

**ADJACENCY AND LOCALITY:
A CONSTRAINT-BASED ANALYSIS OF
COMPLEMENTIZER-ADJACENT EXTRACTION**

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Abstract

This paper provides a new explanation of phenomena related to extraction following an overt complementizer (‘that-t effects’), for which the theory-neutral term *complement-adjacent extraction* is adopted. The analysis stems from the Correspondence Architecture of Lexical-Functional Grammar, making formally explicit certain implicit, native relations of the architecture. No reference is made to traces. The key insight is that complement-adjacent extraction effects concern linear string adjacency, where the string is understood as part of the syntax–phonology interface. A new metavariable, \succ , is introduced and formally defined; \succ identifies the next word’s f-structure. A single constraint is proposed that accounts for a wide range of relevant phenomena.

1 Introduction

This paper provides a new explanation of phenomena related to subject extraction following an overt complementizer (often called ‘that-t effects’ or ‘Comp-trace effects’). This normally leads to ungrammaticality (Perlmutter 1968), as demonstrated in (1), and has received numerous theoretical treatments (Bresnan 1972, 1977, Chomsky and Lasnik 1977, and many others since).

- (1) a. Who do you think saw Kim?
b. *Who do you think that saw Kim?

I adopt the theory-neutral descriptive term ‘Complementizer-Adjacent Extraction’ (CAE).¹ The novel analysis stems from the Correspondence Architecture of Lexical-Functional Grammar (LFG), making formally explicit certain implicit, native relations of the architecture. The key insight is that CAE effects do not concern structural superiority, but instead concern linear string adjacency, where the string is understood as a representation of part of the syntax–phonology interface.

The paper is structured as follows. Section 2 briefly presents the grammatical architecture of LFG and highlights aspects that will be particularly relevant. Section 3 delves further into the CAE phenomenon and presents some relevant complications. In section 4, I present my proposal and discuss the inadequacy of an alternative based on f-precedence. Section 5 presents the formal analysis and applies it to some examples. Section 6 considers some previous proposals, especially in light of the data discussed in section 3. Section 7 concludes. There is also an appendix that considers and rejects f-precedence-based alternatives to the main proposal.

2 The Correspondence Architecture

LFG’s Correspondence Architecture (Kaplan and Bresnan 1982, Kaplan 1987, 1989, Halvorsen and Kaplan 1988, Asudeh 2006) divides the form-meaning mapping into a series of simultaneously-present, discrete modules, each of which represents distinct linguistic information. The part of the architecture that is relevant here is shown in Figure 1. C(onstituent)-structure represents word order, dominance and constituency, as modelled by a standard (non-tangled) tree — i.e., a phrase-structural parse of the

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¹In previous, unpublished work, including the poster presented at LFG09, I have used the term ‘Complementizer-Adjacent Nominal Extraction’. While this makes for a nicer acronym, it is misleading, because the categorial status of the extracted subject is irrelevant:

- (i) a. Kim suspects that that Sandy burped shocked Robin.
b. What does Kim suspect shocked Robin?
c. *What does Kim suspect that shocked Robin?
- (ii) a. The kids claimed that under the bed was a good place to hide.
b. Under where did the kids claim was a good place to hide?
c. *Under where did the kids claim that was a good place to hide?

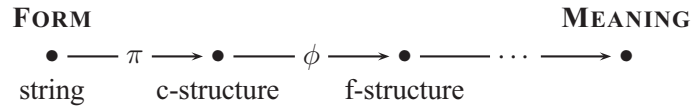


Figure 1: Relevant part of LFG’s Correspondence Architecture

phonological string. F(unctional)-structure represents more abstract aspects of syntax, such as predication and grammatical functions, null pronominals, local and unbounded dependencies, etc. F-structure is modelled as a feature structure. The ϕ correspondence function maps elements of c-structure to elements of f-structure. The syntactically unparsed string and the π correspondence function from the string to the c-structure are two components of the Correspondence Architecture that have received little attention since their proposal by Kaplan (1987). They form the heart of this analysis.

The theory of unbounded dependencies assumed here (Kaplan and Zaenen 1989) does not posit any null element (trace or copy) in the extraction site. This means that a key representational device that is standardly used in accounts of CAE is unavailable. An analysis of CAE that does not posit traces or copies is simpler, since it posits fewer entities. In addition to achieving a simplification and removing a theoretical motivation for traces/copies, this analysis captures a wide range of empirical data with a single constraint.

3 Phenomena and problems

The basic Complementizer-Adjacent Extraction phenomenon is as follows:

- (2) a. Who do you think saw Kim?
b. *Who do you think that saw Kim?
- (3) a. Who do you think Kim saw?
b. Who do you think that Kim saw?

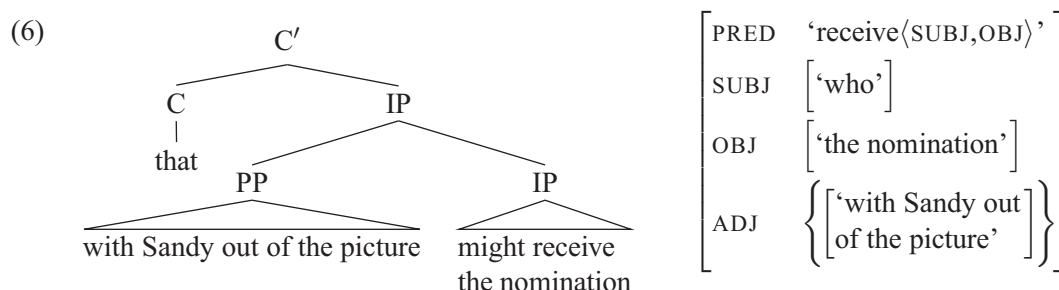
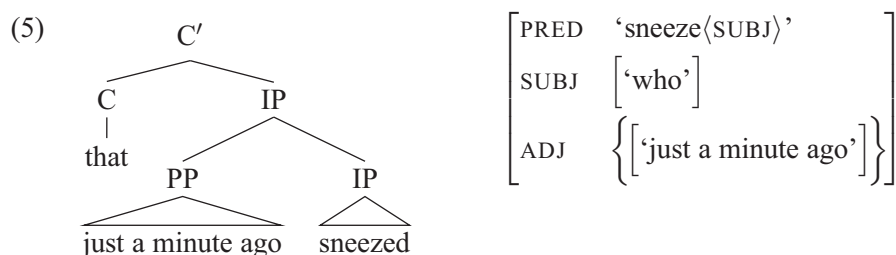
The basic observation is that there cannot be a subject extraction from a complement clause if the clause is introduced by a complementizer (2b); I will call this the ‘basic CAE effect’. In the absence of a complementizer, the extraction is grammatical (2a). Object extraction is grammatical whether the complementizer is present or not. There is considerable dialectal variation in these judgements (Pesetsky 1982, Sobin 1987, 2002), but there are speakers who robustly demonstrate this contrast and their grammars need to be accounted for. The variation must also be properly accounted for; I return to this issue in section 5.1.

CAE is more complex than these facts alone would indicate, due to a phenomenon often called the ‘Adverb Effect’ (Bresnan 1977, Culicover 1991, 1993):

- (4) a. Who did you say that, just a minute ago, sneezed?
b. Who does Kim think that, with Sandy out of the picture, might receive the nomination?

Insertion of an adverbial element immediately after the complementizer neutralizes the basic CAE effect for many speakers. This is unexpected, because the structural relation between the complementizer and the extraction site is not affected by the adverbial, which is adjoined to IP in c-structure and is an ADJUNCT at f-structure:²

²The categorial status of the interpolated adverbial phrase does not seem to matter, although these are both arguably PPs.



If the impossibility of subject extraction in CAE is to be attributed to the presence of an intervening complementizer, then the presence of other intervening structure that does not affect intervention by the complementizer should not improve things, but it does. However, the adverbial element does linearly separate the complementizer and the extraction site.

The Adverb Effect facts gained new life when Culicover (1993) brought them to centre stage in a criticism of then-standard transformational accounts of CAE, which were based on the Empty Category Principle (Chomsky 1981). Another previously well-known complication was, however, subsequently largely ignored in responses to Culicover's work, with some notable exceptions (e.g., Sobin 2002). This second complication is that subject extraction after the complementizer *that* in a relative clause is grammatical (Bresnan 1977):

(7) This is the person that sneezed.

I will call this the Relative Clause Paradox. Some analyses assume that the *that* in relative clauses is a different lexical item from the complementizer *that* (Gazdar 1981, Pollard and Sag 1994:220–222). On such accounts, there is arguably no paradox, if CAE is associated with the complementizer *that*, but not with the relativizer *that*. However, there are long-standing empirical arguments that there is only one *that* (Bresnan 1972, 1977, Emonds 1976) and an analysis that posits no ambiguity is also to be preferred on grounds of parsimony.

There are in fact further complications with relative clauses, because the CAE effect re-emerges if the *that*-relative is embedded:

(8) *This is the person who Kim thinks that sneezed.

An account that reconciles CAE and the Relative Clause Paradox is therefore only successful if it can also account for the contrast between (7) and (8).

CAE, the Adverb Effect and the Relative Clause Paradox are the key phenomena of interest and present a puzzling enough set of problems on their own. However, there is yet another relevant phenomenon, that of Embedded VP Topics:

(9) Mary knows that doubt her John never could.

There is a fronted element here, the VP topic, that appears between the complementizer and the subject of the complementizer's clause. Crucially, unlike the case with the Adverb Effect, this intervening material does not mitigate the basic CAE effect:

(10) *Who does Mary know that doubt her never could?

Embedded VP Topics thus show that a reconciliation of the Adverb Effect and CAE cannot rely on a naive notion of intervening structure between the complementizer and the extraction site.³

4 Proposal

In this section, I sketch the proposed explanation of CAE, including the related phenomena of the Adverb Effect, the Relative Clause Paradox and Embedded VP Topics. I also consider a potential alternative LFG account based on f-precedence (Bresnan 1984, Kaplan 1987) and show that the pattern of data observed in the previous section is fundamentally incompatible with an f-precedence account of CAE.

The analysis that I propose uses two parts of LFG's Correspondence Architecture that appeared in the original presentation of the (extended) architecture (Kaplan 1987), but which have subsequently been largely ignored:

1. The syntactically unparsed string that is the input to c-structure. I assume that this string is phonologically parsed, i.e. tokenized into words (Forst and Kaplan 2006). The string is therefore a representation of linear phonology.
2. The π correspondence function that maps the string to c-structure.

The key observations are the following:

1. The Adverb Effect indicates that the relevant grammatical notion for CAE is linear adjacency, not structural superiority. Linear adjacency is a relation from the syntax-phonology interface, whereas structural superiority is a properly syntactic relation.
2. The Relative Clause Paradox and Embedded VP Topic data show that a notion of phonological realization of the head of the unbounded dependency (FOCUS or TOPIC) is also relevant.

These observations will be put into effect in a single constraint that can be summarized as follows:

(11) **CAE Constraint (informal)**

It is not the case that the string element that immediately follows the complementizer maps to an f-structure that contains a subject that is both phonologically realized and is the head of an unbounded dependency.

The constraint will be part of the lexical entry for complementizers, which permits a standard lexicalist account of the observed variation in CAE dialects.

The notion of realization is already available through the inverse of the ϕ mapping from c-structure to f-structure (Halvorsen and Kaplan 1988). The notion of simultaneously being a subject and the head of an unbounded dependency is also already available, through inside-out functional application (Halvorsen and Kaplan 1988). The new part of the proposal concerns linear adjacency, for which I introduce a function on string elements and, based on this, a new metavariable, \succ , which denotes the next word's f-structure.

5 Analysis

The CAE Constraint was informally presented in section 4 as follows:

(12) **CAE Constraint (informal)**

It is not the case that the string element that immediately follows the complementizer maps to an f-structure that contains a subject that is both phonologically realized and is the head of an unbounded dependency.

³The point here is that intervention alone is not sufficient. However, (10) is also independently ungrammatical without *that*, which muddies things. I return to this point at the end of section 5.2.

I will now formalize this constraint.

The string projection in the Correspondence Architecture must contain a native ordering relation for linear precedence. This can be represented as a function on string elements, which are characterized as words:

(13) $N: W \rightarrow W$, where W is the set of words in the string

The string is assumed to be ‘phonologically parsed’ or tokenized into units. The function name, N , is meant to be mnemonic for ‘next’.

Phonological realization can be defined through the inverse of the ϕ mapping from c-structure to f-structure:

(14) For any f-structure f , $\text{REALIZED}(f)$ is true iff $\phi^{-1}(f) \neq \emptyset$.

In other words, the predicate REALIZED is just packaging, in a shorter and more intuitive form, the independently available equation $\phi^{-1}(f) \neq \emptyset$, which states that the set of c-structure nodes that map to f (the c-structure correspondent of f) is not empty. The predicate REALIZED will thus return false if applied to a null pronominal.

The last piece of formalization is obtained by using the string function N , along with the correspondence functions π and ϕ , to identify the next string element’s f-structure, notated as a metavariable \succ :

(15) $\succ := \phi(\mathcal{M}(\pi(N(\pi^{-1}(*))))))$, where $*$ is a terminal node; undefined otherwise

The variable $*$ picks out the current c-structure node (i.e., the node bearing an annotation involving \succ). We take the inverse of the π correspondence function from string to c-structure and apply it to $*$, returning a string element (a word). We then apply N to the obtained word to get the next word. Having obtained the word that follows the word that corresponds to the current c-structure node, we apply the π function to get back into c-structure. We are then sitting at a terminal node, which may not be directly mapped to f-structure. We therefore apply the c-structure mother function \mathcal{M} to get the pre-terminal node. Lastly, we apply the ϕ correspondence function from c-structure to f-structure. The metavariable \succ can therefore be used in a lexical entry to refer to the f-structure of the word that immediately follows the relevant terminal node.⁴

The CAE constraint can now be defined as follows:

(16) **CAE Constraint (formal)**

$\neg[\text{REALIZED}(\succ \text{ SUBJ}) \wedge (\text{UDF}(\succ \text{ SUBJ}))]$

where UDF is an unbounded dependency function (FOCUS or TOPIC)

The inside-out existential constraint ($\text{UDF}(\succ \text{ SUBJ})$) is true just in case the next word’s subject is in an unbounded dependency, i.e. extracted. The constraint states that it cannot be the case that the next word’s subject is both realized and extracted. I next turn to some examples, which show the constraint in effect.

5.1 Variation

The CAE constraint is associated with lexical entries of complementizers and is not a general structural constraint, e.g. associated with the category C . This lexicalist view has also been argued for independently by Falk (2006:130–131). For example, the lexical entry for *that* would look something like

⁴The restriction of the metavariable to terminal nodes is stated explicitly for clarity, but it follows if we assume that (1) the π correspondence function is an injection (one-to-one), since no two elements in a properly tokenized string map to the same c-structure node and (2) π is not onto (there are c-structure nodes that have no string correspondents — the non-terminals). The relevant point is that we should be able to assume that $\pi^{-1}(*)$ is a string element, rather than a set of such elements. For example, we do not want to have to consider the case of a node such as a branching VP having more than one string correspondent. The π function would likely have a more complex analysis if Lexical Sharing is assumed (Wescoat 2002, 2005, 2007, 2009).

(17). I am not positing any ambiguity between *that* in relative clauses and the complementizer; both occurrences are in fact the complementizer and there is just the single lexical entry.

- (17) *that* C, (↑ TENSE)
 (↑ MOOD) = DECLARATIVE
 ¬[REALIZED(> SUBJ) ∧ (UDF(> SUBJ))]

The lexical analysis explains variation between complementizers as to whether they block CAE or not.

For example, Sobin (1987, 2002) has shown that some English speakers allow CAE with *that* but not with *whether*. The impossibility of CAE with *whether* seems to require an explanation over and above an appeal to the status of *whether*-clauses as weak islands, although caution has to be exercised here, because Sobin does not report explicitly whether the differences in the relevant conditions are significant or not. In sum, it seems that some English speakers do not have a CAE effect with *that* but do have one with *whether*. This can be accounted for if the lexicons of such speakers do not contain the CAE constraint in the entry for *that*. Similarly, Shlonsky (1988) has observed that Hebrew *fe* ('that') allows CAE, but *im* ('if') blocks it. Again, this can be explained as lexical variation with respect to the CAE constraint. There are quite a few other cases of cross-linguistic and dialectal variation for CAE reported in the literature; see Kandybowicz (2009:329) for further references.

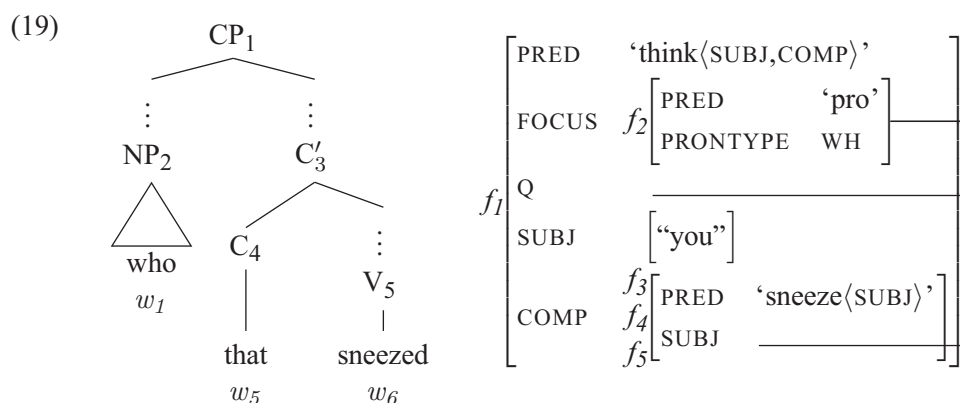
Lastly, there is also variation in whether the Adverb Effect ameliorates CAE effects (Sobin 2002). This variation can be explained with respect to differences between the ↑ and > metavariables. If a speaker has the CAE constraint realized with the > metavariable, then the Adverb Effect holds in the speaker's grammar, as outlined below. However, if a speaker has the CAE constraint with the two instances of > replaced by ↑, then the Adverb Effect does not hold in the speaker's grammar, since interpolation of the adverbial does not affect the relationship when stated in terms of ↑, as sketched in the discussion of f-precedence in the appendix below.

5.2 Examples

In this section I show how the CAE constraint accounts for various cases that have been under discussion.

First, let us look at an example of how the constraint correctly blocks basic CAE:

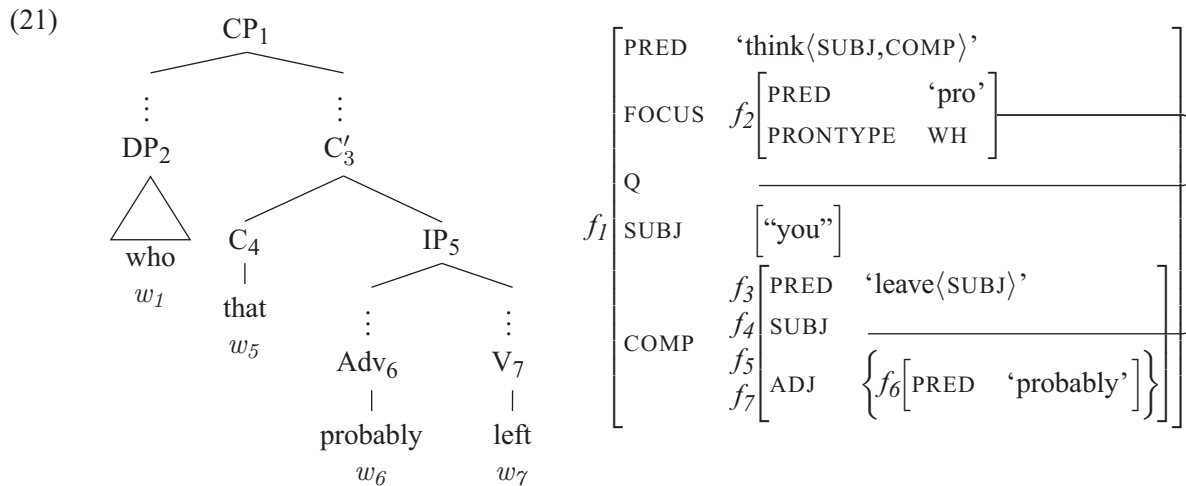
- (18) *Who do you think that sneezed?



The complementizer *that* is the fifth word (w_5) in the string for (18). The next word is the head of the complementizer's clause, *sneezed* (w_6). The > metavariable in the lexical entry for *that* is therefore realized as f_5 , which is the f-structure of the mother of the word immediately following *that* (i.e., *sneezed*). The SUBJ of f_5 is f_2 , which is REALIZED, as *who*, and is also a UDF, since the SUBJ is also the FOCUS of the main clause's f-structure. The CAE constraint is therefore violated and the example is correctly blocked.

Second, let us look at a simple Adverb Effect example:

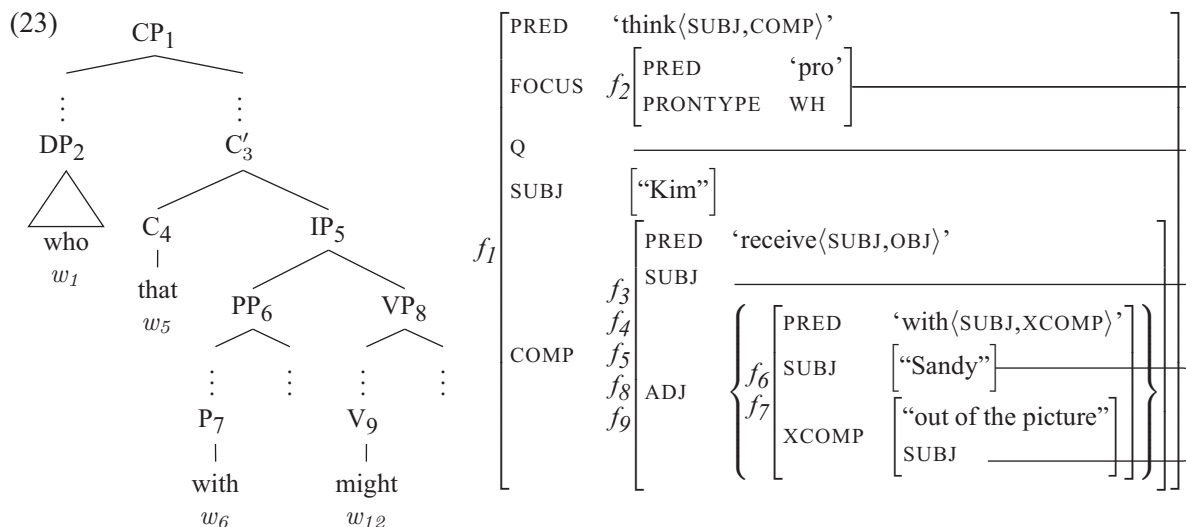
- (20) Who do you think that probably left?



The \succ metavariable in the lexical entry for *that* is here realized as f_6 , which is the f-structure of the mother of the word immediately following *that*, the adverb *probably*. The adverb has no SUBJ, so the CAE constraint is trivially satisfied.

Third, let us consider a more complex adverbial in an Adverb Effect example:

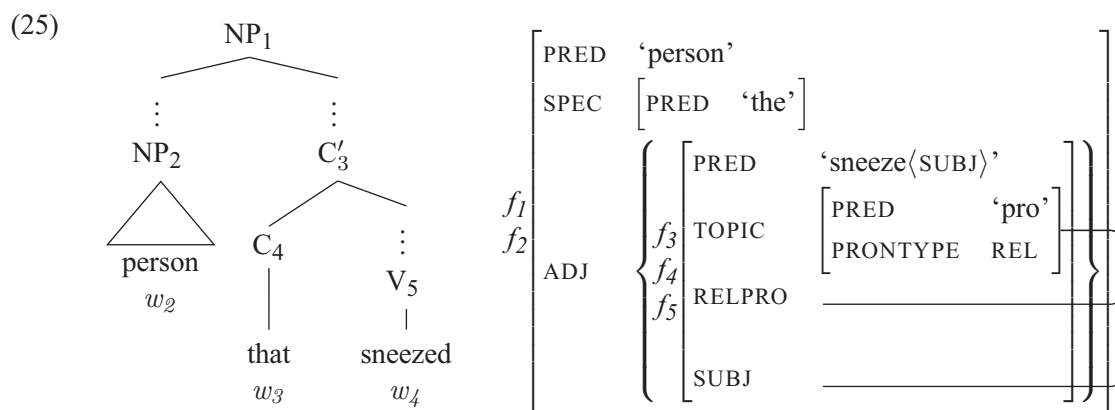
(22) Who does Kim think that, with Sandy out of the picture, might receive the nomination?



The \succ metavariable in the lexical entry for *that* is here realized as f_7 , which is the f-structure of the mother of the word immediately following *that*, the preposition *with*. In contrast to the simpler Adverb Effect example, *with* arguably does have a SUBJ, if it is to be analyzed as having a small clause (i.e., predicative) complement (Pollard and Sag 1987, 1994:110). I am not interested in defending such an analysis here, but rather in showing that the CAE constraint would derive the correct result even if an adverbial does have a subject. The SUBJ of *with*'s f-structure, f_7 , is REALIZED as *Sandy*, but it is not a UDF, since *Sandy* is not the top of an unbounded dependency (i.e., the SUBJ is not extracted). The CAE constraint is therefore non-trivially satisfied by this kind of adverbial, again accounting for the Adverb Effect.

Fourth, let us consider a simple relative clause:

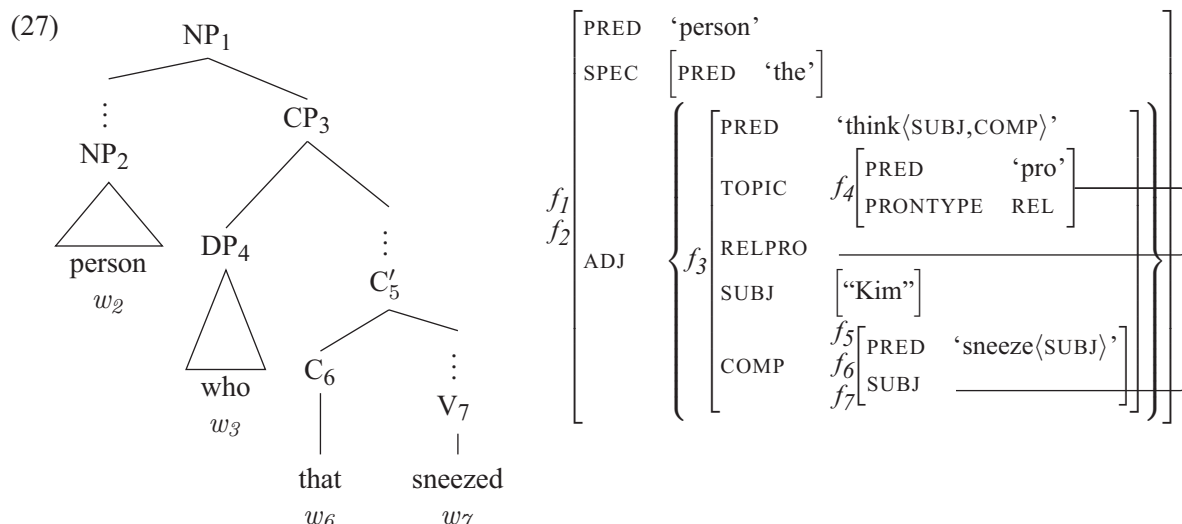
(24) the person that sneezed



The \succ metavariable in the lexical entry for *that* is here realized as f_5 , which is the f-structure of the mother of the word immediately following *that*, the verb *sneezed*. This verb does have a SUBJ and the SUBJ is a UDF, since it is the TOPIC in the relative clause. However, the SUBJ is the null relative pronoun and is not REALIZED — there is no c-structure correspondent of SUBJ. Therefore, the left conjunct in the CAE constraint is false and the constraint is satisfied as a result. The CAE constraint therefore accounts for simple cases of the Relative Clause Paradox.

Fifth, let us consider embedded relative clauses, in which the CAE effect re-emerges:

(26) *the person who Kim thinks that sneezed



The \succ metavariable in the lexical entry for *that* is here realized as f_7 , which is the f-structure of the mother of the word immediately following *that*, again the verb *sneezed*. This verb does have a SUBJ and the SUBJ is a UDF, since it is the TOPIC in the relative clause. This time, the SUBJ is in fact realized by the overt relative pronoun *who*. The CAE constraint is therefore violated in the more complex case, because the relative pronoun is REALIZED. The CAE constraint therefore also accounts for complex cases of the Relative Clause Paradox.

Lastly, the CAE constraint accounts for the Embedded VP Topic contrast, repeated here, although there is insufficient room to show the relevant structures:

(28) Mary knows that doubt her John never could.

(29) *Who does Mary know that doubt her never could?

This contrast shows that not just any intervening material blocks a CAE violation. In (28) the string element following *that* is the verb *doubt*, which has a REALIZED SUBJ, *John*. However, *John* is not a UDF, because there is no extraction of the subject; the CAE constraint is not violated. In contrast, the SUBJ of *doubt* is both REALIZED and a UDF in (29) and the CAE constraint is violated. As mentioned

briefly in footnote 3, the version of (29) without *that* is independently ungrammatical in standard English dialects. However, the account makes the specific prediction that (29) could be ungrammatical in a language even if the version of (29) without *that* is grammatical.

6 Previous proposals

In this section, I briefly review a number of previous proposals for capturing the CAE phenomena. There have been too many particular proposals to do them all justice. I will discuss the proposals as natural classes where possible, even though this risks obscuring differences. I will primarily focus on the empirical issues of whether the proposals capture the data (basic CAE effects, the Adverb Effect, the Relative Clause Paradox, and variation).⁵

6.1 An alternative proposal based on the syntax–phonology interface

Kandybowicz (2006, 2009) provides a theory of CAE based on PF,⁶ which constitutes the syntax–phonology interface in the Minimalist Program (MP; Chomsky 1995). There are other PF-based approaches to the phenomena, but I will only discuss Kandybowicz’s proposals; see Kandybowicz (2009:329) for further citations. Kandybowicz (2009:328–329) also briefly reviews several non-PF-based Minimalist accounts. Based on my understanding of some of the non-PF MP accounts (Pesetsky and Torrego 2001, Ishii 2004) and on Kandybowicz’s review of the others, they cannot account for the Relative Clause Paradox (without positing multiple *thats*) or cross-linguistic and dialectal variation in CAE effects (as stressed by Kandybowicz himself), including lexical variation.

Although Kandybowicz’s proposal assumes the Minimalist framework, the underlying intuition of his account and the present account is shared: CAE effects ought to be captured at the syntax–phonology interface. Kandybowicz (2006) presents a theory of CAE in light of a careful consideration of prosodic data from English and Nupe. Kandybowicz (2009) further elaborates the account of Nupe. Unfortunately, the analysis of CAE in Nupe is insufficiently formalized in Kandybowicz (2006, 2009:334–339) to allow ready comparison with the CAE constraint. However, it seems that the proposal accounts for not only basic CAE effects, but also the Adverb Effect and the Relative Clause Paradox. It seems that the proposal would have trouble with lexical variation, as it offers a structural account based on properties of C^0 .

Kandybowicz (2006:223) proposes the following for English:

- (30) $\ast\langle C^0, t \rangle$ iff: i. C^0 & t are adjacent within a prosodic phrase AND
ii. C^0 is aligned with a prosodic phrase boundary

This raises theory-internal questions if PF in MP is to be understood as follows:

Consider a representation π at PF. PF is a representation in universal phonetics, with no indication of syntactic elements or relations among them (X-bar structure, binding, government, etc.). To be interpreted by the performance systems A-P [Articulatory-Perceptual – AA], π must be constituted entirely of *legitimate PF objects*, that is, elements that have a uniform, language-independent interpretation at the interface. (Chomsky 1995:194; emphasis in original)

It would seem that trace (or unpronounced parts of copy chains) should not constitute “legitimate PF objects”, so it is unclear how (30) could even be stated as a PF constraint. However, PF is generally construed as a syntactic level, despite Chomsky’s original conception (Jason Merchant, p.c.). But then this raises the question of why a syntactic level contains prosodic phrases. The tension remains.

⁵I reject any contention that a theory can explain a phenomenon if its grammatical models cannot generate the correct pattern of data.

⁶PF stands for either Phonetic Form or Phonological Form, depending on the author (e.g., Chomsky 1995, Merchant 2001).

6.2 Alternative constraint-based proposals

There have been numerous previous constraint-based analyses of CAE. Some of these analyses — such as Gazdar (1981), Pollard and Sag (1994) and Ginzburg and Sag (2000) — capture CAE, but do not capture the Adverb Effect and only capture the Relative Clause Paradox by postulating both a complementizer *that* and a relativizer *that*. I focus on two recent accounts that capture a broader range of data: the HPSG account of Levine and Hukari (2006) and the LFG account of Falk (2006).

6.2.1 The Intervention Constraint

Levine and Hukari (2006:99) propose the following constraint in their explanation of CAE:

(31) Intervention Constraint

No complementizer may immediately precede the finite head of the clause marked by that complementizer.

Levine and Hukari point out that their Intervention Constraint is operational even where there is no subject extraction, unlike accounts of CAE that rely on somehow banning a Comp-trace sequence, where the trace in question is that of subject extraction. The Intervention Constraint is similar to the CAE constraint that I proposed above, in that both involve precedence. It should be clear that, in order to capture the Intervention Constraint formally, some precedence-based device like the precedence metavariable that I introduced is still necessary.

In support of their account, Levine and Hukari (2006:100) note the following contrast (the parenthetical remark after the second example appears in the original):

- (32) a. *I wonder if could you move your car from in front of my driveway?
b. I wonder if at one point could you move your car from in front of my driveway?
(with no comma intonation after *point*)

In (32a), there is no subject extraction, but the sentence is nonetheless ungrammatical. In (32b), we apparently see the ameliorating Adverb Effect, even in the absence of subject extraction. The Intervention Constraint accounts for this contrast.

However, the ungrammaticality of (32a) is also explained straightforwardly by the fact that verbs like *wonder* never embed a direct question:

- (33) *Kim wondered if did Sandy snicker?
(34) *Robin pondered whether should Kim care?
(35) *I doubt if could you be quiet?

The issue then becomes explaining the grammaticality of (32b) for those speakers who perceive it as such.

Some light is cast on the issue by considering whether the verb in question supports a parenthetical usage with a direct question. *Wonder* is such a verb, whereas *doubt* is not:

- (36) a. Could you be quiet, I wonder?
b. I wonder: could you be quiet?
(37) a. *Could you be quiet, I doubt?
b. *I doubt: could you be quiet?

The amelioration effect in (32b) is completely absent with *doubt*:

- (38) a. *I doubt if could you be quiet.
b. *I doubt if, even with strong incentives, could you be quiet.

The parenthetical *even with strong incentives* is perfectly fine with *doubt* when its complement is not a direct question:

- (39) a. I doubt if you could be quiet.
 b. I doubt if, even with strong incentives, you could be quiet.

If the Intervention Constraint in (31) is correct, the contrast between (38b) and (32b) is mysterious, particularly in light of the other data adduced in this section.

A further empirical inadequacy of the Intervention Constraint is that it does not resolve the Relative Clause Paradox, since the complementizer equally immediately precedes the finite head in an example like (7), repeated here:

- (40) This is the person that sneezed.

The Intervention Constraint wrongly predicts these cases to be ungrammatical, unless the problematic assumption is made that the *that* in a relative clause is not the complementizer.

In sum, the Intervention Constraint analysis does not account for the full range of facts and the constraint itself arguably rests on a misanalysis of the facts in (32). The adverbial in (32b) is not ameliorating a complementizer–head adjacency, but rather supporting a parenthetical parse of *I wonder if*, which is otherwise impossible, since the normal parenthetical use of *wonder* does not take a complementizer. This effect still requires explanation, and such an explanation may shed further light on the Adverb Effect in CAE, but there is reason to doubt that the data in (32) should be conflated with the CAE data.

6.2.2 The PIVOT Immediate Dominance Constraint

Falk (2000, 2001, 2006) provides an account of CAE in light of his more general theory of *pivots*, which introduces a new grammatical function PIV, such that “The PIV is the element with the function of connecting its clause to other clauses in the sentence” (Falk 2006:74). Informally, his account of CAE is that the complementizers that show CAE effects contain a lexical constraint that states that “The clause [introduced by the complementizer – AA] has its own PIV” (Falk 2006:132). This constraint is formalized as follows (Falk 2006:133):

$$(41) \phi^{-1}(\uparrow \text{PIV}) \Rightarrow \uparrow \rightarrow_f (\uparrow \text{PIV})$$

This constraint depends on a definition of the relation \rightarrow_f , which is functional immediate dominance (f-ID, on analogy to f-precedence):

- (42) **Functional immediate dominance (f-ID)** (Falk 2006:133, (49))
 For any f-structures f_1 and f_2 , f_1 f-IDs f_2 ($f_1 \rightarrow_f f_2$) iff there exists a node n_1 in $\phi^{-1}(f_1)$ and a node n_2 in $\phi^{-1}(f_2)$ such that n_1 immediately dominates n_2 .

Let us call constraint (41) the PIVOT Immediate Dominance (PID) constraint. The constraint is intended to have the consequence that “If $\phi^{-1}(\uparrow \text{PIV})$ exists, one of the nodes in $\phi^{-1}(\uparrow)$ must immediately dominate on the nodes in $\phi^{-1}(\uparrow \text{PIV})$ ” (Falk 2006:132, (48)). Falk (2006:133) shows that, in a basic CAE example, the constraint is not satisfied because there is no node in the c-structure correspondent of the complementizer’s f-structure that immediately dominates the extracted subject (since he also assumes that there is no subject trace in c-structure).

The PID constraint is similar to the CAE constraint. This is more obvious if the left side of (41) is restated as $\phi^{-1}(\uparrow \text{PIV}) \neq \emptyset$, which is just $\text{REALIZED}(\uparrow \text{PIV})$.⁷ The constraint thus not only accounts for basic CAE effects, but also accounts for the Relative Clause Paradox (and Embedded VP Topics), as discussed by Falk himself (Falk 2006:134). It is also a lexical constraint, so it can account for variation (Falk 2006:130–134).

⁷This amendment is necessary, because $\phi^{-1}(\uparrow \text{PIV})$ on its own does not have the intended effect of checking for the existence of a c-structure correspondent, since ϕ^{-1} always returns a set, even when the set is the empty set.

However, the constraint cannot account for the Adverb Effect, because it is stated in terms of \uparrow and, as we have seen, a constraint stated in terms of \uparrow fails to capture the Adverb Effect, since interpolation of an adverbial does not affect the relation between the complementizer's f-structure and the f-structure of its other grammatical functions (whether SUBJ or PIV). In other words, the PID constraint ignores the evidence that CAE is a precedence-based phenomenon, not a dominance-based phenomenon. The PID constraint and the CAE constraint could easily be reconciled if SUBJ in the CAE constraint is replaced by PIV. Lastly, the relation of f-ID is potentially computationally exacting, like f-precedence, since f-ID requires comparison of two sets of c-structure nodes.⁸

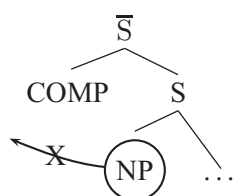
6.3 Other proposals

6.3.1 The Fixed Subject Constraint and the Complementizer Constraint on Variables

Bresnan (1972) generalizes a previous proposal by Ross (1967) such that nothing can be extracted in the environment [COMP _ VP]. This is the Fixed Subject Constraint:

(43) **Fixed Subject Constraint (FSC)**

No NP can be crossed over an adjacent COMP



The FSC accounts for basic CAE effects and also accounts for the Adverb Effect (an interpolated adverbial disrupts adjacency), but does not predict the Relative Clause Paradox, since the banned configuration obtains in relative clauses. This latter problem was one of the motivations for the subsequent generalization of the FSC to the Complementizer Constraint on Variables (CCV) (Bresnan 1977:173), which accounts for the Relative Clause Paradox, without losing the FSC's account of CAE effects or the Adverb Effect. Despite the success of the CCV in accounting for much of the CAE phenomena, it relies on theoretical notions, such as conditions on transformations and structural descriptions, that are no longer part of even transformational theory and are obviously not part of constraint-based theories such as LFG.

6.3.2 The *that-t* filter

Chomsky and Lasnik (1977) propose the *surface filter* in (44) to capture CAE. Surface filters restrict the transformational component of a transformational grammar by marking as ungrammatical a subset of the set of outputs of the component.

(44) * $[_S \text{ that } [_{NP} e] \dots]$, unless \bar{S} or its trace is in the context $[_{NP} NP \dots]$

The term *that-t* filter is still commonly used as a descriptive term, even though the filter itself is no longer adopted.

The filter does capture the Adverb Effect, because it is stated in terms of adjacency, not structural superiority. It also captures the Relative Clause Paradox, but only by directly stipulating relative clauses as an exception to the filter (the “unless” clause). The filter does not capture variation; even if it is generalized to the category C, it would still be a structural constraint that is incapable of capturing lexical variation.

Chomsky and Lasnik (1977) build on work by Perlmutter (1968), who first observed CAE effects. Perlmutter (1968) postulated a universal to the effect that the constraint that blocks CAE (e.g., a filter

⁸Functional ID should be simpler than f-precedence, however, since it is performing an existential check on the first set, not a universal one.

like the one in (44)) is valid for all and only languages that lack Subject Pronoun Deletion (pro-drop). Chomsky and Lasnik (1977) design their filter to entail Perlmutter’s universal. However, the universal is not true; for example, CAE effects do not hold in dialects of English and in certain Scandinavian dialects (Lohndal 2009), even though the dialects in question do not allow subject deletion in the intended sense of Romance pro-drop. Since the *that-t* filter entails a false claim, it cannot be correct.

6.3.3 The Empty Category Principle

There are many accounts of CAE that ultimately attempt to relate it to the Empty Category Principle (ECP). The ECP can be defined as follows, based on Chomsky (1981:274) and Chomsky (1986:88):

(45) **Empty Category Principle (ECP):** Traces must be properly governed

The essential insight common to ECP approaches is that the complementizer blocks proper government of a trace in CAE (Chomsky 1981, Kayne 1981, Pesetsky 1982, Rizzi 1990, among others). Culicover (1993) argues convincingly that the Adverb Effect data is fundamentally incompatible with ECP approaches. The reason is plain: if the complementizer blocks proper government, adjunction of an adverbial cannot undo this. Furthermore, if the complementizer blocks proper government in CAE, it must equally do so in relative clauses, unless the relativizer *that* is a distinct item. ECP approaches thus resolve the Relative Clause Paradox only at the expense of an otherwise unmotivated and empirically problematic ambiguity. Lastly, structural accounts such as these ECP accounts cannot explain the apparent lexical variation displayed in CAE effects.

6.3.4 CP expansion and CP contraction

Browning (1996) and Rizzi (1997) both propose analyses of CAE in which the explanatory mechanism involves an expansion of the CP structure, in some manner. Browning (1996:241ff.) proposes that the Adverb Effect obtains because the adverbial is in SpecCP, which forces ‘CP Recursion’, i.e. creation of another CP layer. Consider example (46) from Browning (1996:241). Due to the adverbial in SpecCP, the complementizer must move, targeting its own CP. The relative operator subsequently moves through the SpecCP created by movement of the complementizer, yielding (47):

(46) Robin met the man that Leslie said that for all intents and purposes was the mayor of the city.

(47) $OP_i \dots [_{CP} t'_i [_{C'} that_c [_{CP} \text{for all intents and purposes } [_{C'} t_{c/i} [_{IP} t_i \text{ was the mayor } \dots]]]]]$

There are severe problems with this proposal. First, it is crucial that the adverb in question be in SpecCP, but this is problematic from a theory-internal perspective, because that position is an operator position and is not appropriate for adverbials. Browning states that she argues for this position (Browning 1996:241), but she seems to just assume it. Second, it is crucial that the complementizer not have an index (hence the subscripted *c*), but it is also crucial that the trace of the complementizer govern the subject trace. This is contradictory. Furthermore, in other cases it seems that the complementizer should have a (real) index according to the assumptions of the theory in question (Sobin 2002). Third, it is not clear why the complementizer must move rather than the structure just being ruled out. The theory provides no a priori baseline for this and therefore risks making no predictions regarding grammaticality. Lastly, the theory does not account for the Relative Clause Paradox, unless an additional relativizing *that* is assumed.

Rizzi (1997) presents a different sort of expanded CP analysis in which CP is split into two obligatory projections of Force and Finiteness, with intervening optional Topic and Focus projections: ForceP > (TopicP) > (FocusP) > (TopicP) > FinP. The complementizer *that* occupies Force⁰ and a null counterpart occupies Fin⁰. Sobin (2002:534–535) raises a number of theory-internal problems for Rizzi’s proposal, the most pernicious of which is how to ensure that the overt and covert complementizers interact properly. Rizzi himself acknowledges a variant of this problem and proposes that an economy constraint (“Avoid structure”) is at play (Rizzi 1997:314). Nevertheless, empirical problems remain,

because the analysis seems not to capture the Relative Clause Paradox and cannot adequately account for variation (see also Sobin 2002:534–536).

Sobin (1987, 2002) builds on work by Pesetsky (1982) to instead argue for an analysis that contracts CP in relevant cases, rather than expanding it. Sobin (2002) proposes an operation called Fuse, following a proposal by Carnie (2000), which is an update of his previous notion of Fusion (Sobin 1987). The basic idea is that, under certain conditions, the specifier and head elements of CP can collapse into a single indexed head, i.e. SpecCP and C Fuse. The adverbial in an Adverb Effect example Fuses with the complementizer through adjunction: the adverbial first adjoins to C and then C and the phrase Fuse to create a new C.

There are a number of problems with Sobin’s analysis. First, as already noted, it requires adjunction of a phrase to a head and subsequent treatment of the head-phrase adjunction structure as a head. This is poorly motivated and also risks undermining fundamental aspects of the theory of phrase structure. Second, in order to properly account for the Adverb Effect and to resolve the Relative Clause Paradox, Sobin (2002) must postulate two distinct variants of Fuse, one for chain heads and one for traces. Third, the two variants of Fuse entail two variants of *that*. Fourth, Sobin (2002:546) is compelled to postulate that the relative *that* is a kind of subject place holder bound by the modified nominal, but *that* cannot in general perform this function, even as a deictic pronoun. Contrast the putative binding of *that* by *nobody* in the grammatical relative clause example (48) with the ungrammatical examples in (49).

(48) There is nobody_i that_i believes the claim. (binding postulated in Sobin 2002)

- (49) a. Nobody_i said that he_i/*that_i believes the claim.
b. Nobody_i is such that he_i/*that_i believes the claim.

Fifth, it is necessary in Sobin’s theory that an element with the feature [+WH] be allowed to Fuse with an element with the feature [–WH]. Why should this be possible? Sixth, in order for the Adverb Effect to be captured by Fuse, it is necessary to assume that the C created by adjunction of the adverbial to the complementizer *that* counts as null. Why should addition of overt structure to an overt element make the element null? Furthermore, he requires that the structure created by the Fuse of the adverbial with the complementizer have a lexical category, C, but that the syntax not treat it as a lexical item. This means that the syntax must be somehow sensitive to the distinction between unfused heads and fused heads. How is the distinction drawn in the syntax?

7 Conclusions and Future Work

The CAE constraint is a simple constraint that captures a wide variety of data, including basic CAE effects, the Adverb Effect, the Relative Clause Paradox, and Embedded VP Topics. The constraint makes no reference to a representational device such as a trace that marks the position of the subject extraction, thus maintaining LFG’s traceless theory of unbounded dependencies (Kaplan and Zaenen 1989). The intuition behind the constraint is that CAE is a constraint at the syntax–phonology interface, where linear precedence is a native relation, an idea that is shared by Kandybowicz (2006, 2009), although under quite different theoretical assumptions. The constraint is stated in terms of the \succ metavariable, which identifies the next word’s f-structure. The metavariable is stated in terms of the π mapping from the phonologically parsed string to c-structure in LFG’s Correspondence Architecture. Several alternatives to this approach were reviewed and were shown to have empirical and theoretical inadequacies. Nevertheless, three approaches were identified as close cousins of this one: the PF proposal of Kandybowicz and the constraint-based proposals of Levine and Hukari and of Falk.

A number of avenues for future work suggest themselves. It would be interesting to connect the notion of linear adjacency developed here with other LFG proposals concerning the syntax–phonology interface and string parsing, such as Butt and King (1998) and Bögel et al. (2009). This would also allow more of the insights of Kandybowicz (2006, 2009) to be captured. It is also important to consider the nature of the π function in light of the theory of Lexical Sharing (Wescoat 2002, 2005, 2007, 2009);

the notions developed here and Lexical Sharing are not necessarily antithetical, but the π function would likely have a more complex analysis.

The kind of adjacency effect observed in CAE is reminiscent of Zwicky’s “shape conditions” (Zwicky 1985, 1986, Pullum and Zwicky 1988), which have been appealed to in previous constraint-based analyses of phenomena such as the *an/a* alternation in English, French liaison and Welsh mutation (Asudeh and Klein 2002, Tseng 2003). The *an/a* alternation is a simple illustration: the form *an* is conditioned by an immediately following vowel-initial word, no matter the structural relation between the article and the following word (e.g., *an orange/a plum*, *an/*a ugly plum*, *an/*a unbelievably nice plum*). Another apparently adjacency-based phenomenon is Welsh syntactic soft mutation (see Tallerman 2009 and references therein), in which a complement α to a head bears soft mutation if a phrase that c-commands α immediately precedes α (i.e., separates the head and the complement; Borsley 1999). The Welsh case is especially compelling, because a trace of extraction counts as a trigger for soft mutation. This constitutes an important challenge to a traceless theory of unbounded dependencies and one that could potentially be met using the metavariable introduced here.

Appendix: Inadequacy of f-precedence

An objection to the \succ metavariable may be that LFG already has the precedence relation of f-precedence (Bresnan 1984) and that, all else being equal, I should not introduce a new mechanism. All else is not equal: there are theoretical and empirical inadequacies with f-precedence compared to the relation that I propose. On the theoretical side, the constraint that I formalize below concerns a very local notion of precedence between two string elements. In contrast, in order to calculate f-precedence a potentially large number of c-structure nodes must be considered. In other words, f-precedence is a computationally inefficient operation; this is presumably partly why it is not implemented in the standard implementation of LFG, the Xerox Linguistic Environment (Crouch et al. 2009), which instead implements a more limited variant (“head precedence”).

Let us consider two alternative definitions of f-precedence (Dalrymple 2001:172–174).⁹

(50) **F-precedence (strong)**

F-structure f f-precedes f-structure g ($f <_{f_{\forall\forall}} g$) if and only if for all $n_1 \in \phi^{-1}(f)$ and for all $n_2 \in \phi^{-1}(g)$, n_1 c-precedes n_2 .

(51) **F-precedence (weak)**

F-structure f f-precedes f-structure g ($f <_{f_{\forall\exists}} g$) if and only if for all $n_1 \in \phi^{-1}(f)$ and for some $n_2 \in \phi^{-1}(g)$, n_1 c-precedes n_2 .

(52) **C-precedence**¹⁰

(Dalrymple 2001:172)

A c-structure node n_1 c-precedes a node n_2 if and only if n_1 does not dominate n_2 , n_2 does not dominate n_1 , and all nodes that n_1 dominates precede all nodes that n_2 dominates.

Strong f-precedence is the relation introduced by Bresnan (1984) in unpublished work and defined in Kaplan (1987) and taken up by Kameyama (1985, 1989) and Zaenen and Kaplan (1995). Weak f-precedence is the relation discussed in Bresnan (1994, 1995, 2001) in different terms, which are almost, but not entirely, equivalent; although it is somewhat tangential, this is a theoretically interesting point and I return to it at the end of this appendix.

In addition to two notions of f-precedence, we need to consider a positive constraint to the effect that the complementizer’s f-structure must f-precede that of the subject of the complementizer’s clause and a negative constraint that states that the subject of the complementizer’s clause cannot f-precede

⁹ The second definition of f-precedence is not the definition from Bresnan (1995:249), which has the extra clause that $\phi^{-1}(f)$ and $\phi^{-1}(g)$ must be nonempty. The nonempty clause entails that a null pronominal does not f-precede anything and is not f-preceded by anything.

¹⁰ This definition makes the standard assumption that dominance is reflexive (Partee et al. 1990:440), which allows it to properly cover terminal nodes.

the complementizer's f-structure. This yields four constraints that could be part of a complementizer's lexical entry, where f is the f-structure of the complementizer:

$$(53) f <_{f_{VV}} (f \text{ SUBJ})$$

$$(54) f <_{f_{V\exists}} (f \text{ SUBJ})$$

$$(55) (f \text{ SUBJ}) \not<_{f_{VV}} f$$

$$(56) (f \text{ SUBJ}) \not<_{f_{V\exists}} f$$

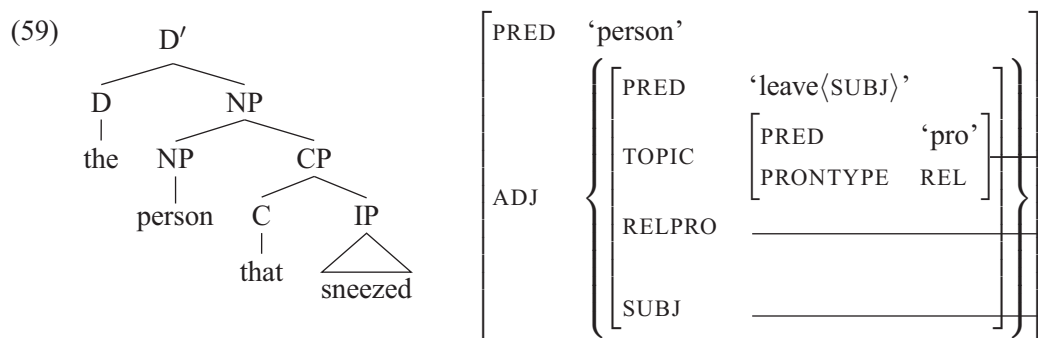
On the standard assumption that C is an f-structure co-head (Bresnan 2001, Toivonen 2003), the two positive constraints are out, because even in examples with no extraction, both constraints are false:

(57) Kim said that Sandy left.

That and *left* correspond to the same f-structure. It is not the case that all c-structure nodes that map to the complementizer's f-structure precede all nodes that map to the subject's f-structure (constraint 53 is false) and it is not the case that all c-structure nodes that map to the complementizer's f-structure precede some c-structure node that maps to the subject's f-structure, because *left* does not precede *Sandy* (constraint 54 is false).¹¹

Next consider constraint (55), which is stated with strong f-precedence. This constraint captures basic CAE effects, because in that circumstance all of the c-structure correspondent of the subject f-precedes all of the c-structure correspondent of the complementizer's f-structure; the constraint is thus violated and correctly blocks CAE. However, the constraint does not fare well on the Adverb Effect or Relative Clause Paradox. With respect to the Adverb Effect, insertion of the adverbial does not affect the f-precedence relation between the subject and the complementizer's f-structure, so the constraint is equally violated when an adverbial occurs after the complementizer and the subject is extracted; the adverbial examples are not generated. In order to appreciate the behaviour of the constraint with respect to the Relative Clause Paradox, it is useful to see the standard LFG analysis of a relevant relative clause example (Dalrymple 2001):¹²

(58) the person that sneezed



The subject is identified with a relative pronoun at f-structure, but the relative pronoun has no c-structure correspondent; it is a null pronoun. Any null element both vacuously strongly f-precedes and is vacuously strongly f-preceded by anything else in the f-structure (Kameyama 1989, Dalrymple 2001). Therefore, by virtue of being equal to the null pronoun, the subject vacuously f-precedes the complementizer's f-structure. The constraint is thus equally violated in the relevant relative clause and there is undergeneration again, this time of a very basic phrase, (58).

¹¹Furthermore, any complementizer maps to the same f-structure as C' , which dominates the c-structure correspondents of the subject and any other grammatical functions in the f-structure of the clause that the complementizer introduces. This means that C' does not c-precede the c-structure correspondents of the grammatical functions inside it, so the complementizer in fact f-precedes none of the grammatical functions in the f-structure that it introduces.

¹²I assume a DP analysis of the nominal with the relative clause NP adjoining to an NP; this preserves the theory of adjunction in Toivonen (2001, 2003), but is not a crucial feature of the analysis.

Lastly, consider constraint (56), which is analogous to constraint (55), but stated with weak f-precedence. Just like constraint (55), constraint (56) captures basic CAE effects, again because the c-structure correspondent of the subject f-precedes all of the c-structure correspondent of the complementizer’s f-structure; the constraint is thus violated. The constraint is also the same as constraint (55) with respect to the Adverb Effect and the Relative Clause Paradox. Again, the adverbial does not affect the f-precedence relation between the subject and the complementizer’s f-structure, so the constraint is still violated when an adverbial occurs after the complementizer. The result for constraint (56) is also the same as constraint (55) for the Relative Clause Paradox. Again, assuming the standard treatment of relative clauses in (59), the subject of the complementizer’s f-structure weakly f-precedes the complementizer’s f-structure because it is vacuously true that all of the subject’s c-structure correspondent (it has none) precedes some (in fact, all) of the complementizer’s f-structure’s c-structure correspondent. Again, the constraint is violated by even a simple relative clause example like (58).

The alternative f-precedence relation to strong f-precedence is typically given a different formulation than the one given in (51), which I have called weak f-precedence. The standard alternative to strong f-precedence, as discussed in Dalrymple (2001:171–174), is:

(60) **F-precedence (edge-based)**

F-structure f f-precedes f-structure g ($f <_{f_{RR}} g$) if and only if for the rightmost $n_1 \in \phi^{-1}(f)$ and for the rightmost $n_2 \in \phi^{-1}(g)$, n_1 c-precedes n_2 .

Edge-based f-precedence cannot be satisfied by null pronominals, because no null pronominal has a rightmost node in its c-structure correspondent.

The Relative Clause Paradox therefore constitutes a case in which weak f-precedence and edge-based f-precedence make different predictions. Constraint (56) is violated by relative clauses such as (58), as outlined above, but the equivalent constraint with edge-based f-precedence would not be violated by (58), because the null pronominal subject in fact does not f-precede the complementizer’s f-structure, since the null pronominal has no rightmost node in c-structure. Edge-based f-precedence thus captures the Relative Clause Paradox and basic CAE effects, but not the Adverb Effect.¹³

Table 1 provides a general overview of some differences between alternative f-precedence relations. A and B are f-structures. The symbol \emptyset represents an f-structure with no c-structure correspondent; i.e. a c-structurally unrealized grammatical function. $A_1 \dots A_2$ represents an f-structure that is mapped from disjoint parts of c-structure; i.e. what Bresnan (1995) calls a “scattered constituent”. The first two columns correspond to the situation of a null pronominal preceding its binder or vice versa, as discussed in Bresnan (2001:193–195) and Dalrymple (2001:173–174, 288–289). The second two columns correspond to the situation of weak crossover with respect to a realized or null pronominal, as discussed with respect to the linear order condition on operator binding by Bresnan (1994, 1995, 2001).

	$\emptyset \dots A$	$A \dots \emptyset$	$A_1 \dots B \dots A_2$	$A_1 \dots \emptyset \dots A_2$
Strong f-precedence ($<_{f_{VV}}$)	$\emptyset <_{f_{VV}} A$	$A <_{f_{VV}} \emptyset$	$A_1 \not<_{f_{VV}} B$ $B \not<_{f_{VV}} A_2$	$A_1 <_{f_{VV}} \emptyset$ $\emptyset <_{f_{VV}} A_2$
Weak f-precedence ($<_{f_{V\exists}}$)	$\emptyset <_{f_{V\exists}} A$	$A \not<_{f_{VV}} \emptyset$	$A_1 \not<_{f_{V\exists}} B$ $B <_{f_{V\exists}} A_2$	$A_1 \not<_{f_{V\exists}} \emptyset$ $\emptyset <_{f_{V\exists}} A_2$
Edge-based f-precedence ($<_{f_{RR}}$)	$\emptyset \not<_{f_{RR}} A$	$A \not<_{f_{RR}} \emptyset$	$A_1 \not<_{f_{RR}} B$ $B <_{f_{RR}} A_2$	$A_1 \not<_{f_{RR}} \emptyset$ $\emptyset \not<_{f_{RR}} A_2$

Table 1: Alternative definitions of f-precedence and some outcomes for unrealized grammatical functions and scattered constituents

¹³The initial version of f-precedence in Bresnan (1995:249), which is subsequently revised to edge-based f-precedence (Bresnan 1995:250), would have the same result, because of the clause that $\phi^{-1}(f)$ and $\phi^{-1}(g)$ must be nonempty; see footnote 9.

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