putting forward a new analysis of partitive specificity, extending Elbourne's (2005) DP format to indefinites.

I begin the chapter with some preliminaries on indefinites. In §3.1.1 I introduce the difference between referential and quantificational elements and I illustrate the problems faced by this analysis with respect to donkey sentences and discourse anaphora, cases of problematic anaphora (§3.1.2).

To account for problematic anaphora there are two possibilities: one is modifying the machinery for interpreting quantified structures, the other is reviewing the assumption that pronouns are variables. The first path is followed by Discourse Representation Theory (Heim 1982; Kamp 1981) §3.1.3, while the second is developed by the description-theoretic approach to indefinites §3.1.4. This leads to the presentation of Elbourne's (2005) D-type account, which ends up being a general theory of the syntax and semantics of individual referring expressions.

After these preliminaries, in §3.2, I review the analysis of different notions of specificity advanced in the semantic literature. I propose a classification in three main families: scopal specificity, epistemic specificity and partitive specificity. The scopal definition of specificity is the object of §§3.2.1. Fodor & Sag (1982) observed the absence of "intermediate scope" readings for indefinites, and proposed that indefinites are lexically ambiguous between referential elements (of type *e*) and existential quantifiers: only the latter are ever submitted to the usual scope restrictions (§§§. Reinhart (1997) argues instead that "intermediate scope" is actually available: this observation leads her to claim that an indefinite may introduce a variable on choice functions that is bound by an existential closure at arbitrary distance, thus obtaining the intermediate scope readings (§§§3.2.1.2). The common characteristic shared by these analyses is the treatment of indefinites as a "special" category, distinct from ordinary generalized quantifiers, and the interpretation of the ambiguity between

specific and non-specific indefinites as an ambiguity of semantic type. In §§3.2.2, I turn to epistemic specificity, a notion linked to the informative state of the speaker. This view is explicitly advanced by Schwarzschild (2002) reviewed in §§3.2.2.1: specific indefinites are not special, but are simply “singleton” existential quantifiers, whose restriction contains just one element. This makes them scopally inert. Singleton indefiniteness is obtained by (usually implicit) restriction of the domain of the existential quantifier, based on information which is asymmetrically available to the speaker, but not to the hearer. In §§3.2.3, I describe Pesetsky’s (1987) analysis of the discourse properties of interrogative elements. When a *wh*-question asks for answers in which the entities that replace the *wh*-phrase are drawn from a set that is salient for both the speaker and the hearer, the *wh*-phrase is D-linked (§§3.2.3.1). Finally, Enç (1991) provides a formalization of , proposing that indefinites are covert partitives to be characterized by two indexes (§§3.2.3.2).

In the final part of the chapter 3.3, building on the previous results, I advance a unified and explicit syntax and semantics for indefinites, which accounts for the three kinds of specificity which I have identified and defined.

IN THE FOURTH CHAPTER I present a number of operational tests for specificity, to be conceived of as partitivity, advanced in the literature and I use these to test its role in WCO configurations.

§4.1 is devoted to the discussion of Lasnik & Stowell’s classic proposal reintroducing the relevance of the \bar{A} operator in WCO. This, in fact, is the starting point of the proposal to be developed here. §4.2 presents a series of syntactic contexts in which it has been argued that the specificity of the extracted DP plays a crucial role in determining grammaticality. In particular, I will consider (Heycock 1995) in §§4.2.1, (Cinque 1990) in §§4.2.2, participial agreement in French (Obenauer 1994) in §§4.2.3, clitic doubling in Romanian (Dobrovie-Sorin 1994) in §§4.2.4, extraction from existential *there* constructions (Heim 1987) in §§4.2.5, and scope reconstruction (Cinque 1990) in §§4.2.6. The predictions of these tests are discussed in detail in §4.3, where I make some important methodological remarks on the use of such contexts as tests for my hypothesis. Bearing this in mind, in §4.4, I systematically combine these tests for specificity with the WCO configuration and conclude that the resulting evidence confirms the hypothesis: specificity (partitivity) of the *wh*-binder alleviates the WCO effect.

THE SIXTH CHAPTER building on the previous results, is devoted to my view of a transparent syntax/semantics mapping.

In particular, in §§5.1.1, I present Rizzi’s (2001a) proposal on the different nature of specific vs. non-specific chains at LF and in §§5.1.2 I argue that his system can be successfully combined with a semantically motivated use of indexes, implementing a transparent mapping algorithm of the LF chains to the semantics.

Finally, in §5.2, I propose a modified version of the interpretive tools used to obtain BV readings, making a semantically motivated use of indexes, and I show how basic principles of interface economy derive the crossover phenomenology as previously established (§??). In particular, I show how crossover is an effect of the index underspecification in argument position, and how the absence of this effect is derived from the presence of a specified index in argument position, due to *shrinking* and in-situ index inheritance.

IN THE CONCLUSION, finally, I review the results achieved.

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The goal of this chapter is to introduce the crossover phenomenology and to assess some of the analyses that have been proposed, both in syntax and in semantics, to account for it. At the same time I highlight the shortcomings of the proposals, especially from the point of view of optimal design.

The perspective on crossover has undergone important changes, according to the development of the theory of binding relations, among which WCO falls in.¹ While the seminal theories on WCO captured the role of specificity, but did not provide a satisfactory account of the phenomenon, since the introduction of LF, the role of specificity has been expelled from the study of crossover, but the understanding of binding mechanisms has become much clearer.

The discovery and the first studies on WCO, going back to the beginning of the 1970s, rise from a less articulated and very different theoretical framework than today's. In the background of the first analyses we need to consider the studies of (BA). The first proposals of Postal postulate a clear distinction between BA and crossover, and are formulated in terms of the ordering of the rules of pronominalization. Instead, the analysis of Wasow (1972), through the concept of trace, reduces WCO to BA. This proposal strives to capture the role of specificity in WCO phenomena, nevertheless it remains on an intuitive level.

In the following studies, the issue of BA has been considered foreign to the study of sentential syntax, and, with the introduction of Logical

¹ It is important to be careful with the terminology. The term *anaphora* is used to refer to the fact that two DPs have the same reference. Nevertheless, *anaphora* subsequently has come to refer to reflexive expressions and reciprocals in the Binding Theory. Moreover in the case of a quantificational antecedent, the term *anaphora* is inappropriate and we will talk instead of pronouns as bound variables. The term *binding* is a syntactic notion to be kept distinct from the notion of binding of variable (on this distinction, see Reinhart 1987). These notions will be further clarified in the following exposition.

Form (LF) (Chomsky 1976), the interest of generative grammarians has moved to interpretive issues. In this thread of research there is a clear-cut bipartition between referential and quantificational antecedents. In the literature, many proposals in this framework have been advanced. I review some of the more influential analyses in §??: Leftness Condition (Chomsky 1976), Leftness Condition revised (Higginbotham 1980b), Accessibility condition (Higginbotham 1983), c-command condition (Reinhart 1983, 1987), Bijection principle (Koopman & Sportiche 1982), Parallel Constraint on Operator Binding (Safir 1984). In the presentation of each I underline the empirical reasons that motivated it and the more evident shortcomings.

2.1 EXCURSUS ON THE SYNTACTIC ACCOUNTS

2.1.1 *The first analyses*

In the background of the first analysis of WCO, we need to consider the results of the studies on . The backward anaphora paradigm (BA) was discovered by the works of Dougherty (1969); Langacker (1969); Postal (1970); Ross (1969). An example of the paradigm is reported in (1).

- (1) a. *John* stays when you ask *him* to leave.
 b. **He* stays when you ask *John* to leave.
 c. When you ask *John* to leave, *he* stays.
 d. When you ask *him* to leave, *John* stays. (Ross 1967)

The generalization on BA reached by these researchers is essentially the following:²

- (2) If a pronoun is to the left of a DP, then that DP may serve the antecedent of the pronoun only if the pronoun is dominated by a subordinate sentence which does not dominate the DP.
 (Wasow 1972: p.48)

Nevertheless, this generalization must be extended to cover the cases where the pronoun is embedded in a nominal phrase (Jackendoff 1972; Lasnik 1976; Wasow 1979), as illustrated by the data in (3).

- (3) a. The portrait of *his* mother always depressed *John*.
 b. The story about *him* that was making the rounds cost *John* many friends.

Wasow (1972), therefore, proposes to modify the definition in ((2)) to include the data in (3):

- (4) If a DP serves as antecedent of a definite pronoun to its left, the pronoun must be more deeply embedded than the DP.

² Many of the proposals we will review precede the formulation of the *DP hypothesis* (Abney 1987). In general in these approaches, the name has the property to refer to the individual entities of the world; whereas, according to the DP hypothesis, is the determiner to possess this property. In the following exposition I will use updated terminology.

Postal (1970) (who attributes the original observation to Sige-Yuki Kuroda) noted that if a definite pronoun is at the left of a DP, this can be an antecedent for the pronoun only if it is definite (5).

- (5) a. ?*The fact that *he* lost amused *someone* in the crowd.
 b. *The man who lost *it* need to find *something*.
 c. ?**His* realization that the world was exploding alarmed *someone*.
 (Postal 1970)

Postal notes an exception to his generalization. As a matter of fact, generic indefinites behave as definites.

- (6) a. If *he* has an ugly wife, a *man* should find a mistress.
 b. When *they* are angry, *gorillas* can be awful mean.
 c. The fact that *he* is being sued should worry *any businessman*.
 d. The girl who *he* is going to marry can upset *any bridegroom to be*.
 (Postal 1970)

Finally, Wasow (1972) notes another family of exceptions to the generalization on BA. Also specific indefinites must be associated to the the indefinite NPs with respect to the BA relations.

- (7) a. After Bill kissed *her* a *certain young lady* blushed repeatedly.
 b. That *he* was not elected upset a *certain leading politician*.
 c. The woman *he* loved betrayed a *man I know*.

Therefore, specific indefinites and generics can be antecedent for BA if they obey the condition in (4), whereas non-specific indefinites and non-generics cannot be antecedents, despite they obey the condition in (4).³

Wasow (1972) proposes to account for the two classes of exceptions reformulating Postal's (1970) generalization to include them. Wasow introduces the term "determinate" to refer to specific DPs and specific indefinites and generics, defined on the basis of their intuitive "semantic" properties. In his proposal, the property that characterizes specific indefinites, generics, and definites is the fact that they are used referentially: a specific DP presupposed the existence of an individual named by the DP, while generics are used to refer to a class of individuals. In the case of non-specific indefinites and non-generics there is nothing in the context that indicates that the speaker is referring to a particular individual or class. On the basis of the additional information on the existence of a referent provided by specific and generic indefinites, Wasow (1972) proposes the term "determinate". The concept of determination therefore substitutes the one of definiteness in the generalizations by Postal to include the exceptions. The weak point

³ Lakoff (1968) notes another class of exceptions. Subject pronouns behave in a different manner, then other elements in BA configurations:

- (i) a. In *Mary's* apartment, a thief assaulted *her*.
 b. *In *Mary's* apartment, *she* was assaulted by a thief.
 c. It was *John's* dog that hit *him*.
 d. *It was *John's* dog that *he* hit.

These constructions do not respect the condition on BA, since the pronouns is not more deeply embedded than the antecedent, nevertheless the expected agrammatical result is obtained only if the pronoun is a subject.

of this treatment, as admitted by the author, is the intuitive character of the notion of “determinate”. As we will, in the meanwhile semantic theories have been advanced, and one of the goals of this work is to fill this gap.

2.1.2 WCO as backward anaphora

The crossover configurations have been assimilated through the theory of traces to the paradigm of BA (Wasow 1972; Cole 1974; Wasow 1979). These analyses, essentially, dissolve Postal’s (1970) idea of crossover, through the concept of trace as “copy” of the moved phrase.⁴ Therefore, in these approaches crossover is simply a case of the BA paradigm. The case of SCO is directly reducible to the BA paradigm exemplified in (1) and corresponds in particular to the case in (1-b). The case of WCO corresponds to the construction in (1-d) once we consider the variable of the determination of the extracted phrase. From this point of view, the introduction itself of the difference between SCO and WCO is functional to the interpretation of the facts in terms of BA.

So far, we have seen only examples of crossover involving *wh*-movement (interrogatives and relatives). These constructions constitute the paradigmatic case identified by Postal (1971). Wasow introduces in his analysis the traces and advances the hypothesis that the phenomenon is present not only with *wh*-movement, but with all movements that leave a trace in argumental position. Chomsky (1977) notes that many constructions with movement behave similarly to *wh*-movement, with respect to the phenomena that induced him to postulate the existence of traces, and formulates the influential proposal that all movements, leave traces in the base position of the moved element. If we accept this idea, we expect that the constructions at issue interact with the pronouns in the same way of the *wh*-movement cases.⁵

The determination, as we saw in the analysis of BA, remains an intuitive notion and effectively the judgements on the construction where it plays a role are subject to individual variability. Despite this, a strong correlation exists in the judgements on BA in WCO cases. The correlation emerges clearly in the cases of movements other than *wh*-movement.⁶ Compare the judgements in the paradigm of BA in (8), with those of the clefts (9) and the topicalizations in (10).

- (8) a. A man who had heard *it* before interrupted *Bill’s story*.
 b. ?*A man who had heard *it* before interrupted *someone’s story*.
 (Wasow 1979: ex. 18 app. II)
- (9) a. It was *Bill’s story* that a man who had heard *it* before interrupted.
 b. ?*It was *someone’s story* that a man who had heard *it* before interrupted.
 (Wasow 1979: ex. 19 app. II)

⁴ Wasow does not propose that the traces are complete (layered) copies, if they were complete copies he could not account for the constructions in (16).

⁵ Lasnik & Stowell (1991) talk about *generalized WCO hypothesis* to refer to the generalization to all \bar{A} -chains of the WCO effects. Wasow (1972, 1979) actually had already adopted this hypothesis.

⁶ It is significant that the proposal of a complete unification between the two phenomena requires, to be, the hypothesis of generalized crossover.

- (10) a. *Bill's story*, a man who had heard *it* before interrupted.
 b. ?**Someone's story*, a man who had heard *it* before interrupted.
 (Wasow 1979: ex. 20 app. II)

In the case of interrogatives the specificity of *wh*-phrases is variable. The interrogatives with *who*, *whose* or *what* in ((i)) are agrammatical, as the corresponding constructions with an indefinite in (12).

- (11) a. ?**Who* did the woman *he* loved betray?
 b. ?**Whose story* did a woman who had met *him* before interrupt?
 c. ?**What* did the man who lost *it* need to find?
 (Wasow 1979: ex. 21 app. II)

- (12) a. ?*The woman *he* loved betrayed *someone*.
 b. ?*A woman who had met *him* before interrupted *someone's story*.
 c. ?*The man who lost *it* needed to find *something*.
 (Wasow 1979: ex. 22 app. II)

While the interrogatives with *which* and *how many* are much more natural, as the corresponding declaratives with a indeterminate indefinite.⁷ *how many* can have a specific and a non-specific interpretation, when it refers to a quantity ("amount" reading). Clearly, in ((13-b)) the relevant interpretation for Wasow is the specific one.

- (13) a. ?*Which picture* did the man who purchased *it* refuse to sell?
 b. ?*How many dachshunds* does your friend who breeds *them* own?
 (Wasow 1979: ex. 23 app. II)
- (14) a. ?The man who painted *it* refused to sell *one picture*.
 b. ?Your friend who breeds *them* owns *many dachshunds*.
 (Wasow 1979: ex. 24 app. II)

Nevertheless, it is not possible to attain a complete unification between BA and WCO, as we will see in the analysis proposed by Postal, restrictive relatives, despite having a definite head, are ill-formed.^{8,9}

2.1.3 *Wh-Constraint*

Postal (1971) contextually to the discovery of crossover has proposed the first analysis of the phenomenon, and subsequently made some marginal modifications. In Postal's proposal crossover cases, both weak and strong,

⁷ This point is further developed in chapter 4

⁸ While the role of specificity is lost in the following literature that consider paradigmatic of WCO only the non-specific case, other observations present in a nutshell in Wasow's (1972) proposal have been revived, often ignoring the original source. For example Wasow notes that appositive relatives are less agrammatical than restrictive relatives. This observation has been revived by Safir (1986) and by Lasnik & Stowell (1991), but they judge them fully acceptable the corresponding appositives. Another observation that is found in the literature (Postal 1993), concerns the fact that WCO effects are amended when the pronoun occur in context with *even* or *only* (Wasow attributes the observation to a personal communication by Larry Horn)

⁹ For a recent revival of this approach to WCO, see Portolan (2005: ch. 6).

are kept clearly distinct from the BA paradigm.¹⁰ WCO and SCO are accounted for in a different way.¹¹

Postal's (1970) proposal is based on the order of application of the rules in the derivation, according to the spirit of generative grammar at the time. To account for the SCO structures, Postal orders the *pronominal anaphora rule* before the rules of movement.¹²

The case of SCO in ((15)) is excluded since the rule *precede and command* is applied to the deep structure where *who* occupies the trace position.

(15) **Who* did *he* say Mary kissed *t*?

Nevertheless the constructions where the antecedent is embedded in a constituent dislocated to the left of the pronoun are grammatical, whereas if the constituent containing the antecedent is dislocated, the sentences are ill-formed (16-a).

(16) a. **He* finally married one of the women *Bill* had been dating.
b. Which of the women *Bill* had been dating did *e* finally marry?

Postal introduces a second rule of binding to account for the case in (16-b). In particular, this second rule is applied after the transformation of movement and allows the establishment of anaphoric relations between a definite pronoun and a DP to its left, that does not command the pronoun.

Finally, Postal proposes the *Wh*-constraint, a restriction operating in his English dialect. According to this, the derivation in which the respective position of a pronoun and of a "*wh*-form" are inverted through *wh*-movement in the derivation of the surface structure from the deep structure, is ill-formed.¹³ This restriction overlaps to the previous for the cases of SCO, thus it is relevant only for the WCO cases. On the basis of this restriction, all the interrogatives and the relatives with WCO are agrammatical in Postal's dialectal variety of English.¹⁴

To defend his treatment which uses specific rules for the crossover phenomena, Postal offers three pieces of evidence: one based on *wh*-in-situ, one on multiple interrogatives and one on restrictive relatives. But only this last one, seems to undermine the treatment of WCO as BA.

¹⁰ The introduction of the term *crossover* is significant since underline the importance of the position of the antecedent after it has been dislocated to the left of the pronoun.

¹¹ Postal does not differentiate the two phenomena, therefore this feature of his analysis can be grasped, only with hindsight.

¹² The pronominal anaphora rule originally formulated by Langacker (1969) states that an antecedent can bind a pronoun only if the antecedent *precede and command* the pronoun. The precedence relation refers to the linear order and the command restriction is defined as follows:

a node A command a node B if (1) neither A dominates B, neither B dominates A; and (2) the node S that dominates more immediately A dominates also B. (Langacker 1969: p. 167)

¹³ As indicated by the name of the restriction, this applies to the cases of *wh*-movement in its strict sense, in other words Postal does not adopt a generalized perspective on crossover (see §§?? and §§2.1.2).

¹⁴ This explains why Postal (1971) does not grasp the difference between construction with SCO and construction with WCO, considered by him as equally ill-formed. Nevertheless, at a later time Postal modifies his judgements and recognize the in terms of acceptability among SCO and WCO.

In some interrogatives in English the *wh*-phrases can remain in situ and these sentences differ with respect to the binding relations from the interrogatives where the *wh*-element is leftward moved. Among the examples of this kind, there are the “incredulity question clauses” and “legalistic question clauses”. The coreference between pronoun and antecedent in this kind of construction seems much more natural than in ordinary interrogatives.

- (17) a. Finding out *he* won surprised *which* candidate?
 b. ?*Which* candidate finding out *he* won surprised?
- (18) a. Remembering you are under oath, the witness who claimed he had never seen *it* was walking towards *which* building?
 b. ?*what* building was the witness who claimed he had never seen *it* walking towards?

Postal add to *wh-in-situ* in (17) and (18), multiple interrogatives (19).

- (19) a. What tyrant tortured *her* mother in front of what helpless princess?
 b. *The tyrant tortured *her* mother in front of some helpless princess.

The constructions with *wh-in-situ* in (17-a) and (18-a) have been interpreted as echo questions and the multiple interrogatives in (19) as double echo questions. These constructions are possible only in pragmatically marked contexts, where the interpretation of the *wh*-antecedent is presupposed (Wasow (1972, 1979) a.o.). These cases can be reduced to the treatment of the ones with determinate antecedent of Wasow (1972), therefore the absence of WCO does not constitute an empirical proof in favor of the analysis proposed by Postal.

The only serious empirical challenge to the treatment of WCO as BA are the relatives with definite head.¹⁵

- (20) a. ??Mary pities *the man who* the woman *he* loved betrayed *t*.
 b. The woman *he* loved betrayed the *man*.

The construction in (20-a) is ill-formed despite it has a definite head. If the cases of WCO are to be explained in terms of BA, the agrammaticality would remain unexplained, while Postal’s proposal accounts for this fact. As a matter of fact in (20-a) the respective position of the antecedent and the pronoun are inverted by *wh*-movement, thus the structure is subject to the *Wh*-constraint (while (20-b)b) respect the command requirement).

Both Wasow (1972, 1979) and Cole (1974) are conscious of the this problem and have tried to explain it. More particularly, Wasow (1972) suggests that there is a difference between a simple DP and the head of a relative

¹⁵ Grammaticality judgements on English restrictive relatives present in the literature are not completely convergent. Postal (1993: note 1) takes stock of the situation: Lasnik & Stowell (1991: p. 698 and p. 706), Safir (1984: p. 608), Safir (1986: p. 667), Higginbotham (1980b: p. 702) and Cinque (1990: p. 155) state that the WCO effects are present in English restrictive relatives, while Chomsky (1982: p. 93) deny the presence of WCO effects. Nevertheless, as we will in Chomsky (1976: ex. 100-101) the ill-formedness of restrictive relatives is adduced as a proof against the treatment of WCO as BA.

with respect to definiteness; but he concedes that judging the definiteness of a relative pronoun is problematic.

2.2 WCO AT LF

In the framework of the theory of LF, that was shaped starting from Chomsky's (1976) work, WCO is conceived of as completely independent phenomenon from BA. The latter is expunged from the domain of study of the syntax of the sentence since it has a pragmatics character (Chomsky 1976; Reinhart 1983, 1987). This change took place for the greater attention to interpretive semantics, that the introduction of LF involved. While in Wasow (1972, 1979) the WCO configurations are reduced to the case of BA, we can say that in the framework we are about to consider the indefinite cases of BA, are reduced to the cases of WCO insofar as they are considered quantificational, or expunged from the domain of inquiry of the syntax insofar as they are considered referential elements (in particular Reinhart 1983, 1987).

As far as the pronominalization relations are concerned, in this framework it is crucial to distinguish between referential and quantificational antecedents. In the first case, pronouns are used in coreference or coincident reference with the referential antecedent, while in the second case they are used as bound variables, that is their values vary according to the assignments of value of their quantified antecedent.

The introduction of this bipartition of the antecedents meant neglecting Wasow's (1972) observation on the determinateness of the antecedents. A more refined theory of the chains at LF, allows us to overcome this bipartition and to account for the role of specificity.

2.2.1 Leftness Condition

The idea of LF was originally crystallized in Chomsky's (1976) proposal, in which he shows that the condition on anaphora, and in particular the use of pronouns as bound variables, are effectively defined at LF. Chomsky accounts separately for the SCO and the WCO effects, but in both cases his explanations based on the LF configurations.

As for the cases of SCO, Chomsky proposes that the trace in subject position in (21-a) functions as the name *John* in (21-b):¹⁶

- (21) a. **Who* [*he* said Mary kissed *t*].
 b. **He* said Mary kissed *John*.

Traces are equated to referential expressions, thus in terms of the theory of binding these examples are considered cases of violation of the condition C, which establishes that a referential expression must be A-free.

Chomsky underlines that it is incorrect to speak about anaphoric relations between the pronoun and the *wh*-element since the latter is a

¹⁶ The examples are quoted from Chomsky (1976) with minor modifications for the present exposition, but the judgements are not. As a matter of fact, Chomsky (1976) does not provide grammaticality judgements in the form of diacritics, but talks about the possibility or impossibility of the bound reading of the pronoun.

referential expression: the operator by it self cannot function as antecedent since it does not possess a referential value.

For the WCO cases Chomsky (1976) proposes to assimilate at LF the constructions in (22-a), (22-b) and (22-d) through the movement of the quantifier at LF of (22-c).

- (22) a. ?*Who did the woman *he* loved betray?
 b. ?*The man *who* the woman *he* loved betrayed - is despondent.
 c. ?*The woman *he* loved betrayed *someone*.
 LF: [_S *someone* [_S the woman *he* loved betrayed *t*]]
 d. The woman *he* loved betrayed *John*.

The conditions for anaphora do not allow for an explanation of these cases. As a matter of fact, the example (22)d, involving the referential expression *John* as antecedent, is grammatical. As for Wasow's (1972) analysis, according to which *wh*-elements are equated to indefinites since they share the indeterminateness, Chomsky challenges this with empirical and conceptual arguments. From the conceptual point of view, it does not make sense to speak of anaphoric relations between the pronoun and indeterminate elements, since they lack reference. Moreover, despite it is clear that we need to capture the cases involving indefinites (excluding specific and generics) and traces left by *wh*-movement in interrogatives and relatives, it is unclear which semantic property they share, in other words it is unclear what determinateness is. From an empirical point of view the case of relatives with a definite head (22-b) remains problematic.

The sentences in (22) have parallel structures at LF, thus it is natural to explain them through a common principle. Chomsky proposes the following condition, christened "Leftness Condition" (LC) by Higginbotham (1980b):

- (23) A variable cannot be antecedent for a pronoun to its left.

Chomsky paraphrases the "Leftness Condition" with the following phrasing:

- (24) [...] a pronoun P in the scope of a quantifier can be rewritten as variable bound by the quantifier unless P is at the left of an occurrence of a variable already bound by this quantifier.

The condition in (24) includes a second condition on the pronouns as bound variables identified by Chomsky (1976): a pronoun to work as a variable bound must be in the scope of its operator. Since, quantification is restricted to the clause that contains the quantifier, we can obtain the bound reading of the pronoun in (25) but not in (26).¹⁷

- (25) a. *Every soldier* has *his* orders.
 b. *Every soldier t* has *his* orders.
 (26) a. *[*Every soldier* is armed], but will *he* shoot?
 b. *[*Every soldier t* is armed], but will *he* shoot?

¹⁷ For a more in depth discussion of quantifier movement see §

Both the structure at LF in (25-b) and (26-b) respect LC, but in (26-b) the pronoun is not in the scope of *every soldier*. In the case of this condition, the rules of anaphora apply to structures at LF.¹⁸

Chomsky proposes to add to the construction in (22), as a further proof, the sentences with focalized antecedents (27).

- (27) a. ?*The woman *he* loved betrayed JOHN.
b. The woman *he* loved betrayed John.

Since the construction in (27-a) displays WCO, the focal accent confers to *John* the status of variable with respect to LC. Chomsky, thus, proposes that focalized structures have LF representation of quantificational type.

Researchers that studied WCO following the path of the proposal I sketched have highlighted some weaknesses that will be described in detail in the review of the proposals of these researchers in the following of this section. In particular, it has been noted that the condition in (23) is expressed in linear terms. This is a conceptual problem if LF is a syntactic level whose principle should operate in a hierarchical way.¹⁹ Furthermore, researchers have showed that from an empirical point of view the principle is too strong in some cases and too weak in others. On the other hand, Chomsky (1976) himself concedes that the evidence he brings is insufficient to define the rule precisely.

Some features and problems of the Chomskyan proposal have not been highlighted by the authors that have tried to improve it. The proposal of the LC reformulated in representational terms the derivational restriction originally proposed by Postal (1970). Like that one, this one too overlaps to another principle for the SCO cases, that is the condition C. Despite it is not explicitly stated, it seems that the overlap accounts for the greater agrammaticality of the SCO cases. The fact that for the SCO cases an additional restriction is necessary emerges considering the BA paradigm: in the cases where the pronoun is not embedded it is not possible to have a rightward antecedent, even if it is determinate.²⁰

Postal (2004) critically analyzes the problems of Principle C to account for the cases of SCO and highlights many defects. As an example consider the paradigm in (28): in (28-a) backward binding of the object pronoun *her* by *Gladys*, inside the adjunct, is allowed, therefore, the object does not C-command the element in the adjunct, otherwise there would be a violation of the Principle C. But (28-b), involving an extraction from the adjunct, shows that, in effect, the object C-commands the trace, since the sentence is ungrammatical.

- (28) a. The doctor told *her* that story while treating *Gladys*.

¹⁸ This restriction, as we will see, is captured directly by the treatment of Reinhart (1983, 1987) through the c-command requirement at LF. While the other approaches seem to need this further restriction.

¹⁹ Moreover, Bianchi (2001) notes that LC cannot even be formulated in terms of the Minimalist Program: since linearization happens at PF, linear restrictions cannot be expressed at LF.

²⁰ In the area of the hypothesis on crossover at LF, the necessity of an additional or different principle to account for the cases of SCO emerges considering the Weakest Crossover paradigm (see §4.1). The constructions that according to Lasnik & Stowell (1991) do not give rise to WCO, give systematically rise to SCO.

- b. *It was *Gladys* who the doctor told *her* that story while treating *t*. (Postal 2004: ex. 70c-d)

The example in (28-b) manifests an extraction from an island. Nevertheless Postal shows that the simple extraction from an island, even when produces a strongly agrammatical result, does not inherently block binding if this is available in the structure, before the extraction. Consider in this respect the example in (29): while the case with extraction from a subject island (29-b) is completely unacceptable, “there is no more interference with the binding relations indicated then there is in the case without extraction” (Postal 2004: p. 15) in (29-a)

- (29) a. I found that Jane and *Mark* both said you would hire *him*.
 b. *It was *Mark* *who* I found that Jane and *t* both said you would hire *him*. (Postal 2004: ex. 47a-b)

Summarizing the data in (28) suggests that it could be advisable to modify principle C.

Finally, the analysis of the focus in terms of LF movement is problematic. In particular, the focalization does not seem to respect syntactic constituency (Jackendoff 1972; Zubizarreta 1998):

- (30) What happened to John ?
 MARY KISSED John.

Despite the problems, following this analysis, the presence and the absence of WCO has become a standard test to establish the quantificational nature of an antecedent.

Finally, the cases of Weakest Crossover (see §4.1) are a problem for the analysis of WCO since the configurations violate the condition, nevertheless on the basis of the judgements of Lasnik & Stowell (1991) are completely acceptable.

2.2.2 LC reformulated and Accessibility Condition

Higginbotham (1980b) proposes a unified treatment of the SCO and WCO cases, as violation of the LC come, opportunely modified.

The author notes the following exception to the LC.

- (31) a. Some musician_{*i*} will play [every piece you want him_{*i*} to]_{*j*}.
 b. some musician_{*i*} *t_i* will play [every piece you want him_{*i*} to]_{*j*}.
 c. some musician_{*i*} [every piece you want him_{*i*} to]_{*j*} *t_i* will play *t_j*.

The LF representation in (31-c) violates the LC, but the bound reading of the pronoun *him* is grammatical.

Higginbotham notes that in the intermediate representation in (31-b) the condition is respected. This consideration leads him to reformulate the LC as a derivational condition on coindexation, a rule that applies to every level.

- (32) *j* can become *i* in a configuration [*e_i pro_j*]

This condition established that a pronoun *pro* can be coindexed with a variable *e* only if the variable is to the left of the pronoun. Nevertheless, Higginbotham notes that both formulations of the LC do not account for another group of exceptions: the cases of *inverse linking* (May 1977). Consider the following SCO examples with quantifiers and *wh*-operators.

- (33) a. *Its_i climate annoys [someone in every city_i]_j.
 b. *every city_i [someone in t_i]_j its_i climate annoys t_j
- (34) a. *[Which picture of which man_i]_j does he_i like t_j.
 b. *which man_i [which picture of t_i]_j does he_i like t_j.

The constructions in (34) are cases of SCO. The bound reading of the pronoun in both cases is not available, despite the fact that the original formulation of LC is respected. Thus, the LC is too weak a condition on crossover to account for “transitivity” effects that these constructions display. To solve this problem, Higginbotham (1980b) proposes another restriction, the C-constraint.


- (35) A pronoun_j cannot change index in *i* if this give rise to a configuration of the form:
 $\dots (\dots e_i \dots)_k \dots \text{pronoun}_i \dots e_k \dots$

However this condition appears not enough general, since it accounts for the transitivity of crossover only for a level of embedding (Higginbotham 1980a):

- (36) a. *[Which picture of [which daughter of which man_i]_j]_k does he_i like t_k.
 b. *which man_i [which daughter of t_i]_j [which picture of t_j]_k does he_i like t_k.

The challenge raised by transitivity is solved in Higginbotham (1983). In this work the author proposes a revision of the binding theory of Chomsky (1981). The proposal of Higginbotham on crossover is based on SCO, and not WCO. Nevertheless, it can easily be extended to the treatment of the latter. The author notes that the construction in (34) seems to be a counterexample to the treatment of traces as referential expressions: *he* and the trace are not coindexed in (34-b), thus the sentences should be excluded. The explanation in terms of LC (Higginbotham 1980b,a) is abandoned in favor of one based on c-command, adding a mechanism to account for transitivity.

Linking in this proposal takes place freely at S-Structure between A-positions, and, by convention, it applies between a moved phrase and its trace.²¹ Another condition requires that the variable C-commands the pronoun. These two ingredients account for the LC effects.

- (37) ?* [Every boy] loves his mother.


²¹ Higginbotham (1983) proposes a mechanism of “linking” alternative to coindexation to account for anaphoric relations with plurals. Linking is crucially different from coindexation since it establishes an asymmetric relation.

(38) ?* [Every boy] t loves his mother.

In (37) the pronoun is bound to the A-position occupied by *every boy*. In the LF representation (38) the pronoun remains bound to this position, that, at this level, is instead occupied by a variable bound, by convention, by the A-operator. The pronoun in (38) is said to be dependent on the variable.

(39) *[Which boy]_i does his_i mother love t_i?

In this configuration the pronoun cannot be c-commanded directly from the operator since the latter does not occupy an A-position, at the same time it cannot be dependent on the variable since it is not bound by the trace in object position.

To account for the transitivity cases, the restriction on c-command that we adopted is too strict. It is sufficient that the variable is contained in an operator whose variable c-commands the pronoun, more perspicuously, c-command can be indirect. Higginbotham (1983) implements this idea through the accessibility condition, based on the notion of variables chain.

A variable chain (V-chain) is a sequence of variables (v_1, \dots, v_n) where every variable v_i , $1 \leq i \leq n - 1$, is contained in the binder of v_{i+1} . For example (34-b) (t_i, t_j) forms a variable chain since t_i is contained in the binder of t_j ; construction with longer V-chains, like the one in (36-b), can be easily constructed.

A pronoun dependent on a variable v must be accessible to v through a V-chain. Suppose that a pronoun P is dependent on a variable and C is the longest V-chain (v_1, \dots, v_n) such that v_1 is v and the binder of v_n does not contain P:

(40) P is accessible to v if v_n C-commands P; P is not accessible to v if P C-commands v_n . (Higginbotham (1983: p. 410))

(41) If a pronoun P depends on a formal variable v , then P is accessible to v . (Higginbotham (1983: p. 410))

The accessibility condition accounts for the cases where the bound reading of the pronoun is grammatical or agrammatical for transitivity, both in the cases of SCO and WCO. For example in the sentence (36-b) *he* has as antecedent the variable t_i which is the head of the V-chain (t_i, t_j) , but since *he* c-commands t_k it is not accessible to t_i .

The mechanism can be applied to WCO cases, even if Higginbotham does not make this extension. Actually, in the WCO configurations the pronoun does not C-command a variable, nevertheless it is c-commanded by no variable, therefore is inaccessible on the basis of (40). As an example, consider the WCO cases with quantifier in (42) and the interrogatives in (43).

In the LF representation of (42-a) the pronoun is not c-commanded by the trace of *every boy* in object position, therefore it is agrammatical. The pronoun in (42-b)b is not accessible for transitivity since in the LF representation the trace of the element containing *every boy* does not c-command the pronoun. A similar reasoning accounts for the interrogatives in (43).

- (42) a. *His_i mother loves [every boy]_i.
 LF: [every boy]_i his_i mother loves t_i
 b. *his_i mother loves every boy_i's father.
 LF: [every boy]_i's [t_i father]_j his mother loves
- (43) a. *[Which boy]_i does his_i mother loves t_i?
 b. *[[Which boy]_i's father]_j does his_i mother love t_j?

Higginbotham's (1983) proposals include a principle for assigning scope to the operators.

This explanation aim to be an alternative to the principle C in accounting for SCO. Nevertheless, if we extend the account to the WCO cases, it is not possible to account for the difference in grammaticality perceived in the two cases, nor for their different behavior in the Weakest Crossover contexts, in SCO and WCO.²²

The discovery of the transitivity effects in crossover is the most important contribution of the proposal, but the explanation in terms of V-chains and the Accessibility condition remains ad-hoc. Moreover the condition must be supplemented by the assumption that pronominal elements can be bound only by A positions.

2.2.3 C-command condition

Reinhart (1983, 1987) proposes to reduce binding theory to the condition on pronouns as bound variables. Pronouns used as bound variables are subject to the conditions of binding theory, while the pronouns used referentially are not subject to any principle of grammar: their behavior should not be the object of study of the sentential syntax. According to Reinhart pronouns can be bound not only by referential expressions such as QNP and *wh*-operators, but also by referential expressions that give rise to sloppy readings in VP ellipsis contexts. Reinhart (1983) assumes that every pronoun that is coindexed with an NP is interpreted as a variable. In the case of QP and *wh*-operators the variable is bound by the operator, while in the case of definite NPs, the pronominal variable is bound by the λ -operator, that is the predicate on the NP. This yields the sloppy readings in VP ellipsis contexts (44).²³

- (44) John λx_i x_i loves his_i mother.

Besides these cases involving a binding relation, two referential DPs appear in a binding relation, but in reality the coindexation is only apparent: it is instead *accidental coreference* (obtained deictically) and not binding.²⁴ Pronouns used in this way are no coindexed with a DP, nevertheless they can be coreferential with a DP on the basis of pragmatic principles.

²² Actually the extension to the WCO cases is not advanced by Higginbotham (1983).

²³ An example of sloppy reading in VP ellipsis context is given in (i):

- (i) John loves his mother and Bill does too.

The sloppy reading is obtained when *his* in the elliptical VP refers to Bill, that is "John loves John's mother and Bill loves Bill's mother". Obviously the sentence give rise to a non-sloppy reading, called the strict reading, where *his* refers only to the mother of *John*.

²⁴ Reinhart revives for this aspect the proposal in Lasnik (1976)

Reinhart (1983) does not adopt the free coindexation mechanism (excluded for restriction on output levels in Chomsky (1981)), but formulates binding theory as a set of restrictions operating on the coindexation procedure itself. Pronouns can be coindexed only under c-command. A pronoun [+pronominal, -anaphoric] cannot be coindexed with a position inside its Minimal Governing Category (MGC), whereas an anaphor, that is an element [-pronominal, +anaphoric], must be coindexed with an element in its MGC.²⁵ Moreover Reinhart assumes that quantifiers move at LF and postulate that elements in Comp cannot C-command a pronoun. The *C-command Condition - CCC* is formulated as follows:

- (45) Quantified NPs and *wh*-traces can have anaphoric relations (that is binding) only with pronouns in their syntactic domain of c-command. (Reinhart 1983: p. 122)

This requirement clearly expresses directly in its formulation a scope requirement.

The condition described accounts for the restrictions on the basis of the use of pronouns as bound variables:

- (46) a. *Every boy* loves *his* mother.
 b. **His* mother loves *every boy*.
 c. *Who t* loves *his* mother?
 d. **Who* does *his* mother love *t*?

In (39) *every boy* c-commands *his* and the pronoun can be interpreted as a bound variable, whereas in (40), since there is no *Quantifier Raising - QR* in the system described, *his* is not c-commanded at any level, therefore coindexation is impossible. In (41) *his* is c-commanded by the trace of *who* while in (42) the trace in object position does not c-command the pronoun and the *wh*-element is in Comp; therefore coindexation is excluded.

Reinhart notes that from an empirical point of view the principle she proposes (as the LC) is too strong in certain cases. She proposes the following contrasts (47) and (48).

- (47) a. Near *his* child's crib *nobody* would keep matches.
 b. *Near *his* child's crib you should give *nobody* matches. (Reinhart 1983: p. 129)
- (48) a. For *his* birthday, each of the *employees* got a Mercedes.
 b. *For *his* birthday, we bought each of the *employees* a Mercedes.

In both construction in (47-a) and (48-b), the pronoun linearly precedes the quantificational antecedent and its trace at LF, violating the "Leftness Condition"; nevertheless the bound reading is agrammatical in both cases. To distinguish between the sentences in (a) and (b), of the examples (47)

²⁵ Reinhart (1983) defines in these terms the MGC (Reinhart 1983: p. 139):

The *element governing* a certain node α is, intuitively, the node that assigns it case and can be for example N, V, INFL or P. The *governing category* of α (GC) is every node S or NP that contains α and the *governing element* of α . The *minimal governing category* of α (MGC) is the GC of α that does not contain another GC of α (that is it is the node S or NP that immediately dominates α that dominates also its *governing element*).

and (47-b), Reinhart introduces a modified notion of c-command according to which a preposed complement PP is c-commanded by a subject, but not by an object.

Reinhart (1987) adopts the rule of QR at LF and Chomsky's (1981) proposal that DP coindexation can obtain freely. The first move, makes possible the coindexation of *his* with *every boy* in (40) at LF. To exclude this possibility, Reinhart assumes that the c-command requirement in (45) must apply at S-Structure.

This requirement excludes the legitimate binding cases from the prenominal possessor originally noted by Higginbotham (1980b) (49).

- (49) a. [Every boy's father] thinks *he* is a genius.
 b. [Some boy's [father's [best friend's [daughter]]]] wants *him* to marry her. (Higginbotham 1980b: p. 691)

Both structures in (49) are grammatical, despite the QP in the Spec of the subject cannot c-command outside of the latter. To explain these cases, Reinhart (1987) proposes to modify the notion of c-command so that the specifier of an NP c-commands all the structure c-commanded by the DP itself (*Specifier Binding*).

This ad hoc move, does not remove the problem since now the agrammaticality of the construction (50) remains unaccounted for.

- (50) *[[Every girl]_{*i*}'s father] admires herself_{*i*}. (Kayne 1994: p. 27)

Finally, the CCC does not differentiate SCO and WCO cases, therefore cannot account for the grammaticality difference and the different behavior in Weakest Crossover contexts.

2.2.4 Bijection principle

Up to Chomsky 1981 variables were characterized as traces of movement from A-positions to \bar{A} -positions. Chomsky (1981) proposes a functional definition of syntactic variable according to which the nature of a variable is determined by looking at the closest antecedent

- (51) α is a variable if and only if:
 a. α is an empty category.
 b. α is in A-position.
 c. α is locally \bar{A} -bound.

Koopman & Sportiche (1982) shows that resumptive pronouns in Vata behave as variables in the terms of the definition in (51), since are subject to the WCO effects. In the constructions with *wh*-movement from a finite sentence, is obligatory to insert a resumptive pronoun in the subject position to avoid an ECP violation:²⁶

²⁶ Koopman & Sportiche (1982) claim that the resumptive pronoun in these cases has a different tone with respect to third person singular non-resumptive pronouns. When it is used as resumptive element, the pronoun has a low tone (ˈɔ, i, ...) whereas when it does not have a resumptive function it has a medium-high tone (ɔ̂, î, ...). Therefore Vata differentiates with the tones the resumptive pronominal series from the standard pronouns. This observation contradicts McCloskey's (2004) hypothesis that the resumptive series is identical to the non-resumptive.

- (52) a. àló *(ò) mlì lá
 who *(he) has left *wh*
 ‘Who has left?’
 b. yī ò gūgū nā *(ì) bìlì lá
 what you think that *(it) sentiva *wh*
 ‘What did you think happened?’
 (Koopman & Sportiche 1982: p. 142)

On the other hand, these pronouns present WCO effects and therefore seems to behave as variables.

- (53) a. *àló_i ò́ nò gūgū nā ò_i mlì lá
 who_i his_i mother thinks that he_i left *wh*
 ‘Who his mother thinks has left?’
 b. *àló_i ò́ yrá ò_i nò nā ò_i mlì lá
 who_i you say his_i mother that he_i left *wh*
 ‘Who did you say to his mother that left?’
 (Koopman & Sportiche 1982: p. 143)

The pronoun with a low tone cannot be interpreted as coreferent with the underlined medium tone possessive pronoun (since it is not resumptive). On the basis of these data, therefore, the first part of the definition of variable in (51) can be eliminated: for an element to behave as a syntactic variable it is not necessary that it is null.

To account for the WCO configurations, Koopman & Sportiche (1982) propose the Bijection Principle (BIP).

- (54) There is a bijective correspondence between variables and \bar{A} -positions.
 (Koopman & Sportiche 1982: p. 146)

According to this principle, in a WCO configuration where there is no c-command relation between the trace T and the pronoun P, both P and T count as variables: neither of the two binds the other, therefore they are both bound by the *wh*-phrase or from the QP. The principle accounts for the restrictions on the basis of pronouns as bound variables.

- (55) a. *Who t* loves *his* mother
 b. **Who* does *his* mother love *t*.

In (55-a) the pronoun is not a variable in the sense of the proposed principle since it is locally A-bound by the trace in subject position. Therefore, the operator *who* binds one variable only, *t_i*; the Bijection Principle is respected and the pronoun can be interpreted as a variable in semantic sense. In (55-b) both the pronoun and the trace are syntactic variables, therefore the operator *who* binds two variables and the principle is violated.

Koopman & Sportiche (1982) assume an independent *Scope Condition*, similar to the LF c-command requirement of Reinhart and to the scope requirement of Chomsky:

- (56) A pronoun can be coindexed with a bound variable by a (semi-)quantifier (that is *wh*-phrases and quantifiers subject to QR) only if it is in the scope of the (semi)-quantifier at LF.
 (Koopman & Sportiche 1982: p. 150)

As an independent proof for the BIP, **Koopman & Sportiche (1982)** propose the following example.

(57) **Who* did you give [a picture of *e*] [to *e*].

The authors note that their analysis makes very similar predictions to **Reinhart's**, but they reach it in a different way. Consider the following paradigm:

- (58) a. **Who* did *he* see *t*?
 b. **Who* does *his* mother like *t*?
 c. *Who* *t* saw *his* mother?
 d. **His* mother wonders *who* *t* left

The c-command condition excludes all the agrammatical sentences in (58) while for **Koopman & Sportiche's (1982)** proposal (58-a) is a violation of the principle C, (58-b) is a violation of the BIP and (58-d) is a violation of the scope condition. The violation of the scope condition and the Principle are more severe than the WCO violation for **Koopman & Sportiche (1982)**.²⁷

Despite the important differences between BP and CCC highlighted by **Koopman & Sportiche (1982)**, the two approaches are quite similar in their empirical predictions. A pronoun that is bound by an NP in an A-position at S-structure, generally will be locally A-bound by the same DP at LF, thus it is an irrelevant case for the BP. On the contrary, a pronoun that is not A-bound at S-structure will be locally \bar{A} -bound by every coindexed operator that c-commands it at LF and therefore it violates BP. The similarity between the two approaches leads to similar problems. So the BIP excludes all the examples that are well formed for transitivity, such as the inverse linking case in (59):

(59) [every city]_{*i*} [someone in *t_i*]_{*j*} *t_j* hates *it_i*.

Every city in this LF representation \bar{A} -binds locally both its trace and the pronoun in subject position, therefore it violates the BIP.

2.2.5 Parallel Constraint on Operator Binding

Safir's (1984) proposal tries to overcome some shortcomings of the BIP, but shares with it the background assumptions, in particular the definition of variable.

Safir (1984) proposes three contexts where the BIP is too strong.

The sentence in (57) with parasitic gaps given by **Koopman & Sportiche (1982)** as independent proof for the BIP is judged grammatical by **Safir**, whereas if in the position of one of the two gaps there is a pronoun, the sentences become worse.

- (60) a. ??*Who* did you give a picture of *him* to *e*.
 b. ??*Who* did you give a picture of *e* to *him*.
 c. *Who* did you give a picture of *e* to *e*. (**Safir 1984**: pp. 605-606)

The same happens in the cases of extractions "Across the Board":

²⁷ Despite the author do not mark the sentences with different diacritics.

- (61) a. I know *who* [[John likes *t*] and [Mary hates *t*]]
 b. *I know *who* [[John likes *him*] and [Mary hates *t*]]
 (Safir 1984: p. 609)

Finally, Safir revives a contrast originally proposed by Higginbotham (1980b) with respect to the WCO effect in “PRO Gates” contexts:

- (62) a. *Who* did [PRO getting *his* car fixed] upset *t*?
 b. **Who* did [*his* getting *his* car fixed] upset *t*?
 (Safir 1984: pp. 611-612)

On the basis of these consideration, the author proposes the Parallel Constraint on Operator Binding (PCOB):

- (63) If O is an operator and *x* is a variable bound by O, then for every *y*, *y* a variable bound by O, *x* and *y* are [α -lexical]. Safir 1984: p. 615

This restriction blocks the usual cases of WCO, where a pronoun ([+lexical]) and a trace ([−lexical]) are both \bar{A} -bound by an operator, but does excludes the case (60-c), (61-a), and (62-a) since they all contain non-lexical variables ([−lexical]).

Safir postulates a supplementary mechanism similar to the variables chains assumed by Higginbotham 1983 to account for transitivity effects. Safir proposes the following definition of Q-chain (64).

- (64) A Q-chain is a sequence of \bar{A} -bound constituents [O_1, O_2, \dots, O_n] such that O_{m-1} binds a variable in O_m for each value of m . O_1 , the initial phrase of the Q-chain, is the “head of the Q-chain”. The variable bound by O_n is the variable of the Q-chain.
 (Safir 1984: p. 626)

The Q-chain definition captures transitivity relations. Safir considers two possibilities to use it to make immune from PCOB the cases with transitivity. One way, consists in assuming (65).

- (65) A variable of the Q-chain head is “analyzable” for PCOB, unless it is c-command by the variable of the Q-chain. (Safir 1984: p. 627)

The second possibility is stating the index of the head of the Q-chain must be attached (under a slash) to the variable index. This mechanism permits to analyze the inverse linking cases.

- (66) [[some city]_{*i*} [[everybody in *t*_{*i*}]_{*j*} [*t*_{*j*/*i*} hates its climate]]]

The variable of the Q-chain in subject position *t*_{*j*/*i*} counts as A-binder of the pronoun in object position, since the index of the pronoun is adjoined to the index of the variable. Therefore, the pronoun does not count as a syntactic for the PCOB.

Through these assumption, transitivity effects seems to be reduced to binding theory Nevertheless, as in the case of the extension of the C-command requirement by Reinhart (1983, 1987), problems arise in the standard case of the anaphors’ A-biding (see the discussion of (50), §§2.2.3). Moreover, the mechanism to account for the transitivity effects, seems to be ad-hoc, as the one proposed by Higginbotham.

2.3 STIPULATIONS OF SYNTACTIC ACCOUNTS

The theoretical challenge raised by crossover forces the assumption that there are syntactic dependencies among argument positions subject to restrictions that rule out the crossover cases. Two main families of approaches to the problem of pronominal dependencies have been advanced in the literature, but, despite the fundamental differences, both approaches must be supplemented with ad-hoc syntactic constraints to account for crossover. Since the constraints deriving the ill-formedness of crossover are not independently justified, they amount to stipulations. Therefore, these syntactic proposals, departing from the optimal view that BV readings are the result of pure semantic binding and being based on conditions devoid of any independent syntactic justification, fail to provide a principled answer to the crossover puzzle, and fall short of explanatory adequacy.

One family of theories of dependencies is based on the traditional symmetric indexing mechanism to express relations. Generally, in these theories, the constraints on the indexing possibilities are expressed through some version of the *c-command licensing principle* (CLP) spelled-out in (67):

- (67) *C-command licensing principle* (CLP)
 If x depends on y , then y has to *c-command* x .
 (Safir 2004: p. 3, cf. Reinhart 1976)

This principle is a generalized version of the *c-command* condition introduced in the influential thesis of Reinhart (1976). The CLP is a sound principle expressing an important constraint on the mapping between syntax and semantics, and accounts for important aspects of bound variable readings and scope phenomena at LF as a result of PA. As for scope, a λ -operator gets scope over another only if it *c-commands* the latter at LF; concerning binding, only the expressions *c-commanded* by a λ -operator can be bound by it.

Under this view, Binding Theory is reduced to the conditions on pronouns as bound variables. Crucially, in this system, the indexing of pronouns responsible for BV readings can obtain only under *c-command*. Reinhart proposes that only bound pronouns are subject to the grammatical principles of Binding Theory, whereas referential pronouns are not subject to any grammatical principle, but only to pragmatic constraints. More precisely, two referential DPs are not in a relation of binding, but of accidental co-valuation.²⁸

The attempts to extend this principle in order to account for crossover (Reinhart 1983, 1987) are orthogonal with respect to the original *raison d'être* of the CLP. As a matter of fact, in crossover configurations, the

²⁸ A part the cases of sloppy readings in VP deletion contexts, which are instances of true binding. Consider the following sentence:

- (i) John loves his mother and Bill does too.

The sloppy reading is obtained when the elliptic VP refers to Bill, that is 'John loves his mother and Bill loves his mother'. Of course, the non-sloppy, or strict, reading is available as well, in that case *his* refers only to the mother of John.

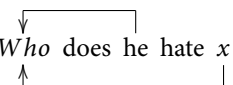
pronoun is c-commanded by Q at LF, therefore the CLP alone is not enough to provide any explanation for crossover. In order to derive crossover from the CLP it is necessary to add something to the principle or simply to postulate that it applies at Spell-Out. The first approach has generally consisted in adding a stipulation that forces the pronoun to depend on the trace of the quantifier, but this move is conceptually dubious under the view that pronouns are bound through PA. On the other hand, forcing CLP to directly apply at Spell-Out (as proposed by Reinhart 1987), produces a clash with the fundamental empirical support for QR and the computation of scope and binding relations after QR has applied. In other words, there is no independent motivation, apart from crossover, for assuming that CLP applies before QR or for assuming that QR does not apply. To sum up, CLP is orthogonal to the problem of crossover, which remains unexplained.

An alternative to the CLP perspective is advanced by Safir (2004). His system departs from the one above in two fundamental respects: he assumes a mechanism of asymmetric *linking* (Higginbotham 1983), instead of symmetric indexing, and proposes that dependent identity interpretations are restricted by a c-command prohibition, not by a c-command licensing condition: c-command does not license dependencies but rules them out.

- (68) *Independence principle* (INP)
If x depends on y , then x cannot c-command y . (Safir 2004: p. 3)

In this system co-valuation of two DPs is encoded by *linking* and grammatical principles are intended as constraints on *linking*.

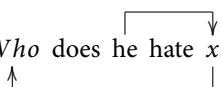
From this perspective, crossover can be viewed as a failure to create a dependency relation in the syntax, since this dependency would imply a violation of INP. However, in order to create the required configuration we have to rule out the possibility that the pronoun directly depends on the operator (in traditional terms, an \bar{A} -dependency). For example, in (69) the pronoun does not c-command the operator, thus INP is respected.

- (69) *Who does he hate x
- 

In order to model crossover in terms of an INP violation, Safir (2004) is forced to introduce the condition in (70), which essentially rules out \bar{A} -dependencies.

- (70) *Quantifier dependency condition* (QDC)
 x can be interpreted as dependent on a quantified antecedent y only if x is a q-variable of y or x is dependent on a q-variable of y , or there is no q-variable of y . (Safir 2004: p. 72)

Now, the pronoun can only be dependent on the trace which it c-commands. Therefore, strong crossover is excluded as an INP violation (71).

- (71) Who does he hate x
- 

WCO is derived as a result of an additional principle, spelled-out in (72).

- (72) if a subpart of x is dependent on y , then x is dependent on y .
(Safir 2004: p. 71)

This principle is intended to extend the account to the configurations where the offending pronoun is embedded within the constituent that c -commands the Q-trace, that is, WCO configurations. In this way, the explanation for SCO and WCO is elegantly unified. At the same time, we have a natural explanation for less robust agrammaticality judgements in WCO, since the dependency established between the pronoun and the trace of the operator is an indirect one, therefore a milder violation is expected, as a result of the application of (72).

In our terms, the problem of Safir's (2004) proposal is that QDC stipulates that a pronoun can be turned into a bound variable only by being linked to the Q-trace, raising the issue of why this should be the case. Whereas INP is a plausible constraint on *linking* and as such it does not constitute a departure from optimal design, QDC (70) and the 'subpart principle' (72) are introduced only to the purpose of deriving crossover effects, for which INP does not suffice, as seen above. It remains thus to be seen whether the challenge posed by optimal design can be met in other ways.

Summarizing, crossover accounts based on CLP and INP are forced to introduce conditions in the syntactic component that are not independently justified and that do not qualify, consequently, as part of an optimal system for creating bound variable readings. More precisely, QDC is not compatible with the idea that BV readings are the result of semantic binding, whereas CLP is a sound and semantically justified principle of grammar, but it is not able to provide an answer to the question raised by crossover, namely why semantic binding should entail syntactic, i.e. binding in 'visible' syntax.

2.4 STIPULATIONS AROUND SEMANTIC BINDING

The standardly assumed semantic rules for interpreting structures undergoing QR or *wh*-movement make stipulations on the insertion of indexes that are incongruent with the copy theory of movement (cf. Chomsky 1993: ch. 3). As a matter of fact, in a semantically motivated theory of indexes it is not sound to assume that Q-elements are endowed with a referential index, because of their quantificational, non-referential, nature (see especially Elbourne 2005).

Bound pronouns, in Heim & Kratzer's (1998) formalization, are such inasmuch as they are syntactically bound by λ -operators that correspond, in post Spell-Out syntax, to the indexes created by Q-movement. The same index must then be realized on the trace of the moved QP, and can be optionally present on pronouns contained in the same sentence, giving rise the BV-reading. In this way, (73-a) has the LF in (73-b) derived by applying QR to the subject:

- (73) a. *Every girl* thinks *she* is smart.
b. [Every girl]₁ [₂ [_{t₂} thinks *she*₂ is smart]].

These special indexes are interpreted by the PA rule (Heim & Kratzer 1998), repeated in (74):

- (74) *Predicate abstraction rule (PA)*
 Let α be a branching node with daughters β and γ , where β dominates only a numerical index i . Then, for every variable assignment a , $\llbracket \alpha \rrbracket^a = \lambda x \in D. \llbracket \gamma \rrbracket^{a^{i \rightarrow x}}$. (cf. Heim & Kratzer 1998: p. 186)

Through the application of this rule both the Q-trace and the pronoun in the nuclear scope end up being bound by the same λ -abstractor, the essential requirement for BV readings.

The copy theory of movement raises a deep question for the proper functioning of , since an individual variable of type $\langle e \rangle$ is needed in argument position in order for the structure to be interpretable.²⁹ By applying QR to (75-a) we obtain (75-b) which is uninterpretable as it stands.

- (75) a. A girl talked to every boy
 b. [Every boy] [a girl talked to \langle every boy \rangle] QR under copy theory

Therefore, we are forced to introduce some type-shifting device for altering lower copies and make them interpretable, that is, syntactic phrases of type $\langle e \rangle$, essentially expressing an individual variable. In the traditional theory of traces, as assumed in Heim & Kratzer 1998, semantic interpretable structures are created by simply stipulating that a Q-trace is converted into the variable x bound by the λ -operator. Fox (1999) shows that this rule, which is completely insensitive to the copy theory of movement, is empirically inferior to a copy-sensitive rule.

Elbourne (2005) proposes a neat implementation of a copy-sensitive rule within a framework where pronouns, definite descriptions, and proper names have a common syntax and semantics, that of definite descriptions, as construed in the Fregean tradition. Bound and referential pronouns occur when definite articles take an index as an argument; as arguments of a D, indexes are syntactically realized as phonologically null NPs. Furthermore, in order to account for the bound reading of definite descriptions (to which pronouns arguably reduce), Elbourne proposes that the definite article takes two arguments, one of which is an index, while the other is a normal NP. Therefore, in his system traces and pronouns have the following syntactic format:

- (76) [THE i [NP]] Traces and pronouns as definite descriptions

In this framework, the treatment of copies as definite description follows naturally. In fact, Elbourne (2005) proposes the following version of Fox's trace conversion rule:

- (77) *Trace conversion rule (TC)*
 When moving an NP, replace the lower determiner with [THE i], for some index i , and adjoin λ_i to the target of movement.
 (cf. Elbourne 2005: p. 119-120)

So, instead of (75-b), we end up with (78).

²⁹ According to the copy theory of movement, traces are complete but silent copies of their antecedents. We express the copy/traces using the angle brackets notation.

- (78) [Every boy] [λ_2 [a girl talked to [THE 2 [boy]]]]
 (Elbourne 2005: ex. 110, p.120)

Elbourne's (2005) TC (77) is certainly more copy-sensitive than the original Heim & Kratzer's (1998) rule: it contributes thus to make the syntax/semantics mapping less arbitrary than it is in a theory where traces must be copies of Q-phrases in syntax and individual variables in the semantics. What fills the gap, in a nutshell, is the idea that bound variables can be construed with the syntax and the semantics of definite descriptions (this is in fact Elbourne's main insight). Nevertheless, it should be noticed that (77) continues to make a stipulative use of indexes, in at least two respects. First of all, the presence of an index in the argument position clashes with the Q-copy nature of the argument position, since a Q-element, by its very nature, cannot have a referential index. Here, there is thus no substantial progress with respect to Heim & Kratzer's stipulation that QPs are devoid of index, whereas their traces are indexed. Moreover, remember that in order to create a bound variable, the index on the Q-trace (and on the pronoun) must be the same as the index of the λ -operator in the target position. If this were not the case, the lower copy of the Q-phrase would fail to be interpreted as bound by the upper copy. However, there is nothing in the proposed technical implementation that ensures that this identity is achieved in a principled way: the upper index is not the index of the upper copy (QPs have no index), but is simply the index created as a result of QR, by resorting to a specific (quite stipulative) interface rule. Elbourne's implementation (77) is quite revealing in this respect: there, the index of the lower copy has simply to be adjoined above in the structure, as the required upper index.

In conclusion, the familiar devices for obtaining bound readings in the semantics make a stipulative use of indexes. Although the TC-rule (essentially corresponding to a type-shifting device) represents an important progress under the view of bound variables as concealed definite descriptions, the insertion of an index in the lower copy (including its identification with the index providing the λ -operator) remains an arbitrary interface rule, as such incompatible, in principle, with optimal design.

2.5 CONCLUSIONS

Summarizing, this critical assessment of the state of the art has led to two main results. First, the syntactic approaches to the theoretical puzzle raised by crossover are forced to depart from optimal design, according to which the BV-readings of pronouns are based on semantic binding (i.e. on syntactic binding by a λ -operator), and not on A-dependencies (i.e. dependencies from the Q-trace). Second, the familiar view of semantic binding is based on an arbitrary use of referential indexes, incompatible as such with optimal design. In the rest of this contribution, we intend to strive towards optimal design: if the latter forces Q-traces to be devoid of a referential index, it is on this principled feature of Q-traces that we intend to capitalize, by proposing that it is not pronouns that are dependent on Q-traces (as in the approaches reviewed above) but it is rather the other way around. However, the challenge posed by the WCO effects is empirically even more intricate than the present discussion has revealed, and it is

to a new class of facts that we have to pay some attention now. Meeting the empirical challenge as a whole will hopefully lead to an increased explanatory adequacy at the theoretical level.

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Recent research on the syntax and semantics of specificity allows us to develop more precisely Wasow's (1972) original observation on the role of specificity in anaphora. On the semantic side, various explicit definitions of the notion of specificity have been explored; on the syntactic side, various operational tests have been identified which are sensitive to (diagnose) the specificity of a noun phrase. So far these two threads of research have been carried out mainly independently, without any significant interaction with each other. Since the late 1980s syntacticians have recognized the crucial role of specificity in many syntactic phenomena (Heycock 1995; Rizzi 2001a; Obenauer 1994; Dobrovie-Sorin 1994; Heim 1987; Longobardi 1986 a.o.) and have often aimed at integrate this in their theory. Nevertheless these efforts commonly relied on the intuitive notion of proposed by Pesetsky (1987), without a critical assessment of the semantic analyses of specificity that have been developed in the meantime. Similarly, proposals in the semantic literature (Fodor & Sag 1982; Reinhart 1997; Enç 1991; Schwarzschild 2002 a.o.) have been more concerned with the notional side of the issue and have not considered all the operational tests that have been advanced in the syntactic literature. One of the goals of this thesis is to bridge this gap.

As a preliminary step, the goal of this chapter is to advance a new D-type analysis of specific indefinites according to which specific indefinites have a usually phonologically null restriction in their LF representation. This hypothesis emerges in different threads of research and receives a neat implementation by adapting Elbourne's (2005) format for definites DPs to indefinites DPs.

Before addressing the issues of specificity with indefinites, we need some preliminaries on the analysis of indefinites themselves. I begin the chapter with some preliminaries on indefinites. In §3.1.1, I introduce the difference between referential and quantificational elements and I illustrate the problems faced by this analysis with respect to donkey sentences and discourse anaphora, cases of problematic anaphora (§3.1.2).

To account for problematic anaphora there are two possible solutions: one is to modify the machinery responsible for pronominal binding by quantifiers, the other is to abandon the assumption that pronouns are variables. The first path is followed by Discourse Representation Theory (Kamp 1981) and File Change Semantics (Heim 1982) §3.1.3, while the second is developed by the description-theoretic approach to indefinites §3.1.4. This leads to the presentation of Elbourne's (2005) D-type account, which provides a general theory of the syntax and semantics of individual referring expressions. The D-type theory of indefinites is implemented by adapting this format for definite DPs to indefinite DPs.

Analyzing the proposal on the notion of specificity in the literature, three separate but intertwined phenomena can be identified, namely scopal specificity, epistemic specificity, and partitivity (Farkas 1994, 2002a).

The scopal definition equates specificity with wide scope of the indefinite with respect to the scope of an operator, such as an intensional verb, a modal or negation. Fodor & Sag (1982) observed the absence of "intermediate scope" readings for indefinites, and proposed that indefinites are lexically ambiguous between referential elements (of type *e*) and existential quantifiers: crucially only the latter are submitted to the usual scope restrictions (§§§). Reinhart (1997) argues instead that "intermediate scope" is actually available: this observation leads her to claim that an indefinite may introduce a variable on choice functions that is bound by an existential closure at arbitrary distance, thus obtaining the intermediate scope readings (§§3.2.1.2). Both these analyses treat indefinites as a "special" category, distinct from ordinary generalized quantifiers, and interpret the ambiguity between specific and non-specific indefinites as an ambiguity of semantic type.

In §§3.2.2, I turn to epistemic specificity, a notion linked to the informative states of the speaker. A phenomenon closely related to, but distinct from the logical notion of specificity as exceptional wide scope, is the pragmatic notion of epistemic specificity, linked to the informative states of the speaker (Farkas 1994, 2002a; Fodor & Sag 1982; Schwarzschild 2002). Schwarzschild's (2002) proposal on singleton indefinites is an elegant implementation of this idea: the domain of the existential quantifier contains a context dependent restriction. It is precisely this restriction which can produce a singleton, based on information which is asymmetrically available to the speaker, but not to the hearer. This notion provides a way to account for scope ambiguities, since existential quantification over a singleton set cannot give rise to distributive readings, thus resembling a wide scope or referential reading. For this reason they are not relevant for binding purposes, since referential elements enter coreference relations, not binding, unless they occur in ellipsis contexts.

A rather different view of specificity treats it as partitivity or presuppositionality (Enç 1991; Diesing 1992). Unlike definiteness, which is associated with presuppositions of uniqueness and existence (Heim 1991), partitivity is associated with a presupposition of existence only. In his classic proposal, Pesetsky (1987) analyzes the discourse properties of interrogative elements and distinguishes them on the basis of these. When the restriction of an interrogative *wh*-phrase denotes a set that is salient for both the speaker and the hearer, the *wh*-phrase is D-linked (§§3.2.3.1). Finally,

Enç (1991) provides a formalization of (cf. Enç 1991: note 8), proposing that indefinites are covert partitives to be characterized by two indexes (§§§3.2.3.2).

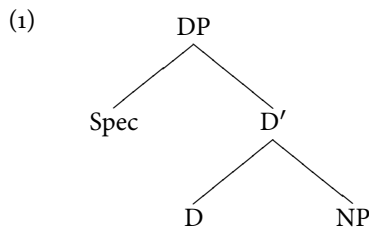
This notion of specificity can be formalized by inserting a silent NP denoting a property in the representation of Qs, a proposal independently advanced by Stanley (2000).

3.1 THE ANALYSIS OF INDEFINITES

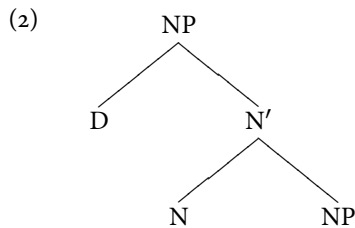
3.1.1 Indefinites and quantification

Before addressing the issues of specificity with indefinites, we need some preliminaries on the analysis of indefinites themselves. They can be defined morphologically and semantically: morphologically they are introduced by an indefinite article, while semantically they belong to a subclass of quantifiers, the so called *weak* or *existential* quantifiers. This section is devoted to the introduction of these two aspects, starting with the morphological characterization of indefinites.

Following Abney's (1987), the noun phrase is strictly speaking a determiner phrase, and the NP designates a subpart of the noun phrase taken to be the complement of the determiner (1). This is opposed to the old view that determiners are specifiers of the noun phrase (2).



This is opposed to the old view that determiners are specifiers of the noun phrase, as illustrated in (2).



Determiners govern the referential or quantificational properties of the noun phrases they embed.¹ On the one hand, referential phrases are introduced by a definite article (*the student*) or an indexical (*that student*), or are proper names (like *John*)². Quantificational phrases, instead, are introduced by quantificational determiners: *every, nobody, some, most of, a,*

¹ The DP hypothesis goes very well with the theory of generalized quantifiers, which is the prevailing theory of the semantics of determiners.

² Proper names are analyzed as elements with an unpronounced definite article, but in some cases the article is overt: e.g. *the MonaLisa*.

all. Quantifiers denote relations among sets, namely the set of the restrictor and the set denoted by the predicate (see (3-a)-(3-b)), thus quantificational DPs are semantically of type $\langle\langle e, t \rangle t\rangle$.

Traditionally, logical semanticists have analyzed definite and indefinite descriptions as quantifiers, and definite pronouns as variables. In Russell's (1905) account, indefinite NPs, such as *a dog*, do not refer: they introduce existential quantifiers, just like *every dog* introduces a universal quantifier (3-b). Hence *a dog* is treated exactly like *some dog*.

- (3) a. A dog come in. $\exists x \text{DOG}(x) \wedge \text{CAME}(x)$
(Heim 1982: ex. 1, p. 5)
 b. Every dog come in. $\forall x \text{DOG}(x) \wedge \text{CAME}(x)$
(Heim 1982: ex. 3, p. 5)

Heim (1982) reports three arguments that convinced semanticists and generative grammarians that indefinites correspond to existential quantifiers.

First of all, indefinites can refer to different individuals in sentences like the one in (4). As a matter of fact, the occurrence of *a dog* may refer to a different dog for John and for Mary.³

- (4) John is friend with *a dog*, and Mary is friend with *a dog*.
Heim (1982: ex. 4, p. 6)

The second argument is given by the sentence (5). In this case the indefinite does not refer to any particular dog, since it says that no dog whatsoever come in.

- (5) It is not the case that *a dog/Fido* come in. (Heim 1982: ex. 5, p. 7)

Finally, consider the example in (6). In this case *a dog* is mentioned once, therefore the indexing approach is not enough. This the type of example that requires the adoption of the bound variable analysis for pronouns. If a dog referred to anything, then the sentence amounts to claiming that every child owns that thing. Russell quantificational analysis is preferable since the sentence means that for every child x the set of dogs owned by x is non-empty.

- (6) Every child owns *a dog/Fido*. (Heim 1982: ex. 7, p. 7)

Conceived as existential quantifiers, indefinites belong to the subclass called *weak* or *existential* DPs. Since Milsark (1974) it is well known that quantifiers are lexically divided into two disjointed sets: the so called *strong*-quantifiers and the *weak*-quantifiers. Since *weak* quantifiers may occur in the context of existential *there* (7-a), whereas *strong* quantifiers are banned (7-b), they are called *existential*.

- (7) a. There are *some students* in the class. weak quantifier
 b. *There are *all the students* in the class. strong quantifier

³ Nevertheless, Heim notes, this is no different from what we find with pronouns, and can thus be handled in the same way, by having indexes that allow each instance of *a dog* to have a different denotation. For example in the sentence *He likes him*, although *he* and *him* refer to different individuals, this does not lead to the conclusion that pronouns do not refer.

The property illustrated by (7) is formalized in (8).

- (8) Existentiality: D is existential if for every $X, N, X \in \|D(N)\|$ if and only if $E \in \|D(N \cap X)\|$
- a. Two/a student(s) read \Leftrightarrow two/a student(s) that read exists
 - b. Every student read \Leftrightarrow every student that read exists

Moreover, in their seminal paper on generalized quantifiers, Barwise & Cooper (1981) show that weak determiners are characterized as symmetric or intersective.

Symmetry is formally defined in (9), and exemplified by the implications in (9-a) and (9-b).

- (9) Symmetry: D is symmetric if for every $X, N, X \in \|D(N)\|$ if and only if $N \in \|D(X)\|$
- a. Two students read \Leftrightarrow two individuals that read are students
 - b. Every student read \Leftrightarrow every individual that read is a student

(9) says that a determiner is symmetric if it may saturate the argument position of either the subject or the predicative NP in a simple predicative sentence. The examples show that quantifiers like *a* or *two* are symmetric, while the quantifier *every* is not. The sentences in (9-a) are truth-conditionally equivalent, therefore the function denoted by *a/two* can be applied either to the set of students, or to the set of people that read, with no difference to the truth conditions. The example in (9-b) shows that this analogy does not hold true for NPs introduced by strong quantifiers, like *every*.

A quantifier is symmetric if and only if it is intersective, in other words intersectivity is equivalent to symmetry. Look at the formal definition of intersectivity given in (10), and the implications in (10-a) and (10-b).

- (10) Intersectivity: D is intersective if for every $X, N, X \in \|D(N)\|$ if and only if $X \in \|D(N \cap X)\|$
- a. Two/a student(s) read \Leftrightarrow two/a student(s) that read read
 - b. Every student read \Leftrightarrow every student that read read

Intersective determiners are only concerned with the intersection of two sets. (10-a) says that the intersection of the set of the students and the set of those who read contains *two* or *a* member. Thus, it is irrelevant which of the sets is denoted by the NP and which by the predicate. However, strong quantifiers place a condition on the cardinality of the intersection of A and B relative to the cardinality of A. In (10-b), the set of reading students makes up a certain proportion of the set of linguists, in the case at issue the whole set of the linguists.

We can conclude that intersectivity, existentiality and symmetry define the logical properties of weak quantifiers, and of indefinites, conceived of as quantifiers. However, this traditional view of indefinites as existential quantifiers was crucially challenged by the analysis of *and*, which therefore constitute problematic cases for the traditional view. Given their pivotal role in the reflection on indefinites, the next section is devoted to introducing these phenomena.

3.1.2 *Indefinites and problematic anaphora*

Significant work on the semantics of indefinites originated from the study of discourse anaphora and donkey sentences in particular. Crucially, in these cases pronouns cannot be understood as having their references fixed by their antecedents, nor as being variables bound by their quantifier antecedents, for this reason they are instances of problematic anaphora.

Let's consider first *discourse anaphora*, that is configurations where a quantifier is the antecedent for a pronoun in another sentence (11)-(12).

(11) A dog come in. *It* lay down under the table. (Heim 1982: ex. 9, p. 8)

(12) Few professors come to the party. *They* had a good time.

Intuitively, *it* the dog refers to the same entity as *a dog*. But for this to be possible the indefinite itself must refer, contra Russell. If instead we treat indefinites as quantifiers, the pronouns in (11) and (12) cannot be bound by their quantified antecedents (Evans 1977).

First of all, such an account would yield the wrong truth conditions for examples like (12), since, if *they* were a bound variable, the sentences (12) should be equivalent to (13). This is clearly wrong since the discourse in (12) means that few professor attended the party, but (13) could be true if many professors attended.

(13) Few professors: x (x come to the party and x had a good time)

The second argument for excluding that pronouns in instances of discourse anaphora are bound variables is based on the anomalous sentences in (14-b) and (14-c): anaphoric pronouns cannot be bound by all quantifiers. Sentences are scope island for these quantifiers, therefore indefinites are not just another quantifier, but they must have something special.⁴

- (14) a. A dog come in. *It* lay down under the table.
 b. *Every dog came in. *It* lay under the table.
 c. *No dog come in. *It* lay down under the table.

(Heim 1982: ex. 9-16-17 p. 13)

The indefinite can be understood neither as a referring expression, nor as a quantifier; and the pronoun, neither as a referring expression, nor as a bound variable. They come to the attention of modern philosophers and linguists through the work of Geach (1962). There are two varieties of donkey sentences, the conditional (15-a) and relative clause (15) donkey sentences, respectively.

- (15) Every farmer who owns *a donkey* beats *it*. relative clause
 a. If John owns *a donkey*, he always beats *it*. conditional
 b. $\forall x \forall y ((man(x) \wedge donkey(y) \wedge owns(x, y)) \rightarrow beats(x, y))$

On the reading we are concerned with, neither in (15) nor in (15-a) are the pronouns referential, so they cannot be coreferential with their antecedents. Nor are the pronouns bound by their antecedents, for all independent

⁴ Heim argues that this is a problem if it is too hard to predict which quantifiers can/cannot bind into the next sentence.

evidence suggests that whatever the syntactic details, “a donkey” is too deeply embedded for taking scope over “it”, both in the case of the relative clause (15) and in the case of the relative conditional (15-a). As a matter of fact inserting a quantifier in the place of the indefinite, the sentences are ungrammatical in the bound readings.

- (16) a. *If John owns *every donkey*, he beats *it*.
 b. *A man who owns *every donkey* beats it.

In addition, even if *a donkey* could magically do this assuming it is an existential quantifier we still would not get the intuitive truth conditions of (15-a) which require that *John* in (15-a) or *a man* in (15) beats every donkey he owns. As a matter of fact the sentence in (16-b) roughly corresponds to (17).

- (17) $\forall x \forall y ((\text{man}(x) \wedge \text{donkey}(y) \wedge \text{owns}(x, y)) \rightarrow \text{beats}(x, y))$

The upshot of the foregoing observations on problematic anaphora is that, apparently, indefinites are neither quantifiers nor referential terms, and this problem entrains another one, for as long as it is unclear what indefinites mean, it will also remain obscure how they can serve as antecedents for pronouns.

Discourse anaphora and donkey anaphora are problematic insofar as the following two standard assumptions are adopted:

- A. Pronouns are logical variables.
 B. The semantics of quantifiers gives rise to a standard notion of scope, namely c-command.

Basically, the solution to account for problematic anaphora have explored modifications to these assumptions. On the one hand, dynamic approaches preserve (i) but revise (ii) (Kamp 1981, Heim 1982), on the other hand the E-type/D-type approaches preserve a version of (ii) but revise (i), taking pronouns to go proxy for definite descriptions (e.g. the donkey, or the donkey that John owns; Evans 1980, Heim 1990, Elbourne 2005).

3.1.3 *The dynamic binding approach*

In the early 1980s, Heim (1982) and Kamp (1981) independently proposed that problematic anaphora cannot be treated within the standard model-theoretical approach and formulated very similar semantic theories that have come to be known as *Discourse Representation Theory* (DRT). The view of meaning on which dynamic theories are based is that of Stalnaker (1979): the meaning of a sentence does not reside in its truth conditions, but rather in the way in which it changes the context of *common ground*, which is roughly the information that parties to a dialogue have in common.

More technically, the first way in which DRT departs from more traditional approaches is that it claims that indefinite noun phrases are essentially predicates with free variables, rather than existential quantifiers, as in the traditional analysis (§§3.1.1). Thus the indefinites in the problematic

contexts discusses above §§3.1.2, have the following format at the level of LF.

(18) donkey (x)

This means that an indefinite introduces a novel variable, thus a pronoun anaphoric on the indefinite is interpreted as an occurrence of the same variable that was introduced by its indefinite antecedent. In this framework, a case of discourse anaphora such as the example in (19) is represented as in (19-b).

- (19) a. *A dog come in. It lay down under the table.*
(Heim 1982: ex. 9, p. 8)
- b. $\text{dog}(x)$
 x come in
 x lay under the table

In addition to this, DRT builds into the assignment of truth conditions default existential quantification of free variables. Thus (19-b) is true if there is some assignment to the variable x that is in the extension of *dog*, *come in* and *lay under the table*, in other words if something is a dog who come in and lays under the table. Therefore, the fact that indefinites appear to have the force of existential quantifiers in cases such as (19) is due to a default existential quantification of free variables, therefore, more generally, the existential force of indefinites is an illusion that derives from the existential closure, not a property of the indefinites themselves. In a nutshell, this is the treatment of discourse anaphora in DRT.

Let's now look at the analysis of donkey anaphora in the DRT framework. As we saw, both the relative clause and the conditional donkey anaphora appear to have “universal force”: for example the truth of (15-a) and (15) require respectively that “John beats every donkey he owns” and that “every donkey owing farmer beats all the donkeys he owns”. Therefore, in these cases the indefinite seems to have universal force, rather than existential as it is the case in discourse anaphora (19). The core idea for dealing with donkey sentences is that the universal force of the indefinite results from the free variable in it being bound by an operator with genuine universal force, instead of the an existential operator.

In the case of the conditional donkey sentence (15-a), the conditional operator has universal force, since it says that in every case, that is every assignment of values to free variables that makes the antecedent true also makes the consequent true. So every assignment to x making “John owns x ” and “ x is a donkey” true, also makes “John beats x ” true. In (15), similarly, the determiner *every*, the universal quantifier, not only binds the variable associated with the predicate “farmer who owns a donkey”, but it also binds the variable introduced by the indefinite “a donkey”. So (15) has the following LF:

(20) Every x, y ($\text{farmer}(x) \ \& \ \text{donkey}(y) \ \& \ x$ owns y) (x beats y)

Crucially the DRT account just sketched departs from more classical approaches in allowing the quantificational determiner (*every*) to bind multiple variables.

Since the DRT claims that indefinites get their apparent quantificational force from other elements that bind the variables in them, it predicts that when different determiners are involved, the quantificational force may vary. As a matter of fact, in many languages, indefinites exhibit quantificational variability effects (QVEs) when combined with adverbs of quantification (21).

- (21) a. A man rarely loves his enemies.
 b. A man usually hates his enemies.
 c. A man sometimes loves his enemies.
 d. A man hates his enemies.

The truth conditions of the sentences above can be roughly stated as in (22).

- (22) a. $\text{Few}(x)$ [man (x)] [x loves x's enemies]
 b. $\text{Most}(x)$ [man (x)] [x hates x's enemies]
 c. $\exists(x)$ [man (x)] [x hates x's enemies]
 d. $\text{GEN}(x)$ [man(x)] [x hates x's enemies]

Dynamic theories rely on the introduction of an indefinite antecedent that is reinterpreted as a variable and inserts a quantifier in the structure. Therefore, constructions where the bound reading obtains without the presence of a proper antecedent are problematic for these theories. This is the basic problem found in the following cases: disjunctive antecedents, deep anaphora, and neontological pronouns.

Disjunctive antecedents are discussed by Stone (1992) and exemplified in (23). In this case, no suitable variable will be introduced by any components of the two sentences in the antecedent of (23), since all the NPs there are definite.

- (23) If Mary hasn't seen John lately, or Ann misses Bill, she calls him.
 (Elbourne 2005: ex.42, p.19)

The case of deep anaphora is illustrated by the example (24). The pronoun *it* in this sentence does not have any linguistic antecedent at all, yet it has a covarying interpretation "for most faculty members x ... x 's paycheck ...", but for this reading to be obtained in the dynamic approach a linguistic expression introducing a new variable into the variable assignment is necessary. Hence the problem of this example.

- (24) A new faculty member picks up her first paycheck from her mailbox.
 Waving it in the air, she says to a colleague:
 Do most faculty members deposit it in the Credit Union?
 (Elbourne 2005: ex.43, p.20)

A subset of the *paycheck pronouns* or *pronouns of laziness* is illustrated by (25). In this case *it* introduces a wholly new variable, but the intuitive antecedent for *it* is *his paycheck* and, since it is definite, it cannot introduce a variable and even if it could the wrong results would ensue, since *it* would then refer to John's paycheck. Since these pronouns introduce new entities, Elbourne christens them *neontological pronouns*.

- (25) John gave his paycheck to his mistress. Everybody else put it in the bank. (Elbourne 2005: ex.44, p.21)

Summarizing, Kamp (1981), Heim (1982) propose that in these sentences the indefinites do not have any quantificational force of their own, but they introduce a variable together with a restriction and are open formulas. The problems raised which the DRT suffers from are solved by the description theoretic approach, to which we now turn.

3.1.4 Description theoretic approaches

The description theoretic approach explores the second solution to the challenge of problematic anaphora: it assumes that pronouns are not out of the mill variables, but instead they are abbreviated definite descriptions, while the standard assumptions on quantification remain untouched. The most recent and refined D-type theory is proposed in Elbourne 2005, developing the ideas first proposed by Heim (1990), who was adapting ideas of Berman 1987. By putting forward a compelling solution for donkey sentences, Elbourne (2005) defends the position that all the referring expressions - pronouns, proper names and definite descriptions - share not only a common semantics, but also a common syntactic format: a definite article taking two arguments, an index and an NP predicate.

More concretely, Elbourne's (2005), as the other D-type proponents, claims that in the donkey sentence (26-a) 'it' means something like 'the donkey' (26-b).

- (26) a. Every man who owns a donkey, beats it.
b. Every man who owns a donkey, beats the donkey.

D-type pronouns continue to be endowed with a free variable (Elbourne 2005: pp. 95-97), which can be bound, or receive a value assignment such has in Elbourne (2005: ex. 8 p. 96):

- (27)

Therefore, we can assume that cross-sentential anaphora is obtained, as usual, through the value assignment to a free variable.

A problem for such an approach, treating pronouns as definite description, is the uniqueness presupposition these carry, which is not implied by the donkey sentences. To account for the lack of uniqueness presupposition, Elbourne adopts Berman; Heim's (1987; 1990) solution built on Kratzer's (1989) situation semantics: for every minimal situation s_1 with farmer y owing a donkey, there is a minimal situation s_2 , such that s_1 is part of s_2 and in s_2 the unique donkey in s_2 is beaten by y . This fine-grained situation semantics, picks out exactly those donkeys made available by the quantifier's restrictor and because the minimal situations involved really do contain only one donkey, this accounts for the data.

Nevertheless, three serious problems for the D-type analysis remain unsolved: the problem of indistinguishable participants, the formal link problem and the problem of pronominal ambiguity. Elbourne's (2005) general theory of definite description takes shape while solving these three

issues, nevertheless the final result goes well beyond the scope of donkey sentences.

The problem of the formal link, has to do with examples such as (28). Since, semantically, there is no difference between these two, the question arises of why (28-b) is out. It seems that the D-type account requires an explicit NP-antecedent as the source of the pronoun's descriptive content.

- (28) a. Every man who has a wife is sitting next to her.
 b. *Every married man is sitting next to her.

(Elbourne 2005: ex.19, p.12)

Finally, pronominal ambiguity refers to the very fact that in the D-type analysis pronouns must be systematically ambiguous between two kinds of meaning that apparently are not easily reducible to each other, namely individual variables and definite descriptions. No language shows lexical or morphological differences between pronouns used as individual variables and pronouns used as definite descriptions. Only a theory that analyzes uniformly all pronouns, as in dynamic semantics, would be ultimately satisfying.

The problem of indistinguishable participants involves the so called bishop sentences (29) to which Hans Kamp has drawn attention. According to the D-type analysis, for every minimal situation of a bishop meeting a bishop, there is a minimal situation $s' > s$ where the bishop blesses the bishop. But since this s' must crucially contain two bishops, neither of them is unique, thus the pronouns/definite description is not licensed.

- (29) If a bishop meets a bishop he blesses him. (Elbourne 2005: ex.18, p.11)

On the other hand, the DRT analysis suffers from a number of other problems. Addressing the problem of pronominal ambiguity by radically changing the logic of variable binding, has trouble with a variety of pronoun uses that are straightforwardly analyzed by D-type theories: basically, all the cases where the bound reading obtains despite the absence of an indefinite antecedent, as we saw at the end of §3.1.3.

In order to solve the problems for the D-type theory, Elbourne fleshes out a new kind of D-type analysis. The idea is to assimilate donkey pronouns to determiners, in particular pronouns have the same syntax and semantics as the definite articles *the* followed by a phonologically deleted NP at LF (30), where '[it donkey]', means 'the donkey'.

- (30) Every farmer who owns a donkey, beats [it donkey].

With respect to the three problems for the D-type analysis that we identified, we immediately see that the first one, the formal link problem, is solved by the NP deletion that requires a previous mention of the same NP.

To solve the issue of pronominal ambiguity, Elbourne extends the NP deletion approach to bound and referential uses of pronouns. In Heim, a regular pronoun is adorned with an index, a natural number which is mapped to an individual by the assignment function. Binding occurs when an index is lambda bound; referential reading obtains when it is free. The new unification consists in analyzing indices as phonologically null NPs,

so that a pronoun with a regular NP as argument (remember pronouns are determiners) is a D-type pronoun, while a pronoun with an index NP, it is a regular pronoun.

The idea that DPs possess an index is supported by the discussion of bound definite descriptions. **Elbourne** shows that the semantics of definite descriptions is better analyzed by the Fregean analysis, where the uniqueness requirement is a presupposition.

$$(31) \quad \lambda f : f \in D_{\langle e,t \rangle} \ \& \ \exists!x \ f(x) = 1 \quad (\text{Heim 1991: p. 495-496})$$

Definite descriptions can be bound, as is illustrated by (32).

$$(32) \quad \text{Mary talked to no senator before the senator was lobbied.} \\ (\text{Elbourne 2005: ex. 77, p. 112})$$

Elbourne settles on the option of adding an index as a second argument to the overt definite determiner. Thus he arrives at the following semantics

$$(33) \quad \llbracket \llbracket \text{THE}_i \rrbracket \text{farmer} \rrbracket^a = \text{the unique } x \text{ such that } x \text{ is a farmer and } x = a(1).$$

To handle D-type uses, he singles out a special index *o*.

$$(34) \quad \llbracket \llbracket \text{THE}_0 \rrbracket \text{farmer} \rrbracket^a = \text{the unique } x \text{ such that } x \text{ is a farmer.}$$

In the final section E proposes to add a second NP argument to pronoun-determiners as well, thus completing the unification of definites and pronouns:

$$(35) \quad \text{it} \rightarrow \llbracket \llbracket \text{it } 3 \rrbracket \text{donkey} \rrbracket$$

Concerning the problem of indistinguishable participants, (**Heim 1990** citing Hans Kamp) (29). Dynamic semantics correctly predicts the bishop sentence to mean (36)

$$(36) \quad \text{for all } x, \text{ all } y: \text{ if } x \text{ and } y \text{ are bishops and } x \text{ meets } y, \text{ then } x \text{ blesses } y.$$

Note already that, since meeting is a symmetric relationship, this entails that we see each bishop blessing his colleague and being blessed in return. A D-type account has trouble since pronouns are definite description requiring unique bishops. After showing why previous D-type solutions fail, **Elbourne** points out a neglected contrast between the classical bishop sentence (37-a) and the sentence in (37-b) with coordinated subjects.

$$(37) \quad \begin{array}{ll} \text{a.} & \text{If a bishop meets a bishop meet, he blesses him.} \\ \text{b.} & *\text{If a bishop and a bishop meet, he blesses him.} \end{array} \\ (\text{Elbourne 2005: ex.26 p.145})$$

Dynamic semantics cannot distinguish these sentences, but **Elbourne's** (2005) new D-type solution not only assigns the right truth conditions to (29), it also explains the infelicity of (37-b). His solution hinges on a subtle situation semantic interpretation of (29) that manages to distinguish the two bishops, or rather the two minimal situations in which they occur. The first situation contains just a bishop *x*, the second a bishop *y* meeting

x. With the two bishops distinguished in this way, it is not hard to postulate contextually salient, deleted descriptions to pick them out in the consequent. Appealing to the syntactic Coordinate Structure Constraint [Elbourne](#) shows that the LF of (37-b) does not allow the bishops to be distinguished in this way.

3.2 INDEFINITES AND SPECIFICITY

Indefinite noun phrases are categorized as specific or non-specific in the semantics and pragmatics literature. Specificity with indefinites encompasses three separate but intertwined phenomena: scopal specificity, epistemic specificity, and partitivity ([Farkas 1994, 2002a](#)).

3.2.1 *Scopal specificity*

The scopal definition equates specificity with wide scope of the indefinite with respect to the scope of an operator, such as an intensional verb, a modal or negation. Consider the following case (38) involving a scopally specific (38-a), and a scopally non-specific (38-b) indefinite *a sailing boat*.

- (38) John would like to buy a sailing boat ...
- | | |
|---------------------------------|-----------------------|
| a. ... but he can't afford it. | scopally specific |
| b. ... but he can't afford one. | scopally non-specific |

Furthermore, indefinites exhibit exceptional scope taking behavior unlike paradigm quantificational phrases, indefinites are able to escape scope islands. Quantifiers can have wider scope than the position where they occur through (QR): that is invisible syntactic movement, before spell-out. It is a syntactic movement because it is submitted to the same island constraints as overt movement. There is a parallelism between *wh*-elements and possibilities of scope of quantifiers which prompted the unification of QR and *wh*-movement in seventies.

The quantifier *every new patient* can have scope over *a doctor* in (39), as it is possible to move the *wh*-elements in (40).

- (39) a. A doctor will interview every new patient.
 b. A doctor will try to assist every new patient personally.
 c. ?A doctor will make sure that we give every new patient a tranquilizer. ([Reinhart 1997](#): ex. 1)
- (40) a. Which patients will a doctor interview *e*?
 b. Which patients will a doctor try to assist *e* personally?
 c. ?Which patients will a doctor make sure that we give *e* a tranquilizer? ([Reinhart 1997](#): ex. 2)

Movement cannot freely happen between any two positions. *Wh*-expressions, for example, cannot move to the beginning of the sentence (Spec,CP) from any position. Compare the following pair of examples ((41) and (42)) where co-indexing identifies the moved element and the position it was moved from. In (41) and (42) an island is present. A *wh*-element cannot be moved from within a DP or an *if*-clause. In (42) the quantifier *every*

new patient cannot have scope over *a doctor* in (41), as it is not possible to move the *wh*-elements in (42).

- (41) a. A doctor will examine the possibility that we give every new patient a tranquilizer. DP island
 b. A doctor should worry if we sedate every new patient. if-island
 (Reinhart 1997: ex. 3)
- (42) a. *Which patients will a doctor examine the possibility that we give *e* a tranquilizer?
 b. *Which patients should a doctor worry if we sedate *e*?
 (Reinhart 1997: ex. 4)

Later, it was discovered that on the one hand that many strong quantifiers are actually more restricted than predicted by QR, in the sense that they are often clause bound. On the other hand, certain existential NPs allow free wide scope that violates all constraints on movement.

3.2.1.1 Quantificational and referential indefinites

Fodor & Sag (1982) bring evidence from multi-clause constructions involving islands and VP deletion to the idea that the *quantificational interpretation* and the *referential interpretation* of indefinites are due to semantic ambiguity, and they ultimately posit two lexical entries.

The quantificational interpretation is a family of interpretations since quantifiers exhibit scope ambiguities, thus the sentence in (43) has three interpretations: one with narrow scope, one with wide scope and one with referential interpretation of the indefinite.

- (43) Every professor met a student in the syntax class.
 (Fodor & Sag 1982: ex. 2)

Logically, the referential reading is equivalent to a wide scope reading. Consider the following sentence:

- (44) A student in the syntax class cheated on the final exam.
 (Fodor & Sag 1982: ex. 1)

If the set of students who have cheated is non-empty then some particular student must have cheated, and, conversely if some particular student has cheated then the set of students who have cheated is non-empty. So the Fodor & Sag's claim is that two semantics analyses are associated to the same truth conditions. To support this claim the authors present data from island extraction and VP deletion: in these cases the assumption that indefinites have only a quantifier interpretation would necessitate ad hoc stipulations and assuming that the indefinite has a referential interpretation solves this problem. The upshot of the discussion is that the data cannot be accounted for by assuming only a quantificational interpretation for indefinites, even if these quantifiers were exceptionally allowed to escape islands.

In the example in (45-a) the indefinite can refer to a particular friend of the speaker, instead of all his texan friends, while the example (45-b)

cannot mean that every friend of the speaker is such that if he would be dead, the speaker would inherit. So only indefinites can present island escaping behavior (45-a), while *if* clauses are scope island for paradigm examples of quantified phrases as *each friend* in (45-b).

- (45) a. If a friend of mine from Texas had died in the fire, I would have inherited a fortune. indefinite
 b. If each friend of mine from Texas had died in the fire, I would have inherited a fortune. paradigm quantifier
(Fodor & Sag 1982: ex. 60-62)

Nevertheless an indefinite that escapes an island does not behave as a scoped element whose scope is immune to island constraints. In particular an indefinite that escapes an island has maximally wide scope with respect to other logical operators outside the island, or more perspicuously, intermediate scope interpretations are absent.⁵

- (46) Each teacher overheard the rumor that a student of mine had been called before the dean. (Fodor & Sag 1982: ex. 69)

If the indefinite is an exceptional quantifier unconstrained by scope islands, three readings are predicted for the sentence (46) Consider the informal representations of the scope relations in (47): in (47-a), the indefinite is restricted to the island, in (47-b) it escapes the island and has scope over the matrix clause, but is in the scope of the *each*, in (47-c) it has scope over the entire matrix clause, including *each*.

- (47) a. (each teacher: x) [x overheard the rumor that [(a student of mine: y) [y had been called before the dean]]]
 b. (each teacher: x) [(a student of mine: y) [x overheard the rumor that [y had been called before the dean]]]
 c. (a student of mine: y) [(each teacher: x) [x overheard the rumor that [y had been called before the dean]]]
(Fodor & Sag 1982: ex. 71)

Now, the interpretation represented by the intermediate scope case (47-b) does not obtain: either the indefinite is fully non-specific (47-a) and scopes over the complement clause only, or it is both specific and independent of the scope of the universal quantifier (47-c).

When no island is present, as in the example (48) where the simple object complement construction replaces the complex DP complement of (46), all the readings become available, including the intermediate scope, which attributes a different specific belief to each teacher. Sentence (49) can be about a particular student, or can be equivalent to *if any student . . .*, but cannot mean that for every professor there is a specific student, but possibly different, in other words intermediate scope is banned.

- (48) Each teacher thinks that a student of mine was called before the dean. (Fodor & Sag 1982: ex. 72)
 (49) If a student in the syntax class cheats on the exam, every professor will be fired. (Fodor & Sag 1982: ex. 73)

⁵ Ruys (1992) show some complications

This is the crucial observation that lead **Fodor & Sag (1982)** to the conclusion that:

[the ability to escape from an island] is not in fact an instance of a quantifier that manages to escape the island, but is an instance of something very like a proper name or demonstrative which does not participate in the network of scope relations between true quantifiers, negation, higher predicates and the like. (Fodor & Sag 1982: p. 375)

While considering indefinites as quantifiers, still needs to be complicated to account for the absence of intermediate scope and the fact that this correlates with the properties of referential elements. Therefore the data cannot be economically described, and explained in a principled way, unless a referential interpretation is assumed.

Summarizing, there is a bipartition between quantificational indefinites that have an existential quantifier as part of their meaning and obey to the usual scope restrictions and referential indefinites which are not quantificational, this distinction corresponds to a lexical ambiguity.

3.2.1.2 *Intermediate scope and choice functions*

The starting point of **Reinhart (1997: p. 346)** is the observation that **Fodor & Sag's (1982)** conclusion does not hold true and cases of indefinites with intermediate scope (above the island but below the higher quantifier) are in fact attested (**Abush 1994; Farkas 1981; Ruys 1992**). On the basis of **Ruys (1992: ex. 18 p. 101)**, **Reinhart** proposes the following example.

- (50) [Every professor]_i will rejoice if a student of his_i cheats on the exam.
- a. [For every professor x [there is some student y of x such that [if y cheats on the exam, x will rejoice]]]
 - b. [For every professor x [if there is some student y of x such that y cheats on the exam, x will rejoice]] (**Reinhart 1987: ex. 19**)

The indefinite contains a pronoun bound by the subject QP of the main clause, therefore the wide scope of the indefinite, corresponding to a referential interpretation is excluded. But, besides the narrow scope of the indefinite, the intermediate scope is possible, too. That is to say that the sentence can be paraphrased as “The Math professor will be satisfied if John fails the exam, the professor of Physics if Mary fails, etc.”⁶

To control for these factors, **Reinhart** proposes the following examples, based on **Ruys (1992)**.

- (51) a. [Most linguists] have looked at [every analysis that solves [some problem]].

⁶ **Kratzer (1998)** argues that the intermediate scope is actually a impression created by the presence of the pronoun and revives **Fodor & Sag's (1982)** intuition that the apparent wide scope is a case of specificity, relating to the discourse status of the indefinite. Moreover in these examples one could argue that the intermediate scope is a matter of vagueness, since the wide scope reading is simply a sub-case of the narrow scope reading.

- b. [Most linguists x][[some problem y] [every analysis z that solves z resolve y] [x looked at z]].
intermediate scope
(Reinhart 1987: ex. 21)

Many analyses have treated such long distance indefinites in terms of choice functions, which map any non-empty set in their domain to a member of this set (Reinhart 1997; Winter 1997; Kratzer 1998; Matthewson 1998; Chierchia 2001).

- (52) A function f is a ($CH(f)$) if it applies to every non-empty set and gives a member of that set. (Reinhart 1997: p. 372)

In the same way a GQ the indefinite introduces a variable on choice functions that is bound by an existential closure at arbitrary distance:

- (53) a. Every lady read some book.
(i) $\exists f(CH(f) \wedge \forall x(\text{lady}(z) \rightarrow z \text{ read } f(\text{book})))$
(ii) $\exists x(\text{book}(x) \wedge \forall z(\text{lady}(z) \rightarrow z \text{ read } f(\text{book})))$
(Reinhart 1997: ex. 65)

(53-a-i) says that exists a choice function such that for every z that is a student, z has read the element selected from the set of books by the function f . The choice function can be bound by an operator arbitrarily far away.

The application of the function f to the denotation of [books] (the set of books) guarantees that the object selected by f will necessarily be a book. In this way the restriction N is interpreted *in situ*, but works as a restriction for a remote operator, at arbitrary distance.

In this frame work the solution for the intermediate scope of indefinites resides in the existential closure on the variable outside the syntactic island, but within the scope of the subject QP. More concretely, look at the example in (54)

- (54) a. [Most linguists] have looked at [every analysis that solves [some problem]].
b. [Most linguists x][[some problem y] [every analysis z that solves z resolve y] [x looked at z]].
c. [For most linguists x] $\exists f(CH(f) \wedge \forall y ((\text{analysis}(y) \wedge y \text{ solves } f(\text{problem})) \rightarrow x \text{ looked at } y))$ (Reinhart 1997: ex. 68)

For the majority of linguists, a choice function f exists - possibly different for every linguist - that selects a certain problem such that x has studied every analysis that solve that problem.

Let's now look at how the choice function interpretation is derived compositionally. As we saw in DRT indefinite NPs lack a quantificational determiner and determiner that appears (*a, some, three*) does not turn the NP into a generalized quantifier, therefore an indefinite of this type just denotes a predicate of type $\langle e, t \rangle$, but it is not clear how to arrive at this denotation and how to proceed from that point in the derivation.

Reinhart (1997) assumes that these determiners actually occupy the D head inside the DP, while the the determiners of the GQ type or the choice function occupy the Spec position of the DP. Semantically, the choice function is the mirror image of with respect to a quantificational determiner:

while a quantificational determiner composes with an element of type $\langle e, t \rangle$, and lifts it to a type $\langle \langle e, t \rangle t \rangle$, the choice function determiner does the opposite and composes with the restrictor of type $\langle e, t \rangle$, yielding an element of type $\langle e \rangle$. Therefore while a quantificational determiner is of type $\langle \langle e, t \rangle, \langle e, t \rangle, t \rangle$, a choice function is of type $\langle \langle e, t \rangle, e \rangle$. The final result is an individual element of type $\langle e \rangle$ or a generalized quantifier, in the case of quantifiers.

The function variable must still be closed, and **Reinhart** maintains the intuition of DRT that indefinites corresponds to free variables, without assuming the individual variables of **Heim**. The function variable is existentially closed and this closure can apply freely anywhere. In this framework the intermediate readings are derived if existential closure applies in the scope of another operator.

Summarizing indefinites have a two interpretive procedures: they can be either construed as standard generalized quantifiers over singular individuals, and thus they behave as any other GQ, with their scope restricted by syntax, or they receive a choice function interpretation, and they can have any scope, depending on where existential closure is applied.

The class of indefinites interpretable by choice function involves a subclass of the weak or existential quantifiers, namely indefinites with unmodified (bare) numerals (such as *a, some, three, which, many*), significantly this group has only the set or group interpretation. The other group of existentials with modified numerals, including all plural numerals which occur with any kind of modifier (*less than three, more than three, exactly three, three or more, between three and five, etc.*) can be interpreted only as generalized quantifiers. Following **Danon (1996)**, **Reinhart** derives this result from the syntax.

So far we have seen that the researchers since **Heim (1982)** have advanced treatments of indefinites as special quantifiers and have interpreted the ambiguity between specific and non-specific indefinites as a semantic ambiguity: referential elements vs. quantificational elements. We now turn to the pragmatic, but intertwined, notion of epistemic specificity. **Reinhart** reduces the collective interpretation of plural indefinites

3.2.2 Epistemic specificity

A phenomenon closely related to, but distinct, from the logical notion of specificity as exceptional wide scope is the pragmatic notion linked to the informative states of the speaker: epistemic specificity, also named identifiability, speaker knowledge, and referentiality (**Farkas 1994, 2002a; Fodor & Sag 1982; Schwarzschild 2002**). An epistemically specific indefinite makes reference to an entity that is known by the speaker and/or inherently identifiable (**Farkas 2002b**) as in (55-a) vs. (55-b). Epistemic specificity is closely linked to scopal specificity in that some semantic analyses of long-distance indefinites make reference to epistemic specificity (**Fodor & Sag 1982; Kratzer 1998; Schwarzschild 2002**), however, as we saw, the choice function analysis of indefinites does not (**Reinhart 1997; Winter 1997**).

- (55) a. A student cheated on the exam. It was the guy who sits in the very back. epistemically specific

- b. A student cheated on the exam. I wonder which student it was. epistemically non-specific

3.2.2.1 *Singleton indefinites*

Fodor & Sag (1982) already recognize the pragmatic nature of the distinction between specific and non-specific indefinites, but the semantic import of the distinction led them to put the burden of the explanation in the lexical ambiguity of the indefinites. Schwarzschild (2002) proposes to charge the burden of the explanation on a pragmatic mechanism. In his system, indefinites are not special and behave as standard existential quantifiers over individuals, subject to the constraint of normal quantifiers. It is the normal mechanism of quantifier domain restriction (implicit or explicit) (von Stechow 1994; Stanley 2000) that, as an extreme case, produces wide and intermediate scope that we described in the previous section. This is possible when the domain of the quantifier is reduced to a singleton set, thus making the indefinite effectively scopeless.

According to Schwarzschild Fodor & Sag's (1982) referential indefinites are actually *singleton indefinites*, that is, an existential quantifier whose domain has a singleton extension. Definites and indefinites are incomplete descriptions, completed by the context. In the case of indefinites the description is asymmetrically available to the speaker and not to the hearer.

Absolute scope neutralization

- (56) a. Everyone at the party voted to watch a movie that Phil said was his favorite.
 b. A movie that Phil said was his favorite was such that everyone at the party voted to watch it. (Schwarzschild 2002: ex. 7-8)

A singleton indefinite is a run of the mill existential quantifier, whose restrictor has a singleton extension. In the case (56-a), if we assume that Phil has only one favorite movie and it is the one he told us about, the indefinite *a movie that Phil said was his favorite* is an instance of singleton indefinite: the scope is neutralized and the quantifier behaves from the logical point of view as a referential element, and is truth conditionally equivalent to the sentence in (56-b).

Actually, Fodor & Sag (1982) noted already this possible account in terms of singleton, but they dismissed it, in favor of a lexical ambiguity because they did not consider the full power of the implicit restriction. Examples of the kind in (57) led Fodor & Sag (1982) to assume lexical ambiguity.

- (57) Everyone at the party voted to watch a movie that Phil liked.
(Schwarzschild 2002: ex. 11 cf. Fodor & Sag 1982: ex. 66-69)

In this case, it is natural to assume that *Phil* likes more than one movie, thus the indefinite appears not to be a singleton. But even it is possible to understand (57) as being about a particular movie, so Fodor & Sag (1982) conclude that this is an instance of a referential indefinite, that is not a singleton. Nevertheless, Schwarzschild (2002) argues, they do not assume the power of the implicit restrictor to narrow down the set to a singleton: in the case of (57) it is restricted to the movies that were relevant at the

time the issue came up, or the one the guests commented on, when the issue come up.

- (58) Every boy voted for a movie that his mother said was her favorite.
(Schwarzschild 2002: ex. 13)

Each mother has only one favorite movie and that was the one she mentioned. What that means is that for each value of the bound pronoun *his*, the indefinite has a singleton interpretation *the one movie that that boy's mother likes best*. Singleton extension is relative to each relevant assignment of value to any bound variables in the restrictor: so neutralization of the scope of a singleton indefinite extends up to the quantifier that binds variables in the operator.

Let's consider a classical case intermediate scope, and see how Schwarzschild (2002) analyses it.

- (59) Most linguists have looked at every analysis that solves some problem.
(Reinhart 1997: ex. 21)

As we saw, the sentence in (61) has intermediate scope, that is a reading in which *some problem* scopes above *every analysis* but below *most linguist*. This indefinite does not seem to fall under the generalization that an indefinite seems to take exceptional intermediate scope, it is actually a singleton indefinite containing a bound variable. Schwarzschild (2002), following Stanley & Szabó (2000) and Stanley (2000) assumes that the implicit restriction on a quantifier may contain a bound variable. For example in (60), there is a reading in which the set of Frenchmen quantified over varies with the choice of class.

- (60) In most of John's classes, ha fails exactly three Frenchmen.
(Stanley & Szabó 2000: ex. 24)

Following this suggestion, Schwarzschild (2002) proposes that in the intermediate scope cases there is an implicit restriction of the quantifier that contains a bound pronoun.

- (61) Most linguists have looked at every analysis that solves some problem *that they have worked on most extensively*.
(Schwarzschild 2002: ex. 24)

To summarize, indefinites are existential quantifiers whose restrictor consists of over and sometimes implicit material, that can contain bound variables. The extension of the restrictor could be arbitrarily small relative to values of the bound variable, the limiting case being the singleton indefinite. In this proposal, every indefinite could be a singleton and the unconstrained scopal behaviour of indefinites is a consequence of scopal inertness. If no bound variable is involved, the indefinite will appear to take widest scope, if a bound variable is involved, its scope will appear to reach up to the quantifier binding the variable in question, or beyond it in case the extension is the same in every case.

- (62) If every Italian in this room (could manage to) watch *a certain program about his country (that will be aired tonight on PBS)*, we

might have an interesting discussion tomorrow.

(Schwarzschild 2002: ex. 22 from Cresti 1995: ex. 66)

Schwarzschild (2002) demonstrated that the appeal to a pragmatic implicit domain restriction that this account build on is independently necessary, even for the theories that postulate that indefinites can take exceptional scope. To illustrate the point consider the following example (63).

- (63) Most linguists have looked at every analysis that has been proposed for some problem. (Schwarzschild 2002: ex. 43)

The intermediate scope reading, using purely scopal mechanisms would be to quantify freely over all problems and assume an analysis captured by the following paraphrase (64).

- (64) For most linguists l , there is some problem p , l has looked at every analysis that has been proposed for p .

This paraphrase is made vacuously true if there is an undiscovered problem, since no analysis have been proposed for an undiscovered problem, but this, intuitively, does not correspond to the truth condition of (63). It is precisely the presence of the contextual restriction which allows us to ignore undiscovered problems. Therefore, Schwarzschild concludes merely assigning wide-scope does not get us all the way to the intended reading, and we need to assume that existential quantifies over a domain that is contextually restricted. Since the presence of a contextual restriction is necessary, to argue that indefinites can take exceptional scope, one need a theory that allow for contextual domain restriction, but which stops short somewhere before singleton status is achieved.⁷

To explain the asymmetry that characterizes the definition of epistemic specificity, Schwarzschild proposes the principle in (65).

- (65) *Privacy Principle*
It is possible for a felicitous utterance to contain an implicit restricted quantifier even though members of the audience are incapable of delimiting the extension of the implicit restriction without somehow making reference to the utterance itself.
(Schwarzschild 2002: ex. 52)

And shows using some tests that implicit domain restrictions have properties from which the principle in (65) follows. Implicit parameters are meanings that in some cases are relativized to other elements of the context as illustrated in the following example of comparison classes (66), adapted from Stanley (2000).

- (66) Most species have members that are small.
Most species S have members that are small relative to other members of S . (Schwarzschild 2002: ex. 57-58)

Relative to other members of S is a comparison parameter determined by the context, that depends on the context for determining its comparison class, suitably determined. The same thing happens with quantifiers: we

⁷ Other quantifiers have a non-singletonness implicature, in most discourse situations.

can distinguish a *quantifier domain parameter* fixed by context and a *quantifier domain restriction* which is the extension of that parameter suitably determined, and implicit parameters can be relativized to the bearer of an attitude.

Consider the case where a lawyer says to John: “You can only sell the house if one of your relatives dies”. John reports that sentence to Mary. The lawyer’s use of *one* is implicitly restricted. John and Mary both know that, but exactly what restriction it consists of, only the lawyer can tell them. This is the privacy principle derived: the only way to say exactly over which set the lawyer quantifies over, is to make reference to the lawyer utterance: it is the person she had in mind when she uttered the sentence. It is precisely this principle, at play in the case of a singleton indefinite, that leads Fodor & Sag (1982) to state that ‘in the typical case the hearer will not know exactly what the speaker is asserting.’

The analysis of Schwarzschild (2002) subsumes the notion of scopal specificity, and provides an explanation and an elegant formalization for the notion of epistemic specificity. Furthermore, the singleton approach is more economic than the choice function approach, in that it does not stipulate the presence of an additional determiner. In the final part of the chapter I propose an explicit syntactic and semantic format for indefinites that formalize not only Schwarzschild’s (2002) proposal, but also partitive specificity. But, before advancing the proposal, we need to introduce this third view of specificity as partitivity.

3.2.3 Specificity as partitivity

A rather different view of specificity is one that treats it as partitivity or presuppositionality (Enç 1991; Diesing 1992). Unlike definiteness, which is associated with presuppositions of uniqueness and existence Heim (1991), partitivity is associated with a presupposition of existence only, as shown in (67). Presuppositional partitive indefinites include overt partitives in English (67-a). (67-a) presupposes the existence of a unique, salient professor, whereas (67-b) presupposes the existence of a salient set of professors.

- (67) a. *The professor* came to the party. # The other professor did not.
existence and uniqueness
 b. *One of the professors* came to the party. The other professor did not.
existence, not uniqueness

3.2.3.1 D-linking

Pesetsky (1987) distinguishes two types of interrogative elements on the basis of their discourse properties. When a *wh*-question asks for answers in which the entities that replace the *wh*-phrase are drawn from a set that is presumed to be salient both to speaker and hearer, the *wh*-phrase is D-linked. Pesetsky distinguishes interrogative elements on the basis of this property, as summarized below.

- *which N*: always D-linked
- *who*, *what*, *how many*, adjuncts: could be D-linked

- *who the hell, what the hell: aggressively non D-linked*

3.2.3.2 Semantic formalization of partitivity

Enç (1991) provides a semantic formalization of the notion of .⁸ Her proposal is based on Heim's (1982) . This theory accounts for the difference between definite and indefinite DPs through the and the .⁹ The *familiarity condition* applies to definites and requires their discourse referents to have been previously introduced in the discourse representation, while the *novelty condition* applies to indefinites and requires them to introduce new referents in the discourse domain. Enç extends this account to include specificity. In her view, specific phrases are equivalent to partitives (e.g. *two of the books*), so they impose one more restriction on the structure of the discourse domain.

Every DP has a double indexing (i, j) : i denotes the DP referent and j a set in which i is included (the index of *books* in the partitive indefinite *two of the books*).

- (68) Every $[_{DP} \alpha]_{\langle i, j \rangle}$ is interpreted as $\alpha(x_i)$ and
- $x_i \subseteq x_j$ if $DP_{\langle i, j \rangle}$ is plural
 - $x_i \subseteq x_j$ if $DP_{\langle i, j \rangle}$ is singular (Enç 1991: p. 7)

Indices have a definiteness feature: the presence of this feature on the first index marks the DP as definite, while its presence on the second index is associated to its specificity. If index j is definite the DP must be familiar and, as (68) requires that the referent of the DP be a subset of x_j , it must have a specific interpretation, i.e. its referent has to be included in a familiar referent. In contrast, if the index j is indefinite, the DP must be new, so x_j is introduced as a new referent in discourse representation.

Both specific and definite phrases require their discourse referents to be familiar, while non-specific indefinites have to be new. In the case of familiar entities, the nature of the link with discourse referents comes in two types: for definites there should always be identity, while for specifics there is only an inclusion relation, corresponding respectively to *strong* and *weak antecedents* in Enç's system.

According to (68) all definites (nouns, pronouns, definite descriptions and demonstratives DP) are specific because identity of referents implies inclusion, so if the first index is definite, the second one is definite, too. Indefinites can be specific or non-specific. Summarizing we obtain the three cases below:

- Definites: $i[+\text{definite}] j[+\text{definite}]$
- Specific Indefinites: $i[-\text{definite}] j[+\text{definite}]$
- Non-specific Indefinites: $i[-\text{definite}] j[-\text{definite}]$

For Enç's (1991) account the problem arises of what it means that *two of the books* is a subset of the set of the books. How can this be expressed formally?

8 Enç (1991: fn. 8) explicitly says that is exactly the same phenomenon as what she characterizes as specificity.

9 Enç 1991 and Heim 1982 use NP instead of DP, but in the text I employ updated terminology.

3.2.4 Partitivity vs. epistemic specificity

Both the notion of partitivity and that of singleton indefinite have an epistemic character linked to the informative states of the speaker, nevertheless they make different predictions.

Gutiérrez-Rexach (1999) showed the syntactic relevance of the *principal filterhood* notion for the clitic doubling phenomenon in Madrid Spanish. The definition of a principal filter is as follows:

- (69) A generalized quantifier Q over E is a *principal filter* iff there is a not necessarily empty set $A \subseteq E$, such that for all $B \subseteq E$, $Q(B) = 1$ iff $A \subseteq B$. The set A is called the generator of Q ($A = GEN(Q)$)
(Gutiérrez-Rexach 1999: ex.31)

An existential quantifier expresses non-empty intersection, possibly restricted to a certain cardinality. For example (70).

- (70) Three (A) = $\{ B \mid card(A \cap B) \geq 3 \}$

If the set A includes more than three elements, for each set B , a different intersection with A can exist. If instead the set A involves exactly three elements, then all the B sets belonging to the quantifier must intersect with A for that same element: therefore a set exists (A , including only three elements) that is a subset of all the sets B belonging to that quantifier. Therefore, for singular indefinites, the ‘principal filterhood’ is equivalent to being a singleton indefinite, with scope neutralization, with distributivity effects undetectable on the truth conditional level.

Consider the following sentence (71), involving partitive specificity (Enç 1991).

- (71) Quiero que me traigas varios de los libros.
(Gutiérrez-Rexach 1999: ex.55)

This sentence, can have two readings illustrated in A. and B..

- A. The speaker desires a subset of a presupposed set of books, and the only characteristic is that this subset contain many different books. Therefore many different subset exists that can satisfy the request of the speaker.
- B. The speaker desired a particular subset of books, not whatever subset that contains different books. The indefinite behaves a ‘principal filter’, a singleton indefinite with respect to a plurality.

Gutiérrez-Rexach (1999) claims that in the variants, with clitic doubling, where the object is presupposed only the second reading is available.¹⁰

- (72) Quiero que me los traigas varios de los libros
(Gutiérrez-Rexach 1999: ex.56)

The existence of two interpretations, A.. and B., shows that Enç’s (1991) partitivity is distinct from principal filterhood or Schwarzschild’s (2002)

¹⁰ This intuition is similar to Lasnik & Stowell (1991) on the sets with members ≥ 2 .

epistemic singletons, at least for non *wh*-interrogatives. If we consider the partitive interrogatives with *which*, such as ‘which of the books’, it seems clear that it is presupposed that there exists a unique set of books, that will be specified in the answer, typically through definite DPs, thus *which* NP (usually conceived of as existentials) seems to have a ‘principal filterhood’ presupposition.

Another interesting question that I leave for future research is understanding how partitive and epistemic specificity interact in various syntactic phenomena. That is, are there contexts that are sensitive to one, but not the other kind of specificity? For example according to Kagan (2006) in Russian *-to* signals the non-speaker identifiability.

3.3 A D-TYPE THEORY OF PARTITIVE SPECIFICITY

Building on the previous results, in this section I propose a unified and explicit syntax and semantics for indefinites, which accounts for the three kinds of specificity which I have identified and defined.

This goal is achieved by combining the following ingredients:

- A. Enç’s (1991) idea that there are two ‘referential indexes’: one for the referent and (*i*) and one for the restriction (*j*).
- B. Elbourne’s (2005) idea that indexes are phonologically null NPs.
- C. Stanley’s (2000) idea that the restriction (*j* of Enç 1991) is enriched by another domain restriction index supplied by the context.

I advance a syntactic format which extends to indefinites Elbourne’s (2005) proposal for definite description (73), but the basic intuition is not dependent on the adoption of his framework. Definites and indefinites determiners select different types of indexes: while the definite selects a referential index *i* (73), indefinites, due to their non-referential nature, crucially do not select such an index *i*. Therefore, their format can be represented as in (74), where \emptyset indicates the underspecification of the referential index on the non-referential indefinite.

(73) [the *i* [NP]] Syntactic format of indefinites

(74) [Q \emptyset [NP]] Syntactic format of indefinites

Nevertheless, indefinites select a different type of index. In order to illustrate this point, let’s consider the examples in (75).

- (75) *Discourse context* A: Ho visto dei cani.
A: I have seen ART.IND dogs.
- a. B: Anch’io ne ho visti.
B: Also I CLIT:PART.GEN have seen.
 - b. B: Anch’io ne ho visti alcuni (dei cani che
B: Also I CLIT:PART.GEN have seen some (of the dogs that
hai visto).
you have seen).

The anaphoric reading is absent in (75-a), in other words the set of dogs seen by the speaker A is different from the set of dogs seen by the speaker

B in (75-a), instead it can be the same set of dogs in the case of (75-b), that is to say the anaphoric reading is possible. In both sentences *ne*, the genitive clitic, cliticizes ART.IND *dogs*. Since the difference between the minimal pair (75-a)-(75-b) is the presence of *alcuni* (some) in (75-b), the anaphoric reading is dependent on its presence, and the anaphoric reading depends on the presence of an index. Thus, it is the indefinite that selects a set-denoting index for the anaphoric reading. In the case in (75-b) with anaphoric reading, the index is valued by the linguistic material of the previous discourse *dogs that you have seen*.

Therefore, indefinites select a different type of index, whose value can be given by a set formula introduced by the previous discourse. The format in (74) must be extended as in (76), introducing the second index denoting a property. Since indexes correspond to silent NPs in Elbourne's (2005) proposal, we can write it as an NP, namely NP₂ in (76).

(76) [Q \emptyset] [[NP₁][NP₂]] Syntactic format of indefinites

Syntactically, in (76) NP₂, corresponding to the second index is adjoined to NP₁. Evidence in favor of this hypothesis comes from considering the anaphoric possibilities of examples involving hypernyms and hyponyms. Look at (77).

(77) I read all the works by Pirandello. Two novels are very intriguing.

(77) means that the two novels belong to the set of the works by Pirandello, the DP therefore has a specific interpretation. If NP₂ (*of the works by Pirandello*) were a complement of NP₁ (*the novels*), the complex NP would correspond to *the novels of the works by Pirandello*, with ellipsis of the partitive at Spell-Out. Nevertheless, this NP is ill-formed. Since adjuncts can be omitted in the syntax, but complements cannot, I conclude that the NP₁ 'novels' does not select the NP₂, instead it is adjoined to NP₁.¹¹

Let's now look at the semantics for the formula in (76). The index-NP is characterized as an element of type $\langle e, t \rangle$ and gets interpreted as $\lambda x. g(j) = x$. This allows to interpret the complex NP with the operation of *Predicate Modification*, that is the intersection of the denotation of NP₁ and the NP₂.

¹¹ Reflection on the example in (77) leads to some interesting observations concerning hyponyms and hypernyms in anaphoric contexts with definites and indefinites. Consider the following minimal pairs ((i) and (ii)), involving definites (i) (*the animal/the dog*) and indefinites (ii) (*two novels/two works*).

- (i) a. They gave me a dog as a present. The animal did a lot of damages.
b. *They gave me an animal as a present. The dog did a lot of damages.
- (ii) a. They gave me all the works by Pirandello. Two novels are very intriguing.
b. *They gave me all the novels by Pirandello. Two works are very intriguing.

In the example (i-a), there is a hyponym (*dog*), whereas in the second part of the example there is the hypernym (*animal*). This order is acceptable, whereas the order hypernym-hyponym is ill-formed (i-b). The sentences involving the indefinite (ii) show an opposite tendency: the more acceptable example is the one that goes from the hypernym (*works*) to the hyponym (*novels*), namely (ii-a), whereas the order hyponym-hypernym is ill-formed (ii-b).

Now let's look at independent evidence that support the format syntax and semantics I advanced. The *argument from binding* by Stanley's (2000) supports my theory.

Stanley (2000) proposes that the quantifier domain restriction is part of the content of the utterance at LF, not something unconstrained that gets communicated without actually having been said and comes from the pragmatics. The simplest version is that each nominal expression is associated with a domain variable. Relative to a context, the domain variable is assigned a set. The semantic relation between the extension of the nominal expression and the set is set-theoretic intersection, that is predicate modification exactly as I proposed. A sentence such as *Every bottle is empty* can communicate the proposition that every bottle in Mary's house is empty, because, relative to the relevant context, the domain variable associated with *bottle* is assigned the set of things in Mary's house. *Every bottle is empty* communicates the proposition that every bottle in Mary's house is empty, because, relative to this context, it semantically expresses this proposition.

The crucial argument to support such a view is the so called *argument from binding* (already seen in the (66)). The most natural interpretation of the sentence (78-a) is the one informally represented in (78-b).

- (78) a. Every student answered every question.
 b. Every student x answered every question y on x 's exam.
 (Stanley 2000: ex. 22b-23b)

One way to generate the readings in (78-b) is to suppose that there are bound variables in the structure of quantified noun phrases, whose values, relative to a context, generate a domain of quantification. More specifically Stanley (2000); Stanley & Szabó (2000) captures these readings syntactically associating with each nominal, domain restriction indexes, of the form $f(i)$. Relative to a context, f is assigned a function from object to properties, and i is assigned an object. So the syntactic structure of the sentence in (78-a), becomes at LF (79).

- (79) [Every student, $f(j)$] _{i} answered every question <question, $f(i)$ >.

Summarizing, my proposal and Stanley's (2000) converge to the same analytical conclusion looking at two different empirical domains. Therefore, the analysis is strengthened from the larger empirical support it receives.

Now, with this format in place we can derive the three types of specificity. Scopal specificity was already subsumed under the epistemic definition of epistemic specificity. As for presuppositional specificity, the presence of the second index is a necessary condition for partitive/presuppositional specificity.¹²

Thus, my analysis suggests that the second index of *Enç* does the same work of Stanley's (2000) domain restriction index. The data in (75) and the argument from binding justifies its presence, while it had a stipulative

¹² I leave open for future research the question if it is necessary to differentiate between partitive (*which of the books*) and non-partitive D-linked elements (*which books*) and how to analyze the possible difference. Basically I assume that the latter reduce to covert partitives, as in *Enç* (1991).

status in the original proposal by Enç. The upshot of the discussion in this section is a new and explicit syntax and semantics for indefinites.

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Weak Crossover (WCO) phenomenology is richer than usually understood. As we saw, the first investigations of WCO (Wasow 1972; Cole 1974) illustrated that the effect is absent when the antecedent is *determinate* (see §2.1.1), but this notion remained at an intuitive level.

In the study of WCO at LF, starting with Chomsky 1976, this empirical observation was shelved and the bipartition between quantificational and referential antecedents (Reinhart 1983) obscured the relevance of subtler differences (see §2.2).

In their paper on *Weakest Crossover*, Lasnik & Stowell (1991) reintroduced the issue of the kind of operator in WCO. They distinguished between *true quantificational operators* and non-quantificational \bar{A} antecedents, which leave a *null epithet* in argumental position ((1-a) versus (1-b)).

- (1) a. ?*Who_i do his_j students admire t_i? *Quantificational*
 b. [This professor]_i, his_j students admire e_i. *Non-quantificational*

What I wish to systematically establish is that *wh*-antecedents, quantificational in the sense of Lasnik & Stowell, induce WCO effects only if they are non-specific (2). If we modify the base example (1-a) by using respectively an aggressively non D-linked (2-a) and a D-linked phrase (2-b) (Pesetsky 1987), we get sharply different grammaticality judgments:

D-linked cases are (almost) acceptable whereas non-specific ones are completely out.^{1 2}

- (2) Only non-specific *wh*-operators give rise to WCO effects
- a. ?*[Who the hell]_i do his_i students admire t_i? Non-specific
 - b. (?)[Which famous professor]_i do his_i students admire t_i? Specific

In order to establish the claim in (2) systematically, both a conceptual and an operational definition of specificity are needed.

Pesetsky (1987) showed that has important consequences for LF syntax. This work marked the beginning of a new trend in the study of syntax: for a long period before, specificity was shelved as a mere discourse property, not part of the study of core syntax. Pesetsky 1987 broke with this tradition and paved the way for a series of studies that aimed at integrating this notion in the syntax, in order to account for a range of empirical phenomena. This research trend brought up a conceptual and operational definition of specificity, though its role in WCO has not yet been systematically addressed.

Concerning the operational definition, a series of syntactic contexts whose grammaticality is sensitive to the specificity of the extracted DP have been advanced in the literature. I carefully combine these tests with the WCO configurations to establish the hypothesis. The resulting generalization is that only non-specific operators give rise to WCO effects. This is the starting point of the analysis to be developed. I propose to refine Lasnik & Stowell's typology of \bar{A} operators: quantificational cases are split into specific and non-specific ones.

The rest of the chapter is organized as follows. Section 4.1 is devoted to the discussion of Lasnik & Stowell's classic proposal reintroducing the relevance of the \bar{A} operator in WCO. This, in fact, is the starting point of the proposal to be developed here. §4.2 presents a series of syntactic contexts where it has been argued that the specificity of the extracted DP plays a crucial role in determining grammaticality. In particular, I will consider (Heycock 1995), (Cinque 1990), participial agreement in French (Obenauer 1994), clitic doubling in Romanian (Dobrovie-Sorin 1994), extraction from existential *there* constructions (Heim 1987), and scope (Cinque 1990). The predictions of these tests are discussed in detail in §4.3, where I make some important methodological remarks on the use

¹ In order to account for the subtler differences of grammaticality in WCO, we introduce a richer set of diacritics than traditionally assumed. The grammaticality scale of the diacritics is the following: (?) < ? < ?? < ?* < *.

² Wasow (1972) originally noted differences in grammaticality judgments with different *wh*-elements:

- (i) a. ?*Who_i did the woman he_i loved betray?
b. ?[Which picture]_i did the man who purchased it_i refuse to sell?
(Wasow 1972: ch. 4, ex. 21-a,23-a)

We rarely find this observation in recent literature. An exception is Culicover & Jackendoff 1995 that propose the following contrast:

- (ii) a. [Which famous senator]_i do his_i constituents despise?
b. ??Who_i do his_i constituents despise? (Culicover & Jackendoff 1995: ex. 39)

However, the authors do not discuss the paradigm in detail.

of such contexts as tests for my hypothesis. Bearing this in mind, in §4.4 I systematically apply the tests and show how the evidence support the hypothesis.

4.1 WEAKEST CROSSOVER

The analysis of the WCO configurations at LF in the literature that I reviewed is based on paradigmatic cases of binding by an operator, that is cases of binding by a quantifier or a *wh*-element. A descriptive generalization on the basic cases of WCO, accepted by the researchers is the following.

- (3) In a configuration where a pronoun P and a trace T are both bound by a quantifier Q, T must c-command P. (Lasnik & Stowell 1991: p. 690)

Lasnik & Stowell (1991) assume this generalization and do not align with respect to the proposals that have been advanced. The starting point of Lasnik & Stowell's (1991) proposal is the *Generalized WCO Hypothesis*: since QR and *wh*-movement are instances of \bar{A} movement, WCO violations are expected in all instances of \bar{A} movement, and not only in the paradigmatic cases involving binding by quantifiers and *wh*-operators.³ Therefore, the generalization in (3) must be reformulated to include all the \bar{A} binding configurations.

- (4) In configuration where a pronoun P and a trace T are both \bar{A} bound by a category C, T must c-command P. (Lasnik & Stowell 1991: p. 691)

However, the authors establish that WCO effects show up only with a subset of \bar{A} movements. As a matter of fact, they claim that the effect is systematically present in the types of constructions illustrated in (5).

- (5) a. *The fact that he_i owned a gun implicated everyone_i. *Quantification*
 LF: everyone_i [_{IP} [_{NP} the fact that he_i owned a gun] [_{VP} implicated t_i]]
 b. *Who_i does his_i boss dislike t_i? *Wh-question*
 c. *The man_i [who_i [his_i mother loves t_i.]] *Restrictive relative*
 d. ??His_i mother shot JOHN_i. *Focus*
 LF: John_i [_{IP} his_i mother shot t_i]
 (Adapted from Lasnik & Stowell 1991: ex. 12-a,12-b,13-a,13-b,82-b)

On the other hand, WCO effects are absent in \bar{A} -movement cases exemplified in (6).

- (6) a. John_i [*Null Op*_i [I believe his_i mother loves t_i]]. *Topicalization*
 b. This book_i was too obscene [*Null Op*_i [PRO to have [its_i author] publicize t_i]]. *Object deletion*
 c. Who did you gossip about t_i [*Null Op*_i [despite his_i teacher's having vouched for t_i]]. *Parasitic gaps*

³ The hypothesis that all \bar{A} -movements have a similar behavior was present in a nutshell in Wasow's (1972) proposal. Nevertheless, a most accomplished formulation of the idea is in Chomsky 1977.

- d. This book_{*i*}, which_{*i*} its_{*i*} author wrote t_{*i*} last week, is a hit.
Appositive relative
- e. It was this book_{*i*} [(Wh)_{*i*}] that I got its_{*i*} author to read t_{*i*}. *Cleft*
 (Lasnik & Stowell 1991: ex. 33-a,29-a,23-a,36-b,78-b)

The sentences in (6) are instances of *Weakest Crossover*, a term indicating the complete (or almost complete) absence of the expected violation.

To explain this pattern, Lasnik & Stowell (1991) propose that two kinds of \bar{A} -operators are involved in the two paradigms. Cases which give rise to WCO effects (5) involve *true quantificational phrases*, which operate on sets with members ≥ 2 , and leave a variable in trace position. The structures that do not give rise to WCO (6), in contrast, involve non-quantificational antecedents, which leave a *null epithet* in argumental position.

Postal (1993) provides further evidence for the idea that the presence of WCO is tied to the operator type, rather than the construction type.⁴ While Lasnik & Stowell (1991) claim that topicalizations and clefts with quantificational phrases are impossible in English, Postal (1993) shows that these constructions are actually possible if the moved DP is modified by an exceptive (for example *anyone else*), a relative (for example *anyone who was sick*), or an adjective phrase (for example *somebody taller and thinner than you*). Consider the following examples (7) with an exceptive phrase.

- (7) a. Anyone_{*i*} else/but Bob/other than her they would have fired t_{*i*}.
 b. It was somebody_{*i*} else/other than her that they would have fired t_{*i*}. (Postal 1993: ex. 6)

The moved phrases in these constructions qualify as true quantifiers and do give rise to WCO effects, as illustrated in the examples (8).

- (8) a. Jack_{*i*}, I told his_{*i*} wife that I had called t_{*i*}.
 b. *Everybody_{*i*} else, I told his_{*i*} wife that I had called t_{*i*}. (Postal 1993: ex. 9-a,9-c)

To sum up, Lasnik & Stowell 1991 reintroduced the relevance of the operator type with respect to WCO. Different kinds of operators (quantificational vs. non-quantificational) show different amounts of sensitivity to WCO. In the next chapters I argue that the specificity of the quantificational operator is relevant for WCO phenomenology, by providing a notional (Chapter 3) and an operational definition (Chapter 4) of specificity.

Lasnik & Stowell (1991) propose a characterization of the empty categories associated to extraction in terms of the Binding Theory. While according to Binding theory, all the trace of \bar{A} -movement are conceived of as variables, the authors claim that there actually are two possibilities, depending on the type of the extracted elements: only true quantificational phrases leave a variable, while for non-quantificational Lasnik & Stowell (1991) propose that the trace is a “null referential expression” (a null epithet).

⁴ Postal 1993 is a critical analysis of Lasnik & Stowell’s (1991) proposal. In the former article the author describes interesting data that complicate WCO phenomenology. Even though these data would definitely deserve further investigation, we will not discuss them here.

4.2 INTRODUCING THE SPECIFICITY TESTS

The literature provides a series of operational tests of specificity, namely a series of contexts where it has been argued that the specificity of the extracted DP plays a role in determining the grammaticality of the constructions. The goal of this chapter is to present these contexts and to show how the idea of specificity the various authors have in mind can be assimilated to the notion formalized in the previous section, following [Enç 1991](#).

4.2.1 *Antireconstruction*

The term is introduced by [van Riemsdijk & Williams \(1981\)](#) to refer to the absence of principle C effects that we would expect if the extracted phrase were to be reconstructed in argument position.

[Heycock \(1995\)](#) analyzes the possibilities of an extracted phrase in terms of its referentiality. Concerning this notion she quotes works by [Comorovski \(1989\)](#), [Kroch \(1989\)](#), [Rizzi \(1990\)](#) and [Cinque \(1990\)](#) in which it is argued that referentiality is relevant for possibilities. The referential/non-referential contrast can thus be reduced to a specific/non-specific one, in terms of the definition we provided above.

- (9) a. [Which stories about Diana_i]_j did she_i most object to t_j?
Specific
b. *[How many stories about Diana_i]_j is she_i likely to invent t_j?
Non-specific ([Heycock 1995](#): ex. 33)
- (10) a. [Which lies aimed at exonerating Clifford_i]_j did he_i expect
t_j to be effective? *Specific*
b. *[How many lies aimed at exonerating Clifford_i]_j is he_i plan-
ning to come up with t_j? *Non-specific*
([Heycock 1995](#): ex. 34)

In the non-referential cases, e.g. the object of creation verbs, as in (9-b) and (10-b), there is no presupposed set of entities specified by the complement of the *wh*-operator. This corresponds to a non-presuppositional interpretation, and in [Enç's \(1991\)](#) terms to a non-specific interpretation. In fact, the restriction of the operator is not a set of entities previously introduced in the discourse and familiar to the speaker and the hearer, which means that the index of the restriction is non-specific. On the other hand, in referential case like (9-a) and (10-a) there is a set of presupposed entities (for example, a set of presupposed stories about Diana whose existence is known to the speaker and the hearer), and this amounts to a D-linked interpretation, or, in [Enç's](#) system, a specific interpretation.

The semantics of *which* presupposes a set of entities defined by the complement of the operator, but this is not the case with interrogatives introduced by *how many*. While in (9-b) and (10-b) above *how many* has a pure cardinal reading, this phrase is actually ambiguous with respect to specificity. In other contexts, *how many* interrogatives can have a referential interpretation, which presupposes the existence of a set of entities. In these circumstances we have effects, as expected. For example, in (11)

a familiar set of stories and of lies, respectively, have to be presupposed because of the lexical choice.

- (11) a. ?[How many stories about Diana_i]_j was she_i really upset by t_j? *Specific*
 b. [How many lies aimed at exonerating Clifford_i]_j did he_i claim that he_i had no knowledge of t_j? *Specific*
 (Heycock 1995: ex. 40)

On the basis of the proposed analysis, effects are a hallmark of the specificity of the extracted element. So if WCO is sensitive to specificity, we expect that in the contexts, WCO effects are absent. In contrast, if a principle C violation shows up, the extracted phrase must be non-specific and WCO effects should arise.

4.2.2 Weak islands extraction

Comorovski (1989), Kroch (1989), Rizzi (1990) and most notably Cinque (1990) have originally established that specific DPs can be (at least marginally) extracted from weak islands, contrary to other elements (non D-linked DPs, predicates, parts of arguments, adjuncts). Rizzi (2001a) systematically collects data that support the treatment of the asymmetries in terms of specificity/non-specificity and proposes a theory that plays a crucial role in the analysis of WCO that I argue for here. In this section I will concentrate only on the empirical part, leaving aside the theoretical considerations that will be discussed in.

Let's consider a paradigmatic case of the asymmetry:

- (12) a. ?Quale dei libri che ti servono non sai dove trovare? *Specific*
 'Which (one) of the books (that) you need don't you know where to find?'
 b. *Che diavolo non sai dove trovare? *Non-specific*
 'What the hell don't you know where to find?'
 (Rizzi 2001a: ex. 19)

In (12-a) the D-linked *wh*-phrase can be extracted from a weak island, while in (12-b) the extraction of an aggressively non D-linked phrase causes ill-formedness.

Apart from paradigmatic cases of like (12), following Heycock 1995, notes that *how many* is ambiguous with respect to specificity and possibilities. There are different strategies for disambiguating these phrases: apart from lexical choice (illustrated in §(3), ex. (11)), the use of some modifiers (*up to how many, how many NPs more*) induces a pure quantitative reading of the DP, as observed by Obenauer (1994). Extraction of these phrases from a weak island is impossible (13-b), as expected.

- (13) a. ?Quanti problemi non sai come risolvere? *Specific*
 'How many problems don't you know how to solve?'
 b. *Fino a quanti problemi non sai come risolvere (in un'ora)? *Non-specific*
 'Up to how many problems don't you know how to solve (in one hour)?'
 (Rizzi 2001a: ex. 24)

On the basis of this proposal, the possibility of weak island extraction of a phrase is thus a diagnostic of its specificity.

4.2.3 *Participial agreement in French*

Obenauer (1994) observes that past participle agreement triggered by object *wh*-movement in French interrogatives is possible only with specific DPs. *Combien de fautes* in (14-a) can only have a specific interpretation; if there is a modifier which excludes this interpretation, agreement is ungrammatical ((14-b)–(14-c)).

- (14) a. Dis-moi combien de fautes tu as faites. *Specific*
 tell me how many of mistakes you have made-*agr*
- b. Jusqu'à combien de fautes ont-ils fait*(es), vos
 up to how many of mistakes have-they made-*(*agr*), your
 élèves?
 students?
- c. Combien de fautes en moins a-t-il fait*(es) cette
 how many of mistakes fewer has-he made-*(*agr*) this
 fois? (Obenauer 1994: 173, ex. 16,17-a,17-b)
 time?

Obenauer (1994) notes that these data are quite delicate. First of all, agreement is optional. Moreover, two phenomena interfere with these data: on the one hand, agreement tends to be suppressed in spoken French; on the other, the normative rule taught at school imposes past participial agreement on all cases, and this goes against some of the naturalistic data.

In any case, if we disregard colloquial registers and hypercorrection, the grammaticality of past participle agreement is a good test to appreciate the role of specificity in WCO.

4.2.4 *Clitic doubling in Romanian*

Dobrovie-Sorin (1994: ch. 6) establishes that the distribution of accusative clitic doubling in Romanian \bar{A} constructions depends on the specific vs. non-specific nature of the moved *wh*-phrase: *cine* ('who') and *ce(N')* ('what') do not allow the presence of the clitic (15-b), while *care* ('which') requires it (15-a). As expected, *citi* ('how many') is ambiguous, and can require or forbid the presence of the clitic according to its interpretive properties.

- (15) a. Pe care (băiat) *(l-)ai vă? *Specific* 'Which
pe which (boy) him-have (you) seen?
 one (which boy) did you see?'
 b. Pe cine (*l-)ai văzut? *Non-Specific* 'Who did
pe who_i him_i-have (you) seen?
 you see?'
 (Adapted from Dobrovie-Sorin 1994: ex. 3-a,2-a-i,2-b-i)

According to Dobrovie-Sorin's proposal, clitic doubling is therefore a hallmark of the specificity of an extracted phrase.

4.2.5 Extraction from existential constructions

The post-copular subject of existential sentences with expletive *there* must be an indefinite DP or, using a term from Milsark 1977, a *weak NP*. This so-called *Definiteness Restriction* is illustrated by the contrast between (16) and (17): *strong NPs* in (17) are incompatible with *there*.

- (16) a. *There is John/the man/every man in the room. *Specific*
 b. *There are they/the people/most people in the room. *Specific*
- (17) a. There is a man/one man in the room. *Non-Specific*
 b. There are men/two men/many men in the room. *Non-Specific*

Heim (1987) argues that the *Definiteness Restriction* must be applied at LF, the level where scope ambiguities are disambiguated and *wh*-elements are subject to partial .

According to Heim, *which* phrases fail to reconstruct and bind an individual variable, i.e. a variable ranging over a set of individuals, and syntactically corresponding to a DP gap; this counts as a strong element (in Milsark's sense), violating the definiteness restriction (18-a). *How many* phrases are instead subject to of the restrictive term; the operator binds a non-individual variable, corresponding to a subpart of the DP and ranging over a set of quantities or degrees. Since there is no *strong* individual variable, the *Definiteness Restriction* is not violated (18-b).

- (18) a. ??[Which one of the two men was there in the room? *Specific*
 LF: which one of the two men was there ν in the room?
 b. [How many soldiers] does John think there were in the infirmary? *Non-specific*
 LF: *Wh-Op* does John think there were x – *many soldiers* in the infirmary? (Heim 1987: ex. 15,14, quoting Safir 1982)

While the question in (18-a) includes an individual variable, a strong element incompatible with *there*, (18-b) involves an occurrence with restricted scope of *x-many N*, which is characterized as a weak phrase (despite the definiteness of the x variable itself).

- (19) a. ??The men/many men who there were in the room were eating guavas. *Specific*
 LF: The men/many men who there were ν in the room were eating guavas
 b. The very few books that/ \emptyset there were on the shelves were all mysteries. *Amount relative* \Rightarrow *Non-specific*
 LF: the very few books *Rel-Op* that/ \emptyset there were x *fewbooks* on his shelves were all mysteries
 (Heim 1987: ex. 33,30, quoting Safir 1982)

The relatives in (19) are examples of *amount relatives* in terms of Carlson 1977, since they involve quantities or degree descriptions. This interpreta-

tion is semantically encoded by the occurrence of *x-many Ns* in argument position, instead of an individual variable, as is the case in (19-a).⁵

Heim's proposal can be reinterpreted in our terms: non-individual variables correspond to a non-specific interpretation, as there is no presupposed set over which the variable bound by the operator ranges. So interrogatives with *how many* and amount relatives with *there* constitute tests for non-specificity: when the trace of an extracted phrase can occur in clauses with existential *there*, the element is non-specific and WCO effects are expected, according to my hypothesis.

4.2.6 Scope

Longobardi (1986) observed that quantifier scope is blocked by weak islands. In the absence of islands, though, the scope properties of an operator are preserved under movement. In (20), for example, no island is crossed by the moved phrase and therefore two interpretations are possible. The moved phrase *quanti pazienti* ('how many patients') can have scope over *ognuno dei medici* ('every one (of the) doctors'). In this case a natural reply to the question is a number, as illustrated in (20-b), without distributive reading. A distributive reading is possible, too: *ognuno dei medici* can take scope over the extracted phrase *quanti pazienti*. In this case, a natural reply to the question is given in (20-a).

- (20) [Quanti pazienti]_i pensi che ognuno dei medici
[how many patients]_i do you think that every one of the doctors
riesca a visitare t_i in un'ora?
can visit t_i in one hour?
- a. I think Doctor Brown could visit three patients in one hour,
Doctor Smith five, ... *Distributive reading*
- b. Only three. *Non-distributive reading*
- (Adapted from Cinque 1990: ex. 33-a)

The distributive reading implies of the interrogative phras, but this is impossible if a weak island is crossed. In this case, the question is marginally possible only in the non-distributive reading, asking about a number (21-b).

- (21) [Quanti pazienti]_i non pensi che ognuno dei medici
[how many patients]_i don't you think that every one of the doctors
riesca a visitare t_i in un'ora?
can visit t_i in one hour?
- a. *I don't think Doctor Brown could visit three patients in one
hour, Doctor Smith five, ... *Distributive reading*
- b. ?Three patients. *Non-distributive reading*
- (Adapted from Cinque 1990: ex. 34-b)

Cinque (1990) argues that scope properties depend on the referential nature of the extracted operator, which is Enç's notion of specificity. Only the non-specific interpretation allows the distributive reading. If a phrase

⁵ Heim also considers comparatives, but to avoid complications I will not discuss this kind of construction here.

can be extracted from a weak island with a grammatical result (21-b), it should be specific (cf. §4.2.2), and the possibility of a distributive reading (present in (20-a)) is lost. In fact, as we said, *how many* phrases are ambiguous between a specific and a non-specific reading.

In conclusion, the impossibility of scope is a diagnostic of the specificity of the extracted phrase. In other words, only non-specific phrases can reconstruct.

4.3 METHODOLOGICAL REMARKS

The table 1 summarizes the predictions of the specificity tests for the hypothesis that WCO is suspended when the antecedent is specific.

	+ SPECIFIC	- SPECIFIC
A. Antireconstruction effect WCO Effects	✓ absent	* present
B. Weak Island extraction WCO Effects	✓ absent	* present
C. Participial agreement in French WCO Effects	✓ absent	* present
D. Clitic doubling in Romanian WCO Effects	✓ absent	* present
E. Extraction from existential constructions WCO Effects	* absent	✓ present
F. Scope WCO Effects	* absent	✓ present

Table 1: Specificity tests and their predictions

In the cases of , , **French past participle agreement**, and **clitic doubling in Romanian**, the base test gives a grammatical result in the specific case. In the specific case we can combine the base test and WCO in the same configuration; the prediction is that the example remains grammatical whenever WCO effects are neutralized. In the non-specific case, however, the base test gives an ungrammatical result; therefore the base test and WCO cannot be combined in the same example, or else the potential agrammatically could not be ascribed to a WCO violation. In this case the only possibility is to separate the base test and the WCO configuration into two distinct examples, which constitute a (nearly) minimal pair.

To illustrate this point, consider again the paradigm of weak island extraction, repeated in (22).

- (22) a. ?Quale dei libri che ti servono non sai dove trovare? *Specific*
 ‘Which (one) of the books (that) you need don’t you know where to find?’
 b. *Che diavolo non sai dove trovare? *Non-specific*
 ‘What the hell don’t you know where to find?’

In the specific case (22-a) we can add a WCO configuration and the sentence should remain grammatical, if the hypothesis that specificity sus-

pendis WCO is true. But in the non-specific case (22-b), the extraction from a weak island is ungrammatical because *che diavolo* ('what the hell') is non-specific. To test what happens in WCO cases we cannot have a configuration with an extraction from a weak island; if we did, we could not ascribe agrammaticality to WCO alone, as it is ungrammatical because of the extraction.

Consider now the case of **extraction from existential sentences**, repeated below (23):

- (23) a. ??Which one of the two men was there in the room? *Specific*
 LF: which one of the two men was there v in the room?
 b. How many soldiers does John think there were in the infirmary? *Non-specific*
 LF: *Wh-Op* does John think there were x – *many soldiers* in the infirmary? (Heim 1987: ex. 15,14, quoting Safir 1982)

The test gives a grammatical result with non-specific phrases; here, we can combine the base test with the WCO configuration in the same sentence. The hypothesis predicts that a WCO effect will show up, and the predicted ill-formedness will be ascribed only to this. In the specific case, though, the base test is ungrammatical and, as before, it is necessary to use two different examples; the prediction is that in the WCO configuration the effect does not show up because the *wh*-phrase is specific.

Finally, consider the **scope paradigm** :

- (24) [Quanti pazienti]_{*i*} pensi che ognuno dei medici
 [how many patients]_{*i*} (do) you think that every one of the doctors
 riesca a visitare t_i in un'ora?
 can visit t_i in one hour?
 a. I think Doctor Brown could visit three patients in one hour,
 Doctor Smith five, ... *Distributive reading* → *Non-specific*
 b. Only three. *Non-distributive reading* → *Specific*

In the base test we have predictions about possible interpretations instead of grammaticality judgments. In the specific case we expect that WCO is suspended but that the only possible reading is the one with wide scope of the *wh*-phrase with respect to another operator, that is without scope. In the non-specific case there is scope but WCO effects are predicted; thus a WCO configuration is incompatible with scope.

4.4 SPECIFICITY TESTS AND WCO

4.4.1 *Antireconstruction*

In order to add a WCO configuration in a pragmatically plausible way, it is necessary to modify the original examples. The sentences in (25) are modified versions of Heycock's original ones. (25-a), with a partitive *wh*-phrase, shows effects; in (25-b) the reference to uncertain future

makes it clear that there is not a familiar set, so we have a non-specific interpretation, and a principle C violation emerges, as expected.⁶

- (25) a. Dimmi [quale dei colleghi di Maria_j]_i pensi che lei_j abbia invitato t_i.
 ‘Tell me [which of Maria_j’s colleagues]_i do you think she_j invited t_i.’
 b. *Dimmi [quanti colleghi di Maria_j]_i pensi che lei_j incontrerà t_i durante la carriera.
 ‘Tell me [how many of Maria_j’s colleagues]_i do you think she_j will meet during her career t_i.’

In (26-a), the combined case, there is , and despite the presence of a potential WCO configuration, the effect does not show up. Examples (26-b)–(26-c) test WCO in isolation. The extraction of the phrase that in (25-a) shows does not show WCO effects in (26-b). Instead the extraction of a non-specific phrase, which in (25-b) is subject to principle C, shows WCO:

- (26) a. Dimmi [quale dei colleghi di Maria_j]_i sua_i moglie pensa che lei_j abbia sedotto t_i. (*Combined case*)
 ‘Tell me [which of Maria_j’s colleagues]_i does his_i wife think (that) she_j seduced t_i.’
 b. Dimmi [quale dei colleghi di Maria]_i pensi che sua_i moglie abbia minacciato t_i.
 ‘Tell me [which of Maria_j’s colleagues]_i do you think (that) his_i wife threatened t_i.’
 c. *Mi chiedo [quanti impiegati]_i le loro_i mogli sperano che il Presidente assumerà t_i nel corso del prossimo anno.
 ‘I wonder [how many workers]_i do their_i wives hope (that) the President will hire t_i during next year t_i.’

4.4.2 Weak islands extraction

The extractions in (27) are the basic paradigm modified in order to add WCO. In the example in (27-a) we see the extraction of a D-linked phrase, while the example in (27-b) involves an *aggressively non D-linked* phrase. Finally, in (27-c) the modifier forces a non-specific interpretation (Obenauer 1994).

- (27) a. (?)Dimmi [quale degli studenti interrogati]_i pensi che Gianni non sappia come valutare t_i.
 ‘Tell me [which of the evaluated students]_i do you think John does not know how to grade t_i.’
 b. ?*Mi chiedo [chi diavolo]_i pensi che Gianni non sappia come valutare t_i.
 ‘I wonder [who the hell]_i do you think John doesn’t know how to grade t_i.’

⁶ I use indirect questions with subjunctive in order to avoid subject inversion in Italian and its possible interference with the phenomenon at issue here.

- c. *Mi chiedo [fino a quanti studenti]_i pensi che Gianni non sappia se riuscirà a interrogare in un'ora t_i.
'I wonder [at most how many students]_i do you think John does not know if he will be able to evaluate t_i in one hour.'

As far as the specific case is concerned, both a combined question with and WCO (28-a) and one with WCO alone (28-b) are acceptable: no WCO effect arises. In the non-specific case, we test the WCO configuration in isolation and the WCO effect emerges, as expected (28-c)–(28-d).

- (28) a. (?)Dimmi [quale degli studenti interrogati]_i pensi che il suo_i insegnante non sappia come valutare t_i. (*Combined case*)
'Tell me [which of the evaluated students]_i do you think (that) his_i teacher doesn't know how to grade t_i'
- b. (?)Dimmi [quale degli studenti interrogati]_i pensi che il suo_i insegnante voglia bocciare t_i.
'Tell me [which of the evaluated students]_i do you think that his_i teacher would fail t_i
- c. ?*Mi chiedo [chi diavolo]_i pensi che il suo_i insegnante voglia bocciare t_i.
'I wonder [who the hell]_i do you think (that) his_i teacher would fail t_i
- d. *Mi chiedo [quanti studenti al massimo]_i pensi che il loro_i insegnante possa interrogare t_i in un'ora.
'I wonder [at most how many students]_i do you think (that) their_i teacher could evaluate t_i (with)in one hour.

The paradigm in (28) shows that the predictions are confirmed by the grammaticality judgments.

4.4.3 Participial agreement in French

For the modified base paradigm, my informants gave judgments congruent with those reported in Obenauer 1994. The example in (29-a) is grammatical in the specific interpretation, with past participle agreement; meanwhile, in examples (29-b) and (29-c), the modifiers force a non-specific reading and past participle agreement is ungrammatical.

- (29) a. Dis-moi [quelles voitures]_i FIAT a mises sur le marché
tell me [which cars]_i FIAT has put-*agr* on the market
t_i à prix réduit.
t_i at a price reduced
- b. ?*Dis-moi [jusqu'à combien de voitures]_i les producteurs
tell me [up to how many cars]_i the producers
ont mises sur le marché t_i à prix réduit.
have put-*agr* on the market t_i at a price reduced
- c. ?*Dis-moi [combien de voitures en plus]_i FIAT a mises
tell me [how many of cars more]_i FIAT has put-*agr*
sur le marché t_i cette année.
on the market t_i this year

The example in (30-a) is parallel to that in (29-a): there is a phrase which can trigger agreement, so it is specific and, as expected, it does not give rise to WCO. Instead the examples in (30-b) and (30-c) are parallel to those in (29-b) and (29-c), they involve phrases which cannot trigger agreement and, as predicted, they give rise to WCO.

- (30) a. Dis-moi [quelles voitures]_i leur_i producteur a mises sur
tell me [which cars]_i their producers have put on
le marché t_i à prix réduit.
the market t_i at a price reduced
- b. ?*Dis-moi [jusqu'à combien de voitures]_i leur_i producteur
tell me [up to how many cars]_i their producer
a mis sur le marché t_i à prix réduit.
has put on the market t_i at a price reduced
- c. ?*Dis-moi [combien de voitures en plus]_i leur_i producteur
tell me [how many of cars more]_i their producer
a mis sur le marché t_i cette année.
has put on the market t_i this year

4.4.4 Clitic doubling in Romanian

Dobrovie-Sorin (1994) argues that specific elements like *care* ('which (boy)') in (31-b) are not quantificational, whereas *cine* ('who') in (31-a) is quantificational.

- (31) a. Pe cine (*l-)ai văzut? *Non-Specific* 'Who did
pe who_i him_i-have (you) seen?
you see?'
b. Pe care (băiat) *(l-)ai vă? *Specific* 'Which
pe which (boy) him_i-have (you) seen?
one (which boy) did you see?'
(Adapted from Dobrovie-Sorin 1994: ex. 2-a-i,2-b-i,3-a)

In order to establish her claim, she uses the WCO test.

- (32) a. *Pe cine_i a certat mama lui_i t_i? 'Who_i did his_i mother
pe who_i has scolded mother his_i t_i?
scold t_i?'
b. *[Ce copil]_i ar pedepsi părinții lui_i t_i? '[What child]_i
[what child]_i would punish parents his_i t_i?
would his parents punish t_i?'
(Adapted from Dobrovie-Sorin 1994: ex. 12-a,12-b)
- (33) a. Pe care_i l_i-a certat mama lui_i t_i? '[Which one]_i
pe which_i him_i-has scolded mother his_i t_i?
did his_i mother scold t_i?'
b. Pe al cui elev_i îl_i nedreptățesc prietenii lui_i t_i?
pe whose student_i him_i wrong friends his_i t_i?
'[Whose student]_i do his_i friends wrong t_i?'
(Dobrovie-Sorin 1994: ex. 13)

We know that *cine* ('who') and *ce* ('what') have a non-specific interpretation as they do not allow clitic doubling (31-a). Thus (32) is a test that confirms that WCO effects do show up with non-specific antecedents. In contrast *pe care* ('which') and *pe al cui* ('whose') in (33) have a specific interpretation, as they require clitic doubling. As we know, in the specific case we can combine the base test and WCO because we expect a grammatical result if specificity suspends WCO.⁷

4.4.5 *Extraction from existential constructions*

The examples in (34) are modified versions of the ones quoted from the literature.

- (34) a. How many soldiers does the commander think there are *t* in the infirmary?
 b. These supplies should be enough for the very few soldiers (that) the commander thinks there are *t* in the trenches at this point.

When the trace of an extracted element can occur in *there* contexts the element is non-specific and we expect WCO violations. If we combine the base test and WCO, a WCO violation is expected.

- (35) a. ?*[How many soldiers]_{*i*} does their_{*i*} commander think there are *t* in the infirmary? (*Combined case*)
 b. ?*These supplies should be enough for [the very few soldiers]_{*i*} that their_{*i*} commander thinks there are *t* in the trenches at this point. (*Combined case*)

If the base test is ill-formed, the extracted phrase is specific (36-a). In this case we have to keep the base test and the WCO configuration separated in order to see the lack of WCO effects (36-b):

- (36) a. ??Which students does the professor think there are *t* in the great-hall?
 b. [Which students]_{*i*} does their_{*i*} professor think are *t* in the great-hall?

4.4.6 *Scope*

The question in (37) is parallel to the example in (20). The allowable responses show that both a distributive non-specific interpretation (37-a) and a specific interpretation of *quanti pazienti* are grammatical.

- (37) [Quanti pazienti]_{*i*} pensi [che ognuno dei medici
 [how many patients]_{*i*} do you think (that) every one of the doctors
 sostenga che Maria ha accompagnato *t*_{*i*}?
 claims that Maria has taken *t*_{*i*}?

⁷ In this test, for the specific case it is not possible to have an example with clitic doubling and WCO separated: the presence of specific *wh*-phrases produces an ungrammatical result without clitic doubling (31-b).

- a. Doctor Brown three, Doctor Smith five, ... *Distributive reading*
- b. Three. *Non-distributive reading*

In the test paradigm with WCO in (38) the distributive non-specific reading is unavailable. It is reasonable to interpret this fact as a consequence of the presence of the WCO configuration: it forces the non-distributive specific interpretation (38-b), in order to prevent the potential violation.

- (38) [Quanti pazienti]_i pensi [che ognuno dei medici [how many patients]_i do you think (that) every one of the doctors sostenga che la loro_i madre ha accompagnato t_i]?
claims that (the) their_i mother has taken t_i
- a. *Doctor Brown three, Doctor Smith five, ... *Distributive reading*
 - b. ?Three. *Non-distributive reading*

4.4.7 Conclusion

The results of the tests we discussed in this section confirm the hypothesis that WCO is suspended if the antecedent is specific. The following empirical generalization ensues.

- (39) In an \bar{A} chain WCO effects arise only if the extracted phrase is non-specific.

4.5 QUANTIFIERS AND WH-IN-SITU

Actually the facts are more complex. As noted by Falco (2007: §§8.2), the generalization concerning and WCO does not extend to instances of covert movement of D-linked constituents, mainly quantifiers, *wh* in-situ, and focalized elements.

As far as quantifiers are concerned, it suffices to consider the sentence in (40) which involves an overtly partitive quantifier crossing the pronoun when QR-ed. Although the operator clearly constitutes a D-linked phrase, the BV reading is strongly ill-formed:

- (40) **His* mother loves *everyone of these children*.
LF: **everyone of these children* his mother loves *t*.
(cf. Falco 2007: ex. 51)

As for *wh*-in-situ, consider the minimal pair (41-b) vs. (41-a): in French, a D-linked *wh*-element can be in-situ (41-b) and ex-situ (41-a). The grammaticality judgements show that there is a sharp contrast in acceptability between the two versions of the question with respect to the possibility to circumvent WCO: the D-linked *wh*-element in (41-b) cannot bind the pronoun.⁸

⁸ Our thanks to Léna Baunaz and Christopher Laenzlinger for their judgements. For the same facts in Modern Greek see Vlachos (2008: ex. 11):

- (41) a. *Lequel des étudiants testés son professeur ne sait pas comment*
which of the students tested his professor know not how
évaluer t? Wh ex-situ
 to grade *t*?
- b. **Son professeur ne sait pas comment évaluer lequel des étudiants testés?*
his professor know not how to grade which of the students tested?
Wh in-situ

Finally, notice that the presence of a focalization operator in (42-a) or of the new information focus in (42-b), with main accent on JOHN, induces covert focus movement and WCO effects in spite of the fact that the antecedent (a proper name) is definite (Chomsky 1976).

- (42) a. ?**His mother loves even/only John.*
 LF: [*even/only John*][*his mother loves t*]
- b. ?**His mother loves JOHN*
 LF: [*John*][*his mother loves t*] (cf. Falco 2007: 49-50)

Summarizing, if we put these empirical observations together, the resulting picture of the WCO phenomena is the following: while operators moved in the covert syntax (after Spell-Out) give rise to WCO irrespective of their specificity, specific *wh*-elements moving overtly (before Spell-Out) do not give rise to WCO (the phenomenon we dubbed *weaker crossover*).

If we look at these facts from the perspective of our analysis of indexing at the interface, the empirical question raised at the outset becomes how to derive the presence of a referential index in *weaker crossover* and its absence in standard WCO configurations. This question arguably admits a principled answer once we consider the syntax and semantics for specific indefinites which I developed and the syntax/semantics mapping, which is the topic developed in the following section.

-
- (i) a. *Pjon ithopio tu theatru thamvase i mitera tu t?* Wh ex-situ
which actor.ACC of theatre admired the mother.NOM his t?
- b. **I mitera tu thavmase pjon ithopio tu theatru* Wh in-situ
the mother.NOM his admired which actor.ACC of theatre

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In §5.1, I put forward my view of a transparent syntax/semantics mapping. In particular, in §§5.1.1, I present Rizzi's (2001a) proposal on the different nature of specific vs. non-specific chains at LF and in §5.1.2 I argue that his system can be successfully combined with a semantically motivated use of indexes, implementing a transparent mapping algorithm of the LF chains to the semantics.

Finally, in §5.2, I propose a modified version of the interpretive tools used to obtain BV readings, making a semantically motivated use of indexes, and I show how basic principles of interface economy derive the crossover phenomenology as previously established (§??). In particular, I show how crossover is an effect of the index underspecification in argument position, and how the absence this effect is derived from the presence of a specified index in argument position, due to *shrinking* and in-situ index inheritance.

5.1 MAPPING SYNTAX TO SEMANTICS

5.1.1 *The syntax of LF chains*

The contrast between weak and *weaker crossover* (1) is parallel to the asymmetries between non-specific and specific *wh*-elements with respect to (2) and (3). In these configurations the specificity of the extracted or of the crossing constituent plays a crucial role in permitting extraction from the *wh*-islands (2) and allowing effects (3) on the one hand, and in alleviating WCO effects (1), on the other hand, as we saw above.

- (1) ?Which famous professor do his students admire *t*?
Weaker crossover (cf. Falco 2007)
- (2) ?Which one of the books that you need don't you know where to find *t*?
Weak island extraction (cf. Cinque 1990)
- (3) Which stories about Diana did she most object to *t*?
Antireconstruction (cf. Heycock 1995: ex. 33)

This parallelism between the role played by specificity in syntactic movement and bound variable readings for pronouns represents an important

empirical motivation for the existence of a mapping between the form of syntactic chains and the indexing possibilities of Q-phrases.

Rizzi (2001b) accounts for the syntactic asymmetries through a theory of LF chains, proposing different structures for specific and non-specific *wh*-elements. In this section we sketch his system and illustrate how the algorithms he postulates derive two crucially different copies/traces in argument position for specific and for non-specific chains. In particular, the *shrinking* mechanism assumed by Rizzi (2001a) derives the presence of a copy involving only the operator in non D-linked cases, whereas it derives, in D-linked configurations, the presence of a copy involving only the restriction. We consider this as a crucial step towards a motivated use of referential indexes with non-referential DPs and a meaningful syntax/semantics mapping. More precisely, while it is semantically incorrect to assume the presence of a referential index on a quantificational DP (both QPs and *wh*-phrases: cf. Elbourne 2005), it is semantically justified to assume that the NP expressing the restriction in quantificational DPs is actually endowed with an index encoding specificity, as explicitly proposed by Enç (1991) (see §§5.1.2 for the semantics of this index).

Rizzi's (2001a) proposal is based on the copy theory of traces (Chomsky 1995: ch. 3), the use of deletion at LF to satisfy the principle of *full interpretation*, and a strictly representational definition of traces/copies. In his system chains are defined as follows:¹

- (4) (A_1, \dots, A_n) is a chain if and only if, for $1 < i < n$
- a. $A_i = A_{i+1}$
 - b. A_i C-commands A_{i+1}
 - c. A_{i+1} is in a Minimal Configuration with A_i (Rizzi 2001a: ex. 15)

Both constructions in (5) are expected to be ungrammatical according to condition (4), given the violation of RM expressed in terms of Minimal Configuration. Nevertheless, as we know, the sentence with a D-linked DP (5-a) is acceptable:

- (5) a. ?Which problem do you wonder how to solve ⟨which problem⟩?
 b. *How do you wonder which problem to solve ⟨how⟩?
 (Rizzi 2001a: ex. 9)

In order to illustrate the account of this asymmetry proposed by Rizzi (2001a), consider the non-specific (6-a) and the specific (6-b) structures in (6). Rizzi proposes that the restriction of non D-linked *wh*-elements must reconstruct in its base position at LF and that only the operator can stay in the left periphery (6-a). On the other hand, the restriction of D-linked *wh*-elements can (and in fact must) stay in the left periphery at LF, due to its topical nature. In (6-b), the non-specific mass noun *money* receives a

¹ The notion of *Minimal Configuration*, is a reformulation of the classic *Relativized Minimality* (Rizzi 1990):

- (i) Y is in a Minimal Configuration with X if and only if there is no Z such that
- a. Z is of the some structural type as X, and
 - b. Z intervenes between X and Y. (Rizzi 2001b: ex. 4 and Rizzi 2001a: ex. 8)

specific interpretation due to the use of the overt partitive ('of the money that you need').

- (6) a. **Quanti soldi non sai come guadagnare* ⟨*quanti soldi*⟩?
Non-specific
 'How much money don't you know how to earn?'
 LF: *quanti* ⟨*soldi*⟩ non sai come guadagnare ⟨*quanti*⟩ *soldi*
- b. ?*Quanti dei soldi che ti servono non sai come guadagnare*
 ⟨*quanti dei soldi che ti servono*⟩?
Specific
 'How much of the money that you need don't you know how to earn?'
 LF: *quanti dei soldi che ti servono* non sai come guadagnare
 ⟨*quanti dei soldi che ti servono*⟩ (cf. Rizzi 2001a: ex. 27b-27c)

The deletion of the restriction in the LF representation in (6-a) triggers a *shrinking* mechanism that redefines the portion of structure that counts as trace/copy in the base position: only *quanti* has a trace status, while the restriction, being deleted from the left periphery, is not part of the trace structure in the base position. This mechanism accounts for traditional asymmetries between the specific and the non-specific cases. Now, to explain the asymmetries with respect to weak island sensitivity ((5) and (6)), Rizzi assumes that DPs can enter into a long distance binding relation not subject to RM.

Crucially for the present perspective, the *shrinking* algorithm in non-specific cases creates a chain involving the operator as illustrated in (6-a), and as can be seen in the LF representation, only the operator-part enters into the constitution of the trace/copy, whereas the restriction is expunged from the portion of structural representation that counts as the trace/copy. Conversely, it may be argued that in the specific cases the *shrinking* mechanism yields the mirror image situation for the trace/copy, as a consequence of the identity requirement on chain-links that applies after *shrinking*.

This result for specific chains can be easily achieved if we follow Rizzi's insight that the restriction is licensed in the left-periphery as Topic, and propose that it undergoes a further movement step to the specifier of the relevant TOP-position, as illustrated in (7).

- (7) ?*Quanti dei soldi che ti servono non sai come guadagnare* ⟨*quanti*
dei soldi che ti servono⟩?
Specific
 'How much of the money that you need don't you know how to
 earn?'
 LF: [_{TOP} *dei soldi che ti servono*] *quanti* ⟨*dei soldi che ti servono*⟩
 non sai come guadagnare ⟨*quanti* ⟨*dei soldi che ti servono*⟩⟩
 (cf. Rizzi 2001a: ex. 27-c)

As soon as this movement takes place, the *shrinking* algorithm automatically creates a chain involving only the NP expressing the restriction. There is thus a chain-algorithm according to which the constituent expressed by the trace/copy is limited to the NP-restriction of the DP.

Overtly moved and covertly moved specific phrases are tied to different LF configurations. We assume that this is due to a rather natural interpretation of Rizzi's (2006) *riterial freezing*, and to the assumption that covert

movement cannot be successive cyclic in nature (Luigi Rizzi, p.c.). Rizzi's *riterial freezing* is defined in (8).

- (8) *Criterial freezing*
A phrase meeting a criterion is frozen in place. (cf. Rizzi 2006: p. 112)

On the one hand, when the *wh*-phrase is overtly moved, further movement of the NP restriction is not subject to *riterial freezing*, since it does not involve the *wh*-operator, and only the latter is responsible for the satisfaction of the *wh*-criterion. On the other hand, the NP-restriction of covertly moved phrases cannot be moved out of the phrase it is part of, since the grammar, by hypothesis, permits only one covert movement step.

Summarizing, combining the LF syntax of Rizzi (2001a) with the hypothesis that displacement of the NP-restriction in overt syntax is allowed by Rizzi's (2006) *riterial freezing*, we obtain the two abstract LF representations in (9-a) and (9-b): non D-linked and covertly moved D-linked Q-phrases form the configuration in (9-b), whereas overtly moved D-linked (9-b) Q-phrases form the configuration (9-a).

- (9) a. $[_{\text{TOP}} \text{NP}]_j \dots [\text{Q} \langle [\text{NP}]_j \rangle]_{\emptyset} \dots [\text{pro}]_j \dots \langle [\text{Q} \langle [\text{NP}]_j \rangle]_{\emptyset} \rangle$
Specific LF chain
b. $[\text{Q} \langle [\text{NP}]_i \rangle] \dots [\text{pro}]_i \dots \langle [\langle \text{Q} \rangle [\text{NP}]]_{\emptyset} \rangle$ Non-specific LF chain

Having established the form of the relevant LF chains, in the following subsection we propose a modified version of Elbourne's (2005) theory of indexes, that tightly ties the presence or absence of a referential index on Q-traces to the properties of the LF-chains discussed above. The task is a fine-grained syntax/semantics mapping.

5.1.2 *The semantics of Q-traces*

In a semantically motivated theory of referential indexes, there are two types of indexes. On the one hand, there is the index on referential DPs, as in Elbourne 2005, where pronouns, names and definite descriptions all have the abstract logical format of definite descriptions: [the *i* [NP]] (§§2.4). On the other hand, there is the index on the NP restriction of quantificational DPs, expressing specificity, as in Enç 1991. In Enç's view, specific phrases are equivalent to partitives (e.g. *two of the girls*): every DP has a double indexing (*i, j*): *i* denotes the DP referent and *j* a 'familiar' set in which *i* is included (the index of *girls* in the partitive indefinite *two of the girls*). We propose to reinterpret Enç's (1991) index *j* as the same sort of referential index that Elbourne posits for referential DPs. It has logical type $\langle e, t \rangle$ and gets interpreted as $\lambda x.g(j) = x$. By enriching Elbourne's (2005) format with insight that NP-restrictions bear an index, traces of specific quantificational DPs are assigned the following syntactic format:

- (10) [the *i* [NP *j*]] Specific Q-trace syntactic format - first approximation

Let us consider now the analysis of indexing that we would like to propose. As we saw in §§2.4, Heim & Kratzer (1998), Fox (1999) and Elbourne (2005) simply posited that the TC they assumed to model type-shifting for the copy/trace is able to add an index to the copy in-situ,

identifying this index with the index created by displacing the DP, as is required for a correct application of PA. However, why should the copy of a Q-phrase be endowed with an index?

Under a neo-Fregean theory of definite descriptions, such as [Elbourne's](#), all is required in order to shift a DP of type $\langle et, t \rangle$ into a DP of type $\langle e \rangle$ is the substitution of Q with THE and the creation of an index slot. Assuming that this index slot is underspecified for an index value has the important conceptual advantage that we can stick to the semantically motivated hypothesis that Q-phrases (and, crucially, their copies) cannot express a referential index. In other words, we get rid of the concealed stipulation that the lower copy of Q-traces is 'magically' endowed with the referential index with which the higher copy cannot be endowed, if our theory of indexes has to adequately serve the syntax/semantics interface. Certainly, the TC rule affects lexical material and creates an index slot within the lower Q-copy, crucially, however, it does not induce a referential index on the Q-copy.² In this way, conceptually, we stick to the fundamental hypothesis that Q-phrases are not inherently endowed with indexes expressing a referential value. Proposing that the TC rule cannot directly induce a referential index on the lower Q-copy means in fact that the referential index cannot be inherent to the copy of a Q-phrase: all the TC rule can do is creating an index slot: the specification of the index value must be the product of independently available mechanisms of the grammar (such as *linking*). Indexing lower Q-copies is not done 'magically': it is a complex interface process, and crossover is the manifestation of this complexity. In particular, we propose that TC is not allowed to directly 'value' the index slot, for the very reason that TC is defined as the minimal set of operations that is necessary to perform type-shifting. As a result, all we get is an underspecified index position. To express the underspecified index position that is produced by our revised version of [Elbourne's](#) TC, applying to the lower copy of the displaced quantificational DP, we use the symbol \emptyset . Therefore we arrive at (11).

(11) [THE \emptyset [NP j]] Specific Q trace syntactic format

What about the index j associated to the NP-restriction? We suggest that it can be naturally interpreted as property-like, exactly as [Elbourne's](#) (2005) first index, used with all referential expressions, having the LF of definite descriptions. Notice that, in fact, whenever a DP is interpreted specifically, the NP-restriction is interpreted as being constrained by a contextually relevant implicit property. We propose that this property is what j expresses, to the effect that the restriction receives the following logical format:

(12) $\lambda x. \text{NP}(x) \wedge g(j) = x.$ NP-restriction logical format

As one can easily see, this amounts to interpret [NP j] by means of the usual *predicate modification rule* (13):

² Note that we assume that TC applies crucially at the interface, that is after each instance of QR has been performed, as a manifestation of the 'syntax by phases' also underlying, conceptually, [Rizzi's](#) *riterial freezing*.

- (13) *Predicate modification rule*
 If α is a branching node and $\{\beta, \gamma\}$ the set of its daughters, then, for any assignment a , if $\llbracket \beta \rrbracket^a$ and $\llbracket \gamma \rrbracket^a$ are both functions of type $\langle e, t \rangle$, then $\llbracket \alpha \rrbracket^a = \lambda x \in D. \llbracket \beta \rrbracket^a(x) = \llbracket \gamma \rrbracket^a(x) = 1$.
 (cf. Heim & Kratzer 1998: p. 95)

This model constitutes thus a natural way to extend Elbourne's use of indexes to capture the role of specificity. We contend that it also provides a natural way to make use of Rizzi's (2001a) *shrinking* to enable a copy in situ of a specific *wh*-phrase to have its underspecified index slot *valued* without being linked to an externally available pronominal position.

If we look at the configurations in (9-b) and (9-a), we notice that in (9-a) we have a three-membered chain only consisting of the NP-restriction. In this sense, the trace/copy of the *wh*-phrase can be said to directly 'express' the NP-restriction and the index that goes with it (the j index discussed above). In a sense, the j index is no longer simply embedded in the complex structure [the \emptyset [NP j]], but may be assumed to be freely available in the trace/copy position, as a result of the chain established with the NP-restriction in TOP and the consequent application of Rizzi's *shrinking*: the trace/copy position directly expresses the NP-restriction.

Given these structural conditions, we propose that the underspecification on the \emptyset index-slot is resolved by identifying \emptyset with the j index: since j has been freed from its original embedded position and is directly expressed by the trace/copy position, it qualifies as the most local potential antecedent for \emptyset , under natural assumptions. At the same time, we have already seen that this process of index-copying in-situ does not face any semantic obstacle, since the j index can be correctly interpreted in both positions (it has the same semantics in both positions). The structure we end up with has thus the form below in (14).

- (14) [THE j [NP j]]

(14) is roughly interpreted, within this extended Elbourne's framework, as 'the unique individual x that g assigns to j and is such that is NP and is assigned to j by g ', intuitively a sound reading for the purposes of a BV-interpretation (remember that in Elbourne's framework the trace/copy must be a definite description §2.4).

Moreover, the shrunk chain headed by the NP-restriction in TOP ensures the presence of the index j in the operator position associated with the moved *wh*-phrase: the difference with respect to Q-movement is actually that we do not need to assume that movement produces an index, since we can exploit the j index associated to the NP-restriction, via *shrinking*. It is this index that PA interprets as the variable bound by the λ -operator, all other things remaining equal. In essence, the presence of shrunk chains with specific *wh*-phrases provides the right structural environment to resolve the index underspecification resulting from the application of TC to the trace/copy without having to resort to *linking* to intervening pronouns, predicting thus, correctly, the absence of WCO effects with D-linked *wh*-phrases.

This result cannot be obtained with quantificational DPs and non-specific *wh*-phrases. The former are subjected to QR and it follows without

stipulations that QR cannot feed movement of the NP-restriction to the Topic-layer. As for covert *wh*-movement, notice that in (9-b) *shrinking* applies to delete the NP-restriction, to the effect that there is no way to rescue the *j* index from its embedded position and to use it to resolve the underspecification of the first index in the trace/copy. If the restriction is not allowed to move as such to the TOP position in the left periphery, its index is buried into the NP and is not made available to the whole DP.

Summarizing, the approach we propose here strives to catch the reasons for which is relevant both for the theory of locality and for crossover. In order to do so, we have developed Rizzi's (2001a) insight that there is a connection between referential indexes and , in the sense that copies/traces of specific DPs are subject to in-situ resolution of index-underspecification, via Rizzi's *shrinking*. Crucially, in our reinterpretation, *shrinking* a DP to its NP-restriction makes the internal index associated to the NP-restriction available for the process of valuation of the underspecified referential index induced on the trace/copy by TC.

5.2 DERIVING CROSSOVER FROM ECONOMY

On the basis of the proposed combination of Elbourne's theory of referential indexes with Rizzi's analysis of LF chains, we can now revise the technical functioning of the interpretive tools for obtaining BV readings and proceed to formalize the economy principles that derive crossover.

As we saw above, the default hypothesis should be that the TC rule consists in the minimal amount of operations necessary to perform type-shifting from $\langle et, t \rangle$ to $\langle e \rangle$. This entails that the lower copy's original determiner is replaced with a structure including a definite determiner and an underspecified index slot, that must be specified in the course of the computation. The revised LF-sensitive TC rule TC* in (15) is obtained.

$$(15) \quad \text{TC}^*: [\text{Det} [\text{NP}]_j] \Rightarrow [\text{the } \emptyset [\text{NP}]_j] \quad \text{LF-sensitive TC: no } \textit{shrinking}$$

On the other hand, we have seen above that the index on the restriction can lead, via *shrinking*, to a process of in-situ resolution of the DP-index underspecification. This explains the absence of WCO effects with the syntactic constituents that do not allow deletion of the NP-restriction in the left-periphery (triggering NP-movement to the TOP-position). The LF of the lower copy after application of the TC rule, *shrinking* and underspecification resolution in situ will be as follows. In this case, the LF-sensitive TC* rule produces the result in (16).

$$(16) \quad \text{TC}^*: [\text{Det} \langle [\text{NP}]_j \rangle] \Rightarrow [\text{the } j [\text{NP}]_j] \quad \text{LF-sensitive TC: } \textit{shrinking}$$

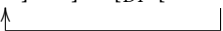
In order to explain why indexes left underspecified can lead, in this new framework, to legitimate BV readings, we adopt the following *generalized* version of PA (17), dubbed PA*. It essentially encodes the insight that the semantics maps underspecified indexes into the same variable associated to the index created by movement and encoding λ -abstraction.

$$(17) \quad \text{Generalized Predicate Abstraction (PA}^*) \\ \text{Let } \alpha \text{ be a branching node with daughters } \beta \text{ and } \gamma, \text{ where } \beta \text{ domi-}$$

nates only a numerical index i . Then, for every variable assignment a , $\llbracket \alpha \rrbracket^a = \lambda x. \llbracket \gamma \rrbracket^{a[i \rightarrow x \wedge \emptyset \rightarrow x]}$. Generalized PA

Given this perspective, crossover is a phenomenon due to conflicting grammatical requirements concerning the resolution of underspecified indexes: on one side, resolution must be as local as possible (forcing *linking* to a locally intervening pronoun); on the other side, local underspecification resolution via *linking* violates economy of interpretation, since PA does not make any distinction between valued and unvalued indexes. To put it shortly, the conceptual roots of crossover lie in the fact that grammar does not tolerate index underspecification and requires local valuation of underspecified indexes, yielding unnecessary redundancy from the point of view of the systems of interpretation. Let us see how this insight can be technically implemented.

Notice first that in the system we have proposed there are two mechanisms of index valuation. On the one hand, we assume *linking* (Higginbotham 1983; Safir 2004) as exemplified in (18): a linked DP bearing a non-specified index receives the same index as the DP it is linked to.

- (18) Linking:
- a. $[_{DP} [\text{the } i] \text{ NP}] \dots [_{DP} [\text{the } \emptyset] \text{ NP}]$

- b. $\Rightarrow [_{DP} [\text{the } i] \text{ NP}] \dots [_{DP} [\text{the } i] \text{ NP}]$

On the other hand, the generalized rule of predicate abstraction PA* we introduced above (17), maps all underspecified indexes to the value of the λ -abstractor.


At this point, it is the conflict between the two following economy principles that is responsible for the deviant status of crossover configurations. The first principle concerns locality of index valuation (19): an underspecified index should find a value by entering the most local dependency available, unless resolving index under-specification less locally allows deriving a different interpretation, as is actually the case when the pronoun is not interpreted as a bound variable.

- (19) Resolve index under-specification as locally as possible, unless avoiding resolution leads to a different interpretation.

The second principle expresses the constraint that a linked DP cannot be interpreted as bound by a higher predicate abstractor, because this would imply the redundant use of both *linking* and PA* in a configuration in which the use of PA* alone could have provided the very same interpretation, given the treatment of underspecified indexes by PA* (20).

- (20) DP interpretation can involve either PA* or *Linking*, but cannot involve both.

To exemplify how the conflict between these principles derives crossover let us consider the WCO configuration in (21).

- (21) $[_{DP} \text{ everyone}] i$ $[[\text{his}_i \text{ mother}] \text{ loves } [_{DP} [\text{the } \emptyset] \text{ one's mother}]]$


Leaving the trace unlinked to he_i /his_{*i*} leads to the violation of (19), because skipping this dependency in favor of a less local one would not lead to a different interpretation. *Linking* the trace to he_i /his_{*i*} leads to the violation of (20): the underspecified index is identified with the index of the intervening pronoun and the index of the upper λ -abstractor, but nothing would change, *modulo* the interpretation so obtained, if the index on the lower copy were left underspecified.

What happens in the *weaker crossover* configurations? Consider the representation in (22)

- (22) [_{TOP} degli studenti interrogati] dimmi [quale ⟨degli studenti interrogati⟩]_{*j*}
j pensi che il suo_{*j*} insegnante non sappia come valutare [THE *j* [NP
j]].
 ‘Tell me [which of the evaluated students]_{*j*} do you think (that) his_{*j*}
 teacher doesn’t know how to grade *t_j*’

In this case the principles of economy on index specification (19) and (20) are not involved, because the trace position is endowed with an index, thanks to the mechanism of in-situ resolution (in a sense, the copy/trace is inherently endowed with an index). Therefore, *linking* is not relevant in this case and no redundancy with respect to PA* can arise.

5.3 STRONG CROSSOVER: LINKING VS. BINDING

I kept SCO out of our discussion. Note that specific *wh*-antecedents do not circumvent SCO:

- (23) a. *Who does *he* think [*t* will win the match]? Non-specific
 b. *Which famous boxer does *he* think [*t* will win the match]? Specific

I propose that the independent principle (24) is responsible for ruling SCO out, irrespective of the specificity of the antecedent:

- (24) If a DP α c-commands a DP β , β can depend on α only through a binding relation, not *linking*.

CONCLUSIONS

I proposed a transparent mapping between Rizzi's (2001a) LF syntax for specific vs. non-specific chains and a refined version of Elbourne's (2005) semantics for traces-copies and pronouns. The nature of this mapping leads to reversing the traditional perspective on dependencies in crossover configurations. While pronouns are endowed with a referential index, copies of Q-phrases are devoid of it, due to their quantificational nature and as a consequence of the LF chains they give rise. In standard WCO configuration they get a value from the intervening pronoun, but this leads to a redundancy. Overtly moved D-linked *wh*-phrases can circumvent WCO effects (Falco 2007) as a consequence of the LF chains to which these phrases give rise. It follows that the intervening WCO pronoun is irrelevant for index-valuation and no redundancy arises in this case.

More technically, I formalize Enç's (1991) index *j* as the same referential index that Elbourne posits for referential DPs and provide a semantics for this format, implementing a transparent mapping algorithm of the LF chains to the semantics. On the basis of these I proposed a modified version of the TC and PA rules, that make sound use of indexes.

Putting the answers together, the overall result is that combining a semantically motivated theory of referential indexes with a syntactically motivated chain-formation algorithm at the LF-interface, I arrived at a theoretically principled and empirically adequate theory of crossover as a conflict of fundamental principles of interface economy.

Besides advancing this proposal, I hope to have achieved another goal: showing how interpretive semantics and the rich syntactic structure postulated by syntactic studies should work hand in hand to provide a principled, yet fine grained, analysis of complex phenomena. Therefore urging syntacticians and formal semanticists to look at and inspire each others theorizing.

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