

# Binding in a Linear Parsing Model

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## 1 Introduction

This paper is a follow-up to Bruening 2012, “Precede-and-Command Revisited.” That paper argues that *c-command* is not a relation that the syntax makes use of; *precede-and-command*, as defined below, is:

- (1) *Precede-and-Command*: X precedes-and-commands Y iff X precedes Y and X phase-commands Y.
- (2) *Phase-Command*: X phase-commands Y iff neither X nor Y dominates the other and there is no ZP, ZP a phasal node, such that ZP dominates X but does not dominate Y.
- (3) Phasal nodes: CP, vP, NP

I assume that the arguments in Bruening 2012 are correct, and sketch in this paper an analysis of binding in a left-to-right parsing model of the syntax, as suggested for Binding Principle C in Bruening 2012. I first provide the account of Binding Principle C from Bruening 2012, then expand the analysis to Binding Principles A and B. I then turn to the binding of variables by quantifiers, and show that variable binding obeys very different principles. Contra Reinhart (1976, 1983), there is no relation between coreference (the Binding Principles) and the binding of variables by quantifiers. While coreference involves *precede-and-command*, variable binding requires precedence and LF sisterhood (scope).

Before beginning, I should stress that this is a short note and is not intended to be a complete account of anaphora and binding. Rather, it presents a suggested account of what I take to be the core facts in English. I also make no attempt to address or even cite the vast literature on this topic (see Bruening 2012 for some of those references).

## 2 Principle C

Binding Principle C rules out coreference between an R-expression and an NP that precedes-and-commands it. Bruening 2012 sketched an analysis that derives this *precede-and-command* restriction. In this analysis, Principle C arises from the left-to-right processing of discourse referents in a discourse model. The account adapts and combines proposals of Schlenker (2005) and Branco (2001), and derives in a natural way the relation of *precede-and-command*. Importantly, Principle C is about coreference between referents in the discourse model; it is not related in any way to variable binding or scope.

Suppose the grammar keeps track of discourse referents as it processes sentences. Processing takes place in a left-to-right fashion, which is almost but not quite equivalent to the top-down model proposed by Schlenker (2005). The grammar places discourse referents into two sets: the total discourse model D; and the active set C. The active set C consists of all those discourse referents currently being processed in the sentence, while D consists of all referents in the discourse. At the right edge of a phase boundary, an NP that was contained within that phase (dominated by that phasal node) is moved out of the active set C and into the total discourse set D (it is backgrounded, in a way, no longer active).

- (4) Discourse Sets:
  - a. Discourse Set D: Consists of all referents in the current discourse.
  - b. Discourse Set C: Consists of referents represented by NPs in the sentence currently being processed.
- (5) Processing Principle:
 

Move discourse referent R denoted by NP N out of active set C and into set D at the right edge of a phasal node that dominates N.

Now, as the grammar processes the sentence, if a newly processed NP is to be coreferential with an NP already in the active set C, it must obey a version of the Minimize Restrictors principle proposed by Schlenker (2005). This principle (modifying Schlenker) says that a definite description of the form *the A* is deviant if A could be dropped without affecting either the denotation of the description or its various pragmatic effects. A pronoun, following among others Elbourne (2001), is a very short description: basically, just the definite article. So, the effect of dropping A in *the A* is to use a pronoun. (A proper name has a hidden definite article, so proper names fall under this principle, too; see Schlenker 2005.)

- (6) Principle C (Minimize Restrictors):
 

A definite description of the form *the A* may not refer to a discourse referent in active set C if A could be dropped without affecting either (i) the denotation of the description or (ii) its various pragmatic effects.

Let us show how this works with several examples.

## 2.1 Illustrations

Consider the following sentence:

- (7) She doesn't like the teacher's students.

Starting from the left, the individual denoted by *she* is placed into the active set of referents C. The verb is processed, and then the definite description *the teacher* is encountered. If this denotes a different individual from the one already in C, everything is fine. If it is meant to be coreferential with that individual, however, it is deviant according to Minimize Restrictors, since *teacher* could have been dropped (to yield *her*) without affecting the denotation or losing any pragmatic effect.

Contrast the sentence above with the following sentence:

- (8) The teacher doesn't like her students.

Here, the referent denoted by *the teacher* is first put into set C, and then *her* can be coreferential with it, since it is not of the form *the A* (it is basically just *the*).

Consider now the following case:

- (9) Her assistant doesn't like the teacher's students.

The individual denoted by *her* is first placed into the active set C, but at the right edge of the NP *her assistant*, it is moved out of C into D, while *her assistant* stays in C. Upon encountering *the teacher*, the referent denoted by *her* is no longer in C, so Minimize Restrictors has nothing to say about *the teacher*, and coreference with *her* is fine.

Turning to an example where left-to-right rather than top-down processing makes a difference, consider the following example:

(10) Rosa is kissing him passionately in the President's high school picture.

First the referent denoted by *Rosa* and then the one denoted by *him* are placed in the active set C. In between the adverb *passionately* and the PP, however, the grammar reaches the right edge of the vP phase. The referent denoted by *him* is moved to set D, since it is dominated by vP. The referent denoted by *Rosa* is not, since it is not dominated by vP. Hence, when *the President* is encountered, it can be coreferential with *him*, but could not be coreferential with the subject:

(11) \*She<sub>1</sub> is kissing the President passionately in Rosa<sub>1</sub>'s high school picture.

## 2.2 Summary of Principles and Discussion

The principles involved are summarized below:

(12) Discourse Sets:

- a. Discourse Set D: Consists of all referents in the current discourse.
- b. Discourse Set C: Consists of referents represented by NPs in the sentence currently being processed.

(13) Processing Principle:

Move discourse referent R denoted by NP N out of active set C and into set D at the right edge of a phasal node that dominates N.

(14) Principle C (Minimize Restrictors):

A definite description of the form *the A* may not refer to a discourse referent in active set C if A could be dropped without affecting either (i) the denotation of the description or (ii) its various pragmatic effects.

This version of Schlenker's theory accounts for precede-and-command by processing sentences left-to-right rather than top-down. Precedence comes in because elements that precede are entered into the local set of discourse referents C *first*, before elements that come later in linear order. Phase-command comes in because elements are shifted out of the local set C at the right edge of phase boundaries. The idea is that phases are closed off and finished; elements within them are no longer part of the domain actively being processed. Using Schlenker's Minimize Restrictors principle confers many of the advantages that he discusses, for instance accounting for exceptions to Principle C; see that paper for details.<sup>1</sup> The difference is that the workings of the principle are not about scope, as Schlenker claimed, but about left-to-right, phase-sensitive processing.

I now go on to incorporate Principles A and B into the model.

## 3 Principles A and B

To begin, the single best description of the condition that anaphors are subject to is the Specified Subject Condition (Chomsky 1973):

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<sup>1</sup>One advantage that is lost is that Minimize Restrictors is just about Principle C; for Schlenker, it is much more general, and has numerous other effects. Whether these can be related is a question for future work, although a few possible directions suggest themselves. For instance, the speaker and hearer might always be part of set C, accounting for why they cannot except in particular pragmatic circumstances be referred to with anything but a pronoun. Schlenker's "super-salient" individuals might also be part of set C, and one could imagine set C sometimes being maintained across sentences in particular discourse circumstances, as well. (However, see Johnson 2012 for some reasons to think that not all of the things discussed by Schlenker should be viewed in the same way.)

- (15) The Specified Subject Condition (Chomsky 1973):  
The antecedent for a reflexive or a reciprocal cannot be farther away than the most local subject.

I will use this descriptive generalization to construct the analysis, and justify it as we proceed to account for data that have been problematic for every theory of anaphora.

Again, there is no category of pronouns; pronouns are simply the result of minimizing restrictors in definite descriptions. There is a category of anaphors, namely reflexives and reciprocals. We need to add a third set of discourse referents to the model actively being constructed by a language user in a particular discourse:

- (16) Discourse Sets:
- a. Discourse Set D: Consists of all referents in the current discourse.
  - b. Discourse Set C (the *active* set): Consists of referents represented by NPs in the sentence currently being processed.
  - c. Discourse Set A (the *local* set): Consists of referents represented by NPs in the phrase currently being processed.

We need to split the Processing Principle into two principles:

- (17) Processing Principle 1:  
Move discourse referent R denoted by NP N out of local set A and into the active set C upon processing a new subject.
- (18) Processing Principle 2:  
Move discourse referent R denoted by NP N out of active set C and into set D at the right edge of a phasal node that dominates N.

And now we can define Binding Principles A and B:

- (19) Binding Principle B:  
If a newly processed NP N is to be interpreted as denoting a discourse referent R already in set A, then N must have the form of an anaphor.
- (20) Binding Principle A:  
If a newly processed NP N has the form of an anaphor, it must denote a discourse referent in set A.

### 3.1 Illustrations

The simplest example involves arguments of the same predicate (verb) within the same clause:

- (21) Max criticized himself/\*him.

Here, the referent denoted by *Max* is placed into the local set A. The verb is processed, and then the object. If the object is to refer to this same referent, it must be an anaphor. If the object is an anaphor, it must refer to a referent in set A (in this example, only *Max*).

In cross-clausal cases, any matrix NP will be moved out of local set A and into the active set C upon encountering the embedded subject:

- (22) a. Max said [that Sally offended him/\*himself].  
b. The kung fu masters said [that Sally offended them/\*each other].

The role of phase command appears in cases like the following:

- (23) a. Max's mother criticized him/\*himself.  
 b. That Max won astonished him/\*himself.

In both cases, *Max* is moved out of set A and into set D at the right edge of the subject, because it is a phase in both cases (an NP in one, a CP in the other).

With multiple arguments in a single clause, an anaphor can refer to any of the arguments that preceded it, since they are all in set A:

- (24) a. The kung fu masters sent me to each other.  
 b. I sent the kung fu masters to each other.  
 c. The kung fu masters sent each other to me.

However, an anaphor may not refer to an NP that follows it, because at the point of processing the anaphor, subsequent referents have not yet been added to local set A:

- (25) a. \*Himself criticized Max.  
 b. \*I sent each other to the kung fu masters.

There is no need for a Chain Condition, as in Reinhart and Reuland (1993); this would be problematic anyway, given that the PP in such cases as (25b) c-commands the object that precedes it (Bruening 2012). Command phenomena are actually about precedence and phase command, not c-command, as shown by Bruening (2012). Precedence follows here from left-to-right parsing.

Of course, movement can change precedence relations:

- (26) Himself, Max will criticize.

I assume that the anaphor here is reconstructed into its A-position, and it is at that point that Binding Principles A and B are evaluated. Apparently, such a moved anaphor can also (optionally) be evaluated in its moved position (Lasnik and Saito 1992, 110–111):

- (27) Max said that himself, Sally will criticize.

Here, no subject has yet been encountered, and so *Max* is still in set A.<sup>2</sup>

### 3.2 ECM and Raising

Movement becomes much more interesting when it affects what is a subject. This is the case for ECM and raising, instances of A-movement. In such cases, *both* positions of the NP involved are relevant. Consider ECM first:

- (28) ECM  
 a. Lucie expects herself/\*her to charm Bill.  
 b. Lucie expects Bill to charm her/\*herself.  
 c. Lucie expects Bill to charm himself/\*him.

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<sup>2</sup>Embedded topics could actually be exempt anaphors; hanging topics certainly can be (Pollard and Sag 1992). If this is correct, then A-bar movement like topicalization never gives rise to new binding possibilities; it is only when the anaphor can be exempt (for instance, by virtue of being in a picture-NP; see below) that A-bar movement will give the impression of changing binding possibilities.

An ECM NP is in many respects an object (case, agreement in languages with object agreement, word order, etc.). I therefore hypothesize that it is first parsed as an object, whether or not this involves actual movement to an object position (which I will remain agnostic about). As such, in (28a), *Lucie* is still in set A when the ECM NP is parsed, and can only be referred to with an anaphor, not a pronoun. In a subsequent step, the ECM NP is then parsed as the subject of the embedded clause. At this point, *Lucie* is shifted out of set A and into set C, so that a subsequent NP that refers to *Lucie* must be a pronoun and may not be an anaphor (28b). A lower NP that refers to the ECM NP must be an anaphor and not a pronoun (28c), because the ECM NP is still in set A when the lower NP is parsed.

Similar mechanisms are at work in raising to subject, where overt movement clearly does occur:

- (29) Raising
- a. Lucie seems to herself/\*her [*t* to be beyond suspicion]. (Reinhart and Reuland 1993, (42a))
  - b. Lucie seems to me [*t* to have betrayed herself/\*her/\*myself].

In both of these examples, the raised NP *Lucie* is processed and put in set A. Upon encountering the experiencer inside the PP in (29a), if it is to refer to *Lucie*, it must be an anaphor and may not be a pronoun. Subsequently, the raised NP is parsed again, in its trace position, as the embedded subject. This is a subject, so the matrix subject and experiencer are both shifted out of set A and into set C. The embedded subject, which is the same as the matrix subject, is put (back) into set A (or, it never leaves it). Any subsequent NP must therefore be an anaphor if it refers to the embedded subject *Lucie*, but may not be an anaphor if it refers to the matrix experiencer (29b).

In A-movement, then, raised NPs play dual roles, and are parsed as both (object and then subject in ECM, subject and then lower subject in raising to subject).

### 3.3 Prepositional Phrases

Reinhart and Reuland (1993) noted that with many PPs, pronouns and anaphors are not in complementary distribution:<sup>3</sup>

- (30) a. Max saw a gun near himself/him. (Reinhart and Reuland 1993, (7a))
- b. Max<sub>1</sub> saw a ghost next to him<sub>1</sub>/himself<sub>1</sub>. (Reinhart and Reuland 1993, (59a))
  - c. Max<sub>1</sub> put the book next to him<sub>1</sub>/himself<sub>1</sub>. (Reinhart and Reuland 1993, (59b))
  - d. Max<sub>1</sub> pulled the cart towards him<sub>1</sub>/himself<sub>1</sub>. (Reinhart and Reuland 1993, (59c))

Reinhart and Reuland's own theory fails here, though. In their theory, if pronouns and anaphors are not in complementary distribution, then the anaphor must be an exempt anaphor (a *logophor*, in their terminology). However, as noticed by Hestvik and Philip (2001), the anaphors here are *not* exempt anaphors; they cannot take long-distance or non-phase-commanding antecedents, contrasting with exempt anaphors inside picture-NPs:<sup>4</sup>

- (31) (Hestvik and Philip 2001, (2a–b))

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<sup>3</sup>Here is a nice near minimal pair, from the same author:

- (i) a. Instead, arms crossed as if he were cold, he stood very close to the fire, hugging his cup to him. (Robin Hobb, *Golden Fool*)
- b. When I covered him with a light blanket, he clutched it to himself and complained, teeth chattering, of the cold. (Robin Hobb, *Fool's Fate*)

The same author uses an anaphor in one case, and a pronoun in the other.

<sup>4</sup>Reinhart and Reuland (1993, 686) claim that they can, giving *Lucie said that Max saw a ghost next to herself* as grammatical (their example (60b)). However, this does not accord with my intuitions, or those reported by Hestvik and Philip (2001).

- a. Clinton's car carried a picture of himself on the roof.
  - b. \* Clinton's car backfired/collapsed/exploded behind himself.
- (32)
- a. Max<sub>1</sub> thinks that you saw a gun near him<sub>1</sub>/\*himself<sub>1</sub>.
  - b. Max<sub>1</sub> said that Mary saw a ghost next to him<sub>1</sub>/\*himself<sub>1</sub>.
  - c. Max<sub>1</sub> said that I put the book next to him<sub>1</sub>/\*himself<sub>1</sub>.
  - d. Max<sub>1</sub> told me to pull the cart toward him<sub>1</sub>/\*himself<sub>1</sub>.

What we have with these PPs is a genuine case of non-complementary distribution between pronouns and local anaphors.

Note also that these PPs have semantic subjects: the prepositions are transitive. *Near* relates *a gun* and its object; *next to* relates *a ghost* and its object; etc. If these two arguments are to be co-referential, only an anaphor is allowed (Reinhart and Reuland 1993, 687):

- (33)
- a. Max saw two guns near each other/\*them.
  - b. Max saw two ghosts next to each other/\*them.
  - c. Max put the books next to each other/\*them.
  - d. Max pulled the carts toward each other/\*them.
  - e. Max rolled the carpet over itself/\*it. (Reinhart and Reuland 1993, (61b))

Semantically, then, these PPs have subjects. Syntactically, they do not. What counts as the semantic subject of the PP is a syntactic object. I therefore propose that the grammar/parser faces indeterminacy here. It can choose to treat the object as a subject, or not. Take the following example:

- (34) Max pulled the cart toward him/himself.

First, *Max* is put into the local set A. The verb is parsed, and then *the cart* is parsed and put into set A as well. Upon encountering *toward*, the parser can decide whether to take *the cart* as a subject (which it is, semantically) or not (syntactically it is not). If it is taken as a subject, then *Max* is moved from set A to set C. In this case, *Max* can only be referred to with a pronoun. If *the cart* is not taken to be a subject, *Max* is not removed from set A, and it can only be referred to with an anaphor. In either case, *the cart* is still in set A, and so it can only be referred to with an anaphor.

This accounts for the non-complementarity in PPs as a case of indeterminacy: the object is both a subject (semantically) and not (syntactically). The grammar can decide to parse it either way. Note that if the semantic subject of the PP is also a syntactic subject, only an anaphor is allowed:

- (35)
- a. They stood next to each other/\*them.
  - b. The rug folded (up) over itself/\*it.

This is predicted by the analysis.

### 3.4 Exempt Anaphors

As shown by Pollard and Sag (1992) and Reinhart and Reuland (1993), certain anaphors are exempt from the Binding Principles. Chief among these are hanging topics and anaphors inside NPs:

- (36) John<sub>1</sub> had worked hard to make sure that the twins would be well taken care of. As for himself<sub>1</sub>, it was relatively unlikely that anyone would be interested in hiring an ex-convict who had little in the way of professional skills. (Pollard and Sag 1992, (8a))

- (37) a. [Kim and Sandy]<sub>1</sub> knew that *Computational Ichthyology* had rejected each other<sub>1</sub>'s papers. (Pollard and Sag 1992, (7i))
- b. John<sub>1</sub>'s campaign requires that pictures of himself<sub>1</sub> be placed all over town. (Pollard and Sag 1992, (7g))

I have no great insight to add concerning these exempt anaphors; for some reason, anaphors are exempt from the Binding Principles in these types of contexts, and get their reference in some manner other than as described above for argument anaphors (point of view, etc.). Simply to be concrete, I will formalize the conditions as follows:

(38) **The Anaphor Exemption Condition:**

Anaphors are exempt from Binding Condition A when:

- a. They appear within NP;
- b. They serve only a discourse function (hanging topics);
- c. They are focused (see Reinhart and Reuland 1993).

Note that Reinhart and Reuland (1993) tried to derive the contexts where anaphors are exempt: basically, in non-argument positions. Their theory runs into a number of difficulties, however, such that this derivation does not actually succeed. For instance, anaphors in PPs, above, and in coordinated NPs, next, do not fit their theory.

### 3.5 Coordinated NPs

Coordinated NPs raise a problem for Reinhart and Reuland's theory that the current approach solves. Consider the following:

- (39) a. Max<sub>1</sub> said that the Queen invited both Lucie and himself<sub>1</sub> for tea. (Reinhart and Reuland 1993, (29c))
- b. The Queen invited both Max and myself for tea. (Reinhart and Reuland 1993, (29b))
- c. The Queen<sub>1</sub> invited both Max and herself<sub>1</sub> to our party. (Reinhart and Reuland 1993, (30a))
- d. \*The Queen<sub>1</sub> invited both Max and her<sub>1</sub> to our party. (Reinhart and Reuland 1993, (30b))

Coordinated NPs must be a context where anaphors are exempt, because of (39a–b). In (39a–b), the anaphor does not have a local commanding antecedent. However, anaphors and pronouns are still in complementary distribution with a local antecedent in (39c–d).

Reinhart and Reuland (1993) are forced to give a convoluted account of this pattern, involving syntactic versus semantic predicates, and the different Binding Principles holding differentially over the two types of predicates. None of this is necessary in the current account; the facts simply fall out. First, Principle B says that if an NP is to be coreferential with the local subject (or any NP in set A), it must be an anaphor. This rules out (39d) and permits (39c). However, an anaphor that appears inside an NP can be exempt from Binding Condition A, given the Anaphor Exemption Condition, above. This means that the anaphors in (39a–b) do not need to refer to a discourse referent in set A, and (39a–b) are grammatical.

It is worth highlighting the problem for Reinhart and Reuland here. In their theory, in any given context, either anaphors and pronouns are in complementary distribution, or else they are not and the anaphors are exempt. This is not true in PPs and in coordinated NPs: in PPs, anaphors and pronouns are not in complementary distribution, but anaphors are not exempt. In coordinated NPs, anaphors are exempt, but anaphors and pronouns are not in complementary distribution. Reinhart and Reuland's theory fails to account for this pattern. The current account captures it without difficulty.

### 3.6 Possessors

Possessors have always raised particular difficulties for theories of anaphora. In English, a possessive pronoun may refer to a local antecedent:

- (40) Max lost his keys.

This violates many formulations of Principle B, including the one here.

Many languages have possessive anaphors. English happens not to. This seems to be relevant. In some languages, including older stages of English, there just are no anaphors for particular persons, and pronouns can refer to local or non-local antecedents. It appears to be crucial that the language have contrasting anaphors and pronouns for a given context. One way to approach this is to reformulate Binding Principle B in the following way:

- (41) Binding Principle B:  
If a newly processed NP N is to be interpreted as denoting a discourse referent R already in set A, then N must have the form of an anaphor. If there is no anaphor appropriate to the morphosyntactic context, then Minimize Restrictors.

In this reformulation, a pronoun will be used if there is no anaphor.

### 3.7 Summary of Final Principles

- (42) Discourse Sets:
- a. Discourse Set D: Consists of all referents in the current discourse.
  - b. Discourse Set C (the *active* set): Consists of referents represented by NPs in the sentence currently being processed.
  - c. Discourse Set A (the *local* set): Consists of referents represented by NPs in the phrase currently being processed.
- (43) Processing Principles:
- a. Processing Principle 1:  
Move discourse referent R denoted by NP N out of local set A and into the active set C upon processing a new subject.
  - b. Processing Principle 2:  
Move discourse referent R denoted by NP N out of active set C and into set D at the right edge of a phasal node that dominates N.
- (44) Binding Principles:
- a. Binding Principle C (Minimize Restrictors):  
A definite description of the form *the A* may not refer to a discourse referent in active set C if A could be dropped without affecting either (i) the denotation of the description or (ii) its various pragmatic effects.
  - b. Binding Principle B:  
If a newly processed NP N is to be interpreted as denoting a discourse referent R already in set A, then N must have the form of an anaphor. If there is no anaphor appropriate to the morphosyntactic context, then Minimize Restrictors.
  - c. Binding Principle A:  
If a newly processed NP N has the form of an anaphor, it must denote a discourse referent in set A.

### 3.8 Discussion

The above subsections have shown that the proposed account of Binding Principles A and B succeeds in capturing the empirical facts in a simple way. Many of these facts have presented intractable difficulties for other theories of anaphora, for instance Reinhart and Reuland (1993). One could ask about the current proposal, though, How explanatory is it? That is, what is the nature of explanation in this account, and what needs to be stipulated as first principles?

It has often been claimed that the predicate-based theory of Reinhart and Reuland (1993) fares the best in terms of explanation, since it tries to derive the distribution of anaphors and pronouns from the need to mark semantically reflexive predicates. The traditional binding theory stipulates three classes of NPs— anaphors, pronouns, R-expressions—and posits the binding principles as irreducible principles holding of each class. In contrast, the predicate-based theory tries to make the different classes of NP follow from a fundamental need of language to mark reflexive predicates. Thus, languages need things that can mark predicates as reflexives, and so they have SELF anaphors.

In reality, though, the binding theory proposed here, which is squarely in the camp of the traditional binding theory, does no worse than the predicate-based theory conceptually. Both say that languages want to mark coreference between two NPs in a local domain. The predicate-based theory says that that local domain is the predicate. In contrast, the theory here delineates domains according to subjects. Within the domain of a subject, coreference is marked. Conceptually, the two are equivalent, and the subject theory has the advantage of getting the facts right. In addition, both have to stipulate Binding Principles A and B as first principles; again, the two are equivalent in this respect.

Proponents of the predicate-based theory have also pointed to the domain of A-movement as being important to anaphora. However, the domains of A-movement and anaphora are *not* equivalent. With PPs and an object, the object of the preposition can never move to subject position (*\*He was pulled the cart toward*). Objects of prepositions can in principle move to subject position in English, however, in pseudopassives. However, one member of a coordinated NP must be an anaphor and may not be a pronoun in the case of local coreference, as we saw above, but movement out of a coordinated NP is never permitted:

- (45) a. The Queen<sub>1</sub> invited Max and herself<sub>1</sub>/*\*her*<sub>1</sub> to tea.  
b. *\*The Queen* was invited Max and to tea.

Although there is significant overlap between the domains of A-movement and anaphora, it is clear that they are not equivalent, and pronouns are not ruled out just when they could have moved to the position of their antecedent. Theories that try to relate anaphora and A-movement are on the wrong track.

Empirically, then, the binding theory presented here fares much better than the predicate-based theory or any theory that relates anaphora to A-movement. Conceptually, it is no worse (and perhaps it is better, because it includes an account of Principle C). It stipulates as a fact about language that coreference within a certain local domain must be marked. This domain is delimited by subjects. Languages have a type of NP that marks this coreference, namely anaphors (reflexives and reciprocals). Pronouns are just the result of the desire to minimize restrictors, and that desire combined with left-to-right, phase-sensitive parsing results in Principle C. Everything follows from two main concerns: marking local coreference, and minimizing restrictors. Both are conceptually well-motivated concerns of language.

The theory presented here also has the advantage of being connected to parsing (comprehension and production), and can be related directly to what is known about the processing of anaphora. It is also connected to discourse, including as it does a theory about how the parser keeps track of discourse referents in a dynamic discourse model. This can be elaborated as necessary to include insights from studies of discourse and reference resolution.

## 4 Variable Binding

I show now that what looks like a reasonable extension of the basic ideas behind the Binding Principles does not work for variable binding. Variable binding obeys different principles from anaphora.

First, it appears that a reasonable extension *will* work for the binding of pronouns as variables by quantifiers that are not wh-phrases. Bruening (2012) showed that Binding Principle C and the binding of pronouns as variables by quantifiers differ in a number of respects. For instance, adjuncts that are adjoined high, to IP, are outside of the command domain of an object, as shown by the lack of a Principle C effect in (46), but an object quantifier can still bind a pronoun inside the same adjunct as a variable (47):

- (46) a. Rosa is kissing him<sub>1</sub> passionately in Ben<sub>1</sub>'s high school picture. (Reinhart 1976, 79, (27a))  
b. People worship him<sub>1</sub> in Kissinger<sub>1</sub>'s native country. (Reinhart 1976, 79, (28a))
- (47) a. Rosa is kissing every boy<sub>1</sub> passionately in his<sub>1</sub> high school picture.  
b. People worship every UN Secretary-General<sub>1</sub> in his<sub>1</sub> native country.

The conditions on variable binding can be stated as the following:

- (48) A quantifier Q can bind a pronoun P as a variable only if:  
a. P is within Q's scope at LF, and  
b. The highest A-position occupied by Q precedes the highest A-position occupied by P.

That is, variable binding requires both LF scope, and precedence. Now, one might think that the difference between quantifiers and R-expressions (as shown by Principle C) will fall out from them having different scope possibilities at LF: namely, quantifiers but not R-expressions may move at LF to higher positions.

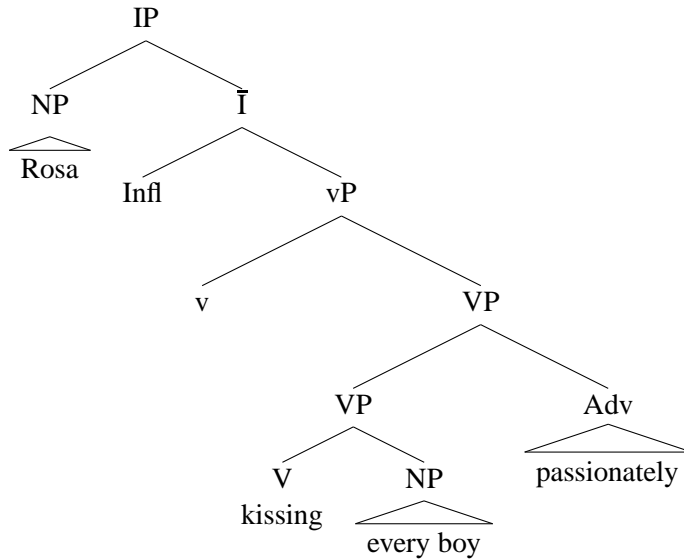
Here is a way to fit variable binding into the same linear processing model outlined above for the Binding Principles (which regulate anaphora). Again, the grammar processes sentences left-to-right. I assume that the only possible way a pronoun could be bound by a quantifier is if the pronoun is in the quantifier's scope. Scope I assume to be LF sisterhood: the scope of a quantifier is the node it combines with at LF. This follows from the mechanism of interpretation itself, and does not need to be stipulated or otherwise explained. The precedence requirement does. Suppose that precedence follows from an *activity condition* on variable binding, as follows:

- (49) Activity Condition  
a. A pronoun P may only be bound by a quantifier Q if Q is *active* when P is processed.  
b. An NP N is *active* at any given point of processing iff at that point there is no ZP, ZP a phasal node, such that ZP dominates N and the right edge of ZP has been processed.  
(All NPs that denote discourse referents in sets A and C are active.)

This formulation tries to make phase-command relevant to variable binding, the way Reinhart (1976, 1983) claimed they were both about c-command. That is, this formulation is an attempt to maintain Reinhart's main thesis, but unfortunately it will not work.

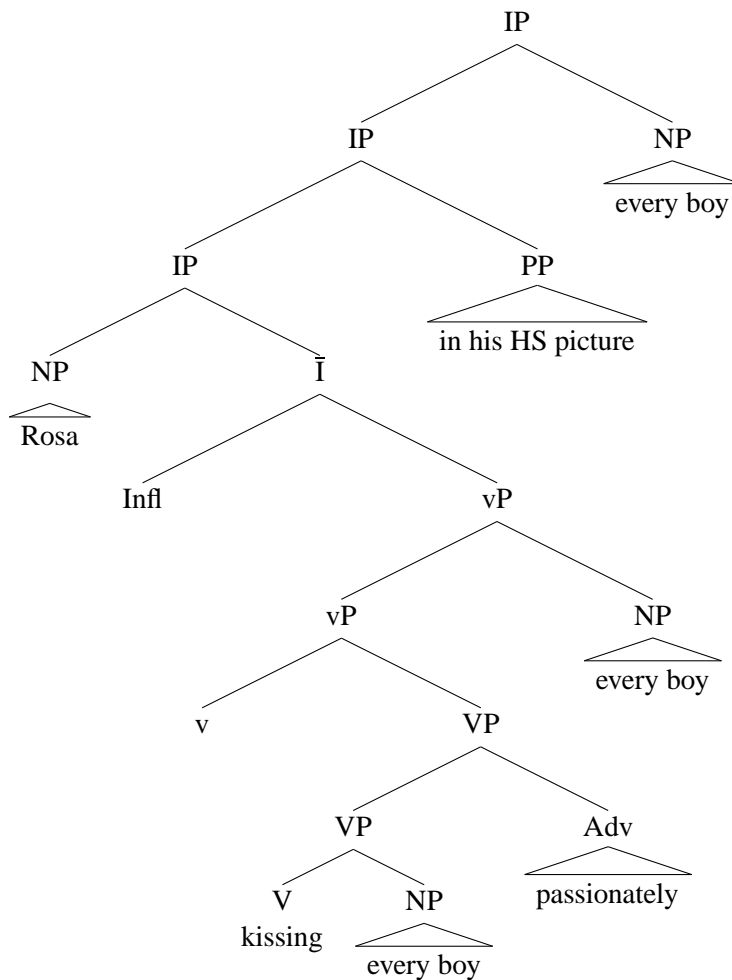
First, we can account for discrepancies between Principle C and variable binding through the availability of quantifier raising at LF. Take (47a) as an example. After *passionately* has been processed, the following structure will have been built (ignoring the auxiliary for now):

(50)



At this point, when the PP is encountered, it will be attached to IP, meaning that the right edge of the vP phase will have been processed. This should render *every boy* inactive, and make variable binding ungrammatical. However, QR can keep a quantifier active by raising it into the higher phase. Simply for the sake of concreteness, I assume that it moves first to Spec-vP, and then adjoins to IP, after the PP has been added:

(51)



It does not matter whether the higher position is on the left or the right, all that matters is that the PP is now in the scope of the quantifier (which I assume is its sister in the tree). The quantifier *every boy* is still active, by virtue of having undergone movement out of the vP phase, and so it can bind the pronoun inside the PP. If non-quantificational NPs do not undergo QR at LF, at least in the usual case, then we account for the difference between Principle C and variable binding while still maintaining their fundamental unity.

Consider now cases where the quantifier follows the pronoun:

(52) (Pesetsky 1995, 162, (435))

- a. ?? Sue spoke to his<sub>1</sub> friends about each employee<sub>1</sub>.
- b. ?? Sue spoke to Mary about its<sub>1</sub> flaws in each house<sub>1</sub>.
- c. ?? Mary danced in his<sub>1</sub> hometown with no employee<sub>1</sub>.

In all of these cases, at the point where the pronoun is processed, the quantifier is not even part of the syntax yet. It does not matter that the quantifier will later be introduced into the same phase, nor would any amount of QR help. The activity condition is not met, and variable binding is ungrammatical.

So, it appears that we can fit variable binding into the same model as anaphora, discussed above. However, it will not work once we turn to the binding of pronouns by wh-phrases. These show clearly that the principles that variable binding are subject to are *different* from those that regulate coreference, contra Reinhart (1976, 1983).

As Bruening (2012) showed, c-command is not relevant to variable binding with wh-phrases, precedence is. The highest A-position occupied by a wh-phrase needs to precede a pronoun in order to bind it as a variable. For instance, in the same types of examples with high adjuncts, an object wh-phrase can bind into a high adjunct that its base position does not c-command (as shown by a lack of Principle C effects in (53)):

- (53) a. So many people wrote to him<sub>1</sub> that Brando<sub>1</sub> couldn't answer them all. (Reinhart 1976, 47, (63))
- b. Rosa won't like him<sub>1</sub> anymore, with Ben<sub>1</sub>'s mother hanging around all the time. (Reinhart 1976, 23, (19c))

- (54) a. Who<sub>1</sub> did so many people write to t<sub>1</sub> that he<sub>1</sub> couldn't answer them all?
- b. Who<sub>1</sub> is Rosa going to stop going out with t<sub>1</sub>, with his<sub>1</sub> mother hanging around all the time?

Since wh-phrases come *first* and are very high, scope and precedence are apparently not at issue. Rather, precedence needs to be relativized to A-positions. Phrasing this within the Activity Condition analysis, elements in A-bar positions are processed and may be interpreted in the position in which they are processed (i.e., take scope), but they are not active. An element that is in an A-bar position is put in a memory buffer during processing and reactivated when lower positions that it occupies are encountered. Take the following standard weak crossover contrast as an example. In the grammatical (55a), *who* is processed but is not active, because it is in an A-bar position. It is put in a buffer, for later reactivation. Upon reaching the gap (immediately after *who*), *who* is reactivated. At this point, it is now active. When the pronoun is encountered, the wh-phrase can bind it, because the pronoun is in the scope of the quantifier and the quantifier is active.

- (55) a. Who<sub>1</sub> t<sub>1</sub> loves his<sub>1</sub> mother?
- b. \* Who<sub>1</sub> does his<sub>1</sub> mother love t<sub>1</sub>?

In (55b), in contrast, *who* will not be active when the pronoun is encountered. The A-position that would (re-)activate it has not been encountered yet. Hence, variable binding fails, and weak crossover follows from the account.

Unfortunately, this account will not cover all of the cases of weak crossover, for instance (54a), above. In this example, *who* will be processed first but is not active, because it is in an A-bar position. It is put in

a buffer, for later reactivation. Upon reaching the gap after *to*, *who* is reactivated. At this point, it is now active. However, it will become inactive again once the right edge of the vP phase is encountered (this is what protects the adjunct from a Principle C violation in 53). When the pronoun is encountered, the wh-phrase cannot bind it, because, while the pronoun is in the scope of the quantifier, the quantifier is no longer active.

The same problem arises with cases of grammatical extraction out of islands, where the trace of the moved wh-phrase does not command out of the island (from Bruening 2012, based on examples in Chaves 2012).

- (56) a. Which president<sub>1</sub> would [the impeachment of *t*<sub>1</sub>] cause more outrage within his<sub>1</sub> party?  
 b. Which problem<sub>1</sub> will [no solution to *t*<sub>1</sub>] ever be found by its<sub>1</sub> discoverer?
- (57) a. \* Which president<sub>1</sub> would his<sub>1</sub> party agree that [the impeachment of *t*<sub>1</sub>] would cause more outrage?  
 b. \* Which problem<sub>1</sub> did its<sub>1</sub> discoverer declare that [no solution to *t*<sub>1</sub>] would ever be found?

Command apparently has nothing to do with variable binding. Cases where it seems to, like the following, show something else instead:

- (58) a. \* Because every unicorn<sub>1</sub> has magical powers, it<sub>1</sub> will be tough to catch.  
 b. \* The rider of no unicorn<sub>1</sub> thinks it<sub>1</sub> is tough to handle.

The problem here is probably scope: the quantifier is embedded in some constituent from which it cannot raise to a position that would have the pronoun within its scope. That is, the failure here is not command, but movement; movement out of constituents like those above (adjuncts and subjects) is banned.

I conclude that variable binding by quantifiers has nothing to do with command. This has two important consequences: First, the entire syntactic literature that has argued or assumed that variable binding requires c-command is simply wrong; and second, that Reinhart's (1976, 1983) hypothesis that variable binding and coreference are related and obey the same conditions is also wrong.

The first formulation of the descriptive condition on variable binding seems to be correct. I repeat it below:

- (59) A quantifier Q can bind a pronoun P as a variable only if:  
 a. P is within Q's scope at LF, and  
 b. The highest A-position occupied by Q precedes the highest A-position occupied by P.

The Activity Condition account above, which attempted to relate variable binding to coreference by reference to phase-command, cannot be right. However, an even simpler account of the role of precedence is available. We can reformulate the Activity Condition as follows:

- (60) Activity Condition (revised)  
 a. A pronoun P may only be bound by a quantifier Q if Q is *active* when P is processed.  
 b. An quantifier Q becomes *active* when the highest A-position it occupies is processed.

Notice that this formulation makes no reference at all to command, whether that is phase-command or c-command. Only precedence is involved.

The result of this condition is that pronouns that precede the highest A-position of a quantifier cannot be bound by that quantifier. Similarly, quantifiers that have not even entered a derivation yet when a pronoun is encountered are unavailable for the binding of that pronoun. However, once the highest A-position of a quantifier is encountered, it will be available for binding any pronoun that follows. Command will not be necessary, so long as the quantifier can take scope over the pronoun, and the conditions on scope are essentially those governing LF movement.

## 5 Conclusion

The main empirical finding of Bruening (2012) that has been elaborated in this note is that coreference and variable binding obey very different principles. Coreference is regulated by phase-command, whereas no notion of command plays any role in variable binding. Both coreference and variable binding involve precedence, which emerges as one of the fundamental relations in syntax.

I have also sketched an account of the Binding Principles, which regulate coreference and anaphora. I have also suggested an account of variable binding, where variable binding requires precedence among A-positions (the Activity Condition) and LF scope. I have not investigated the restrictions on LF scope, but I assume that they are those that regulate LF movement; see the voluminous literature on QR for discussion of these conditions. Command plays no role in variable binding, and coreference and variable binding are therefore not related. Theories that attempt to relate them are on the wrong track.

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