PROJECT MUSE®

Zagona, Karen. 1988a. Proper government of antecedentless VPs in English and Spanish. *Natural Language and Linguistic Theory* 6:95–128.
Zagona, Karen. 1988b. *Verb Phrase syntax: A parametric study of English and Spanish*. Dordrecht: Kluwer.

Department of Linguistics
Ghent University
Blandijnberg 2
9000 Ghent
Belgium

lobke.aelbrecht@ugent.be
liliane.haegeman@ugent.be

Quantificational Binding Does Not Require C-Command

Chris Barker

Some version of the following claim is almost universally assumed: a quantifier must c-command any pronoun that it binds. Yet as I show, the evidence motivating this claim is not particularly strong. In addition, I gather here a wide variety of systematic counterexamples, some well-known, others new. I conclude that c-command is not relevant for quantificational binding in English (nor is any refinement or extension of c-command).

Keywords: c-command, binding, quantification, scope, Reinhart's Generalization

1 Introduction

At least since Reinhart 1983, the standard wisdom has been that a quantificational expression must c-command any pronoun that it binds.

(1) Everyone$_i$ loves his$_i$ mother.

For instance, on the indicated interpretation, the quantificational expression *everyone* in (1) both binds and c-commands the pronoun *his*. Usually there is an additional requirement that a quantificational expression can only bind from an A-position. Since the subject position in (1) is an A-position, the binding in (1) is correctly predicted to be grammatical.

I gratefully acknowledge the advice of two *LI* referees, Mark Baltin, Jeroen van Craenenbroeck, Alec Marantz, Jim McCloskey, Line Mikkelsen, Chris Potts, Ken Safir, Anna Szabolcsi, and audiences at New York University, the University of California at Santa Cruz, and the University of Massachusetts at Amherst.

Linguistic Inquiry, Volume 43, Number 4, Fall 2012
614–633

I review the evidence in favor of the c-command requirement and suggest that many examples argue not for a c-command requirement, but for a scope requirement.

(2) *Scope requirement* (following Safir 2004b:chap. 2)
A quantifier must take scope over any pronoun that it binds.

We will see that the scope requirement is by no means a complete characterization of the conditions under which a quantifier can bind a pronoun. However, it certainly is a necessary condition for quantificational binding.

Once the scope requirement is in place, the evidence in favor of a c-command requirement is not particularly strong. I will present a number of systematic counterexamples to the c-command requirement, including not only well-known cases such as binding from possessors, inverse linking, binding out of prepositional phrases, binding within double object constructions, binding into adjuncts, connectivity effects, donkey anaphora, and reconstruction, but also some less well-known cases, including binding out of adjuncts and binding out of tensed clauses. Given this evidence, I will suggest that c-command is not a requirement on quantificational binding, at least not in English.

Although as of this writing the standard wisdom remains firmly in place, the claim that quantificational binding does not obey a c-command constraint has a number of predecessors. There is a minority tradition suggesting that c-command is not adequate for characterizing quantificational binding, both pre–Reinhart 1983 (including Postal 1971, Wasow 1972, Jacobson 1972, Higginbotham 1980, 1983) and post–Reinhart 1983 (including Gawron and Peters 1990:162, Bresnan 1994, 1998, Safir 2004a,b, Barker 2005, Jäger 2005, Shan and Barker 2006, Barker and Shan 2008, Barker 2009).

There are also a few works that remain agnostic about the c-command constraint, notably Szabolcsi 2010:18. Likewise, in the psycholinguistics literature, Carminati, Frazier, and Rayner (2002) were unable to observe any processing cost when quantifiers bind pronouns they do not c-command. Bresnan (1994, 1998) surveys weak crossover in a variety of languages and concludes quantificational binding is sensitive both to hierarchical structure and to linear order. Jäger (2005) (see below, section 5.2) argues against c-command and in favor of a linear order constraint, specifically for English.

Safir (2004a,b) develops a particularly thorough and probing reconsideration of the role of c-command in anaphora. He argues that there is no positive requirement that a quantifier must c-command its pronoun, only a negative requirement that the pronoun must not c-command the quantifier. Although Safir discusses some quantificational examples, he mainly discusses ellipsis, *wh*-constructions, and other nonquantificational examples, and he does not present the full range of counterexamples given here to the c-command restriction. This remark, then, can be viewed as an in-depth case study compatible with Safir's larger program.

In much of my own work, including Shan and Barker 2006, Barker and Shan 2008, and Barker 2009, to appear, quantificational binding must obey an evaluation order constraint, which says that a quantifier must be evaluated (in a specific technical sense) before any pronoun that it binds. Descriptively, evaluation order closely approximates reconstructed linear order (as dis-

cussed below in section 5): after reconstruction, a quantifier must precede any pronoun that it binds.

2 The Standard Wisdom and Its Origin

A node A c-commands a node B iff

- neither A nor B dominates the other, and
- every branching node dominating A also dominates B.

There are many variations on c-command that have been argued to be relevant for some aspect of the description of natural language, including Langacker's (1969) command (minimal clause), Reinhart's (1983) segment-sensitive refinement of command (discussed below), and Chomsky's (1986) max-command (first maximal projection), to name just three. (See Barker and Pullum 1990, Kayne 1994, and Frank and Vijay-Shanker 2001 for theoretical discussions of command relations.) I will discuss some variations on c-command in section 3. Although each of these variations accounts for different patterns of the data given below, none of them provides a complete solution.

If my main claim is correct (that c-command is irrelevant for quantificational binding), it is somewhat surprising that the c-command requirement should have been so widely and unquestioningly accepted for so long. It is therefore worthwhile to review some of the original arguments in favor of a c-command requirement. I will suggest that most of this evidence supports only a scope requirement, not a c-command requirement. Then part of the explanation for the robustness of the c-command belief follows from the fact that scope and c-command overlap in a large number of cases.

One key factor in the acceptance of a c-command requirement for quantificational binding is that Reinhart (1983:14) provides compelling arguments that c-command is relevant for what she calls definite anaphora, by which she means anaphora in which a pronoun takes a name or a definite description as its antecedent.

(3) She_i *denied that* Rosa_{*i} *met the shah.*

(4) The man who traveled *with* her_i denied that Rosa_i met the shah.

In (3), the pronoun c-commands the italicized material, including the name *Rosa*, and it is not possible to interpret the pronoun as referring to the same person as the name. In contrast, in (4), the pronoun c-commands only the preposition *with.* It does not c-command the name, and coreference is possible. Reinhart (1983:43) therefore proposed the following generalization:

(5) *Reinhart's constraint on definite anaphora*
A given [DP, e.g., *she* in (3)] must be interpreted as non-coreferential with any distinct non-pronoun [e.g., *Rosa*] in its c-command domain.

In the years since Reinhart 1983, the work of this constraint has been divided up into various other principles (on some theories, Principles B and C; see Safir 2004a or Büring 2005 for

comprehensive discussions). What is important here is that the evidence that supports this claim makes it plausible that c-command is relevant for at least one constraint on anaphora.

Reinhart (1983:34–35) goes on to explicitly argue that linear order is not relevant for definite anaphora.

(6) In her_i bed, Zelda_i spent her sweetest hours.

(7) In Zelda_i's bed, she_{*i} spent her sweetest hours.

These examples suggest that having the antecedent linearly precede a pronoun is neither necessary nor sufficient for definite anaphora. If so, Reinhart argues, then a purely hierarchical constraint such as the c-command constraint is the correct way to characterize at least some types of anaphora.

What about quantificational binding? As Reinhart (1983:113) recognizes, quantificational binding behaves differently than definite anaphora.

(8) The secretary who works for him_i despises Siegfried_i.

(9) The secretary who works for him_{*i} despises each_i of the managers.

This minimal pair suggests that quantificational binding is more restrictive than definite anaphora. Reinhart (1983:122) proposes that quantificational binding obeys the following additional constraint (my paraphrase):

(10) A quantified DP must c-command any pronoun that it binds.

At least since the early 1980s, this assumption has been so much taken for granted that most authors do not even state it explicitly. To take examples at random from the literature: ''An element α binds an element β if and only if the two are coindexed and α c-commands β'' (Cormack 1998:20); ''Variable binding is only possible if the antecedent c-commands the pronoun'' (Koornneef, Wijnen, and Reuland 2006:66); ''[T]here can be no binding relation between *every student* and *his*, since the quantifier . . . doesn't c-command the pronoun'' (Huitink 2008: 193); and so on.

In fact, it is easy to get the impression that quantificational binding requires c-command as a matter of definition, that it quite literally could not be otherwise. One reason it may be tempting to think so is that for many logical languages, such as standard predicate logic, binding does require c-command as a matter of definition. This is because in predicate logic, a quantifier takes scope over exactly the proposition it is adjoined to, and there are no syntactic operations capable of separating a quantifier from its scope domain. For instance, the universal in $(\forall x.P(x)) \wedge P(x)$ c-commands the first occurrence of x but not the second, and therefore binds the first but not the second.

But in natural languages, the scope of a quantificational expression can often be quite different from its (surface) c-command domain.

(11) Someone loves everyone. $\forall x \exists y.\textbf{loves}\ x\ y$

For instance, in (11), *everyone* can take scope over *someone*, even though it does not c-command the subject position. Since it is logically possible for quantifiers to bind any pronoun they take

scope over, it follows that the c-command requirement is an empirical claim, and not a matter of definition, at least when we are considering scope and binding in a natural language.

One particularly prominent place where the assumption that quantificational binding requires c-command is carefully spelled out is in this definition in Heim and Kratzer 1998:261:

(12) A DP A semantically binds a non-null DP B iff
- A and B are co-indexed
- A c-commands B
- A is in an argument position (an A-position)
- Minimality holds (there is no other node C that semantically binds B and that is closer to B, i.e., is c-commanded by A).

The requirement that the binder be in argument position prevents a quantificational expression from binding a pronoun after the quantifier has been raised to an Ā- (nonargument) position via Quantifier Raising. Roughly speaking, the A-position requirement ensures that the c-command requirement must hold at the level of surface syntax, and not only at LF.

Büring (2004:24, 2005:91) also carefully makes explicit the c-command assumption, which he calls Reinhart's Generalization.

(13) *Reinhart's Generalization*
Pronoun binding can only take place from a c-commanding A-position.

As near as I can tell, the assumption that Reinhart's Generalization holds has been adopted (with only a few exceptions mentioned above) throughout the fields of syntax and semantics.

Reinhart (1983) did not provide detailed arguments in favor of this assumption, and as far as I know, no one else has either. We can, however, adapt Reinhart's evidence given in (3) and (4) relating to definite anaphora by replacing the definite antecedent with a quantificational expression. Although these data may initially appear to support the c-command requirement, on closer examination they support only a scope requirement.

(14) Each_{i} woman *denied that she$_i$ met the shah*.

(15) The man who traveled *with* each_{i} woman denied that $\text{she}_{*\text{i}}$ met the shah.

In (14), the quantificational expression c-commands the pronoun, and a bound reading is possible. In (15), the quantificational expression does not c-command the pronoun, and a bound reading is not possible. These data, then, are at least consistent with Reinhart's Generalization.

However, this contrast is not strong evidence in favor of the generalization. The reason is that there is a separate, weaker constraint that explains the contrast equally well, namely, the scope requirement: that a quantificational expression must take scope over any pronoun that it binds. The quantificational expression in (14) takes scope over the pronoun and can also bind it; but the quantificational expression in (15) cannot take scope over the pronoun.

In order to demonstrate scope possibilities, I will rely here and below on the following diagnostic:

(16) *Operational test for scope*
A quantifier can take scope over a pronoun only if it can take scope over an existential inserted in the place of the pronoun.

Like all transderivational tests, this one should be applied with caution (particularly when polarity-sensitive items are involved), but it can provide useful confirmation for intuitions about possible truth conditions. We can apply this test to (14) and (15) by constructing the following variants in which an existential replaces the pronoun in question:

(17) Each woman denied that someone met the shah.

(18) The man who traveled with each woman denied that someone met the shah.

In (17), there is a reading on which *each* takes scope over *someone*, so that what each woman denies is that anyone met the shah. This supports the claim that *each* can take scope over the pronoun in (14).

However, in (18), there is no reading on which *each* takes scope over *someone.* That is, there is no interpretation on which the man in question makes a potentially different denial corresponding to each woman. Since *each* cannot take scope over the matrix verb phrase, it certainly cannot bind a pronoun in the verb phrase: it simply isn't possible to state the truth conditions of a bound reading unless the universal has scope over the variable contributed by the pronoun. (However, it is possible for a variable to appear to covary with a universal through some semantic mechanism other than direct binding; see section 4.2 for a discussion of donkey anaphora.)

Whenever it is possible to demonstrate that the quantifier in question cannot take scope over the pronoun position, we will not have any compelling evidence that c-command is in play, since the scope requirement alone is sufficient to explain the facts. The only evidence that would argue for a c-command constraint, then, involves situations in which the quantifier can take scope over the pronoun yet cannot bind it.

There is a name for such configurations: crossover.

(19) Someone loves everyone. *everyone* > *someone* possible

(20) He_{*i} loves everyone_i. strong crossover

(21) His_{*i} mother loves everyone_i. weak crossover

In (19), *everyone* certainly can take scope over the subject position, since *Someone loves everyone* has a reading on which the universal takes wide scope over the existential. Therefore, the scope requirement is met. Yet (20) shows that *everyone* cannot bind a pronoun in subject position. Nor can it bind a pronoun embedded within the subject position, as illustrated in (21). These crossover situations are cases in which the scope requirement alone does not explain the lack of bindability, but a c-command requirement correctly predicts no binding.

Thus, crossover is the only evidence I am aware of that supports a c-command restriction over and above the scope requirement. Certainly any approach that rejects the c-command require-

ment (e.g., Safir 2004b, Jäger 2005, Shan and Barker 2006) must offer an explanation for cross-over, as discussed in section 5.

By the same token, any account that endorses the c-command restriction must explain the data in the following section.

3 Counterexamples to the C-Command Requirement

This section makes an empirical case that c-command is not a requirement for quantificational binding.

Many of these example types have been discussed in the literature, but always as isolated problems for the c-command hypothesis. Here I present them in succession, adding a few new ones.

3.1 Possessors

Perhaps the best-known and most exceptionlessly productive class of counterexamples involves quantificational possessors. As noted by Higginbotham (1980), followed by Reinhart (1983: 177–178), quantificational possessors can effortlessly bind pronouns outside their possessive hosts.

(22) a. [Everyone$_i$'s mother] thinks he$_i$'s a genius.
b. [No$_i$ one's mother-in-law] fully approves of her$_i$.
c. [Each$_i$ student's advisor] paid his$_i$ gambling debts for him$_i$.
d. [[[Everyone$_i$'s mother]'s lawyer]'s dog] likes him$_i$.

Even the most deeply embedded possessor can bind a pronoun external to the subject. And, in accord with the scope requirement, in each case the quantifier can take scope over an existential in the place of the pronoun (e.g., *No one's mother-in-law fully approves of an unemployed son-in-law*).

In view of examples like those in (22), Reinhart tentatively revises her definition of c-command so that possessors can c-command whatever their possessive hosts c-command.

Kayne (1994:23–24) suggests a more principled modification of c-command: that specifiers in general can c-command whatever phrase they are the specifier of c-commands. Like Reinhart, Kayne assumes that in adjunction structures, mothers and daughters with the same syntactic label count as a single multisegment node. The idea is that in [[*John's*] [*mother*]$_{DP}$]$_{DP}$, the top DP label is only one-half of a multisegment DP node and therefore does not dominate the possessor.

In addition, Kayne proposes that all specifiers are adjoined to their host projections. It follows that a possessor automatically c-commands everything that its host DP c-commands.

3.2 Inverse Linking

Whatever the virtues of Kayne's (1994) refined notion of c-command, it does not immediately extend to other well-known example types, such as inverse linking (May 1985).

(23) a. [Someone from every$_i$ city] hates it$_i$.
b. [One page in every$_i$ book] had something written on it$_i$.

To be sure, inverse linking is notoriously sporadic: *Most people from every city hate it* does not have an interpretation on which *every* takes scope over *most*, let alone a reading on which *every* binds the pronoun. But for present purposes, if any good inverse linking example allows a quantifier to bind a pronoun that the quantifier does not c-command, it constitutes support for the claim that c-command is not a requirement for quantificational binding.[1]

3.3 Binding out of Nominal Arguments

Other refinements and extensions of c-command are possible. Hornstein (1995:108) proposes a variation compatible with Kayne's (1994) notion of c-command that Hornstein calls ''almost c-command'': a node A almost c-commands a node B just in case A c-commands B or the projection that dominates A dominates B. This definition is intended to capture an apparent asymmetry between adjuncts and arguments.

(24) a. At least one picture of every senator$_i$ graced his$_i$ desk.
b. A small part of every article$_i$ undermined it$_i$.

Hornstein judges the binding interpretations given in (24) as ungrammatical. He claims that the reason the binding in (23) is grammatical, but the binding in (24) is not, is that in (23) the prepositional phrases are adjuncts, but in (24) they are complements of the head nominal.

However, even if we accept Hornstein's judgments for (24), it is unlikely that the source of the binding difficulty is an argument/adjunct asymmetry.

(25) a. The policemen turned a citizen of each$_i$ state over to it$_i$s governor. (Gawron and Peters 1990:163)
b. [A friend of each$_i$ contestant] stood behind her$_i$.
c. [The cost of each$_i$ item] was clearly marked on it$_i$s label.

In (25), the quantificational DPs are part of a nominal argument, yet they can still bind a pronoun external to the subject DP.

In fact, it is fairly easy to find naturally occurring examples (collected using a Google search), especially when the container DP is definite (see also the treatment of functional relative clauses in Sharvit 1999).

[1] DP is often taken to be a scope island (notably May 1985, Büring 2004). If so, then the relationship between the quantifiers and the pronouns in (23) is not a true binding relationship; on Büring's account (discussed below in section 4.2), it is a form of donkey anaphora. On the other hand, Sauerland (2005) argues that DP is not an island, though Charlow (2010) defends the scope island claim against Sauerland's arguments. Unfortunately, this complicated issue cannot be settled here.

(26) a. This shows that [the fate of every$_i$ individual] is decided by his$_i$ inner ego.
b. [The scope of each$_i$ book] has expanded on that of it$_i$s predecessor.
c. Since [the name of every$_i$ thing] expresses it$_i$s essence . . .
d. [The weighting of each$_i$ attribute] expresses it$_i$s relative importance.
e. . . . [the Number of each$_i$ Overtone] expresses it$_i$s wavelength as a fraction of the fundamental wavelength . . .
f. [The work of each$_i$ student] will be reviewed at the end of every semester in order to determine his/her$_i$ progress and the advisability of continuing graduate studies.

Indeed, variations on Hornstein's own examples allow the quantifier to bind out of complement position (all embedded within a containing DP) fairly gracefully.

(27) a. We need to get hold of (at least) [one picture of every$_i$ senator] before he$_i$ leaves town for the summer.
b. [A small part of every article$_i$] is always inconsistent with it$_i$s main conclusions.

A referee notes that it is difficult to give the universal widest scope when replacing the pronoun in (27a) with an existential (e.g., replacing *he* with *a page*), but that the desired scoping can be forced by including a pronoun in the existential (*a page of his*).

In any case, it appears that it is possible for a quantifier to bind out of the possessor of a DP, as well as from other positions in the DP, whether those positions are within adjuncts or within complements.

3.4 Binding Transitivity

Ruys (2000:517) unifies possessive and inverse linking cases under a single generalization, which he calls the *transitivity* property of bound anaphora (the formulation of the generalization is my paraphrase).

(28) *Binding transitivity*

[Everyone$_A$'s mother]$_B$ loves him$_C$.

If a DP A is contained within some larger DP B, and B can potentially bind a pronoun C, then [as long as A takes scope over C] A can bind C.

Note that the container must itself be a potential binder (i.e., a DP). That is, Ruys requires that in order to transmit binding power, the container must itself be capable of binding the pronoun in question. The prediction, then, is that quantificational DPs will be able to bind out of containing DPs, but there is no prediction about other sorts of containers. This means that if quantifiers can bind out of containers that are not DPs, binding transitivity will not automatically generalize to such cases.

In sections 3.5–3.8, I will show that quantificational DPs appear to be able to bind out of containers of essentially any syntactic category, and therefore that binding transitivity is at best an incomplete explanation of the full pattern of binding facts.

3.5 Binding out of a PP

In these naturally occurring examples, quantifiers embedded inside prepositional phrases bind pronouns that they do not c-command.

(29) a. [In everyone$_i$'s own mind], they$_i$ are the most important person in the world.
b. [After the name of every$_i$ student] will be added his$_i$ place of residence.
c. John gave [to each$_i$ participant] a framed picture of his$_i$ mother.
d. [Under each$_i$ picture] was the verse in the poem it$_i$ was intended to represent.
e. Our staff keeps a watchful eye [on every$_i$ situation] and on it$_i$s developments.

The examples include prepositions that are semantically transparent case-marking prepositions, as well as prepositions with lexical content.

Barbiers (1995) suggests modifying c-command so that (roughly) DP objects command whatever their prepositional phrase host c-commands. However, like Reinhart's (1983) and Kayne's (1994) versions of c-command discussed above, this extension would still provide far from a complete picture of all the ways that c-command has to be adjusted in order to cover the full set of data.

3.6 Binding out of a VP

Examples of binding out of VP are common in the linguistics literature, (30a–e), and naturally occurring examples are easy to come by, (30f–i).

(30) a. We [will sell no$_i$ wine] before it$_i$s time.
[syntax lore (ad for Paul Masson)]
b. John [left every$_i$ party] angry at the person who had organized it$_i$.
(Kayne 1994:71)
c. Sue [spoke to each$_i$ employee] about his$_i$ paycheck.
(Pesetsky 1995:161)
d. A book [was given to every$_i$ boy] by his$_i$ mother.
(Harley 2003:64)
e. John [visited each$_i$ student] on his$_i$ birthday.
(Shan and Barker 2006:117)
f. She [copied each$_i$ book] without hurting it$_i$.
g. . . . the elders [called each$_i$ student to the front] and prayed for [him or her]$_i$ individually . . .
h. Despite its record sales (300 million and counting), [reading each$_i$ book] moments after it$_i$s simultaneous worldwide release feels as intimate as . . .
i. I then [caught each$_i$ fish], measured it$_i$, and placed it$_i$ in the plastic container.

Clearly, a quantifier embedded within a verb phrase can bind a pronoun outside of that verb phrase.

3.7 Binding out of an Adjunct

These naturally occurring examples involve a prepositional phrase functioning as an adverbial adjunct:

(31) a. [After unthreading each$_i$ screw], but before removing it$_i$, make sure to hold the screw in place while seperating [*sic*] the screw from the driver.
b. . . . [after seeing each$_i$ animal] but before categorizing it$_i$ on the computer or recording it$_i$ on their response sheet.
c. . . . [after fetching each$_i$ pointer], but before dereferencing it$_i$.
d. These processors use branch prediction techniques to forecast the code path that will be followed [after each$_i$ branch instruction], but before it$_i$s execution.

Note that the object of *after* can be a gerundive VP as well as a DP.

3.8 Binding out of a Tensed Clause

Supposedly, a universal never takes scope outside of a tensed clause.

(32) a. [That Mary seems to know every boy] surprised someone.
b. [That Mary seems to know every$_i$ boy] surprised his$_{*i}$ mother.

Because *every* is embedded in a (tensed) sentential subject, it cannot take scope over the indefinite in (32a). As a result, it certainly cannot bind a pronoun outside of the sentential subject, as shown in (32b).

However, as Szabolcsi (2011) notes, unlike *every*, *each* often can take scope outside of a tensed clause. In fact, it is even possible for *each* to bind outside of its container when it is embedded in a tensed relative clause.

(33) The grade [that each$_i$ student receives] is recorded in his$_i$ file.
(Lauri Karttunen, via James McCloskey, pers. comm.)

The naturally occurring data in (34) further support the claim that *each* can take scope outside of a tensed clause.

(34) a. It ended and the amount of Wealth [that each$_i$ person had] was added to their$_i$ overall score.
b. But the actual thinking seems to be [that each$_i$ person owns his own body], and that he$_i$ may not alienate his own body, by selling it, and that no one may buy . . .
c. [That each$_i$ person is a unique individual] and that he$_i$ alone can work out his own individuality?
d. It is only nowadays, when strife prevails [that each$_i$ person needs his neighbour], and that he$_i$ [n]eeds to pray for peace.

It is especially easy to find naturally occurring examples of quantificational binding out of tensed-clause containers when the container is in the first element of an *after . . . before* construction.

(35) a. The extra credit, then, is this: [after $each_i$ word has been read in] (but before it_i is inserted or updated in the list), convert it_i to lowercase and . . .
b. [After $each_i$ defendant was adjudicated], but before he_i was sentenced, the judges would read or refer to their court order . . .
c. Consider using a holdable cursor when your application needs to query a user [after it fetches $each_i$ row], but before it modifies it_i.
d. [After the growth of $each_i$ structure was completed], but before it_i was removed from the reactor, it_i was annealed.
e. Called [after $each_i$ bus is probed], but before it_is children are examined.
f. SNePS will pause just [after $each_i$ input is read], but before it_i is executed.
g. . . . function gets called [after $each_i$ record is read], but before doing anything with it_i . . .

3.9 Summary of Data So Far

To summarize: A quantifier can be embedded arbitrarily deeply within a container and yet still robustly bind a pronoun outside the container. In well-known cases involving possessives or inverse linking, the container can be a DP. But the container can also be a PP, a VP, an adjunct, a gerundive VP, even a tensed S. Given the long list of possible containers, the strategy of extending or adjusting c-command is unlikely to prove adequate. In other words, the data suggest that a quantifier need not c-command a pronoun in order to bind it.

4 Other Potential Classes of Counterexamples

There may be situations in which a quantifier appears to bind a pronoun without c-commanding it, yet that we should not count against Reinhart's Generalization. This will be the case if there is good reason to believe that the appearance of binding is due to some semantic mechanism other than ordinary quantificational binding.

4.1 Copular Connectivity Effects

It has been known since Higgins 1973 that certain copular sentences display what appears to be quantificational binding without c-command.

(36) a. [The person $everyone_i$ loves the most] is his_i mother.
b. What [$everyone_i$ hates most] is to have his_i mother insulted.

Some naturally occurring examples:

(37) a. [The goal of $every_i$ man] was his_i own salvation.
b. [$Every_i$ country's most precious resource] is it_is young people.
c. [The criterion of the intelligence of $every_i$ newcomer] was his_i opinion of Bricho's articles.

There are analyses on which connectivity effects do not involve ordinary binding (see, e.g., Jacobson 1994, 2003, Sharvit 1999, Winter 2004). On these theories, the two DPs denote certain sets of individuals or sets of functions, and the relationship between the two denotations creates the semantic illusion of binding.

Other types of connectivity, including question-answer connectivity, might also belong in this category.

(38) Q: Who does every$_i$ Englishman love?
A: His$_i$ mother.

Just as with copular connectivity, the apparent binding relationship between this question and its answer may not be an example of true quantificational binding.

Whatever the correct analysis, copular examples and the question-answer examples are at the very least consistent with my main claim, that c-command is not required for quantificational binding.

4.2 Donkey Anaphora

By definition, a donkey pronoun is a pronoun that covaries with an antecedent that does not c-command it.

(39) a. If [a farmer owns a$_i$ donkey], he beats it$_i$.
b. Every farmer [who owns a$_i$ donkey] beats it$_i$.

For each choice of a farmer, the pronoun *it* varies with the corresponding donkey. If we view the indefinite as quantificational (contra Heim 1982 and most work in Discourse Representation Theory), and if we view the covariance as the result of the pronoun's being bound by the indefinite, then donkey anaphora stands as a systematic class of counterexamples to Reinhart's Generalization.

It is natural to wonder whether most or all of the counterexamples in section 3 might be assimilated to donkey anaphora. However, there are significant obstacles to generalizing donkey anaphora in this way. In donkey anaphora, a pronoun (*it*) covaries along with an indefinite (*a donkey*) that does not c-command it. But in traditional donkey anaphora, there is always crucially a third element that supplies some kind of universal quantificational force, and that does c-command the pronoun. In (39a), the universal force is supplied by the conditional construction, which is interpreted as saying that every situation that satisfies the antecedent will also satisfy the consequent; in (39b), it is the quantifier headed by the determiner *every*, which clearly c-commands the donkey pronoun.

(40) Everyone$_i$'s mother called him$_i$.

In contrast, in the binding-out-of-a-possessor case in (40), there is no source of quantification other than the alleged donkey antecedent *everyone*, which does not c-command the pronoun. This means that the usual accounts of donkey anaphora will not extend to (40).

To emphasize the difficulty, if the relationship between *everyone* and *him* in (40) were of the same nature as the relationship between *a donkey* and *it* in (39a), then we should expect to be able to insert the universal in place of the indefinite in the donkey sentence.

(41) If a farmer owns every$_i$ donkey, he beats it$_{*i}$.

But of course, this isn't remotely possible.

In fact, it is precisely in order to avoid mistaking donkey anaphora for true violations of Reinhart's Generalization that the examples in section 3 all involve the universal quantifiers *every*, *each*, or *no*.

Despite these theoretical obstacles to generalizing donkey anaphora, Büring (2004) extends a donkey anaphora account to binding by universals in possessor cases and in inverse linking. Quantifiers within DP adjoin to their container DP, as advocated by May (1985) and as discussed by Heim and Kratzer (1998:197); the adjoined quantifier undergoes a semantic type shift (in order to reconcile semantic types); a special binding operator introduces a situation variable for the container; and pronouns denote E-type definite descriptions as in Heim 1990 and Elbourne 2005, which allows them to capture a contextually salient functional meaning that maps a situation onto an individual contained within the situation. For instance, Büring's analysis of (40) depends on there being a salient contextually supplied function from each situation involving a mother to some unique son in that situation (see Barker 2005 for additional discussion).

Crucially, however, just as for Ruys's (2000) binding transitivity discussed in section 3.4 (one of the inspirations for Büring's (2004) approach), the quantificational DP in question must adjoin to a DP container (in Büring's analysis, for semantic reasons). Therefore, it is unclear how to extend Büring's analysis to cases involving binding out of other sorts of containers (PPs, VPs, adjuncts, etc.).

Now, there are other, somewhat more flexible situation-based systems in which pronouns can covary with some quantificational operator through the mediation of some situation variable rather than through direct binding (e.g., Schwarz 2009). To the extent that such systems require only that the pronoun be within the scope of the quantificational operator, it is unclear how they will handle crossover. Nevertheless, many cases that appear to involve binding without c-command may turn out to involve situation-mediated covariation.

Since we do not currently know how to reliably tell the difference between genuine quantificational binding and situation-mediated covariation, we have one more reason for being cautious about drawing conclusions about c-command relations from examples that appear to involve binding. But in any case, given the limitations of our current state of knowledge, I will assume here that donkey anaphora and binding without c-command are independent problems.

4.3 Clausal and Gerundive Subjects

There remain some cataphoric examples that may or may not involve quantificational binding.

(42) That people hate him$_i$ disturbs every$_i$ president.

This example is from Reinhart 1983:180 (see also Williams 1994:238). Binding in such examples should presumably follow somehow from the syntactic properties of ''psych'' predicates like *disturbs*.

Another type of example, due to Higginbotham (1980:688), is known as a PRO gate.

(43) Having to make his_i mother breakfast kept $everyone_i$ in the kitchen.

If these examples do involve genuine binding, they constitute yet another class of counterexamples to Reinhart's Generalization.

5 If Not C-Command, Then What?

If c-command is not relevant, then just how should quantificational binding be managed?

In this section, I will informally describe what various strategies for handling quantificational binding might look like. I will discuss three strategies, in order of increasingly accurate approximation of the data: scope, scope plus linear order, and scope plus reconstructed linear order.

5.1 The Scope Requirement Alone

One obvious strategy would be to simply allow a quantifier to bind any pronoun that it takes scope over. The scope theory improves on Reinhart's Generalization in that it handles the many cases in which the quantifier does not c-command a pronoun that it binds. However, assuming that scope alone is enough to characterize quantificational binding makes no distinction between weak or strong crossover on the one hand and cases in which binding is possible on the other. One crucial requirement of a viable system, then, is that it must have something principled to say about crossover.

5.2 Scope Plus Linear Order

The next most obvious candidate would be to combine the scope requirement with an additional requirement that a quantifier must linearly precede any pronoun that it binds.

The scope-plus-linear-order strategy is adopted in Barker 2005 and Jäger 2005. This approach correctly rules out many basic cases of weak and strong crossover. However, because it relies entirely on linear order, it fails to account for any of the cases (some of which are discussed immediately below) in which a quantifier can bind a pronoun that linearly precedes it.

Reinhart (1983:119) explicitly argues that linear order is not required for quantificational binding on the basis of examples like these:

(44) a. In his_i own way, however, $each_i$ man is petitioning for the same kind of administration.
b. Near his_i child's crib $nobody_i$ would keep matches.
c. Thinking about his_i problems, $everyone_i$ got depressed.

Jäger (perhaps justifiably) calls into question the grammaticality of (44b). Therefore, it is worthwhile providing some similar, naturally occurring examples of quantificational cataphora.

(45) a. Unless he_i's Mr. T, no_i straight man should be wearing much more than one, or maybe two, small subtle pieces of jewelry (watches not included).
b. Unless she_i has had sex without her_i consent, no_i woman has to become a single mother.
c. Unless he_i's been a bandit, no_i man can be an officer; unless she_j's been a trollop, no_j woman can be a noble lady.
d. Unless he_i enter the gate, no_i man can see the beauty of the Ancestral Temples, the wealth of the hundred officers.
e. Unless he_i's some desperate pervert no_i man in their right mind would say that.

In each case here, the quantifier almost c-commands the bound pronoun, in accord with Reinhart's Generalization (where *almost* is the difference between something like max-command versus strict c-command). Therefore, one salient possibility that may be worth pursuing is a disjunctive condition: a quantifier can bind a pronoun if it either (almost) c-commands the pronoun or precedes it.

Whether c-command is necessary for this type of backward quantificational binding depends on the grammaticality of examples similar to these:

(46) a. Unless he_i is cruel, [no_i man's wife] truly hates him_i.
b. Unless she_i is famous, [the fate of no_i woman] fascinates the media for long.
c. Unless he_i is rich, universities admit no_i student whose grades are bad.

Although I haven't found any natural examples, I am inclined to believe that sentences like these are grammatical.

In any case, it is clear that under certain circumstances it is possible for a quantifier to bind a pronoun that precedes it, and therefore that a simpleminded linear order requirement on quantificational binding is not adequate.

5.3 Scope Plus Reconstructed Linear Order

If simple linear order is not the right additional requirement, we can try adjusting linear order. The clearest way to motivate this strategy is with so-called reconstruction examples.

(47) a. Which of his_i relatives does $every_i$ man love ____ the most?
b. the relative of his_i that $every_i$ man loves ____ the most

These constructions are widely accepted as grammatical, even though the quantifier follows the pronoun that it binds.

On the usual reconstruction accounts, at least part of the fronted *wh*-phrase in cases like (47a)—crucially, including at least the pronoun—moves downward into the position of the *wh*-trace (marked here with ''____''). Alternatively, on a copy theory of movement, the trace position contains a silent full copy of the *wh*-phrase. Likewise, in relative clause examples like (47b), some portion of the head nominal reconstructs into the trace position in the relative clause.

Along similar lines, it has been well-known since, for example, Lebeaux 1991:231 that syntactic A-movement may fail to trigger weak crossover.

(48) [His$_i$ mother]$_t$ seems to every$_i$ boy ____$_t$ to be a genius.

If the semantics of raising requires us (or at least allows us) to interpret (evaluate) the subject *his mother* in the trace position ____$_t$ (i.e., in the position of the embedded subject), then the grammaticality of (48) is predicted on the scope-plus-reconstructed-linear-order approach.

Crucially for the main question, the reconstructed position can be bound by any of the non-c-commanding quantificational binders scouted in section 3. A small selection of examples will illustrate the point.

(49) a. Which of his$_i$ relatives does everyone$_i$'s mother hate?
b. Which of it$_i$s pages did some reader of each$_i$ book remove?
c. Which of her$_i$ questions did John praise each$_i$ student for asking?

In each case, the quantifier does not c-command the pronoun either before or after reconstruction.

At this point, we should briefly return to the adjunct examples given in section 5.2. Reinhart (1983) argues that the examples in (44) involve fronting of a prepositional phrase. If the *unless*-phrases in (45) and (46) can be given a fronting analysis as well, then they can potentially receive the same explanation as the reconstruction examples.

5.4 A Formal Implementation

In a series of related papers (Shan and Barker 2006, Barker and Shan 2008, Barker 2009, to appear), a formal system is developed that delivers scope plus reconstructed linear order for quantificational binding. Quantifiers take scope by projecting into a separate layer of composition involving *continuations* (Barker 2002). Pronoun binding also occurs in the continuation layer. Because the continuation layer is independent of the hierarchical function/argument layer, there is no need for the quantificational binder to c-command a pronoun in order to bind it.

Crossover is accounted for by a left-to-right bias in the method for composing constituents. As a result, a quantifier can bind a pronoun only if the quantifier is *evaluated* (in a specific technical sense imported from the theory of programming languages) before the pronoun.

(50) a. Which of his$_i$ relatives does everyone$_i$ love ____?
b. *Which of his$_i$ relatives ____ loves everyone$_i$?

Regarding reconstruction, an independently motivated account of *wh*-question formation automatically predicts that the evaluation of material in the fronted *wh*-phrase will be *delayed* (once again, in a specific technical sense) until the evaluation of the *wh*-trace. This means that (50a) can receive a bound reading without any special stipulation, even though the quantifier linearly follows the pronoun that it binds. The account also correctly predicts that (50b) is a crossover violation, since the *wh*-trace (and therefore the reconstructed material) will be evaluated before the quantifier.

A complete presentation of the concepts and the formal details would require too much space to include here. See Barker and Shan 2008 for an introduction to the system, including quantification, binding, and simple cases of crossover; and see Barker 2009, to appear for an exploration of the predictions concerning reconstruction.

6 Conclusions

Standard wisdom says that when a quantificational expression binds a pronoun, the binder must c-command that pronoun. This belief is so universally accepted that it is often treated as if it were a definition rather than an assumption vulnerable to empirical evidence.

Examples that appear to be inconsistent with the c-command requirement typically prompt three kinds of reactions. The first kind of reaction is to adjust or extend the definition of c-command, the strategy (as discussed above) of Reinhart (1983), Kayne (1994), Barbiers (1995), Hornstein (1995), and Ruys (2000), among others. The second kind of reaction is to adjust the syntactic structures over which quantificational binding occurs in order to arrange for the c-command requirement to be fulfilled, as in Larson's (1988) ''rightward-is-downward'' VP-shell analysis and its many extensions and variations. The third kind of reaction is to propose some radically different mechanism to explain the appearance of binding through some indirect means that circumvents the c-command requirement without technically violating it, as in Büring's (2004) generalization of donkey anaphora.

However, when we gather all the exceptions together, both the well-known ones and the less well-known ones, they begin to pile up. We should consider a fourth reaction: perhaps we were wrong all along, and c-command is not in fact required for quantificational binding.

No doubt we could continue to construct exceptions and special mechanisms with various degrees of independent motivation that would explain away some (or, perhaps, someday even all) of the data presented above. But even if this is possible, what will we have accomplished? That is, why should we try to save the c-command restriction? I have also called into question the original evidence for positing the c-command restriction in the first place. That evidence is not strong. I suspect that much of the original inclination to accept Reinhart's Generalization comes from an implicit assumption that quantificational binding probably behaves like other types of anaphora for which c-command requirements are better motivated. But it is quite clear that quantificational binding is different from other types of anaphora.

Let me emphasize that I have not said anything about whether c-command might still be relevant for characterizing other aspects of anaphora. For instance, the difference between strong crossover and weak crossover is precisely whether the pronoun in question c-commands its quantificational binder. Building on Higginbotham 1983, Safir (2004b) proposes the Independence Principle, which has for a corollary that if a pronoun is bound by a quantifier, that pronoun cannot c-command the quantifier. Safir (2004b:chap. 3) discusses in detail the relevance of the Independence Principle for crossover.

Let me also emphasize that I have not said anything about languages other than English. Languages differ in important ways that bear on the status of the c-command constraint. For instance, in Chamorro, possessors are not able to bind out of their DP hosts (Chung 1998:77).

There may even be languages in which Reinhart's Generalization holds. However, English is not one of them. I take it that the evidence presented above shows that in English, quantificational binding does not require c-command.

References

Barbiers, Sjef. 1995. *The syntax of interpretation*. The Hague: Holland Academic Graphics.

Barker, Chris. 2002. Continuations and the nature of quantification. *Natural Language Semantics* 10: 211–242.

Barker, Chris. 2005. Remark on Jacobson 1999: Crossover as a local constraint. *Linguistics and Philosophy* 28:447–472.

Barker, Chris. 2009. Reconstruction as delayed evaluation. In *Theory and evidence in semantics*, ed. by Erhard Hinrichs and John Nerbonne, 1–28. Stanford, CA: CSLI Publications.

Barker, Chris. To appear. More on reconstruction as delayed evaluation. In *Reconstruction effects in relative clauses*, ed. by Manfred Krifka, Rainer Ludwig, and Mathias Schenner. Munich: Oldenbourg Academic Publishers.

Barker, Chris, and Geoffrey K. Pullum. 1990. A theory of command relations. *Linguistics and Philosophy* 13:1–34.

Barker, Chris, and Chung-chieh Shan. 2008. Donkey anaphora as in-scope binding. *Semantics and Pragmatics* 1:1–42.

Bresnan, Joan. 1994. Linear order vs. syntactic rank: Evidence from weak crossover. In *CLS 30: Papers from the 30th Regional Meeting of the Chicago Linguistic Society*. Vol. 1, *The main session*, ed. by Katharine Beals, Jeannette Denton, Bob Knippen, Lynette Melnar, Hisami Suzuki, and Erika Zeinfeld, 57–89. Chicago: University of Chicago, Chicago Linguistic Society.

Bresnan, Joan. 1998. Morphology competes with syntax: Explaining typological variation in weak crossover effects. In *Is the best good enough? Optimality and competition in syntax*, ed. by Pilar Barbosa, Danny Fox, Paul Hagstrom, Martha McGinnis, and David Pesetsky, 59–92. Cambridge, MA: MIT Press.

Büring, Daniel. 2004. Crossover situations. *Natural Language Semantics* 12:23–62.

Büring, Daniel. 2005. *Binding theory*. Cambridge: Cambridge University Press.

Carminati, Maria Nella, Lyn Frazier, and Keith Rayner. 2002. Bound variables and c-command. *Journal of Semantics* 19:1–34.

Charlow, Simon. 2010. Can DP be a scope island? In *Interfaces: Explorations in logic, language and computation. ESSLLI 2008 and ESSLLI 2009 student sessions, selected papers*, ed. by Thomas Icard and Reinhard Muskens, 1–12. Berlin: Springer.

Chomsky, Noam. 1986. *Barriers*. Cambridge, MA: MIT Press.

Chung, Sandra. 1998. *The design of agreement: Evidence from Chamorro*. Chicago: University of Chicago Press.

Cormack, Annabel. 1998. *Definitions: Implications for syntax, semantics, and the language of thought*. New York: Garland.

Elbourne, Paul. 2005. *Situations and individuals*. Cambridge, MA: MIT Press.

Frank, Robert, and K. Vijay-Shanker. 2001. Primitive c-command. *Syntax* 4:164–204.

Gawron, Jean Mark, and Stanley Peters. 1990. *Anaphora and quantification in situation semantics*. Stanford, CA: CSLI Publications.

Harley, Heidi. 2003. Possession and the double object construction. In *Linguistic variation yearbook 2*, ed. by Pierre Pica and Johan Rooryck, 31–70. Amsterdam: John Benjamins.

Heim, Irene. 1982. The semantics of definite and indefinite noun phrases. Doctoral dissertation, University of Massachusetts, Amherst.

Heim, Irene. 1990. E-type pronouns and donkey anaphora. *Linguistics and Philosophy* 13:137–177.

Heim, Irene, and Angelika Kratzer. 1998. *Semantics in generative grammar*. Oxford: Blackwell.

Higginbotham, James. 1980. Pronouns and bound variables. *Linguistic Inquiry* 11:679–708.

Higginbotham, James. 1983. Logical Form, binding, and nominals. *Linguistic Inquiry* 14:395–420.

Higgins, F. R. 1973. *The pseudo-cleft construction in English*. New York: Garland.
Hornstein, Norbert. 1995. *Logical Form: From GB to minimalism*. Oxford: Blackwell.
Huitink, Janneke. 2008. Modals, conditionals, and compositionality. Doctoral dissertation, Radboud Universiteit, Nijmegen.
Jacobson, Pauline. 1972. Crossover and some related phenomena. Master's thesis, University of California, Berkeley.
Jacobson, Pauline. 1994. Binding connectivity in copular sentences. In *Proceedings of SALT 4*, ed. by Mandy Harvey and Lynn Santelmann, 161–178. Available at elanguage.net/journals/salt/issue/view/287.
Jacobson, Pauline. 1999. Towards a variable-free semantics. *Linguistics and Philosophy* 22:117–184.
Jacobson, Pauline. 2003. Direct compositionality and VFS: The case of binding into heads. In *Proceedings of SALT 12*, ed. by Brendan Jackson, 144–163. Available at elanguage.net/journals/salt/issue/view/295.
Jäger, Gerhard. 2005. *Anaphora and type logical grammar*. Dordrecht: Springer.
Kayne, Richard. 1994. *The antisymmetry of syntax*. Cambridge, MA: MIT Press.
Koornneef, Arnout, Frank Wijnen, and Eric Reuland. 2006. Towards a modular approach to anaphor resolution. In *Ambiguity in Anaphora Workshop proceedings*, ed. by Ron Artstein and Massimo Poesio, 65–72. University of Essex.
Langacker, Ronald. 1969. On pronominalization and the chain of command. In *Modern studies in English*, ed. by David Reibel and Sanford Schane, 160–186. Englewood Cliffs, NJ: Prentice-Hall.
Larson, Richard. 1988. On the double object construction. *Linguistic Inquiry* 19:335–391.
Lebeaux, David. 1991. Relative clauses, licensing, and the nature of the derivation. In *Perspectives on phrase structure*, ed. by Susan Rothstein, 209–239. Syntax and Semantics 25. New York: Academic Press.
May, Robert. 1985. *Logical Form: Its structure and derivation*. Cambridge, MA: MIT Press.
Pesetsky, David. 1995. *Zero Syntax: Experiencers and cascades*. Cambridge, MA: MIT Press.
Postal, Paul. 1971. *Cross-over phenomena*. New York: Holt, Rinehart and Winston.
Reinhart, Tanya. 1983. *Anaphora and semantic interpretation*. Chicago: University of Chicago Press.
Ruys, E. G. 2000. Weak crossover as a scope phenomenon. *Linguistic Inquiry* 31:513–539.
Safir, Ken. 2004a. *The syntax of anaphora*. Oxford: Oxford University Press.
Safir, Ken. 2004b. *The syntax of (in)dependence*. Cambridge, MA: MIT Press.
Sauerland, Uli. 2005. DP is not a scope island. *Linguistic Inquiry* 36:303–314.
Schwarz, Florian. 2009. Two types of definites in natural language. Doctoral dissertation, University of Massachusetts, Amherst.
Shan, Chung-chieh, and Chris Barker. 2006. Explaining crossover and superiority as left-to-right evaluation. *Linguistics and Philosophy* 29:91–134.
Sharvit, Yael. 1999. Functional relative clauses. *Linguistics and Philosophy* 22:447–478.
Szabolcsi, Anna. 2010. *Quantification*. Cambridge: Cambridge University Press.
Szabolcsi, Anna. 2011. Scope and binding. In *Semantics: An international handbook of natural language meaning, vol. 2*, ed. by Klaus von Heusinger, Claudia Maienborn, and Paul Portner, 1605–1641. Berlin: Mouton de Gruyter.
Wasow, Thomas. 1972. Anaphoric relations in English. Doctoral dissertation, MIT, Cambridge, MA.
Williams, Edwin. 1994. *Thematic structure in syntax*. Cambridge, MA: MIT Press.
Winter, Yoad. 2004. Functional quantification. *Research on Language and Computation* 2:331–363.

Department of Linguistics
New York University
10 Washington Place
New York, NY 10003

chris.barker@nyu.edu