

A THEORY OF STRUCTURE-SHARING:
FOCUSING ON LONG-DISTANCE
DEPENDENCIES AND PARASITIC GAPS

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1 Introduction

As is common practice in LFG, the term *Long-Distance Dependencies* (LDD, for short) refers to those constructions that in other frameworks are referred to as unbounded dependencies, filler-gap dependencies, wh-movement, A'-movement, A' dependencies, etc. In LFG, LDD are characterized by the presence of a structure-sharing relation in the f-structure, in which a within-clause grammatical function (GF) such as a subject or an object has the same f-structure as its value as an information-structure GF. Standard treatments of LDD in LFG currently assume that this structure-sharing relation is licensed by a control equation, specifically, a functional uncertainty control equation, as in Kaplan and Zaenen (1987). So far, all theories assuming such treatments have failed to give an account of *multiple gap* (or *parasitic gap*) constructions, constructions in which two different within-clause GFs share their value with the same information-structure GF (in other words, constructions in which a single filler corresponds to two different gaps).

One of the goals of this paper is to propose a theory of LDD that successfully accounts for multiple gap constructions, allowing LDD to involve multiple gaps, while excluding ungrammatical instances of those constructions. Another of the goals of this paper is to integrate the treatment of LDD with that of raising as part of a larger theory of structure-sharing. Both LDD and raising are assumed to involve structure-sharing in their f-structure representation in all current versions of LFG. By extracting what these two classes of constructions have in common, this paper proposes a set of constraints—the theory of structure-sharing—accounting for the facts of both LDD and raising. Thus, a simpler and more general theory is achieved.

An assumption that plays an important role in the present theory is the idea that there is a class of GFs that groups the subject with the information-structure GF involved in LDD (from Bresnan 2001). The constraints on structure-sharing make crucial appeal to this class of GFs. Another important assumption that is implied by this theory is the claim that there are no functional control equations (equations expressing the functional identity of two different GFs), whether these are the control equations involved in raising constructions or the functional uncertainty equations posited in other theories for LDD. The well-formedness constraints that make up the theory of structure-sharing define which structure-sharing relations are possible and which are not. A consequence of dispensing with control equations is that we also have to give up the idea that all information in the f-structure is encoded as functional annotations: at least some f-structure information is. This naturally leads to the idea that no f-structure information is encoded by

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means of annotations: instead, we have well-formedness constraints, including constraints on the mapping between structures, which rule out ill-formed c- and f-structures and ill-formed pairings of these two structures.

Section 2 outlines the proposed approach to LDD. Section 3 presents the main constraint of the theory of structure-sharing and illustrates some of its effects. Section 4 provides evidence for one of its most significant claims: that there is no structure-sharing between a filler and a subject in the same clause. The locality and binding conditions complete the theory in section 5.

2 What drives LDD?

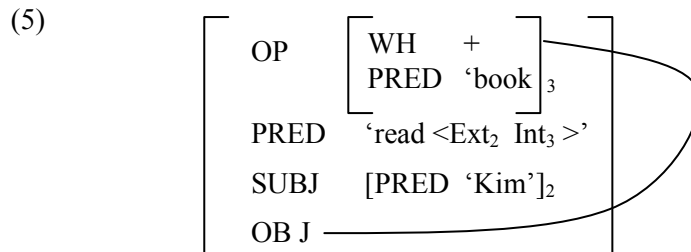
LDD arise in various types of constructions including interrogative clauses, as in examples (1)–(2), relative clauses, as in (3), and topicalizations, as in (4). The commonly accepted assumption is that a dependency is created between the clause-initial constituent, shown in *Italics*, in such examples, and a GF in either the same clause or a clause embedded in it. The latter GF is represented in these examples and subsequent ones by means of a dash in the position that this GF would occupy (in an unmarked order of constituents) were it not identified with the *Italicized* clause-initial constituent. This dash should not be taken to have any theoretical correlate as a null constituent, empty category, or trace, since the present theory assumes no such categories, following much work within LFG (such as Kaplan and Zaenen 1987, Alsina 1996, Dalrymple 2001, Dalrymple, Kaplan, and King 2007, among others) and within HPSG (Pollard and Sag 1994, Sag 1997, among others).

- (1) *Which book* did Kim read ___?
- (2) *Which book* did Kim suggest that I should read ___?
- (3) This is the book *which* Kim asked you to read ___.
- (4) *That book*, Kim should not talk about ___.

Following standard practice in LFG, LDD are represented at f-structure as structure-sharing of an information-structural function and a within-clause function (such as SUBJ, OBJ, OBL) in either the same or a subordinate f-structure. In most existing versions of LFG, there are two information-structural functions: TOPIC and FOCUS, and both are used in LDD. However, since the distinction between these two GFs has to do with information packaging, it seems more appropriate to make this distinction at the level of information-structure and have a single GF at the level of f-structure that correlates with the information-structural notions of topic and focus. Therefore, in what follows, instead of TOPIC and FOCUS, we will use a single GF: OP(ERATOR). Having one theoretical construct instead of two is a simplification of the formal framework and, therefore, a desirable goal.¹

¹ If the distinction standardly made between TOPIC and FOCUS should be shown to be of a syntactic nature (not only of an information-structure nature), it could be

As an example of an f-structure of a clause involving LDD, the f-structure of example (1) is given in (5) (omitting irrelevant information):



This structure shows that the OP and the OBJ of the clause are structure-shared: they have the same f-structure as their value. Coindexing signals correspondence between elements at different levels of structure: In this case, it signals correspondence between arguments in the argument-structure and GFs (e.g., the external argument corresponds to the subject). The OP and the structure-shared within-clause GF need not be in the same clause, as shown by examples like (2) and (3), where the within-clause GF is in a clause embedded in the clause where the OP is. In fact, the distance in terms of embeddedness between the two GFs is unlimited (hence the term “long-distance dependencies” used even when the two GFs are in the same clause).

A question that needs to be addressed is what requires this link, or structure-sharing relation, to arise between two GFs. The principle that requires an OP to link to a within-clause GF is the Extended Coherence Condition, posited by Zaenen (1980) and assumed by many researchers within LFG, including Fassi Fehri (1988), Bresnan and Mchombo (1987), Bresnan (2001), Dalrymple (2001), and Falk (2001), among others, which we can formulate as follows:²

- (6) **Extended Coherence Condition (ECC):** An OP must link to a th-role bearing GF, either through structure-sharing or anaphoric binding.

We are not concerned here with the possibility of satisfying the ECC through anaphoric binding. This is the situation that occurs with resumptive pronouns, where an OP binds a pronoun, an option that English makes little use of, but other languages use quite freely. We will only be concerned with the possibility of satisfying the ECC through structure-sharing.

The ECC requires the value of an OP to fill another GF as well, which accounts for the contrast between (1) and (7):

maintained, and the GF OP, which is used in the rest of this paper, could be taken to be a class of GFs comprising TOPIC and FOCUS.

² An alternative formulation might say that an OP must link to a within-clause GF. The crucial difference between the two formulations is that there are athematic within-clause GFs, such as expletive *there* and *it*. Since these athematic GFs cannot link to an OP, the formulation of the ECC in (6) seems preferable to this alternative.

and it is always the other GF structure-shared with the OP that is licensed as an argument or an adjunct. In raising, by definition, one of the GFs in the structure-sharing relation does not bear a thematic role in its clause: in (8), for example, the matrix subject *Kim* is not a semantic argument of *seems*; if it appears to bear a thematic role, it is because the structure-shared subject of the embedded clause is a semantic argument of *resist*. This observation holds both for raising-to-subject constructions such as (8) or examples like *Kim strikes me as lacking the necessary enthusiasm*, where the matrix subject is nonthematic, and for raising-to-object constructions like *I believe Kim to be a good candidate*, where the matrix object is nonthematic.

The second property common to structure-sharing relations is the claim that the nonthematic GF in this relation is always structurally more prominent than the other GFs involved in the relation. In raising, the nonthematic GF of the raising predicate is always in a less embedded f-structure than the other GF structure-shared with it. In (8), for example, the nonthematic GF is in the matrix clause, whereas the thematic GF structure-shared with it is in the embedded clause. The nonthematic SUBJ or OBJ of a raising predicate is structure-shared with a GF in a subordinate f-structure; never vice versa. In LDD, the thematic GF structure-shared with an OP is either in an f-structure subordinate to that in which the OP appears or, if it is in the same f-structure, is lower in the GF hierarchy than the OP. The contrast between (9) and (10) illustrates the claim that the OP cannot be in an f-structure subordinate to that in which the structure-shared thematic GF appears.

- (9) a. Which book do you think [Kim will read]?
 b. Which book do you hope [will amuse Kim]?
- (10) a. * announced [who (that) the car broke down]?
 (Who announced that the car broke down?)
 b. * Kim told [(that) she thought [who (that) Fred could go]]?⁴
 (Who did Kim tell that she thought that Fred could go?)

We can capture these two characteristic properties of structure-sharing relations—the nonthematicity and greater syntactic prominence of one of the GFs involved—as a well-formedness condition on f-structures. For this, we need to define the relevant concept of syntactic prominence, which we will call *f-prominence*. This definition combines the notions of *f-command* and the hierarchy of grammatical functions or *GF hierarchy*. The notion of f-

⁴ As noted by a reviewer, a sentence like *Kim told who that she thought that Fred could go?* is essentially ok, but that is because it can be taken to contain an in-situ *wh*-phrase and therefore is not an instance of LDD.

command, from Bresnan 1982, defined in (11), is similar to the notion of c-command, only based on f-structure, rather than on c-structure, relations.

- (11) **F-command**: GF α f-commands GF β iff the value of α does not contain β and every f-structure that contains α contains β .

Existing versions of the GF hierarchy, of which there are several in the literature, often only include within-clause functions and place the subject in the highest position and oblique functions in the lowest, with objects in an intermediate position. However, since we need to refer to the OP function in order to determine whether it is more or less prominent than other GFs, we must include the OP function in the GF hierarchy. Given the proposal in Bresnan (2001) and Falk (2001), schematized in (12), that OP and SUBJ constitute a class of GFs, called DF (Discourse Function) in Bresnan (2001), it seems logical to assume that the natural position of the OP in the GF hierarchy is together with its classmate SUBJ, as DF, at the top of the hierarchy, as in (13).⁵ And, so, we can define f-prominence as in (14).

- (12) DF (Discourse Function) = {OP, SUBJ}

- (13) **GF Hierarchy**: DF > OBJ > OBL

- (14) **F-prominence**: GF α is more f-prominent than GF β iff α f-commands β and either β does not f-command α or α is higher than β in the GF Hierarchy.

With this asymmetrical relation we can state the main principle of the theory of structure-sharing—the Nonthematic Condition on Structure-Sharing:

- (15) **Nonthematic Condition on Structure-Sharing**: In every f-structure containing structure-sharing, one of the structure-shared GFs is nonthematic and more f-prominent than any GF identified with it.

This condition gives the right results in raising constructions such as (8), where, of the two structure-shared GFs, one is nonthematic and more f-prominent than the other one. The raising function, whether a subject or an object, is nonthematic and asymmetrically f-commands the GF structure-shared with it. These properties of raising follow from condition (15) and don't have to be stipulated in the lexical entries of raising verbs, as control equations or in any other way, as argued in Alsina (to appear).⁶

⁵ Bresnan (2000:349, 356) also assumes that the information-structural GFs (TOP and FOC) occupy the highest position in the GF hierarchy, with the subject being in the second position. The present theory is an argument for placing these GFs (OP and SUBJ) in the same position in the hierarchy.

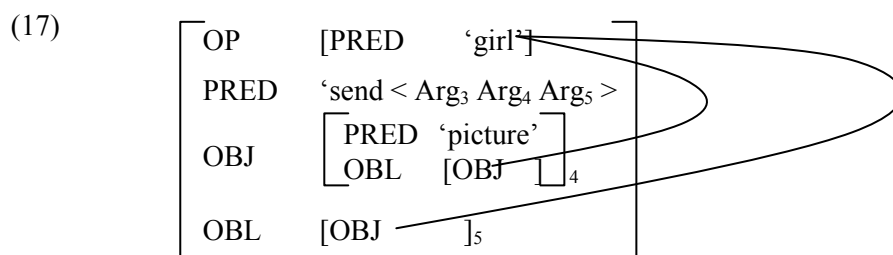
⁶ A consequence of Condition (15) is that the null subject of the complement of equi control constructions is not structure-shared with its controller, as the controller is thematic in such constructions. Here, the null subject is assumed to be a null pronominal coindexed with the controller, as argued convincingly in Pollard and Sag 1991 and assumed in much of GB/MP, HPSG (Pollard and Sag 1991, 1994), and

As for LDD, condition (15) predicts contrasts such as those illustrated in (9) vs. (10). In (9), the OP—a nonthematic GF—is more f-prominent than the other GF in the structure-sharing relation as the former asymmetrically f-commands the latter. In (10), on the other hand, the structural relation is reversed and it is the thematic GF that is more f-prominent than the OP, which is in a clause embedded in that where the thematic GF belongs. So, structures like (10) are ruled out by the nonthematic condition (15).

In addition, a theory like the present one allows structures in which a single OP is structure-shared with two thematic GFs, which we may call *multiple gap* constructions, also known as *parasitic gap* constructions. The following, from Engdahl (1983:69), are examples of this type:

- (16) a. Which articles did John file ___ without reading ___?
 b. This is the kind of food you must cook ___ before you eat ____.
 c. Which girl did you send a picture of ___ to ___?
 d. Which boy did Mary’s talking to ___ bother ___ most?

In these examples, a single filler (or OP) is structure-shared with two gaps or thematic GFs. The ECC is satisfied because the OP is linked, by structure-sharing, with a thematic GF, and the fact that it is linked with two thematic GFs is not excluded by this condition. Also, the structure-sharing relation satisfies the Nonthematic Condition (15) because a nonthematic GF—the OP—is involved in it in all cases and it is more f-prominent than all of the GFs structure-shared with it. In (16a), for example, the OP is structure-shared with the object of the same f-structure, whose predicate is *file*, and with the object of an f-structure in the adjunct introduced by *without*: it is higher in the GF hierarchy than the former structure-shared GF and asymmetrically f-commands the latter. A schematic f-structure representation of example (16c) will serve to illustrate how this sentence satisfies the two relevant conditions:



4 The same-clause OP-SUBJ ban

One of the corollaries of the Nonthematic Condition on Structure-Sharing (15) is what we may call the “same-clause OP-SUBJ ban.” Since, by (15), the

LFG (Dalrymple 2001). See Alsina (to appear) for details. Similar observations apply to the null subject of adjuncts.

nonthematic GF in a structure-sharing relation must be more f-prominent than any other GF in the relation, it follows that an OP cannot be structure-shared with a SUBJ in the same f-structure: the two GFs are equal in f-prominence, as they f-command each other and they occupy the same position in the GF hierarchy. Thus, any f-structure containing the feature structure shown in (18) is ruled out by the Nonthematic Condition (15):



A consequence of (18) is that a *wh*-phrase filling the subject of the main clause of an interrogative or relative clause is not an OP, but simply a SUBJ. In other words, there is no LDD in sentences like *Who ate the cookies?* or *I saw the girl who ate the cookies*: There is just a subject that has the appropriate features as an interrogative or relative pronoun.

This section presents some of the empirical consequences of the same-clause OP-SUBJ ban: the facts of *do*-support in matrix interrogatives, the facts of coordination of clauses with a topicalized constituent, the facts of *that*-less non-*wh* relative clauses, and the implications for multiple gaps, all of these facts from English, and the distribution of French interrogative *que*.

4.1 Do-support

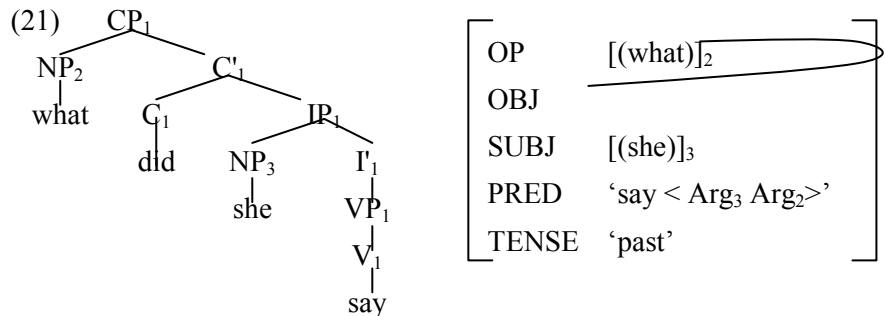
The generalization about the distribution of supportive *do* in English is that, in a direct question with a clause-initial *wh*-phrase, an auxiliary must immediately follow this phrase, except if this *wh*-phrase is the matrix subject. Auxiliary *do* appears in this context, when no other auxiliary is semantically appropriate and it makes no semantic contribution. Hence the term *do-support*. The presence of *do* in (19) compared with its absence in (20) illustrates the generalization (examples from Grimshaw 1997:383–388):

(19) What did she say? (cf. **What she said?*, **What said she?*)

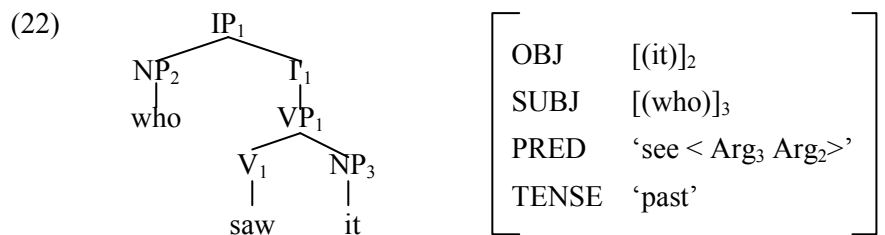
(20) Who saw it? (cf. **Who did see it?* with unstressed *did*)

In (19), the *wh*-phrase fills the object function and an auxiliary is required following it; in (20), it fills the subject of the matrix clause and no auxiliary is required. The main hypotheses that can be used to explain the distribution of *do* are the following: (a) IP and CP are the categories of tensed clauses, as assumed in much work in GB/MP and, within LFG, in Bresnan (2001), Dalrymple (2001), Falk (2001), among others; (b) In English, auxiliaries, unlike non-auxiliary verbs, can occupy the I and C positions (they belong to both categories); (c) By Economy of Expression (Bresnan 1998, 2001), c-structure nodes are used only if necessary; (d) A question phrase in Spec-CP maps onto OP, and a phrase in Spec-IP maps onto SUBJ (principles of c-to-f-structure mapping); and (e) a matrix CP has an obligatory X⁰ head.

Given these hypotheses, the c-structure and f-structure of example (19) would be as shown in (21):



The interrogative phrase *what* appears in Spec-CP and maps onto an OP; as there is a CP and it is a matrix CP, it must have an X⁰ head; auxiliary *did* satisfies this requirement. On the other hand, when the interrogative phrase fills the subject function, as in (20), it cannot be in Spec-CP, as it would then map onto an OP creating the ill-formed configuration in (18). If, however, this phrase is in Spec-IP, it does not map onto an OP, but onto a SUBJ, and no principle is violated, as in the structures in (22) corresponding to (20):



Since there is no CP in (22), as there is no Spec-CP, there is no head C either. Consequently, there is no position for auxiliary *do*. Thus, the contrast between (19) and (20) is explained in a way that crucially depends on the same-clause OP-SUBJ ban. If it weren't for this, nothing would prevent having the *wh*-phrase in (20) in Spec-CP, mapping onto an OP and being structure-shared with the SUBJ of the same clause. We would then expect supportive *do* to appear in (20), as it does in (19).

4.2 Topicalization and coordination

Topicalization is an LDD construction in which a non-*wh* phrase in clause-initial position satisfies a GF either in the clause where the topicalized phrase appears or in a clause indefinitely embedded in it, as in (23):

- (23) a. Dogs, Fred is scared of ____.
- b. Dogs, I've always known Fred is scared of ____.

Here, *dogs* is both OP, as required by the position it occupies, and the OBJ of the preposition *of*, with an unbounded distance between the two GFs. If there were no restriction against an OP being structure-shared with the SUBJ of the same f-structure, we might expect an example like (24) to have an analysis in

which *dogs* is both the OP and the SUBJ of the same clause, as an alternative to the analysis in which *dogs* is simply the SUBJ.

(24) Dogs drive me crazy.

The evidence that it is not possible to analyze *dogs* as an OP in an example like (24) comes from coordination of clauses involving topicalization. It is possible to coordinate two sentences with a shared topicalized phrase, as shown by examples like (25), but this coordination is not possible if the topicalized phrase has to fill the subject function of the main clause in one of the two conjuncts (and not in the other), as in (26).

(25) a. Dogs, Fred is scared of ___ and Kim adores ___.

b. Dogs, Fred is scared of ___ and I know ___ can be dangerous.

(26) a. *Dogs, Fred is scared of ___ and ___ drive me crazy.

b. *Dogs, ___ drive me crazy and Fred is scared of ___.

If it were possible to have an OP structure-shared with the SUBJ of the same f-structure, the examples in (26) should be fine. The ungrammaticality of (26) follows from the same-clause OP-SUBJ ban and from standard assumptions about topicalization and coordination. These assumptions are: (a) a topicalized phrase is adjoined to IP and a phrase adjoined to IP maps onto OP (see Bresnan 2001, Dalrymple 2001, among others); (b) coordinated constituents map onto a set of f-structures; and (c) a constituent that maps onto a GF in a set is a GF in each of the set's f-structures (see Bresnan, Kaplan, and Peterson 1985, Kaplan and Maxwell 1996, Dalrymple 2001, Peterson 2004, among others). It follows from these assumptions that, if a phrase like *dogs* in (25)–(26) is an OP, it is an OP in each of the f-structures of the set corresponding to the conjoined clauses. As an OP, it can be structure-shared with any GF in each f-structure, except for the subject at the top level. In (25a), the OP *dogs* is the object of an oblique in the first conjunct and the object of the verb in the second one; in (25b), it is the object of an oblique in the first conjunct and the subject of an embedded clause in the second one. In contrast, in (26), whereas it is the object of an oblique in one conjunct, it is the subject at the top level in the other conjunct, violating the OP-SUBJ ban. In (26b), if we chose to analyze the clause-initial NP as a subject, the second conjunct would be incomplete, as the required object of the oblique would be missing.

4.3 That-less non-wh relative clauses

Relative clauses in English, bracketed in (27) and subsequent examples, can be formed without any clause-initial *wh*-phrase or complementizer:

(27) a. This is the book [I read ___].

b. This is the book [I hoped ___ would sell like hot cakes].

As in all relative clauses, there is a missing or relativized GF, which is generally assumed to be structure-shared with an OP at the top level of the relative clause. However, there is one restriction in this type of relative clause: the missing or relativized GF cannot be the subject at the top level of the relative clause:

- (28) a. *This is the book [___ is selling like hot cakes].
 b. *This is the book [___ makes me laugh].

The relativized GF can be an object, as in (27a), the subject of an embedded clause, as in (27b), but not the subject of the relative clause, as shown in (28). In order to explain this fact, let us assume that a relative clause is a CP or an IP adjoined to N' (see Dalrymple 2001), that a *that*-less non-*wh* relative clause is an IP, and that an IP adjoined to N' licenses an OP in the f-structure of the IP, as expressed in the following mapping principle, where the feature [CLAUSETYPE REL] marks the structure as a relative clause:

$$(29) \quad \begin{array}{c} \text{N}' \\ \swarrow \quad \searrow \\ \text{N}' \quad \text{IP}_1 \end{array} \Rightarrow \left[\begin{array}{cc} \text{OP} & [\text{PRED 'pro'}] \\ \text{CLAUSETYPE} & \text{REL} \end{array} \right]_1$$

The OP introduced by this mapping principle has to satisfy the ECC by being in a structure-sharing relation with another GF. This structure-sharing relation has to satisfy the Nonthematic Condition (15), which means, among other things, that it cannot involve an OP and a SUBJ at the same level of structure. This explains the contrast between (27) and (28): in (28), the OP introduced by rule (29) would have to be structure-shared with the subject of the same clause, violating condition (15), whereas in (27) this condition is not violated because the OP is structure-shared with GFs other than the subject of the same f-structure.

It is worth noting that the presence of the complementizer *that* introducing the relative clauses in (28) makes the examples grammatical:

- (30) a. This is the book [that is selling like hot cakes].
 b. This is the book [that makes me laugh].

We can assume that this complementizer optionally licenses a pronominal DF in the relative clause it introduces. Since a DF is either OP or SUBJ, this means it either licenses a pronominal OP, as in (29), or a pronominal SUBJ. The latter option makes the examples in (30) grammatical.⁷

4.4 *No parasitic gap structure-shared with a higher subject*

Another consequence of the same-clause OP-SUBJ ban is that a *wh*-phrase filling a subject function cannot fill another GF in a structurally less

⁷ Alternatively, one could assume that, as well as a complementizer, *that* is a subject *wh*-phrase, as proposed in Sag (1997) and Hudson (1990).

prominent position. This is because the *wh*-phrase cannot be an OP: if it were, it would have to be structure-shared with the subject at the same level creating the ill-formed OP-SUBJ configuration. As the *wh*-phrase has to be a SUBJ, being a thematic GF it cannot be structure-shared with a less prominent GF without incurring a violation of the Nonthematic Condition (15). Relevant examples corresponding to the ill-formed structures are the following (from Engdahl 1983:84):

- (31) a. * Which articles got filed by John without him reading ___?
 b. * Who sent a picture of ___?
 c. * Which articles did you say [___ got filed by John without him reading ___]?

In (31a–b), the *wh*-phrase is the subject of the matrix clause and therefore cannot be the OP of the matrix clause as well. As a subject and a thematic argument, if it were structure-shared with a less f-prominent GF, it would violate the Nonthematic Condition (15). Therefore, the GFs signaled by a dash don't have any features and, so, result in a violation of completeness. In (31c), the *wh*-phrase is the OP of the matrix clause and the SUBJ of the embedded clause. However, as the Nonthematic Condition (15) has to be satisfied in every f-structure containing structure-sharing, it also has to be satisfied in the embedded clause, signaled by brackets in (31c), but here the structure would violate this condition as the structure-sharing relation would not involve a nonthematic GF.

The contrast between (32) and (33), from Engdahl (1983:89), follows from this condition and from the difference in structure between the two examples. In (32), the f-structure complement of *say* does not satisfy (15) because there is no nonthematic GF involved in the structure-sharing relation. In (33), on the other hand, neither of the embedded clauses contains structure-sharing and condition (15) is satisfied in the matrix f-structure.

(32) * Which caesar did Cleopatra say
 | [___ was impressed [by her singing to ___]]?
 OR [SUBJ [OBJ]]

(33) Which caesar did Brutus imply
 | [___ was senile] [by mimicking ___ in public]?
 OP [SUBJ] [OBJ]

4.5 Interrogative *que* in French

A superficial comparison between the interrogative elements *qui* and *que* in French might suggest that the difference is merely semantic: *qui* is animate

and *que* is inanimate. The following examples seem to suggest that the two elements have a similar syntactic distribution:⁸

(34) Qui / Qu' est-ce que tu as vu ____ ?
 who what is-it that you have seen
 'Who/What have you seen?'

(35) Qui / Qu' est-ce qui ____ te dérange?
 who what is-it that ____ you annoys
 'Who/What annoys you?'

In (34) and (35), both *qui* and *que* can be either the object or the subject of a verb. However, the structure of these examples is biclausal, with the OP licensed by the interrogative element being in the matrix clause and the within-clause GF structure-shared with it being in the embedded clause that follows the matrix verb *est-ce*. An alternative interrogative structure exists that does not use this dummy verb, as in the following examples. In (36), the interrogative elements fill the object function of the matrix verb, but in (37)–(38), where they fill the subject function of the matrix verb, the structure is good with *qui* and bad with *que*.

(36) Qui / Que vois-tu?
 who what see-you 'Who/What do you see?'

(37) a. *Que te dérange?
 what you annoys 'What annoys you?'

b. Qui te dérange?
 who you annoys 'Who annoys you?'

(38) a. *Qu' est tombé en terre?
 what is fallen on floor 'What fell on the floor?'

b. Qui est tombé en terre?
 who is fallen on floor 'Who fell on the floor?'

All that needs to be assumed in order to explain these facts is that interrogative *que* is required to map onto an OP. In contrast, *qui* is not restricted as to the GF that it can map onto: it is an ordinary interrogative NP, and as such it can occupy any NP position and map onto any GF that an NP can map onto. Both *qui* and *que* map onto OP in (34)–(36): as such, they can also satisfy the object or the subject function of the embedded clause, as in (34) and (35) respectively, or the object function of the same clause, in (36). The contrast in (37) and (38) follows from the claim that *que* must map onto OP, whereas *qui* is not restricted in this way: in (37b)–(38b), *qui* maps onto the subject function (not onto the OP function) and the structures satisfy all available constraints; in (37a)–(38a), *que* maps onto the OP function and

⁸ The relevance of the facts that follow to the theory of structure-sharing presented here was suggested by Anna Gazdik's talk at the LFG08 Conference.

cannot be structure-shared with the subject of the same clause because of the same-clause OP-SUBJ ban, which means that the structures lack a subject.

The ungrammaticality of (37a)–(38a) cannot follow from a restriction against *que* satisfying a subject function because *que* can satisfy a subject function, provided the subject is in a clause embedded in the clause introduced by *que*, as shown by example (35a) and by (39):

- (39) Que crois-tu qui est tombé en terre?
 what think-you that is fallen on floor
 ‘What do you think fell on the floor?’

In support of the claim that *qui* is not restricted as to the GF it can map onto, unlike interrogative *que*, note that *qui* can appear as an object of a preposition or as an *in situ* object of a verb, whereas *que* lacks this distribution: *de qui* ‘of whom’ vs. **de que* ‘of what’, *avec qui* ‘with whom’ vs. **avec que* ‘with what’, or *tu connais qui?* ‘you know whom’ vs. **tu connais que?* ‘you know what’, etc. The form *quoi* ‘what’ can appear in these contexts.

5 Locality and f-binding

Although the theory of structure-sharing presented so far accounts for significant restrictions in both raising and LDD constructions, there are still some facts that the Nonthematic Condition (15) alone cannot account for. This condition does not account for two observations about the relation between structure-shared GFs in raising: (a) given any two structure-shared GFs, there must be a GF in this structure-sharing relation in every clause containing only one of the two structure-shared GFs, and (b) the less prominent of the two is a SUBJ. In other words, the less prominent of any two structure-shared GFs in raising is always a SUBJ and there is a GF structure-shared with it not more than one level up. The following are ungrammatical examples in which the structure-sharing relation either skips a clause (involves GFs at non-adjacent clauses), as in (40), or does not involve a SUBJ in the lower clause, as in (41):

- (40) a. *Mary seemed [that I thought [to be impatient]].
 SUBJ [[SUBJ]]
 b. *I believed Fred [that it was likely [to arrive late]].
 OBJ [[SUBJ]]
- (41) a. *Kim appeared [for a new sweater to please].
 SUBJ [OBJ]
 b. *I believed Fred [that I should invite to stay].
 OBJ [OBJ]

These examples satisfy the Nonthematic Condition on Structure-Sharing (15) and yet they are ungrammatical. In all of them, the matrix GF indicated in the schematic representation beneath the example is nonthematic (e.g., the subject of *seem* or the object of *believe*) and it is more f-prominent than the GF they are structure-shared with.

In order to rule out these examples, we need to further constrain the structure-sharing relation. In the case of raising, we want the structure-sharing relation to involve a SUBJ in every f-structure containing the lower of two structure-shared GFs. This requirement can be generalized so that it is also valid for LDD by requiring the presence of a DF (the class of GFs that includes OP, as well as SUBJ), as in the following principle:

- (42) **Locality of Structure-Sharing:** If f-structure F contains a GF G structure-shared with a GF that f-commands F, F has a DF structure-shared with G.

By this principle, every f-structure that contains the less f-prominent of two structure-shared GFs has a DF (a SUBJ or an OP) involved in this structure-sharing relation. This principle makes the representations indicated in (40)–(41) ill-formed. However, if we assume that a GF, such as an OP, can be freely included in a structure, provided its presence serves to satisfy a principle, such as (42),⁹ then Locality (42) by itself does not exclude examples (40)–(41), as there are alternative representations that satisfy this principle, such as the following:

- (43) a. *Mary seemed [that I thought [to be impatient]].
 SUBJ [OP [SUBJ]]
 b. *I believed Fred [that it was likely [to arrive late]].
 OBJ [OP [SUBJ]]

The OP in these structures would allow these structures to satisfy Locality, as every f-structure containing the lower of two structure-shared GFs has a DF (in this case, an OP) involved in the structure-sharing relation.

It is clear that, whereas in raising only a SUBJ can be chosen as the DF referred to by Locality (42), in LDD only an OP can be chosen for this purpose. The choice of one or the other depends on the “binding” conditions that follow. For example, in order to rule out the structures in (43), we need to assume that only a subject can be “bound” by a non-OP (i.e., only a subject can be “bound” by a GF other than an OP). The statement of these binding conditions depends on the definition of the relevant notion of “binding”, which we will call *f-binding*, to distinguish it from the notion of binding used

⁹ This can be done by generalizing Bresnan’s (1998, 2001) Economy of Expression to apply not only to c-structure categories, but also to features in the f-structure: elements of structure (categories in c-structure, GFs in f-structure) can be used only if their presence serves to satisfy some principle (or is required for semantic reasons).

in anaphoric relations. F-binding is defined as follows:

- (44) **F-binding**: α f-binds β iff
- a. α and β are different GFs with the same value, and
 - b. there's an argument in α 's f-structure that is equal to β or has β as a feature and is not higher than α in the GF hierarchy.

In other words, in order to say that there is an f-binding relation between two structure-shared GF, one of them has to be an argument or a feature of an argument in the f-structure where the other structure-shared GF is a feature and the latter cannot be lower than said argument in the GF hierarchy. This notion is relevant to both raising and LDD, as we will see. The first f-binding condition to be presented is the Non-SUBJ Binding Condition:

- (45) **Non-SUBJ Binding Condition (NON-SUBJ)**: a non-SUBJ can only be f-bound by an OP.

This principle rules out the representations given under the examples in (43), since the OP shown there (a non-SUBJ) is f-bound by a GF other than an OP—a SUBJ in (43a) or an OBJ in (43b). Thus, Locality (42) and NON-SUBJ (45) together rule out the examples in (40)–(41).

These two principles also rule out well-known ungrammatical instances of multiple (or parasitic) gaps:

- (46) a. *Which slave did Cleopatra give ___ to ___?
 b. *Which slave did Cleopatra give _____? (Engdahl 1983:87)
- (47) a. *Who did you inform ___ that you disliked ___?
 b. *Who did you show ___ pictures of ___?
 c. *Robin wasn't someone who I was able to persuade ___ to (allow Terry to) talk about ___. (Levine and Hukari 2006:40, 43)

These sentences are ruled out by NON-SUBJ (45).¹⁰ The following schematic representations of examples (46b) and (47c) show this:

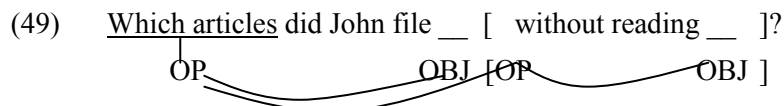
- (48) a. *Which slave did Cleopatra give ___ ___ ?
 OP _____ OBJ OBJ
- b. *Robin wasn't someone [who I was able
 [to persuade ___ [to allow Terry [to talk [about ___]]]]]
 [OP [OP OBJ [OP [OP [OP OBJ]]]]]

The dotted line in these representations shows the part of the structure-sharing relation that violates NON-SUBJ (45). In (48a), each OBJ is f-bound by the other OBJ; in (48b), the OP in the f-structure corresponding to the

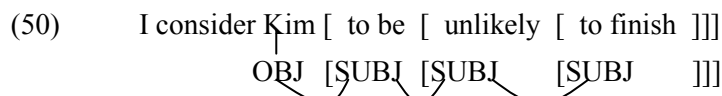
¹⁰ In other theories (e.g., Engdahl 1983) they are ruled out by an anti-c-command condition, which does not allow a gap to be c-commanded by a coindexed gap.

clausal complement of *persuade* is f-bound by the OBJ of this verb. The crucial difference between ill-formed instances of multiple gaps like (48b) and well-formed ones like (16a–b) is that the clausal f-structure following the object gap is an argument in the former, but an adjunct in the latter. Given the definition of f-binding (44), an adjunct and any GF of its f-structure is not f-bound; consequently, condition (45) is always satisfied with respect to the relation between a GF in a clause with an adjunct and a GF in that adjunct.

The Locality condition (43), together with NON-SUBJ (45), requires an OP structure-shared with the gap to appear in every f-structure containing a gap and f-commanded by the overt OP, except in an f-structure with a subject gap. Thus, long-distance dependencies are decomposed into a sequence of local dependencies.¹¹ Example (16a) would have an OP in the f-structure of the adjunct introduced by *before*, to satisfy Locality:



Needless to say, raising can also involve a dependency across several clauses, provided all relevant conditions are satisfied, in particular, the Nonthematic Condition (15), Locality (42), and NON-SUBJ (45), as in example (50):



The NON-SUBJ condition is vacuously satisfied in this structure, because there is no f-bound non-SUBJ, but it prevents the appearance of an OP structure-shared with the raised GFs in any of the embedded clauses.¹²

Certain additional facts about raising and LDD still need to be accounted for. In the first place, raising is restricted to occur out of complements: it does not occur out of subjects or adjuncts. Relevant ill-formed examples of these types of structures are the following:

- (51) a. * [To have missed the train] was believed Kim.
 b. * There seemed [after being a storm] that Kim would come.

¹¹ Notice that this resembles the standard GB/MP analysis of LDD (since Chomsky 1973), where a constituent moves into the closest Spec-CP and subsequently to higher positions, the standard GPSG and HPSG analysis (since Gazdar 1981), where every phrase containing a gap up to the phrase containing the filler has a SLASH feature specified with the syntactic features of both the filler and the gap, and even some LFG analyses, such as Sells (2000), Berman (2003), and Asudeh (2004), although there are significant difference with all of these proposals.

¹² A consequence of NON-SUBJ (45) is that in raising only a subject may be structure-shared with a more f-prominent GF (see Alsina to appear). This encounters a problem in the claim that some languages have raising of an object by Seiter (1983), but the evidence is compatible with an analysis as a *tough*-construction.

(51a) satisfies the relevant conditions: as the object *Kim* is nonthematic and more f-prominent than the structure-shared subject of the subject clause, it satisfies the Nonthematic Condition (15); as the structure-shared subject of this clause is a DF, it satisfies Locality (42); and, as there is no f-bound non-SUBJ, NON-SUBJ (45) is satisfied as well. Similar observations can be made about (51b), only here the embedded clause is an adjunct.

In the second place, extraction of subjects can only occur out of complements: there is no subject extraction out of subjects and adjuncts, as the following examples illustrate:

- (52) a. *Those politicians, who [that ___ came] bothers me, ...
 b. *Who did you enter the room [once ___ started talking]?

In (52a), there is an extraction of a subject out of a subject clause and, in (52b), there is an extraction of a subject out of an adjunct clause. Again, the corresponding structures satisfy all relevant conditions proposed so far.

In the third place, raising can only occur out of tenseless clauses, as the contrast in (53) illustrates. The main difference in structure is that (53a) has a tensed clausal complement and (53b) has a tenseless clausal complement: whereas raising is possible in the latter, it is not in the former

- (53) a. *Kim seems (that) has missed the train.
 b. Kim seems to have missed the train.

These facts can be accounted for by the fourth and last principle of the theory of Structure-Sharing:

- (54) **SUBJ Binding Condition (SUBJ Bind):** A SUBJ that is structure-shared with a more f-prominent GF is
 a. f-bound in a non-SUBJ f-structure and
 b. in a tenseless f-structure if its closest f-binder¹³ is not OP.

Clause (a) of this condition rules out examples (51) and (52). Structure-sharing into an adjunct implies no f-binding into the adjunct, accounting for (51b) and (52b). An object does not f-bind into the subject, accounting for (51a). In (52a), the extracted subject is f-bound, but not in a non-SUBJ f-structure, as clause (a) of (54) requires, as it is in a SUBJ f-structure. Clause (b) rules out example (53a), as the structure-shared subject is in a tensed f-structure and its closest f-binder is not OP, but SUBJ, and accepts example (53b), where the structure-shared subject is in a tenseless f-structure.

An additional consequence of SUBJ Bind (54) is that it rules out instances of multiple gap constructions not ruled out so far, such as the following, where there is a subject gap whose closest f-binder is an object:

¹³ We can define *closest f-binder* as follows: Given two or more f-binders of γ , of which α is one, α is the closest f-binder of γ if α does not f-bind any f-binder of γ .

- (55) *Who did you inform ___ [___ should submit the abstract as soon as possible]?

The structure-shared subject of the embedded clause has a non-OP as its closest f-binder (the object of *inform*), but it is in a tensed f-structure and thus violates SUBJ Bind (54), clause (b).

6 Conclusion

The theory presented here unifies the treatment of LDD and raising through a small set of principles governing structure-sharing. Regarding LDD, it captures significant restrictions about the relation between the filler and the gap, it allows for multiple gap constructions (such as parasitic gaps), it excludes ungrammatical instances of multiple gaps, and it appropriately constrains possible structure-sharing relations in raising. It dispenses with functional control equations (e.g., functional uncertainty) as a means of expressing one-to-many mappings between c- and f-structure. It requires abandoning the idea that everything in the f-structure is encoded through annotations on the c-structure. This calls for a new conception of the mapping between c-structure and f-structure, one in which general well-formedness conditions—on each structure and on their mapping—govern this correspondence, doing away with the additional level of annotated c-structure.

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