Projection, Heads, and Optimality

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This article argues that inversion of the subject and auxiliary in English matrix questions and elsewhere is the effect of a violable optimality-theoretic constraint that requires head positions to be filled. When no other auxiliary is available, *do*-support occurs to satisfy this constraint, resulting in the presence of an expletive verb. When a higher-ranked constraint prohibits inversion, no inversion or *do*-support is found. The argument is then extended to cases where the complementizer *that* is obligatory, which are shown to offer best satisfaction of the proposed set of violable constraints.

Keywords: inversion, constraints, ranking, *do*-support, complementizers

1 Introduction

The goal of this article is to show that the distribution of heads in English clauses, including inversion of the subject and auxiliary verb, and the appearance of the auxiliary verb *do* and the complementizer *that*, can be explained by the interaction of universal constraints, under Optimality Theory as proposed in Prince and Smolensky 1993. The core of Optimality Theory (OT) lies in these ideas:

Constraints are universal.
Constraints can be violated.
Grammars are rankings of constraints.
The optimal form is grammatical; all nonoptimal candidates are ungrammatical. An optimal output form for a given input is selected from among the class of competitors in the following way: a form that, for every pairwise competition involving it, best satisfies the highest-ranking constraint on which the competitors conflict, is *optimal*.

This research was generously supported by Rutgers University and by the National Science Foundation through grant SBR-9511891. The analysis has benefited immensely from discussions with, and (often extensive) comments from, the following colleagues: Peter Ackema, David Adger, Eric Baković, Maria Bittner, Claudia Borgonovo, Christine Brisson, George Broadwell, Daniel Büring, Harald Clahsen, Veneeta Dayal, Viviane Déprez, Liliane Haegeman, Hubert Haider, Katharina Hartmann, Marco Haverkort, Teun Hoekstra, Norbert Hornstein, Riny Huybregts, Sabine Iatridou, Ingeborg Lasser, Géraldine Legendre, Jim McCloskey, Armin Mester, Gereon Müller, Ad Neeleman, Jaye Padgett, Susan Pintzuk, Andrew Radford, Vieri Samek-Lodovici, Yael Sharvit, Nomi Shir, Sten Vikner, Fred Weerman, Ken Wexler, Edwin Williams, Ellen Woolford, and Raffaella Zanuttini. Many suggestions came from audiences at Brandeis University, CUNY, University of Delaware, Girona International Summer School in Linguistics, Lund University, University of Massachusetts at Amherst, MIT, the University of Pennsylvania, Rutgers University, Universität Stuttgart, and Wuppertaler Linguistisches Kolloquium. I owe a particular debt to Alan Prince and Paul Smolensky, for their extremely generous contributions to this work, and to Eric Baković, Ed Keer, and Vieri Samek-Lodovici for their invaluable scrutiny of the manuscript. Four reviewers provided helpful commentaries.

Linguistic Inquiry, Volume 28, Number 3, Summer 1997
373–422

The constraints that play a central role in the proposal are these:[1]

Constraints related to specifiers

OPERATOR IN SPECIFIER (OP-SPEC)
Syntactic operators must be in specifier position.

CASE MARKING (CASE)
DPs must be Case-marked.

SUBJECT (SUBJ)
Clauses have subjects.

Constraints related to heads

OBLIGATORY HEADS (OB-HD)
A projection has a head.

HEAD LEFT (HD-LFT)
The head is leftmost in its projections.

HEAD RIGHT (HD-RT)
The head is rightmost in its projections.

NO LEXICAL HEAD MOVEMENT (NO-LEX-MVT)
A lexical head cannot move.

Government constraints

TRACE IS GOVERNED (T-GOV)
A trace is governed.

TRACE IS LEXICALLY GOVERNED (T-LEX-GOV)
A trace is lexically governed.

Others

PURITY OF EXTENDED PROJECTION (PURE-EP)
No adjunction takes place to the highest node in a subordinate extended projection; and no movement takes place into the highest head of a subordinate extended projection. (Note that this constraint was called *PROJ(ection) PRIN(ciple)* in Grimshaw 1993.)

ECONOMY OF MOVEMENT (STAY)
Trace is not allowed.

FULL INTERPRETATION (FULL-INT)
Lexical conceptual structure is parsed.

CONDITIONAL (COND)
A dependent head c-commands the extended projection containing it.

LOCAL θ-MARKING (θ-MARK)
Lexical heads θ-mark within their lexical projection.

[1] In Grimshaw 1993 and 1994 I assumed an additional constraint, MINIMAL PROJECTION, which required that a functional projection make a contribution to the functional representation of the extended projection that it is part of, thus ruling out entirely empty projections. In the current system, there is no need to stipulate such a constraint: the main effects follow from OB-HD and STAY, as will be shown in section 2.

I will discuss the formulation of the constraints and their relationship to ideas in the literature at the appropriate points in the article. The constraints are assessed at S-Structure, and the account is, as far as I can tell, entirely consistent with the view that S-Structure is freely constructed from the primitives of the theory, including traces, and then evaluated by well-formedness constraints, among them the ones discussed here.

Because OT constraints are violable, they are not in general "surface-true." Under standard assumptions, positing a constraint that is violated requires corrective work. The constraint may be modified to a less general form so that no violation occurs, or taken to be satisfied by an invisible element or piece of structure. Or it may be relegated to some level of representation where it can be held to be unviolated, LF having proved most useful for this purpose. Under OT, violability is the norm, and this is what makes it possible to have general constraints freely interacting. The generality of the constraints leads to systematic conflicts. For example, OB-HD may mandate movement to provide a head for a projection, yet STAY is always violated by movement. Similarly, PURE-EP will prohibit head movement if the projection is a subordinate clause. Such conflicts, and their resolutions, prove essential to explaining the empirical generalizations at issue.

When constraints conflict, it is their relative ranking that determines which will be satisfied and which violated. The relative ranking of constraints is determined on a language-particular basis. The rankings for English that are crucial and central in the proposal to come are given in figure 1. A total ranking that is consistent with all of these dominance relations is the following: θ-MARK ≫ COND ≫ PURE-EP ≫ OP-SPEC ≫ NO-LEX-MVT ≫ HD-LFT ≫ OB-HD ≫CASE ≫ SUBJ ≫ FULL-INT ≫ STAY ≫ T-GOV ≫ T-LEX-GOV. The constraints appear in this order in all tableaux.

The competitors, Prince and Smolensky's "candidate set," are alternative realizations of an input. The *input* for a verbal extended projection is a lexical head plus its argument structure and

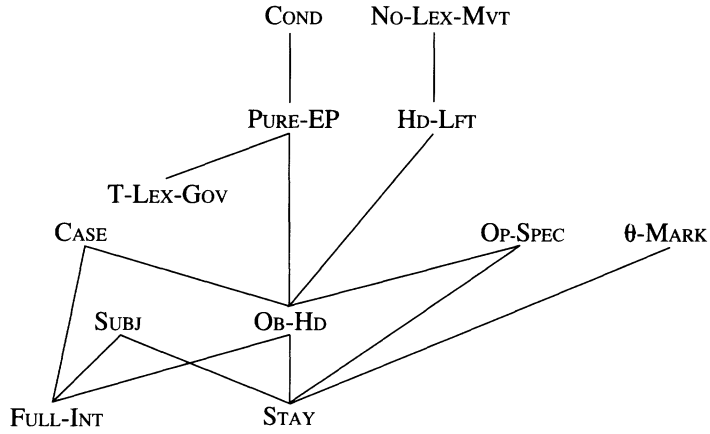


Figure 1
Ranking diagram for constraints of central importance with a known ranking

an assignment of lexical heads to its arguments, plus a specification of the associated tense and aspect.

The input is passed to Gen (see Prince and Smolensky 1993), which generates all extended projections that conform to X-bar theory, that is, in which all projections are of the right basic structure. Thus, Gen introduces functional heads that do not appear in the input, *that* being an example discussed in this article. I assume a minimal X-bar theory, which simply says that each node must be a good projection of a lower one, if a lower one is present. The presence of a head is mandated by OB-HD, which is violable. (For a very different view of the head position, see Baković, to appear, where properties of the Spanish inversion system are argued to follow if OB-HD is considered to be part of Gen, hence inviolable.)

An extended projection (Grimshaw 1991, to appear; see also Haider 1989 and Van Riemsdijk 1990 for related proposals) is a unit consisting of a lexical head and its projection plus all the functional projections erected over the lexical projection. The smallest verbal projection is VP, but IP and CP are both extended projections of V. Other projections such as Agr_S and Agr_O can be incorporated into the overall program, but are not discussed here.

Suppose, for example, that the lexical head is *see*, and that *John* is assigned to its external argument and *who* to its internal argument: *see*(x, y), x = *John*, y = *who*. Gen will construct all extended projections of this lexical specification. Among the candidates will be some with *who* in object position, some with *who* in the specifier of a functional projection, some with *that*, some with *do*, and so forth.[2] Competing candidates are evaluated as analyses of the same lexical material because of the way the input is defined. Thus, say, *John saw who* as an analysis of the above input is compared with other analyses of the same input, and not with, say, analyses of an input that has a different lexical head, or in which different arguments are assigned to the predicate. I will assume that competing candidates have nondistinct logical forms, in a sense which must be made precise by further research, but which certainly must entail that they are truth-functionally equivalent. Reinhart (1993) and Iatridou and Embick (1994) discuss this issue with respect to minimalism and economy (Chomsky 1991, 1993, 1995). It may turn out that the input should include a specification of LF-related properties, such as scope, as suggested in Legendre et al. 1995.

The entire set of candidates is compared with respect to conformity to the set of violable constraints provided by Universal Grammar (UG) and ranked by the grammar of the language, and the optimal one(s) survive as grammatical.

2 The Basics of Inversion

Patterns of inversion follow from the interactions among universal constraints affecting heads in the verbal extended projection. The key constraints for this initial exploration are STAY, OP-SPEC, and OB-HD.

[2] Among other candidates are those that do not analyze elements of the input: those with violations of Prince and Smolensky's (1993) PARSE constraints. FULL-INT is a constraint of this type (see section 3.3).

First, consider an English matrix declarative sentence, where inversion is neither required nor allowed.

(1) a. They will read some books.
b. *Will they read some books.

What well-formedness requirements are relevant for a matrix declarative? In an IP analysis of a matrix declarative with an auxiliary verb, such as the one in (1a), both projections have heads: a lexical V heads VP, and the auxiliary *will* heads IP. Thus, there is no head missing from the structure, and herein lies the crucial contrast between a declarative and an interrogative. *Wh*-questions are operator-variable constructions, and the *wh*-phrase is subject to OP-SPEC. OP-SPEC is based on the insight of Rizzi (1996) and Haegeman (1992) that there is a special relationship between the specifier position and a syntactic operator, a scope-bearing expression that takes its scope by virtue of its syntactic position. All phrases that are marked as *wh* by virtue of percolation (through an extended projection) of a *wh*-feature from a *wh*-head or -specifier (as in Grimshaw 1991) count as *wh*-operators. OP-SPEC requires that such expressions be in specifier positions, motivating one more projection than occurs in the corresponding declarative. [Spec, VP] is filled by the underlying subject and [Spec, IP] by the surface subject; hence, the operator must be in the specifier of an additional projection (CP). This extra projection has no head and thus violates OB-HD, which requires a projection to have a head (either lexically realized or occupied by a trace), much as in Haider 1989. Head movement provides a head for the CP. *Wh*-movement thus violates STAY in order to satisfy OP-SPEC. Similarly, inversion violates STAY, but it results in satisfaction of OB-HD.

(2) a. Which books will they read?
b. *Which books they will read?

In questions introduced by *how come* there is no empty C because *how come* itself is a C (Collins 1991) and OB-HD is satisfied without inversion. To complete the explanation for (2), it is necessary to show that there is no C to head the CP in (2b), an obvious candidate being the complementizer *that*. Section 8 addresses this issue.

The basic idea, then, is that subject-auxiliary inversion in interrogatives is movement to C, following Den Besten (1983), due to the OB-HD constraint, which induces movement to provide a head for a projection that would otherwise lack one. The projection is absent altogether in declaratives; hence, no movement is necessary for the satisfaction of OB-HD.[3]

[3] Verb-second (V2) languages show a much-studied paradigm in which inversion is found in matrix declaratives. Although there are numerous different accounts of V2, many view the typological property that distinguishes the V2 languages from the others as a property of the C position (see for example the work reviewed in Weerman 1989 and Vikner, in press), taking the filling of [Spec, CP] as a secondary property. The analysis of English given here invites a different perspective, in which what is special about these languages is that they require the presence of a specifier position of a particular kind; hence, an extra projection can appear and OB-HD motivates V2 to fill the empty head position. (The specifier-related constraint in question must outrank STAY in V2 languages, and not in English; see sections 3.3 and 7 for discussion of effects of reranking.) The correct formulation of the constraint requiring the specifier position is a complex issue, however, and I will not pursue it further.

Tableau 1
Matrix interrogatives

Candidates	OP-SPEC	OB-HD	STAY
$[_{IP}$ DP will $[_{VP}$ read what]]	*!		
$[_{CP}$ **e** $[_{IP}$ DP will $[_{VP}$ read what]]]	*!	*	
$[_{CP}$ what **e** $[_{IP}$ DP will $[_{VP}$ read t]]]		*!	*
☞ $[_{CP}$ what **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ read t]]]			**
$[_{CP}$ **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ read what]]]	*!		*

Tableau 1 shows the key competitors for the interrogative. If the interrogative is just an IP, it will inevitably violate OP-SPEC (except when the *wh*-phrase is the subject; see section 3.4). The CP structures with no *wh*-movement also violate OP-SPEC, and without inversion they violate OB-HD as well. The CP structure with *wh*-movement but no inversion violates OB-HD and STAY. The CP with *wh*-movement and inversion violates STAY twice. It is optimal.

This illustrates some of the fundamentals of OT. Every candidate, including the grammatical one, violates some constraint. The optimal one, however, marked with the pointing finger, violates only STAY, whereas the competitors all violate at least one constraint that is higher ranked than STAY. (Because of the way constraint violations are reckoned, no number of violations of STAY would evict the winning candidate from its position as optimal; see Prince and Smolensky 1993.) Since OP-SPEC is the highest ranked of these constraints, any candidate that violates it will fail if there are candidates that do not violate it, as there are in this case.

Several rankings are crucial here. OP-SPEC must outrank, or "dominate," STAY; otherwise, the candidates with no *wh*-movement would be preferred over candidates that satisfy OP-SPEC. OB-HD must outrank STAY, for similar reasons: this is why head movement is possible if it leads to satisfaction of OB-HD. Furthermore, we might wonder why the *wh*-phrase cannot be base-generated in specifier position, avoiding violation of STAY and satisfying OP-SPEC. This possibility is eliminated, for arguments at least, if locality of θ-marking is invoked: either as a violable constraint dominating STAY or as an inviolable principle (Vieri Samek-Lodovici, personal communication). The result is that the system prefers to generate the *wh*-phrase inside the VP to satisfy θ-MARK, at the cost of violating STAY in satisfying OP-SPEC.

In the declarative, OP-SPEC is always satisfied, vacuously, since no operator is present. Hence, the extra structure is not needed (see tableau 2). When the matrix is an IP, every constraint considered so far is respected, and this is the optimal candidate. OB-HD is satisfied by *will* in I and by a lexical head in V. OP-SPEC is vacuously satisfied. When the matrix is a CP, there are two alternative patterns. If inversion does not occur, OB-HD is violated; if inversion does occur, STAY is violated. (This is why there is no need to appeal to the constraint MINIMAL PROJECTION of Grimshaw 1993, 1994 to eliminate empty projections. Joan Bresnan (personal communication)

Tableau 2
Matrix declaratives

Candidates	OP-SPEC	OB-HD	STAY
☞ $[_{IP}$ DP will $[_{VP}$ read books]]			
$[_{CP}$ **e** $[_{IP}$ DP will $[_{VP}$ read books]]]		*!	
$[_{CP}$ **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ read books]]]			*!

points out, however, that empty adjunction structures are not excluded by the system.) Thus, of the three competing possibilities discussed, the IP is the best. In effect, there is no point to inversion, since it leads to violation of STAY, with no compensating improvement on a higher-ranked constraint. In contrast, in interrogatives the STAY violation has the benefit of allowing OB-HD to be satisfied.

Under the VP-internal subject hypothesis (Zagona 1982, Koopman and Sportiche 1991, Kitagawa 1986, McNally 1992, Burton and Grimshaw 1992), the subject in both the declarative and the interrogative has raised from [Spec, VP] to [Spec, IP], satisfying CASE and SUBJ but violating STAY. I will factor this out for now and not represent it in the analysis, until it becomes strictly relevant in section 3.

Returning to the interrogatives, OP-SPEC merely requires that the *wh*-phrase appear in a specifier position—it says nothing about the position of this specifier relative to the remainder of the clause. Why, then, does the extra projection go on top of IP, instead of, for example, between IP and VP? It does so because of the scopal properties of *wh*-phrases: they take scope by virtue of their syntactic position, and must have scope over the entire propositional structure (roughly speaking, IP) in order to perform their semantic function. There are several different ways to incorporate this into the present solution. The assumption in Grimshaw 1993 was that structures with the *wh*-phrase in the wrong specifier would be uninterpretable and hence would never be grammatical. Here I will instead take the tack that OP-SPEC requires an operator to be in the specifier from which it takes its scope (see Ackema and Neeleman, to appear, Baković, to appear, Legendre et al. 1995). Thus, OP-SPEC for a *wh*-operator will be satisfied only by movement to a position from which the operator c-commands the entire extended projection.

This solution predicts that when more than one *wh*-phrase is present in a clause, only one moves, so that (3b), for example, is ungrammatical.

(3) a. What will they put where?
b. *What will where they put?

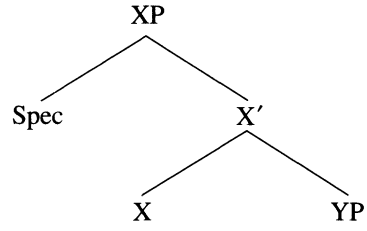
This is because the movement of *where* to an internal specifier violates STAY, but fails to satisfy OP-SPEC since it is not moving the *wh*-phrase into a scope position. Thus, both candidates have one OP-SPEC violation, and the decision falls to STAY, which selects the candidate with fewest movements. The (simplified) tableau 3 illustrates this.

Tableau 3
Multiple interrogatives

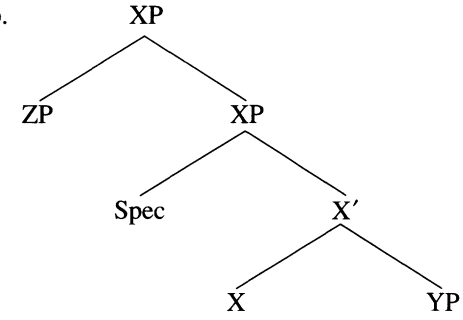
Candidates	OP-SPEC	OB-HD	STAY
☞ [$_{CP}$ *what* will [$_{IP}$ they [$_{VP}$ put *t* where]]]	*		*
[$_{CP}$ *what* will [*where* [$_{IP}$ they [$_{VP}$ put *t t*]]]]	*		**!

Movement to specifier position induces inversion, as we have seen. Adjunction, however, does not. As (4) illustrates, adjunction leaves the number of projections present in the representation unchanged.

(4) a.



b.



There are no more heads to be filled in an adjoined structure than in a structure with no adjunction, and OB-HD will be satisfied in exactly the same way in both. Inversion will therefore never be necessary and therefore never be possible, since inversion always violates STAY. Along with Baltin (1982) and Lasnik and Saito (1992), I take topicalization to be a case of adjunction. See Cinque 1990, Lasnik and Stowell 1991, Postal 1992, and Müller and Sternefeld 1993 for discussion of differences between topicalization and true operator movements. Possibly English exclamatives, which have no inversion, are also adjunction structures.

In English matrix yes-no questions, inversion is again required.

(5) a. Will they read some books?
b. *They will read some books?

The most straightforward way to subsume them under the same system is to posit a null operator in [Spec, CP].[4] Then matrix yes-no questions are CPs, the C position will be empty without inversion, and OB-HD will induce inversion. The assumption that yes-no questions involve an operator is crucial for other aspects of the syntax of interrogatives, such as licensing of polarity items and Relativized Minimality effects for interrogative complements (Rizzi 1990).

[4] George Broadwell (personal communication) points out that crosslinguistically, overt yes-no question markers seem to be X^0s rather than XPs, casting some doubt on analyses that treat yes-no questions and *wh*-questions in parallel. This suggests exploring an alternative that would more closely resemble the proposal made in section 6 for conditionals, where the operator is taken to be a head rather than a phrase.

Empty layers of structure in the system presented here always violate OB-HD without movement and STAY with movement. The effects of a constraint against empty structure follow without stipulation.[5] It is a consequence of competition among candidates that a clause is only as big as it needs to be. It is an IP unless it has to be a CP. A clause always has the minimal structure consistent with maximal satisfaction of constraints, under the OT theory of ranking. There is no fixed structure for clauses, no unique answer to the question of whether they are IPs or CPs (or indeed VPs, as we will see). Sometimes they are one, sometimes the other, depending on what well-formedness conditions are relevant.

It should be noted that it is crucial that all extended projections that can be formed above the lexical projection be in the candidate set; otherwise, both the optimal CP candidates and the optimal IP candidates would be grammatical, giving inversion in declaratives alongside a no-inversion structure, and admitting an interrogative in which neither *wh*-movement of the operator nor inversion occurred.

3 *Do*-Support

The generalization governing *do* in English is simple to state but has proved challenging to formalize: that *do* is possible only when it is necessary (Chomsky 1957, 1991). The proposal developed so far in this article allows us to make precise this conceptualization of *do*, given two assumptions. First, *do* is a semantically and functionally empty verbal head: this seems to be the minimal specification we can give it. As a result, every occurrence of *do* violates FULL-INT. Second, OB-HD outranks FULL-INT, so *do* occurs when its presence results in satisfaction of OB-HD. The distribution of *do* then follows. The consequences are that *do* is impossible in (positive) matrix declaratives and subordinate interrogatives, is required in matrix interrogatives with no auxiliary, never cooccurs with other auxiliaries, and never cooccurs with itself.

3.1 Background

Emonds (1978) and Pollock (1989) argue that in French the main verb raises to I, whereas in English the main verb appears to stay in its base position (see these works on English and French, and Vikner 1995 on Scandinavian). If we assume, more or less as they do, that I is the locus of verbal inflection, then the French system is immediately comprehensible, since V raises to I in order to combine with its inflection. On the other hand, the English system becomes quite mysterious, since it is self-evident that the verb and its inflection do in fact combine, yet there is no obvious way for this result to be achieved. There have been a variety of responses to this problem. Under checking theory, English main verbs raise at LF (Chomsky 1993). In Distributed Morphology, tense and the verb are merged in Morphological Structure (Halle and Marantz 1993). Williams (1994) argues that inflectional features are not syntactic nodes, but part of X-bar projections: under this view, there is no V-to-I movement even in French-type languages. Here I will take a

[5] In Grimshaw 1993, 1994, however, MINIMAL PROJECTION was necessary, because STAY was not among the constraints.

position that maintains features of both Emonds's and Pollock's proposal and the alternatives. Suppose that the difference between the French system and the English system (determined by their different constraint rankings) is that in the English system inflection is morphologically associated with a V (i.e., it is lexically attached to a V head), whereas in French it is syntactically projected as head of a projection. (Whether inflection is syntactically projected as an I, or morphologically attached to V, the result is the same in one respect, namely, the entire verbal extended projection has an inflectional specification, regardless of which (extended) head of the projection is the source of it.) French will then have V-to-I raising, whereas English will not. That English and French differ in whether they attach inflection morphologically or syntactically will follow from the constraint rankings for the two languages. For example, we might hypothesize a constraint NO-MORPHOLOGY, which is violated by morphological structure and hence requires that all syntactic heads contain exactly one morpheme, forcing I and V to be generated separately. I and V must eventually be combined (I set aside the question of what kind of principle requires this) by head movement, violating NO-LEX-MVT (a constraint discussed in more detail in section 3.3). Thus, either NO-LEX-MVT or NO-MORPHOLOGY must be violated. In English NO-LEX-MVT dominates NO-MORPHOLOGY, so morphologically complex items are inserted under V. In French NO-MORPHOLOGY dominates NO-LEX-MVT and lexical verbs raise. If, as has been suggested by Pollock (1989) and Platzack and Holmberg (1989), there is an important relationship between the existence of V-to-I movement and richness or "strength" of inflection, this should now be understood as reflecting a relationship between properties of inflection and existence as an independently projected head.

For concreteness I will adopt the position that the first auxiliary verb, like a finite main verb, is morphologically associated with tense features and ϕ-features. It is generated in I. I assume a constraint, not further discussed here, requiring that the finite verb must c-command all other heads in the extended projection, except C. (This penalizes extended projections containing more than one finite verb and extended projections in which the finite verb is not the first verb, and will in practice rule them out.) CASE and SUBJ constrain the position of the subject relative to functional heads in the extended projection. Their role will be examined in the discussion of negation, but in the meantime I consider only candidates that satisfy them both. A consequence of this analysis is that a tensed clause that contains a main verb and no auxiliaries must be a VP in English, since inclusion of an IP in its representation will violate OB-HD with no compensating effects.[6] Thus, main clauses can be VPs, IPs, or CPs, depending on their contents.

3.2 The Distribution of Do

I will first show how the analysis works out for the contrast between matrix declaratives and matrix interrogatives, starting with declaratives. (I will omit CP representations for declaratives,

[6] Adjunction to X′ will have to be admitted, to accommodate the position of the adverb in *John usually likes tomatoes*, as pointed out by Sten Vikner and Marco Haverkort (personal communication). If adjunction is regulated only by scope considerations and by PURE-EP, this is not a problematic conclusion. Haverkort suggests that adjunction to X′ is needed in any case for examples like *Peter said that Carl, had he been on time, would have caught the train.*

Tableau 4
Matrix declaratives with and without *do*

Candidates	OP-SPEC	OB-HD	FULL-INT	STAY
☞ [$_{VP}$ DP V that]				
[$_{IP}$ DP **do** [$_{VP}$ V that]]			*!	
[$_{IP}$ **e** [$_{VP}$ DP V that]]		*!		

always nonoptimal for reasons given above.) The first issue, then, is why *do* does not occur in declaratives, even when no other auxiliary is present.

(6) a. She said that.
b. *She did say that.

Tableau 4 shows how this result is obtained. Note that FULL-INT, which was satisfied in all previous cases and was omitted from the tableaux for reasons of presentation, is now crucial. The VP form of the clause, with no auxiliary verb projection, is the optimal one, since it involves no violations, whereas the alternative with *do* violates FULL-INT, and the final alternative, which has an extra projection but no *do*, violates OB-HD. Thus, auxiliary *do* cannot occur in a declarative. The crucial difference between *do* and other auxiliaries is that they differ from *do* in having semantic content. They are part of the input.

In interrogatives, *do* must appear in the absence of another auxiliary verb.

(7) a. What did she say?
b. *What she said?
c. *What she did say?

I simplify by considering in tableau 5 only those forms that do not violate OP-SPEC, that is, where *wh*-movement has occurred. Further, I will temporarily ignore candidates in which the main verb moves to supply the otherwise missing head, returning to the analysis of these cases in section 3.3. The optimal form is the one in which *do* occurs and inverts to C: this one violates only FULL-INT and STAY. Inversion of *do* satisfies OB-HD, which all other candidates violate. The ranking

Tableau 5
Matrix interrogatives with and without *do*

Candidates	OP-SPEC	OB-HD	FULL-INT	STAY
☞ [$_{CP}$ *wh* **do**$_i$ [$_{IP}$ DP **e**$_i$ [$_{VP}$ V *t*]]]			*	**
[$_{CP}$ *wh* **e** [$_{IP}$ DP **e** [$_{VP}$ V *t*]]]		*!*		*
[$_{CP}$ *wh* **e** [$_{VP}$ DP V *t*]]		*!		*
[$_{CP}$ *wh* **e** [$_{IP}$ DP **do** [$_{VP}$ V *t*]]]		*!	*	*

Tableau 6
Cooccurrence of *do* and another auxiliary in a matrix interrogative

Candidates	OP-SPEC	OB-HD	FULL-INT	STAY
☞ $[_{CP}$ *wh* **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V *t*]]]				**
$[_{CP}$ *wh* **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{XP}$ do $[_{VP}$ V *t*]]]]			*!	**
$[_{CP}$ *wh* **do**$_i$ $[_{IP}$ DP **e**$_i$ $[_{XP}$ will $[_{VP}$ V *t*]]]]			*!	**

of OB-HD over FULL-INT is crucial here: the opposite ranking would select as grammatical a form in which the C is empty and *do* does not appear.

Thus, we obtain the desired result: *do* is possible only where it is necessary, and it is necessary when its presence makes a clause obey a constraint that has a higher ranking than FULL-INT, in this case OB-HD.[7] We will see in section 4 that in subordinate interrogatives, OB-HD is violated anyway, regardless of whether an auxiliary verb is present or not. As a result, there is no possible advantage to including *do*, so it never occurs in embedded questions.

This analysis explains why *do* never cooccurs with another auxiliary verb, or with another token of *do*. Consider, for example, a matrix interrogative clause in which *do* and *will* cooccur. Movement of *will* to C satisfies OB-HD. As tableau 6 illustrates, there is no advantage to including *do* and its projection, which will always add a FULL-INT violation; hence, only the *will* version is possible.

(8) a. What will she say?
b. *What will she do say?
c. *What does she will say?

Main *be* and *do* will not occur together. Since *be* has the capacity to move to C to satisfy OB-HD, the form with *do* will have no competitive advantage over the one without, and the *do*-less form will be optimal.

Obviously, auxiliary *do* will also not repeat. Clauses containing *do* will be in competition with all otherwise equivalent clauses containing more and fewer occurrences of *do*. Each occurrence of *do* yields a violation of FULL-INT, and no occurrence of *do* after the first one can ever improve the success of the structure with respect to the constraints. Hence, a clause with more than one instance of *do* can never be optimal. This is illustrated in (9) and in tableau 7 with respect to a matrix question with no semantic auxiliary, where one *do* is possible.

(9) a. What did she say?
b. *What did she do say?
c. *What did she do do say?

[7] Although Roberts (1993:293–294) notes that *do*-insertion appears to have been freely available in 16th-century English.

Tableau 7
Multiple occurrences of *do* (illustrated for matrix interrogative)

Candidates	OP-SPEC	OB-HD	FULL-INT	STAY
☞ $[_{CP}$ *wh* **do**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V $t]]]$			*	**
$[_{CP}$ *wh* **do**$_i$ $[_{IP}$ DP **e**$_i$ $[_{XP}$ **do** $[_{VP}$ V $t]]]]$			**!	**
$[_{CP}$ *wh* **do**$_i$ $[_{IP}$ DP **e**$_i$ $[_{XP}$ **do** $[_{XP}$ **do** $[_{VP}$ V $t]]]]]$			**!*	**

The fundamental point of analysis for *do*, then, is that it violates FULL-INT; hence, it is present only when its presence leads to improvement on a higher-ranked constraint. Since OB-HD ≫ FULL-INT, *do* will appear in order to satisfy OB-HD.

3.3 Constraint Ranking and the Lexicon: Main Verbs and the Availability of Do

In section 3.2 I set aside a central property of the English inversion system, namely, that main verbs do not invert, *do* occurring instead.

(10) a. *What said she?
b. What did she say?

This motivates a constraint that penalizes movement of a lexical head, the constraint named *NO-LEX-MVT*. This constraint is ranked above FULL-INT in English; therefore, English will violate FULL-INT (introducing *do*) in order to avoid violating NO-LEX-MVT. Thus, the full constraint analysis is the one given in tableau 8, which compares the winning candidate from tableau 5 with the alternative involving movement of a main verb.

In English, then, we know that OB-HD ≫ FULL-INT and that NO-LEX-MVT ≫ FULL-INT. There is no evidence concerning the ranking of OB-HD with respect to NO-LEX-MVT, since the winning candidate violates neither. Evidence for ranking NO-LEX-MVT over HD-LFT is sketched in footnote 16.

What about a language that allows main verbs to move? In such a language, both OB-HD and FULL-INT must dominate NO-LEX-MVT. This ranking yields a system that selects filling a head position with a main verb over leaving the head position unfilled or filling it with a meaningless item. This is schematized in tableau 9.

There is no crucial ranking here of OB-HD and FULL-INT—either ranking will yield the desired result.

Tableau 8
Inversion of a main verb versus presence of *do*

Candidates	OP-SPEC	NO-LEX-MVT	OB-HD	FULL-INT	STAY
$[_{CP}$ *wh* **V**$_i$ $[_{VP}$ DP **e**$_i$ $t]]$		*!			**
☞ $[_{CP}$ *wh* **do**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V $t]]]$				*	**

Tableau 9
Effect of reranking on inversion of a main verb versus presence of *do*

Candidates	OP-SPEC	OB-HD	FULL-INT	NO-LEX-MVT	STAY
☞ $[_{CP}\ wh\ \mathbf{V_i}\ [_{VP}\ \text{DP}\ \mathbf{e_i}\ t]]$				*	**
$[_{CP}\ wh\ \mathbf{do_i}\ [_{IP}\ \text{DP}\ \mathbf{e_i}\ [_{VP}\ \text{V}\ t]]]$			*!		**
$[_{CP}\ wh\ \mathbf{e}\ [_{VP}\ \text{V}\ t]]$		*!			*

The difference between the English ranking and the alternative is farther-reaching than might appear at first glance: it does not just concern the ability of a main verb to move. A grammar in which NO-LEX-MVT is dominated by both FULL-INT and OB-HD will be inconsistent with the use of a semantically empty verb like English *do* in inversion. In fact, it will be inconsistent with the *existence* of such a verb, which can never appear. Thus, we can derive a gap in the behavior of verbs from the ranking of constraints, following the line of reasoning developed by Prince and Smolensky (1993) for segmental inventories.

Pursuing this point further, we can also ask whether it is an accident that English has a semantically empty verb, and whether it is an accident that the morpheme *do* is the one used in this way. Can we characterize the presence of *do* in English as a necessary consequence of the constraint rankings, just as its absence in the grammar of tableau 9 is a necessity? The starting point for the answer is that there is only one *do* in English. When its lexical conceptual structure (LCS) is parsed, *do* is a θ-marking and argument-taking predicate. However, its LCS can also be unparsed, and this is the source of "auxiliary" *do*.

(11) a. Parsed LCS: *do*——(ACT *x*)
b. Unparsed LCS: *do*—/—(ACT *x*)

When its LCS is unparsed, *do* has no meaning; it is a "light verb" in the sense of Grimshaw and Mester (1988), using a term from Jespersen 1954. Light *do* will always vacuously satisfy NO-LEX-MVT. Only an element with an LCS is "lexical"; hence, only such an element is subject to the constraint. This is why *do* shows the characteristic auxiliary-verb property of appearing outside the lexical projection: it patterns with the semantic auxiliaries and presumably *be* in having no LCS. Light *do* will, however, violate FULL-INT, since it will have no LCS interpretation associated with it. With a parsed LCS, FULL-INT will be satisfied, so "main" or "heavy" *do* does not violate FULL-INT. Thus, light *do* will not be affected by NO-LEX-MVT, but it will violate FULL-INT, whereas heavy *do* will be regulated by NO-LEX-MVT but will satisfy FULL-INT.

We can now address the question of why *do* is the morpheme that appears when an auxiliary is required by OB-HD. This follows if, as seems reasonable enough, *do* is the lexically simplest verb of the language, though perhaps it is necessary to appeal to further details of its analysis in order to explain why it, rather than *be*, minimally violates FULL-INT. At any rate, the reason *do* appears and not *shout* or *obfuscate* is that the LCS of *do* is simpler; hence, there is less in the LCS of *do* to be unparsed. Failure to parse the LCS of *do* results in a less severe violation of

FULL-INT than failure to parse the LCS of any other verb in the language. This proposal treats FULL-INT as a "gradient constraint" (see Prince and Smolensky 1993 for theoretical background).

We can also see that it is inevitable that light *do* exists in the language, given the constraint rankings. A grammar with the rankings of English will necessarily select the least offensive FULL-INT violation in order to satisfy OB-HD, and since LCS unparsing is freely available, there will always be (at least) one candidate that minimally violates FULL-INT and is therefore optimal.

Finally, one might ask why "auxiliary" *do* must occur even when the main verb is itself *do*, if they are really both the same verb. The answer has already been implicitly given. When the LCS of *do* is parsed, it can θ-mark but cannot occur outside VP. When its LCS is unparsed, it can occur outside VP but cannot θ-mark. Thus, when the LCS of *do* is parsed, (12a) violates NO-LEX-MVT, but when it is unparsed, the sentence violates the θ-Criterion, since *do* cannot θ-mark when its LCS is unanalyzed. Assuming that the θ-Criterion is an inviolable principle, the optimal form will contain both occurrences of *do*.

(12) a. *What did he e t?
b. What did he do t?

The top half of tableau 10 shows the choice among candidates respecting the θ-Criterion and satisfying OB-HD and OP-SPEC. Candidates not respecting the θ-Criterion are shown in the bottom half of the tableau; these candidates are not generated by Gen and hence are not otherwise evaluated by the constraint hierarchy.

Tableau 10
Cooccurrence of heavy and light *do*

Candidates	OP-SPEC	NO-LEX-MVT	OB-HD	FULL-INT	STAY
$[_{CP}\ wh\ \mathbf{do}_i\ [_{VP}$ he $\mathbf{e}_i\ t]]$ (+LCS)		*!			**
☞ $[_{CP}\ wh\ \mathbf{do}_i\ [_{IP}$ DP $\mathbf{e}_i\ [_{VP}\ \mathbf{do}\ t]]]$ (–LCS, +LCS)				*	**
$[_{CP}\ wh\ \mathbf{do}_i\ [_{IP}$ DP $\mathbf{e}_i\ [_{VP}\ \mathbf{do}\ t]]]$ (+LCS, +LCS)		*!			**
$[_{CP}\ wh\ \mathbf{do}_i\ [_{VP}$ he $\mathbf{e}_i\ t]]$ (–LCS)	*θ-Criterion!			*	**
$[_{CP}\ wh\ \mathbf{do}_i\ [_{IP}$ DP $\mathbf{e}_i\ [_{VP}\ \mathbf{do}\ t]]]$ (+LCS, –LCS)	*θ-Criterion!			*	**
$[_{CP}\ wh\ \mathbf{do}_i\ [_{IP}$ DP $\mathbf{e}_i\ [_{VP}\ \mathbf{do}\ t]]]$ (–LCS, –LCS)	*θ-Criterion!			**	**

An advantage of this solution is that it eliminates positing ambiguity for *do*. That is, we no longer have to say that English has a main verb *do* and an auxiliary verb that is accidentally identical to a main verb that itself is semantically extremely vague. There is only one verb, recruited to occur in nonlexical positions because it is the least costly choice. Note that Japanese *suru* is similarly "ambiguous" between a light and a heavy use (Grimshaw and Mester 1988), inviting the same analysis. See Ritter and Rosen 1993 for related ideas about *have*.

In this view, there cannot be a language that lexically lacks a semantically empty verb, any more than there can be a language that lexically lacks an epenthetic vowel. The occurrence of such items is not regulated by lexical stipulation. Rather, the semantically simplest verb will appear if the constraint rankings for the language induce its presence, and not otherwise, just as an epenthetic vowel appears when it is induced by constraint interaction. Thus, we can predict both that a language with the constraint rankings in tableau 9 will not have a light verb like *do* and that a language with the constraint rankings of English will inevitably have such a verb. In this way, we avoid lexical stipulations concerning the inventory of the language and instead explain the visible lexical items as the result of constraint interaction (see Brisson 1994, Legendre et al. 1995, Legendre, Smolensky, and Wilson, to appear, and Grimshaw and Samek-Lodovici 1995, to appear, for similar arguments).

3.4 Do *and* Wh-*Subjects*

The one matrix interrogative configuration in which *do* does not appear is one with a *wh*-subject.

(13) a. Who saw it?
b. *Who did see it?

The key here is the formulation of OP-SPEC, which does not require that a *wh*-operator occur in [Spec, CP], just that it occur in a specifier position from which it c-commands the verbal extended projection. An interrogative clause is therefore not required to be a CP, but just a verbal projection with a *wh*-specifier. When a *wh*-phrase is a nonsubject, it will always have to move to a specifier position. The candidate positions are basically VP, IP, and CP. Both of the first two are filled, so nonsubject *wh*-phrases move to the specifier of a higher projection, which we label CP. [Spec, VP] is not a possible position for a *wh*-operator, both because it is (usually) filled and because it does not give the *wh*-operator the right scope.

The one case where the requirements of an interrogative are met without any movement arises when a *wh*-phrase is a subject. It is already in a specifier position; moreover, it is in the specifier of the highest phrase in the verbal extended projection. Thus, an IP (when the clause contains an auxiliary verb) or a VP (when no auxiliary is present) will be a perfectly good interrogative, provided it has a *wh*-phrase as subject.

As a result, a subject *wh*-phrase can never occur in [Spec, CP], because the STAY violation incurred by such movement will not be offset by satisfaction of OP-SPEC: OP-SPEC is already satisfied. By the same reasoning, a subject *wh*-phrase cannot occur in [Spec, IP] when no auxiliary is present. This is illustrated in tableau 11. The *wh*-phrase in this case would be moving from [Spec, VP] to [Spec, IP], violating STAY, again with no improvement on OP-SPEC. This is why *do* never occurs in subject *wh*-clauses.

Tableau 11
The position of subject *wh*-phrases

Candidates	OP-SPEC	NO-LEX-MVT	OB-HD	FULL-INT	STAY
☞ $[_{VP}\ wh\ V\ \ldots]$					
$[_{IP}\ wh\ \mathbf{e}\ [_{VP}\ t\ V\ \ldots]]$			*!		*
$[_{IP}\ wh\ \mathbf{do}\ [_{VP}\ t\ V\ \ldots]]$				*!	*

Thus, we conclude that subject *wh*-phrases do not move, but remain in the specifier of the verbal head with ϕ-features—that is, IP or VP. This specifier position must then count simultaneously as an A-position (by virtue of its relationship to ϕ-features) and an Ā-position (by virtue of being a scope position). The idea that subject *wh*-phrases do not move has been frequently entertained (see, e.g., Gazdar 1981, Chung and McCloskey 1983, Haider 1989, and Rizzi 1991; also Travis 1991, Vikner and Schwartz 1996, and Cardinaletti 1992 for discussion of similar issues in V2 systems).

It is important to counter an apparently overwhelming argument against the idea that *wh*-questions with subject *wh*-phrases are just VPs (when they contain no auxiliary verb) or IPs (when an auxiliary is present): this is based on selection. The very same predicates select questions with *wh*-subjects as those with other *wh*-phrases, despite the VP versus IP versus CP distinctions. How is it possible to explain why they are selected by the same predicates? This problem does not arise under the type-category theory of selection (Grimshaw 1991), in which any verbal projection with a [+wh] specifier is equivalent to any other verbal projection with the same property, as far as selection is concerned; hence, it necessarily follows that a verb that takes an interrogative will combine with all of these subcases. See section 9.1 for further discussion.

Interrogatives with *wh*-subjects show that OP-SPEC does not stipulate which specifier must house the *wh*-phrase. This suggests the desirability of a theory in which reference cannot be made to such information, in which notions like "CP" and "IP" really have no status. I return to this issue in section 10.

3.5 Negative Clauses with Do

The appearance of negation, like inversion, induces the presence of *do*. The core idea is that when *not* is present, so is a higher projection that is absent from clause structure when *not* is absent. The head of this projection is an auxiliary verb, or *do* if no other auxiliary verb is present in the clause. In this way, the analysis of *do* with negation resembles the analysis for interrogatives, although, as we will see, the situations are not identical.[8]

What requires the presence of the extra projection? A number of possibilities could be explored. One would be to appeal to the idea that T must c-command negation (Laka 1990). This

[8] I will not discuss emphatic *do* here. It may well be that the general line of explanation will support Laka's (1990) proposal that emphasis induces a projection, although this projection, like all the others discussed, will not be present in all clauses.

would force the generation of a tensed verb above *not*, and when the only contentful verb is a main verb, it would force the generation of tensed *do* as a head c-commanding negation. A second line might try to use the idea that *not* is a clitic and a verb must appear to its left to support it. This is essentially the proposal made by Roberts (1993), and as he argues, it explains why in English *do*-support entered the language at the same time as *n't*. However, whereas a clitic analysis may be correct for *n't* (though see Zwicky and Pullum 1983 and Williams 1994 for arguments that *n't* is lexically attached), it is less clearly so for *not*, which occurs unsupported elsewhere (e.g., in subjunctives, as we will see).

The proposal I will make here uses independently necessary constraints on subjects and verbs to achieve the desired result. The first constraint, SUBJ, corresponds essentially to the Extended Projection Principle (Chomsky 1981) and says that a clause must have a subject. There are two alternative formulations, either of which will be satisfactory here. The constraint may require that the highest A-specifier in a clause must be filled. Alternatively, it could require that the specifier of the highest I-related head be filled, where "I-related" includes V, T, Agr, Neg, and so on—that is, the cluster of heads that are neither lexical nor type-affecting. Which of these formulations is to be preferred depends on the theoretical development of the notions "A-position" and "I-related," and I will not address these questions here. The second constraint, CASE, requires that the head of a DP A-chain be in a Case position. CASE must dominate STAY, because the specifier of VP raises to [Spec, IP] to get Case, when I contains the Case assigner.

In the positive declaratives in (14), both constraints are satisfied: by a DP in [Spec, VP] in (14a) and by a DP in [Spec, IP] in (14b), where movement has occurred from [Spec, VP] to the higher specifier position, assuming the VP-internal subject hypothesis (see references in section 2). The reason is that the DPs in (14a) and (14b) are both in Case positions, and the clause has a subject. Inclusion of *do* could not improve the fate of the examples with respect to these or any other constraints; hence, the FULL-INT violation that accompanies the presence of *do* is fatal.

(14) a. John left.
b. John will t leave.

When a negative is present, however, the situation is disrupted. If *not* is a head, as in Roberts 1993 and Williams 1994, it is not one that has Case-assigning ability, so if the subject is in its specifier as in (15a), CASE is violated. On the other hand, if the DP is in [Spec, VP] as in (15b), CASE is obeyed but SUBJ is violated (assuming that the specifier position is an A-position; see Haegeman 1992 for an alternative perspective).

(15) a. *John not t left.
b. *Not John left.

Even if *not* is a specifier as in Zanuttini 1991, the conflict still arises, since the subject in (15a) must then be in a higher specifier, and again CASE is violated. (A more precise formulation of SUBJ must be given to eliminate the possibility that *not*, if it is a specifier, might satisfy the constraint. Perhaps SUBJ should require that an argument fill the position.) In contrast, the presence of an intervening adjoined element such as *rarely*, as in *John rarely left on time*, does not affect satisfaction of the two constraints. Thus, they conflict when negation is present but not otherwise.

Tableau 12
Presence of *do* with negation

Candidates	NO-LEX-MVT	CASE	OB-HD	SUBJ	FULL-INT	STAY
[*John* **not** [$_{VP}$ *t* left]]		*!				
[**not** [$_{VP}$ John left]]				*!		
☞ [*John* **did** [*t* **not** [$_{VP}$ *t* leave]]]					*	
[*John* **left** [*t* **not** [$_{VP}$ *t* **t**]]]	*!					

The candidate in (16) does succeed in satisfying both SUBJ and CASE, but at the cost of a NO-LEX-MVT violation, since the main verb heads a nonlexical projection. The ranking of NO-LEX-MVT higher than FULL-INT, established above for inversion in interrogatives, thus properly eliminates this candidate.

(16) *John left not.

The conflict caused by *not* is resolved by the presence of *do*, which is both the feature-carrying head and the highest I-related head in (17), just as *will* is in (14b). Provided that FULL-INT is dominated by both SUBJ and CASE, this candidate will be the optimal one.

(17) John did not leave.

Tableau 12 displays the analysis for a clause with no meaningful auxiliary. (I have omitted OP-SPEC from the tableau since it is vacuously satisfied by all candidates.) The tableau assumes that *not* is a head, although as previously mentioned, this is not crucial. It also assumes that subjects are generated VP-internally and shows the resulting traces, factored out elsewhere in the article.

One instance of *do* makes it possible to satisfy both subject-related constraints: additional instances would constitute fatal violations of FULL-INT, although I do not show these cases. Note the crucial ranking of FULL-INT with both SUBJ and CASE. If FULL-INT dominated both constraints, then (17) could not be the optimal candidate; instead, either (15a) or (15b) would be, depending on the ranking between SUBJ and CASE. If FULL-INT dominated just SUBJ, then (15b) would be optimal, since it satisfies CASE and FULL-INT, violating only SUBJ. If FULL-INT dominated just CASE, then (15a) would be optimal, since it satisfies SUBJ and not CASE. The ranking between NO-LEX-MVT and FULL-INT is crucial also, as pointed out already.

In the account given here, (15a) is ungrammatical because there is an alternative that better satisfies the constraints, given the constraint rankings for English. This solution contrasts with proposals by Pollock (1989) and Chomsky (1991), discussed in Baker 1991, which appeal to hidden elements or movements. Pollock's account posits a null counterpart of *do*, which must move to T, the movement being blocked when *not* is present. In a similar vein, Chomsky (1991) uses obligatory LF V-to-I raising, triggered by an invisible affixal Q morpheme, but blocked by *not*.

The full system of constraints predicts the distribution of *do* in a negative question: here *do*

will appear even when the *wh*-phrase is in subject position, for the same reason it appears in negative declaratives, and only one *do* is permitted.

(18) a. Who did not leave?
b. *Who not left?

Construction of the tableaux for these examples is left for the reader.

What happens when a clause does not contain a head bearing ϕ-features? One answer is that CASE is simply violated in this configuration. This is the case in infinitives and subjunctives (thanks to Hubert Haider for drawing the importance of subjunctives to my attention).[9] The conflict that gives rise to *do*-support in (17) is not in effect, with the result illustrated for subjunctives in (19).

(19) a. I insist that John not leave.
b. *I insist that not John left.
c. *I insist that John do not leave.
d. *I insist that John leave not.

As tableau 13 illustrates, the extended projection in (19a), with the subject in the specifier of *not*, satisfies SUBJ and violates CASE. Since none of the other candidates can satisfy CASE either, and they all do worse on one of the other relevant constraints, (19a) is optimal, and the variant that includes *do* is impossible. (Calculations of STAY violations are omitted, as they involve many irrelevant commitments and have no effect on the outcome here.)

Thus, the different behavior of *not* in tensed and nontensed clauses follows from the effect of CASE. Nothing need be said about *not* itself. This contrasts with the analysis given in Williams 1994, where *not* has an arbitrary [− tense] specification and hence does not take a tensed complement.

Under this proposal, the nature of the problem solved by "*do*-support" with negation is a little different from the nature of the problem solved by "*do*-support" in interrogatives. In the

Tableau 13
Negation in subjunctives

Candidates	NO-LEX-MVT	CASE	OB-HD	SUBJ	FULL-INT	STAY
☞ [$_{IP}$ *John* [**not** [$_{VP}$ *t* leave]]]		*				?
[**not** [$_{VP}$ John leave]]		*		*!		?
[$_{IP}$ *John* **do** [*t* **not** [$_{VP}$ *t* leave]]]		*			*!	?
[$_{IP}$ *John* **leave** [*t* **not** [$_{VP}$ *t* **t**]]]	*!	*				?

[9] Imperatives, such as *Do not collect $200*, do not pattern with subjunctives and infinitives, although the reason is unclear, having to do perhaps with their morphology (note that they take finite tag questions) or the missing subject.

interrogative case the role of *do* is to fill an otherwise empty head. In the negation case the role of *do* is to provide a head that is structurally higher than *not* and that agrees with the subject. More precisely, the occurrence of *do* in inversion depends on the ranking of OB-HD with FULL-INT. The occurrence of *do* with negation depends on the ranking of CASE and SUBJ with FULL-INT. But both depend on the ranking of NO-LEX-MVT and FULL-INT. This partial separation receives indirect support from the historical development of English: Roberts (1993) notes that the use of *do* in interrogatives predates its occurrence in negatives. This suggests that the two instances of *do*-support represent the same solution to different problems, rather than the same solution to the same problem. In any case, it is no accident that the same verb appears in both circumstances: the verb that minimally violates FULL-INT.

In this analysis, then, the finite auxiliary is freely generated in any head of the verbal extended projection, its distribution being reined in by a set of constraints. One consequence of this is that no movement is involved even in cases where the auxiliary precedes *not*. This will later turn out to be important: we will see that the effects of raising an auxiliary verb to C are detectable from their interaction with PURE-EP, whereas the presence of negation produces no such effect.

4 Adjunction, Heads, and Purity of Extended Projection

As is well known, inversion in interrogatives is limited to main clauses in most varieties of English (see McCloskey 1992 for analysis of inversion in Hibernian English).

(20) a. They found out when they should take the train.
b. *They found out when should they take the train.

This simple fact is initially quite puzzling. OP-SPEC will be violated unless the *wh*-phrase is in a specifier in subordinate interrogatives, for just the same reason as in matrix interrogatives. Yet if this is correct, OB-HD is regularly violated in examples like (20a). I will develop a solution here that attributes the difference between matrix and subordinate interrogatives to a constraint that conflicts with OB-HD, namely, PURE-EP. The constraints conflict because filling the head position of a subordinate clause by head movement would violate PURE-EP. Since PURE-EP is the dominant constraint, and since it is not possible to satisfy both PURE-EP and OB-HD, the structure with no head is well formed. It is the optimal structure; hence, it is the only one possible.

4.1 Purity of Extended Projection

PURE-EP is loosely related to the Projection Principle proposed in Chomsky 1981, and it prohibits movement into the head of, and adjunction to, a subordinate clause. This is a development of two proposals in the literature. The first, made by Rizzi and Roberts (1989), is that the root nature of certain head movements (see Emonds 1975) follows from the Projection Principle. In particular, Rizzi and Roberts propose that head movement that is direct substitution is disallowed in selected contexts. The second is McCloskey's (1992) argument that configurations in which inversion is ruled out seem to be systematically related to configurations in which adjunction is disallowed, the correspondence being particularly clear in the case of arguments. The constraint proposed by

McCloskey, based on that in Chomsky 1986, states, "Adjunction to a phrase which is s-selected by a lexical head is ungrammatical." The contrast in (21), from McCloskey 1992, illustrates the motivation for the constraint.

(21) a. It's probable that in general/most of the time he understands what is going on.
b. *It's probable in general/most of the time that he understands what is going on.

(Note also the observation made by Rochemont (1989) that topicalization adjoins to either CP or IP in a matrix clause, but only to IP in a subordinate clause.)

Both of these proposed constraints make specific reference to selection. That is, they take the primary cut to be between selected arguments, on the one hand, and matrix and adjunct clauses, on the other (see also Kayne 1982, 1983, Den Besten 1983). This split was followed in Grimshaw 1993; there is, however, a problem with such a formulation. McCloskey shows that adjunction to relative clauses and adjuncts is not possible, despite the fact that they are not selected.

(22) a. *The people [when you get home [who want to talk to you right away]]...
b. *I graduated [while at college [without having really learned anything]].

This suggests that all nonroot clauses, including adjuncts and relatives, are subject to the constraint. Moreover, as Rizzi and Roberts (1989) note, inversion is impossible in relative clauses, again suggesting that all subordinate clauses behave in the same way. This is supported by patterns such as the one displayed by temporal adjuncts and relative clauses introduced by *when*, illustrated in (23a) and (23b). They behave exactly like the corresponding indirect question in (23c), and unlike the corresponding matrix question in (23d).

(23) a. I left when *he had*/**had he* arrived.
b. The day when *he had*/**had he* arrived...
c. I found out when *he had*/**had he* arrived.
d. When **he had*/*had he* arrived?

If PURE-EP governs adjuncts, then both patterns have the same explanation: in each case inversion violates PURE-EP, and since there is no movement-inducing constraint dominating PURE-EP, the optimal forms violate OB-HD.

Examples with *whether*, raised by Armin Mester and Andrew Radford (personal communication), make the same point: as in complements, there is no inversion in adjuncts introduced by *whether*.

(24) a. Whether we can agree or not, we have to make a decision.
b. *Whether can we agree or not, we have to make a decision.

The most attractive position is obviously that the absence of inversion in all of these cases reflects a general property of adjuncts and complements—that is, of subordinate clauses. Hence, PURE-EP must ban adjunction and head movement for all subordinate clauses.

PURE-EP
No adjunction takes place to the highest node in a subordinate extended projection; and no movement takes place into the highest head of a subordinate extended projection.

I will leave a number of questions open here, including whether head movement is substitution (as Rizzi and Roberts (1989) argue for I-to-C movement) or adjunction. Also, it is possible that PURE-EP is properly understood as two constraints, one on adjunction and one on head movement, which both regulate subordinate clauses. In this case, it will be possible to rank them separately. For English I see no reason to separate them, so I will continue to treat PURE-EP as a single constraint.

In order to be clear about the effects of PURE-EP, some further explication of the notion of an extended projection is necessary. A clause is the highest extended projection of V: that is, if CP is present, it is normally the highest node, and other extended projections of V, such as XP or IP, are not highest. The highest head of the extended projection of V is C if CP is present, I if there is no CP, and so on. PURE-EP is therefore violated by head movement or adjunction to complements to lexical heads, relative clauses, and adjuncts, which are all subordinate clauses. It is not violated by head movement to the top head of a matrix clause, or adjunction to the highest node of a matrix clause, since matrix clauses are not subordinate. Similarly, it is never violated in complements to functional heads, since the highest node or highest head in such a complement is not the highest in its extended projection. The definition thus essentially singles out *subordinate clauses* for special restrictions.

This leaves us with one problem: if adjunction and head movement are both ruled out in adjuncts, including relative clauses, why is head movement admitted in one kind of adjunct clause—namely, conditionals—even though adjunction is disallowed?

(25) a. Had I learned anything at college, I would be better off now.
b. *While at college had I learned anything, I would be better off now.

This is a dilemma that can be dissolved under OT, if PURE-EP is violated in (25a) because of the effects of a higher-ranked constraint. I will suggest in section 6 that this is in fact the case here.

4.2 Purity of Extended Projection and Subordinate Interrogatives

PURE-EP is irrelevant for matrix clauses, clearly; in fact, it is vacuously satisfied in all of the cases we have looked at so far, and has been omitted from tableaux. Subordinate interrogatives are subordinate clauses in the sense relevant for PURE-EP, however. Let us for now consider just the CP version of the complement, with *wh*-fronting. These candidates satisfy OP-SPEC at the cost of a STAY violation. With respect to the other constraints there are two possibilities: if inversion occurs, OB-HD will be satisfied (at the cost of a STAY violation), but PURE-EP will be violated, since the CP is a subordinate clause. If inversion does not occur, OB-HD will be violated, but PURE-EP will be satisfied (and STAY will be violated only once, although this is not relevant to determining the optimal form). Since the clause with no inversion is the grammatical one, we conclude that PURE-EP $\gg$ OB-HD; hence, the optimal form is one that satisfies PURE-EP and OP-SPEC but violates OB-HD. Ranking PURE-EP above OB-HD thus derives the absence of inversion in subordinate interrogatives, illustrated in (20). There is another candidate to be ruled out here, included as the final candidate in tableau 14. Here the auxiliary has been generated within the projection containing the *wh*-phrase, rather than moving there. Since this strategy evades a violation of PURE-EP, the candidate threatens the success of the actual winner. However, CASE is

Tableau 14
Subordinate interrogatives: candidates that satisfy OP-SPEC

Candidates	PURE-EP	OP-SPEC	CASE	OB-HD	SUBJ	FULL-INT	STAY
$[_{CP}$ *wh* **should**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V *t*]]]	*!						**
☞ $[_{CP}$ *wh* **e** $[_{IP}$ DP **should** $[_{VP}$ V *t*]]]				*			*
$[_{IP}$ *wh* **should** $[_{VP}$ DP V *t*]]			*!				*

violated here, since the DP is never in a specifier-head relationship with the Case-marking head. Thus, the final candidate is eliminated. (Having made this point, I will set such candidates aside, and omit SUBJ and CASE from tableaux in this section, along with NO-LEX-MVT.) If the picture is as in tableau 14, then CASE ≫ OB-HD. If SUBJ is also violated by the final candidate, which depends on the exact formulation of the constraint, we can conclude only that at least one of CASE and SUBJ dominates OB-HD.

Some alternative candidates that do not satisfy OP-SPEC are illustrated in tableau 15. A CP with no *wh*-movement but with inversion violates PURE-EP, which guarantees that it will lose to one of the other candidates. A CP with no *wh*-movement and no inversion, the last candidate in tableau 15, satisfies PURE-EP, but at the cost of violating OP-SPEC and OB-HD, so it too compares unfavorably with the optimal candidate in the first row. An informative comparison is between the optimal candidate and the last candidate: an IP with no *wh*-movement. This extended projection necessarily violates OP-SPEC, but it satisfies all the other constraints. Comparison of this alternative with the grammatical one reveals that there is a crucial ranking between OP-SPEC and OB-HD: OP-SPEC ≫ OB-HD. Otherwise, the IP structure would be optimal, since it violates OP-SPEC but not OB-HD.

We can now see why *do* never occurs in subordinate interrogatives, given the analysis of *do* from section 3.

(26) a. *I don't know what did she say.
b. *I don't know what she did say.
c. I don't know what she said.

Tableau 15
Candidates that violate OP-SPEC, compared to the optimal candidate

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
☞ $[_{CP}$ *wh* **e** $[_{IP}$ DP **will** $[_{VP}$ V *t*]]]			*		*
$[_{CP}$ **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V **wh**]]]	*!	*			*
$[_{IP}$ DP **will** $[_{VP}$ V **wh**]]		*!			
$[_{CP}$ **e** $[_{IP}$ DP **will** $[_{VP}$ V **wh**]]]		*!	*		

Tableau 16
Subordinate interrogatives with *do*

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
[$_{CP}$ **wh do$_i$** [$_{IP}$ DP **e$_i$** [$_{VP}$ V *t*]]]	*!			*	**
☞ [$_{CP}$ ***wh*** **e** [$_{VP}$ DP V *t*]]			*		*
[$_{CP}$ **wh e** [$_{IP}$ DP **do** [$_{VP}$ V *t*]]]			*	*!	*

As tableau 16 illustrates, when no auxiliary verb is present and there is no inversion, a subordinate interrogative violates OB-HD because the head of the projection housing the *wh*-operator is empty. Including *do* adds a FULL-INT violation, and if it inverts, a PURE-EP violation. Since OB-HD is violated in subordinate interrogatives in all candidates that respect PURE-EP, and since the only virtue of *do* is that it can satisfy OB-HD, the presence of *do* can only add violations in this situation; it can never reduce them. Hence, there can be no advantage to the presence of *do*; hence, it is impossible.

If *if* and *whether* are heads, then both inversion and the appearance of *do* will be ruled out in subordinate yes-no questions because the C position will be filled by a complementizer. As a result, the *if* and *whether* forms satisfy OB-HD, without inversion or the appearance of *do*. Tableau 17 shows the optimal candidate, for an input that includes an auxiliary, under this analysis. Since inversion violates STAY and *do* violates FULL-INT, it is clear that the inverted and *do* forms will always lose to the optimal ones.

(27) a. They asked if/whether he will leave.
b. *They asked if/whether will he leave.
c. They asked if/whether he left.
d. *They asked if/whether he did leave.

If, on the other hand, *whether* is a specifier of CP, as in Kayne 1991, then the analysis for clauses with *whether* is essentially the same as for other subordinate interrogatives, except for the fact that no *wh*-movement is involved, and hence there is no STAY violation. Comparison of the optimal *if* clause in tableau 17 and the optimal *whether* clause in the specifier analysis shows that under Kayne's proposal, the two clause types must not be competitors. If they were, then the *if* variant would be optimal because it does not violate OB-HD. Perhaps the structural difference between them is sufficient to guarantee that their logical forms are distinct. However, another reason why they might not be in the same candidate set is provided by Donca Steriade's suggestion

Tableau 17
Subordinate interrogatives with *if* and *whether* as heads

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
☞ [$_{CP}$ **if/whether** [$_{IP}$ DP **will** [$_{VP}$ V]]]					

(personal communication) that the *if* clause is really a kind of adjunct. This is supported by Steriade's observation that *if* clauses occur naturally only with verbs that allow null complement anaphora as defined in Grimshaw 1979.

So far, then, three questions concerning inversion patterns have been addressed: why there is no inversion in matrix declaratives, why there is inversion in matrix interrogatives, and why matrix and subordinate interrogative clauses should show different inversion patterns. OB-HD makes heads obligatory except where PURE-EP makes them impossible. The fact that an empty head is possible is a side effect of the fact that movement is not. Since PURE-EP does not affect matrix clauses, a head can be empty only in a complement clause or adjunct.

4.3 Some Alternatives

The essential property of the solution for inversion is that each component principle is fully general: none of the principles is specific to interrogatives or to inversion, for example. In fact, there is no theory of inversion; it is just the result of OB-HD, whose effects are seen whenever the effects of PURE-EP do not obscure them. Conflict among general constraints, and the resolution of the conflict, lies behind the observed patterns.

Consider an alternative to the constraint conflict proposal for the absence of preposing in subordinate interrogatives—namely, that there is a null C, or a C filled by [+wh], in subordinate interrogatives. Now it is necessary to distinguish in a principled way between the empty head in this case, which by hypothesis would be filled by a null element, and other empty heads, such as the one in a matrix interrogative (and others to be analyzed in section 8), which cannot be filled by a null complementizer. One might take the position that only selected heads can be null. This would run into serious empirical problems with adjuncts (see section 4.1) and *that* complements (see section 8). But it is worth dwelling on, because it has a revealing property—it builds the effects of PURE-EP into the principle governing empty heads. The real situation is that heads can be empty in exactly the case where PURE-EP will not allow them to be filled. This is a direct consequence of constraint conflict but not of an empty heads solution, where elaboration of the constraint, reflecting the effects of conflict, must be stipulated. A useful example is the following:

> *Specifier Licensing Condition* (Plunkett 1991:128)
> If a maximal projection is in a nonsubcategorized position, its specifier may not be filled at S-Structure unless its head position has also been filled by that time.

This is an accurate description of the empirical situation, setting aside adjuncts; examining each part of the condition reveals that it states the effects of the interaction of the relevant constraints. The highly specific character of this kind of solution entails that it cannot extend over the range of cases that follow from the OT proposal: this will be particularly clear in the case of obligatory complementizers (section 9). It is, moreover, inevitably language-particular (see section 7).

Similar points hold with respect to the proposal for inversion developed by Rizzi (1996) and Haegeman (1992). It uses the idea that a head with a certain feature has to raise in cases of inversion in order to participate in a specifier-head relationship with a specifier with the same feature, to meet a well-formedness principle (the *Wh*-Criterion for the interrogative cases). An

important insight in this work, that the relationship of specifiers and heads lies behind inversion, is, however, incorporated into the present proposal.

A large part of the work done by the *Wh*-Criterion and related principles results from an auxiliary hypothesis concerning the initial distribution of the feature: it is on I at D-Structure in matrix clauses (hence, it must raise to C), and it is on C already in subordinate clauses (hence, inversion is not required to put it in the right relationship to [Spec, CP]). What is the result of constraint interaction in the present article is instead the result of feature distribution in Rizzi's and Haegeman's approach. From the present perspective, the *Wh*-Criterion, like the Specifier Licensing Condition, builds in the effects of the independently existing PURE-EP. As expected, this is accompanied by significant loss of generality. For example, there is no relationship between the explanation for inversion and the explanation for the obligatoriness of *that* discussed below: inversion is necessary to get features in the right place, and *that* is necessary for some other reason.

The constraint conflict proposal is more general in another way: it predicts that any constraint that forces an element to occur in specifier position will have the effect of inducing inversion. English offers a number of other instances of inversion, some of which do not seem to be insightfully subsumed under a feature-based account. These inversions have the same distribution as inversion with negative preposing, analyzed in section 5.

(28) a. So wealthy will he become that...
b. I will be rich and so will you.
c. I don't like coffee and neither/nor does Bill.
d. Only under these circumstances will you be able to win.

Although of course possible, it seems unlikely that there is a criterion governing specifier-head relationships for all of these, with a feature generated on I in matrix clauses and so forth. Rather, it seems that the patterns in (28) reflect the existence of a set of expressions that must occur in specifier position. Inversion is simply a structural consequence.

Maximally general principles will inevitably conflict. The alternative is to formulate more specific principles that are designed never to conflict, and one price is generality. Only by allowing constraints to conflict can we avoid building the effects of every principle into all of the others that it potentially conflicts with. There is another price: universality. These points will be developed further in section 7.

5 Inversion inside a Subordinate Clause

We know from the previous discussion that OB-HD will induce inversion wherever PURE-EP does not prevent it. PURE-EP is violated by inversion into the highest head of a subordinate clause—that is, into the highest head of the extended projection of V. It is not violated, however, by inversion into other heads of the extended projection, since they are not the highest heads. Therefore, inversion should be possible when the relevant head is not the highest head of a subordinate clause but is contained within the extended projection. This prediction is verified by the pattern of inversion that accompanies preposing of a negative.

If a negative operator is preposed, inversion is required, as illustrated in (29) (Klima 1964, Liberman 1974).

(29) a. Never/Under no circumstances will she work this hard again.
b. *Never/Under no circumstances she will work this hard again.

In the absence of preposing, inversion is not allowed.

(30) a. She will never work this hard.
b. *Will she never work this hard.

This paradigm follows the same pattern as that of interrogatives: negative operators occur in specifier position, so a projection is present when preposing occurs, which is otherwise absent. The head of this projection is empty. Hence, head movement must occur to fill the head, and inversion follows.

What is the projection that is present when negative preposing occurs? It cannot be CP since the negative element follows C in subordinate clauses, where the entire paradigm can be replicated.

(31) a. She said that never/under no circumstances would she work this hard again.
b. *She said that never/under no circumstances she would work this hard again.
c. She said that she would never work this hard again.
d. *She said that would she never work this hard again.

Nor can the projection be IP since [Spec, IP] is already filled by the subject. Thus, the projection must be a further member of the verbal extended projection, which intervenes between IP and CP, and which I label *XP*. The relative position of the *wh*-phrase and the preposed negative follows from the nature of the operator. *Wh*-movement is type changing, so the *wh*-operator must be outside everything pertaining to the propositional structure. Negative preposing, on the other hand, is a variety of sentential negation, so the operator c-commands IP but is c-commanded by C. There is no need, then, to stipulate which specifier position each operator appears in.[10]

The constraints discussed so far dictate that the structure of the matrix clause in (29a) is (32a), with no CP present just as for matrix declaratives, whereas the structure of the complement in (31a) is (32b).

(32) a. $[_{XP}$ never/under no circumstances . . . X $[_{IP}$ DP I $[_{VP}$ V . . . t]]]
b. $[_{CP}$ C $[_{XP}$ never/under no circumstances . . . X $[_{IP}$ DP I $[_{VP}$ V . . . t]]]]

The discussion here is simplified by proceeding as if all negative phrase operators are subject to OP-SPEC and therefore must move. This is approximately true for some, presumably those for which sentential scope is the only possibility.

[10] Teun Hoekstra (personal communication) raises the question of whether *wh*-movement and negative preposing can cooccur, in examples like *Which book will never in her life Mary read?* Such an example presumably violates Relativized Minimality (Rizzi 1990) and certainly has a highly marginal status. It seems clear, however, that this version comes closest to well-formedness—positioning the auxiliary after the proposed negative seems worse, which is what the proposal made here would predict. Exchanging the positions of the *wh*-phrase and the negative gives clear ungrammaticality.

Tableau 18
Negative-induced inversion in matrix clauses *(u. no circs.* stands for *under no circumstances)*

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
$[_{IP}$ DP will $[_{VP}$ V *u. no circs.*]]		*!			
$[_{XP}$ **e** $[_{IP}$ DP will $[_{VP}$ V *u. no circs.*]]]		*!	*		
$[_{XP}$ *u. no circs.* **e** $[_{IP}$ DP will $[_{VP}$ V *t*]]]			*!		*
☞ $[_{XP}$ *u. no circs.* **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V *t*]]]					**
$[_{XP}$ **will**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V *u. no circs.*]]]		*!			*

(33) a. *She would do this under no circumstances.
b. Under no circumstances would she do this.

It is not true for, say, *never*. I assume that this reflects the fact that such negatives can take scope from more than one position, unlike *wh*-phrases.

Tableau 18 shows how inversion is induced by preposing. If the matrix is an IP, then there will be no possibility for preposing in the first place, so OP-SPEC will be violated. If the matrix is an XP, there are four possibilities: no inversion and no preposing will violate OB-HD and OP-SPEC, preposing without inversion will violate OB-HD, inversion without preposing will violate OP-SPEC, but preposing with inversion will violate nothing other than STAY twice. Since STAY is ranked below both OP-SPEC and OB-HD, as we already know, the form that violates only STAY is optimal and grammatical. In this way, the constraints and rankings predict that preposing ''induces'' inversion, and inversion is impossible without preposing.

(31) shows that inversion with negative preposing has no matrix-subordinate contrast, unlike inversion in interrogatives. The reason is that PURE-EP is vacuously satisfied by inversion into X—the highest head of the extended projection in (31a) is the C and not the X. In general, PURE-EP is violated by head movement into the complement of a lexical head, but not by movement into the complement of a functional head; this follows from the fact that complements to functional heads are not clauses. An XP embedded within a CP is thus like a matrix clause in the critical respect, and the pattern of constraint violation and satisfaction is exactly the same for negative preposing in a subordinate clause and in a root clause, as can be seen from comparing tableau 19 with tableau 18.

As expected, given this line of reasoning, PURE-EP admits adjunction to VP (when dominated by IP) and to IP (when dominated by CP), as can be seen in (34), based on McCloskey 1992.

(34) They announced that at Christmastime $[_{IP}$ the president has generally $[_{VP}$ gone to visit his mother]].

This is due to the fact that PURE-EP is not violated by adjunction to the complement of a functional head, just as it is not violated by movement into the head of such a complement.

Tableau 19
Negative-induced inversion in subordinate clauses

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
[$_{CP}$ **that** [$_{IP}$ DP will [$_{VP}$ *u. no circs.*]]]		*!			
[$_{CP}$ **that** [$_{XP}$ **e** [$_{IP}$ DP will [$_{VP}$ V *u. no circs.*]]]]		*!	*		
[$_{CP}$ **that** [$_{XP}$ *u. no circs.* **e** [$_{IP}$ DP will [$_{VP}$ V *t*]]]]			*!		*
☞ [$_{CP}$ **that** [$_{XP}$ *u. no circs.* **will**$_i$ [$_{IP}$ DP **e**$_i$ [$_{VP}$ V *t*]]]]					**
[$_{CP}$ **that** [$_{XP}$ **will**$_i$ [$_{IP}$ DP **e**$_i$ [$_{VP}$ V *u. no circs.*]]]]		*!			*

Two further issues arise in connection with tableau 19. First, what happens when the CP is absent? This will be taken up in section 9. Second, why is it not possible for subordinate interrogatives to elude the effects of PURE-EP in the same way? What prevents, for example, the containment of a subordinate interrogative structure as a complement to *that*, giving *They found out that when should they take the train* as the grammatical alternative to (20a–b)? Of course, this question arises independently of the present proposal, and so far it has not received a general answer. Two possibilities suggest themselves. The answer may lie in the noninterrogative character of *that*, which might be represented by specifying it as [− wh] (see section 8).

Returning to negative preposing, it is important to stress that the structure assigned to a clause is entirely determined by the constraints. Hence, the analyst cannot simply declare that some clause has a certain structure, without providing the system of constraints that will guarantee that desired result. In the present case the constraints require that the XP intermediate verbal projection be omitted except when preposing to specifier position occurs. An XP that is empty will always violate OB-HD, and moving an auxiliary to fill the head X position will always violate STAY. Thus, the optimal representation of a clause will not include XP unless some constraint ranked higher than STAY can be satisfied by virtue of its presence. As a consequence, the structure of a subordinate clause with a preposed negative is different from that of one with no preposing. One has the extra XP and the other does not. This is crucial to inversion, of course: when the XP is present, inversion must occur; when the XP is absent, inversion is not possible.

6 Inversion in Adjuncts

PURE-EP is violated by inversion into the head of any subordinate clause, including an adjunct. Hence, adjuncts systematically resist XP adjunction and inversion. However, as mentioned above, inversion is possible in conditional adjuncts, which show the pattern illustrated in (35)–(36), discussed in Rizzi and Roberts 1989, Pesetsky 1989, and Iatridou and Embick 1994.

(35) a. Had I been on time, I would have caught the train.
b. Were he to be asked, he would probably say no.
c. Should it ever happen, you will be sorry.

(36) a. *I had been on time, I would have caught the train.
b. *He were to be asked, he would probably say no.
c. *It should ever happen, you will be sorry.

These examples show that a higher-ranked constraint can force violation of PURE-EP. In support of this, note that I-to-C movement is sometimes also possible in complements, though not in English. In the Aux-to-Comp process studied by Rizzi (1982:chap. 3) and Raposo (1987), an Aux raises to C to assign Case to an otherwise Caseless subject. Here too PURE-EP is overridden by another constraint, this time in a complement.

There are two properties of conditionals that might form the basis of the relevant constraint: the morphology of the auxiliary and its semantics. Unlike conditionals introduced by *if*, which allow any auxiliary to occur, inverted conditionals admit only certain auxiliaries, those in (35), which never occur in this form in declaratives (apart from *should* in its root meaning).[11] These auxiliaries, then, are not independent elements, but require a connection to the consequent. The constraint COND enforces this restriction, by requiring a dependent head to c-command the extended projection containing it. The idea is that the inverting auxiliaries are semantic and/or morphological dependents, and thus must be locally accessible to the supporting main clause, and hence at the top of the extended projection that houses them. COND dominates PURE-EP; hence, as tableau 20 shows, the inverted form is grammatical despite the violation of PURE-EP.

In a clause introduced by the conditional element *if*, there is no dependency of relevance to COND, and the constraint is satisfied without inversion. In this circumstance, inversion will violate STAY and will not improve the status of the extended projection on any other constraint, hence the ungrammaticality of examples like (37b).

(37) a. If he were to be asked, he would probably say no.
b. *If were he to be asked, he would probably say no.

It is important that the *if* and inversion conditionals are not in the same candidate set, given that inversion conditionals always violate PURE-EP and STAY whereas *if* conditionals respect both. The inversion conditionals would always be ungrammatical if the two were in competition. The

Tableau 20
Inversion in conditional adjuncts

Candidates	COND	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
$[_{IP}$ DP **had** $[_{VP}$ V ...]]	*!					
☞ $[_{XP}$ **had**$_i$ $[_{IP}$ DP **e**$_i$ $[_{VP}$ V ...]]]		*				*

[11] The auxiliary *do* will never invert, because it has neither the semantics nor the morphology to be subject to COND. Pesetsky (1989) attributes absence of inversion with *do* to its language-particular status, which makes it inert. In the present system, *do* is most certainly not inert, since OB-HD induces *do* to move just like any other auxiliary. Indeed, *do* is not so very language-particular either, given the proposal in section 3.3.

issue arises in any theory with economy constraints; see Iatridou and Embick 1994 for discussion of this point and an argument that the two kinds of conditional have different logical forms.

In sum, inversion in conditionals is motivated not by OB-HD, which is dominated by PURE-EP in English, but by a constraint that dominates PURE-EP. Hence, conditionals provide the lone example of inversion into the head of a subordinate clause in the language.

7 Typological Consequences of Constraint Ranking

As Prince and Smolensky (1993) show, positing universal constraints subject to ranking by individual grammars offers a theory of language typology, with often striking predictions. (See also Legendre, Raymond, and Smolensky 1993 for an OT typology of case systems.) It is not strictly speaking possible to determine the effects of alternative rankings of constraints without knowing what all the constraints of UG are. Nonetheless, it is revealing to examine rerankings, and in particular to compare reranking with parametric accounts of variation.

As an illustration of the systems generated with alternative rankings, consider the interaction of STAY with OB-HD and OP-SPEC, crucially ranked in English with STAY dominated by both OB-HD and OP-SPEC. The six possible rankings of these three constraints are illustrated in (38).

(38) a. OP-SPEC OB-HD STAY
b. OB-HD OP-SPEC STAY
c. STAY OP-SPEC OB-HD
d. STAY OB-HD OP-SPEC
e. OB-HD STAY OP-SPEC
f. OP-SPEC STAY OB-HD

(38a) shows the English option, giving *wh*-movement and inversion. Both (38c) and (38d) yield systems with neither *wh*-movement nor inversion, since STAY suppresses the effects of both OB-HD and OP-SPEC. (38e) in fact yields the same result: when OB-HD dominates STAY and STAY dominates OP-SPEC, the effect is the same as when STAY dominates both. This is because the ranking of OP-SPEC relative to STAY will prohibit *wh*-movement; hence, there will be no CP present and no empty C to fill. Thus, rankings (38c–e) all give a system with no movement.[12] (38f) corresponds to a system that has *wh*-movement but no inversion. These all seem to be natural possibilities.

One a priori possible language type is characterized as impossible—namely, one in which there is no general inversion process, yet there is inversion, but no *wh*-movement, in interrogatives. This is ruled out by the reasoning governing (38e): without XP-movement to specifier position, there is no head to be filled.

Finally, the ranking in (38b) gives a system in which both *wh*-movement and inversion occur in a matrix clause, and also in a subordinate clause if OB-HD dominates PURE-EP. If, however,

[12] If Japanese and Korean "*wh*-phrases" are, as first argued in Kim 1989, simply QPs with no *wh*-properties, then the absence of movement might be properly attributed to the irrelevance of OP-SPEC.

PURE-EP outranks OB-HD, in subordinate clauses there will be no *wh*-movement (compare the first and third candidates in tableau 15). Whether this corresponds to a possible language, or whether some other constraint interferes here, perhaps concerning selection, is a question that I leave open.

Reranking constraints gives typological effects of the kind treated as parametric in other perspectives. Within OT, the constraints are universal. Whether the effects of a constraint are visible in a given language depends on the constraint rankings. In contrast, if only inviolable constraints are admitted into the theory, then some notion like a parameter is essential, since there is no set of nonparameterized constraints such that every language satisfies them. Consider, for example, the descriptive generalization cited in section 4.3 concerning the distribution of inversion in English, which, as noted there, is an inviolable counterpart, in some sense, of the proposed OT constraint system. It is accurate for English, but it is not true of all languages, and it cannot be a universal constraint, but must be parametric. Hence the need for parameters—they accommodate language variation in a system of inviolable constraints. In contrast, when such generalizations are understood not as part of the grammar of any language but rather as descriptions of the state of affairs that results from the constraints as ranked in a particular grammar, the constraints are seen to be universal and not parameterized.

There is a systematic relationship between the constraint rankings in an OT grammar and the formulation of the consequences of these rankings as an inviolable constraint, varying parametrically. What happens if we reformulate a violable constraint C_v as an inviolable constraint C_i? If C_v is undominated, no change is required. However, if C_v is dominated, the reformulation will have to build into C_i the effects of its interaction with every dominating constraint. The more numerous the constraints that crucially dominate C_v, the more complicated the formulation of C_i will have to be. Needless to say, the form that C_i eventually takes will vary crosslinguistically, since C_v stands in different dominance relations in different grammars.

Variation determined by constraint interaction entails the existence of an entire set of grammars: there is no way to simply eliminate a system by stipulation. Given the constraints, each grammar is inevitable, as illustrated by (38). Of course, the constraints could be wrong or other constraints could be at play, but any change in the posited constraints, or the addition of new ones, will itself make further predictions about possible rerankings. For this reason, there is no way to surgically remove exactly those systems we wish to dispose of. This is not true of a parametric system. For the sake of illustration, suppose we posit a parametric system using inviolable constraints to replace the one posited here. We could formulate it as in (39).

(39) Matrix/Subordinate interrogatives have *wh*-movement/no *wh*-movement.
Matrix/Subordinate interrogatives have inversion/no inversion.

This system allows the problematic system yielded by ranking (38b). It also allows the grammar that reranking of the universal constraints makes impossible: inversion without *wh*-movement. But the point is that it can easily be reformulated, in any way we choose. For instance, we could write in a dependency between the specification concerning *wh*-movement and the specification concerning inversion. Any other arbitrary dependency could equally well be established. The

reformulation may involve complication, but it is always possible. In the limit we can just list the alternative systems, call the list a "parameter," and call its members "values" of the parameter. What appears on the list and what does not is arbitrary, and mere descriptive convenience is the driving force. In this sense, parametric values are isolated from each other, and interacting constraints are not. Ranking constraints has inevitable consequences for the entire grammatical system in a way that rewriting parameters does not. Ranking of universal constraints clearly promises a more illuminating theory of typological variation.

8 Head Position and Subordinate Interrogatives

The interaction of OB-HD and PURE-EP explains why inversion does not occur in subordinate interrogatives. It does not, however, explain why the optimal candidates have no complementizer, rather than some element such as *that*. Such a representation would satisfy both OB-HD and PURE-EP. In Grimshaw 1993 it was assumed that the answer lies in the lexicon of English: *that* is a [− wh] complementizer, hence cannot occur in a specifier-head relationship with a [+ wh] expression, and English offers no alternatives that are compatible both semantically and syntactically with an interrogative structure. However, it seems that despite the apparently parochial character of this puzzle, the answer, which builds on a proposal made by Pesetsky (to appear), in which a constraint on pronunciation is violated whenever *that* is not on the left edge of CP, nonetheless resides in UG.

In order to develop this more interesting alternative, we will need to build a picture of how X-bar theory can be treated under OT assumptions—in particular, a theory of how heads are positioned. Travis (1989) discusses two cases where a head V is not uniformly initial or final. In Chinese, according to her analysis, the V precedes arguments but follows adjuncts. This follows if the default is head-final, overridden by directionality of θ-marking, which is to the right. In Kpelle the default is head-initial, and it is overridden by directionality of Case marking, which is to the left. Hence, NP complements precede V whereas PPs follow. (Note that this solution is not technically coherent under standard assumptions, since it crucially relies on notions like "default" and "override," which have no place in a system of inviolable constraints.) In OT terms, in Chinese θ-RT ≫ HD-RT (and both of these constraints dominate all others concerning θ-marking, Case marking, and head position).[13] In Kpelle, CASE-LFT ≫ HD-LFT (and these constraints dominate all relevant others, as for Chinese). Thus, in Chinese and Kpelle the head position constraints HD-LFT and HD-RT conflict with other constraints affecting position, and when the other constraints dominate, the pattern of head position is perturbed as a result. These constraints, which require that the head of every projection be leftmost/rightmost, are alignment constraints (Prince and Smolensky 1993, McCarthy and Prince 1993; see also Pesetsky, to appear).

English shows a different kind of mixture: it is head-final at the XP level and head-initial at the X′ level. This too is the result of interaction between the head position constraints and

[13] The head-finality of nominals in Chinese (Huang 1982) could be due to a constraint treating N as final, N-RT, outranking θ-RT. More interestingly, it could be attributed to N's not θ-marking, as Travis (1989) suggests, in which case θ-RT would not be violated in a head-final NP. The issue is subtle, however, in view of the evidence (Grimshaw 1990) that nouns take obligatory arguments just like verbs when they have an event structure.

others. Suppose that in English HD-LFT ≫ HD-RT. (If all structure is binary, then HD-RT is satisfied whenever HD-LFT is violated.) HD-LFT is violated by subjects (specifier of VP when there is no auxiliary, specifier of IP when there is). This is the effect of a dominant constraint on specifier positions: SPEC-LFT. This constraint, which is not relevant elsewhere in the article, must dominate its counterpart, SPEC-RT in English, as well as HD-LFT. In this analysis, then, English is a left-headed language because of HD-LFT, except where other constraints demanding other head configurations intervene. More generally, heads are uniformly left or right within a language, to the extent that they are able to be so. Apparently mixed systems always arise from constraint conflict.

This sketch of the theory of head position in UG makes possible a simple solution to the residual problem of heads in subordinate interrogatives. The candidates of interest are one with no C (the successful one for English) and the alternative in which C is filled with *that*, or with any other morpheme. The crucial comparison is between the pair in (40).

(40) a. I wonder when I will see such a sight again.
b. *I wonder when that I will see such a sight again.

Both of these sentences, in the analyses in tableau 21, violate STAY twice, because of *wh*-movement and movement of the subject DP. Both also violate HD-LFT twice, because V and I are not leftmost in their XP projections, owing to the presence of specifiers. The critical difference is that the candidate lacking *that* violates OB-HD, whereas the candidate with *that* satisfies OB-HD but at the cost of an additional HD-LFT violation, in CP. We conclude that HD-LFT dominates OB-HD; hence, English chooses to have no C rather than a C in the wrong position. (The opposite ranking of OB-HD and HD-LFT would give a language in which a complementizer occurs obligatorily with interrogatives, as well as with adverbial clauses.) This solution treats the ungrammaticality of a complementizer cooccurring with a *wh*-phrase as the consequence of a constraint on head position.

Tableau 21 omits PURE-EP, OP-SPEC, and FULL-INT, all satisfied in the two candidates at issue. There is no crucial ranking of SPEC-RT and HD-RT with respect to each other or with respect to OB-HD and STAY.[14]

Tableau 21
Subordinate interrogatives: presence versus absence of *that*

Candidates	SPEC-LFT	HD-LFT	SPEC-RT	HD-RT	OB-HD	STAY
$[_{CP}$ *wh* **that** $[_{IP}$ DP **will** $[_{VP}$ **t** V *t*]]]		***!		***		**
☞ $[_{CP}$ *wh* **e** $[_{IP}$ DP **will** $[_{VP}$ **t** V *t*]]]		**		**	*	**

[14] Violations of HD-RT (strictly irrelevant here) are calculated on the assumption that a complement to the right of X induces two violations, since X is final neither in X′ nor in XP. Alternative formulations of the constraint would give different outcomes, but no evidence here bears on the issue.

Why doesn't the null complementizer in the optimal candidate violate HD-LFT also? If it does, then the two candidates will tie on HD-LFT, and the decision will be made by OB-HD, which will choose the wrong candidate. The answer must be that no "null complementizer" is present. This conclusion allows us to choose between two alternative conceptions of OB-HD. We might have taken the position that Gen always includes a head X for a projection of X. Then both candidates in (40) would have a head, and the OB-HD violation would be due to the emptiness of the head. But this interpretation is inconsistent with the explanation just given here for the absence of a complementizer in interrogative CPs. Thus, we conclude that Gen includes a head X for a projection of X only when there is an element filling X. Only the first candidate in tableau 21 has a head C present; the other has no C position at all, just a C′ dominating IP. OB-HD, then, is violated by this configuration; that is, it regulates the presence of X^0 in a projection, and not the filling of X^0 with linguistic material. With this interpretation, the problem of why the null complementizer in the optimal candidate does not violate HD-LFT is trivial: there is no null complementizer, so HD-LFT is (vacuously) satisfied.[15]

When an auxiliary verb raises to a higher position, as in matrix questions and with negative preposing, OB-HD is satisfied, but what of HD-LFT? The raised head has a specifier on its left in both cases, so it is apparently not in the optimal head position. Since we know that HD-LFT dominates OB-HD, we are in danger of making the incorrect prediction that raising of an auxiliary verb should never be the best response to an empty head, which would undermine the entire analysis of inversion. This suggests that HD-LFT (and presumably HD-RT) holds only of perfect heads in the sense used in Grimshaw 1991—that is, heads that match the projection in all respects. The relationship of I to IP is that of perfect head, but that of any raised head to the projection it raises into is not. Hence, HD-LFT is not violated by moved heads. This will have no effect on X-bar structure in general, since simple X′ projections are always perfect projections; hence, HD-LFT is always effective here.

We know, then, that unprojected heads and moved heads do not figure in calculating violations of HD-LFT (and HD-RT): the same proves to be true for traces. Tableau 22 is a revision of

Tableau 22
Matrix interrogatives with and without *do* (revised)

Candidates	OP-SPEC	HD-LFT	OB-HD	FULL-INT	STAY
☞ $[_{CP}\ wh\ \mathbf{do}_i\ [_{IP}\ DP\ \mathbf{e}_i\ [_{VP}\ t\ V\ t]]]$		*		*	***
$[_{CP}\ wh\ \mathbf{e}\ [_{IP}\ DP\ \mathbf{e}\ [_{VP}\ t\ V\ t]]]$		*	*!*		**
$[_{CP}\ wh\ \mathbf{e}\ [_{VP}\ DP\ V\ t]]$		*	*!		*
$[_{CP}\ wh\ \mathbf{e}\ [_{IP}\ DP\ \mathbf{do}\ [_{VP}\ t\ V\ t]]]$		**!	*	*	**

[15] Thanks to Alan Prince for aid in developing this proposal.

tableau 5, which now includes HD-LFT and also shows the trace left by movement of DP from within VP. How many violations of HD-LFT are there? If unprojected heads and traces left by head movement are exempted from the constraint, the violations are those indicated. All candidates except the last incur one violation; hence, the decision passes to OB-HD, which prefers the first candidate, with inversion. Note that if unprojected heads alone were exempted from the constraint, we would get the wrong result. The trace of head movement in the first candidate would violate HD-LFT, thus incurring two violations of the constraint, which would eliminate the actual optimal candidate from the competition. We conclude that the constraint holds of overt perfect heads.[16]

Thus, UG provides constraints on head position, in the form of HD-LFT and HD-RT. The ranking of HD-LFT relative to OB-HD in English ultimately explains the absence of complementizers in subordinate interrogatives, and a fact that appears to be highly language-specific is derived from the interaction of universal constraints.

Note too that this is another example where a lexical gap is explained as a function of constraint rankings. English has no word that appears in the head position in subordinate interrogatives. The constraint ranking of English makes it impossible for such a word to be used; thus, in effect it makes it impossible for it to exist in the lexicon. Even if *that* or some other English complementizer is [+wh], in other words, it will not be able to appear in subordinate interrogatives. The same point has been made previously: no language in which NO-LEX-MVT is dominated by both FULL-INT and OB-HD can have a semantically empty use for a verb such as auxiliary *do* in English (section 3.3). Gaps in the lexicon can be epiphenomena of constraint rankings, and the same is true of the existence of lexical items in particular analyses, if the analysis of *do* in section 3.3 is correct. These results are quite surprising, in light of the more standard view (Chomsky 1993) that language variation is due to differences in the lexicon, rather than, as here, that lexical variation may be due to differences in the grammar.

This raises the question of whether *all* principled lexical variation—in particular, all cross-linguistic variation in functional categories—might be derived from constraint ranking. Typological differences attributed to "strong" versus "weak" features in work in the Minimalist Program (Chomsky 1993, 1995), for example, can be understood as resulting from the ranking of checking constraints and STAY. When STAY outranks a checking constraint, there will be no movement; when it is outranked by a checking constraint, movement will occur. Minimally, it seems that reranking of violable constraints offers an extremely interesting window on the relationship between lexical and syntactic properties.

9 The Obligatoriness of *That*

9.1 Complements with and without That

My aim in this article is not to characterize inversion, but to derive the distribution of inversion from the properties of heads in general. I will show here that the obligatory appearance of *that*

[16] The other cases of *do*-support—those involving negation—provide evidence for a ranking. In tableau 12 the final candidate (with no violation of HD-LFT) will win unless NO-LEX-MVT dominates HD-LFT. This ranking is entirely consistent with the system but is not further explored here.

in subordinate clauses with topicalization or operator movement to specifier position follows from the principles already laid out.

The constraints allow sentential complements to be VPs, IPs, or CPs, or in principle XPs, although as we will see, this possibility is in fact excluded by the constraints. When a complement is a CP, it must have its head filled, because of OB-HD. Hence, a clause that is not introduced by a complementizer cannot be a CP. (Doherty (1993) argues extensively in favor of analyzing clauses without *that* as IPs.) Similarly, a clause with no auxiliary cannot be an IP. Thus, verbs like *think* allow three complement structures, as in (41).

(41) a. I think [$_{CP}$ that it will rain].
b. I think [$_{IP}$ it will rain].
c. I think [$_{VP}$ it rained].

An apparent objection to this analysis is that we have to stipulate that *think* and every verb like it select VP, IP, and CP as a complement. Not only would this complicate the lexical representation for all of these verbs; it would also make it impossible to explain why there is no verb of approximately the same semantics as *think* that takes just one of the three, since such a verb would be exploiting the simplest possible selection option available.

The same issue arose in connection with the claim that interrogatives with *wh*-subjects are VPs or IPs, in section 3.4, and the same answer holds here, exploiting type-category selection (Grimshaw 1991). Recall that in the theory of extended projection, functional heads do not select at all. Lexical heads do select: they c-select the syntactic category and s-select the semantic type of their complements. All members of the verbal extended projection (C, I, V, and whatever other heads participate) are of the same syntactic category (verbal). They differ in their functional analysis, not in their syntactic category. It follows that they cannot be distinguished by c-selection. What about s-selection? Suppose finite VP, IP, and CP are good realizations of the same semantic type; let us call it "proposition." Then it will follow that all verbs that take propositional arguments take all three realizations (VP, IP, and CP) of their arguments. (Those verbs that appear to take just CP, such as factives and manner-of-speaking verbs, have different selectional specifications.)

Given the constraints and rankings developed so far, when there is no semantic auxiliary in the input, the two optimal candidates are a CP with *that* and a bare VP (see tableau 23). When the input includes a semantic auxiliary, there are two optimal candidates: a CP with *that* as its head, and an IP headed by the auxiliary (see tableau 24). A CP with no head is nonoptimal in both cases, since it violates OB-HD. Note that the complementizer *that* does not violate FULL-INT, since it does not have an unparsed LCS, unlike *do* as analyzed in section 3.3.

Tableau 23
VP and CP propositional complements

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
☞ V [$_{VP}$ DP V . . .]					
☞ V [$_{CP}$ **that** [$_{VP}$ DP V . . .]]					

Tableau 24
IP and CP propositional complements

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
☞ V $[_{IP}$ DP will $[_{VP}$ t V . . .]]					*
☞ V $[_{CP}$ **that** $[_{IP}$ DP will $[_{VP}$ t V . . .]]]					*

The structure of OT makes the survival of more than one candidate a difficult result to achieve. In fact, some adjustment of the present proposal will be necessary if the head position constraints include HD-RT, as suggested in section 8. Otherwise, the CP complement will always be eliminated in favor of the VP or IP complement, since the CP complement contains an extra left-headed projection (C′) and hence violates HD-RT one more time than the VP or IP complement. It is also necessary to assume that *that*, and presumably all other functional heads, can be freely included in an extended projection or not, without violating constraints of either the FILL or PARSE type. Both of these issues merit further exploration.

In general, then, VP, IP, and CP alternate in complement position. Nonetheless, there are certain circumstances in which the complementizer occurs obligatorily. When topicalization or any other adjunction occurs in a subordinate clause, the *that* complementizer is obligatory. We can see this here: (42), with no adjunction, is equally good with and without the complementizer, whereas (43), with *most of the time* adjoined to IP and construed with the subordinate clause, becomes very seriously degraded if the complementizer is omitted.[17]

(42) a. She swore/insisted/thought that they accepted this solution most of the time.
b. She swore/insisted/thought they accepted this solution most of the time.

(43) a. *She swore/insisted/thought(,) most of the time(,) they accepted this solution.
b. She swore/insisted/thought that(,) most of the time(,) they accepted this solution.

The solution builds on a suggestion by Eric Hoekstra (personal communication): when the complement is a CP, then adjunction to the IP is possible, whereas when the complement is an IP, then adjunction to IP is ruled out. Hence, only when there is a CP projection over the IP projection will the IP projection be a possible adjunction site.

[17] The complementizer is obligatory also in all positions except when the clause is a complement to a verb (Stowell 1981, Kayne 1981). This generalization, illustrated for subject clauses and complement clauses in (i), is more robust than the obligatory *that* effect analyzed here. There are speakers who systematically accept adjunction and negative-related inversion even in the absence of the complementizer (Andrew Radford, personal communication), but such speakers still reject examples like (ib).

(i) a. That he left so early shows (that) he was tired.
b. *He left so early shows (that) he was tired.

The explanation for this effect seems to concern the root character of complements to some verbs, but the issue will not be developed further here.

Tableau 25
Adjunction to IP and CP complements

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
V [$_{IP}$ *adjunct* [$_{IP}$ DP will [$_{VP}$ t V . . .]]]	*!				*
V [$_{CP}$ **will$_i$** [$_{IP}$ *adjunct* [$_{IP}$ DP **e$_i$** [$_{VP}$ t V . . .]]]]	*!				**
V [$_{CP}$ **e** [$_{IP}$ *adjunct* [$_{IP}$ DP will [$_{VP}$ t V . . .]]]]			*!		*
☞ V [$_{CP}$ **that** [$_{IP}$ *adjunct* [$_{IP}$ DP will [$_{VP}$ t V . . .]]]]					*

Let us consider first of all the situation for adjunction (see tableau 25). If the complement is an IP, PURE-EP will be violated, because the IP is a subordinate clause. If the complement is an XP (not shown in the tableau), or a CP with no C, OB-HD will be violated, and if inversion takes place, PURE-EP will be violated. But if the complement is a CP headed by *that*, PURE-EP and OB-HD will both be respected. Hence, the optimal configuration is a CP with a filled head; hence, this is the only grammatical configuration.

Obligatoriness of *that* is predicted both with adjunction and with negative preposing. The reasoning for negative preposing parallels that for adjunction (see tableau 26). If the complement is an XP, either PURE-EP or OB-HD must be violated: PURE-EP if inversion to X occurs, and OB-HD if inversion to X does not occur. When the complement is a CP headed by *that*, OB-HD is satisfied in CP, and inversion to X is not prohibited by PURE-EP, and satisfies OB-HD for X. This is the optimal structure, and it includes *that*. As (44) shows, *that* is indeed required with negative preposing.

(44) a. She swore/insisted/thought that never in her life would she accept this solution.
b. *She swore/insisted/thought never in her life would she accept this solution.

The CP in all of these cases is present to protect the projection below it from the effects of PURE-EP. When the IP or XP is a subordinate clause, it cannot be adjoined to, and its head cannot be filled by movement. It is no longer necessary to appeal to the idea that selectional properties

Tableau 26
Negative preposing in XP and CP complements

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY
V [$_{XP}$ *never* **e** [$_{IP}$ DP will [$_{VP}$ V . . .]]]			*!		*
V [$_{XP}$ *never* **will$_i$** [$_{IP}$ DP **e$_i$** [$_{VP}$ V . . .]]]	*!				**
V [$_{CP}$ **that** [$_{XP}$ *never* **e** [$_{IP}$ DP will [$_{VP}$ V . . .]]]]			*!		*
☞ V [$_{CP}$ **that** [$_{XP}$ *never* **will$_i$** [$_{IP}$ DP **e$_i$** [$_{VP}$ V . . .]]]]					**
V [$_{CP}$ **e** [$_{XP}$ *never* **will$_i$** [$_{IP}$ DP **e$_i$** [$_{VP}$ V . . .]]]]			*!		**

of *that* (its ability to select a CP complement for "CP recursion") are responsible for its appearance here (Rizzi and Roberts 1989, Cardinaletti and Roberts 1991, McCloskey 1992, Vikner 1995). Such a solution rests on a lexical stipulation, whereas the solution based on constraint conflict rests on general properties of the grammatical system of English. (It seems very likely that the same basic analysis explains the obligatoriness of a complementizer in some embedded V2 systems; see Vikner 1995.)

Comparison of the situation with negative preposing and *wh*-movement in subordinate clauses shows an interesting contrast. In subordinate interrogatives, inversion simply fails, since PURE-EP and OB-HD conflict and PURE-EP outranks OB-HD. Why then does inversion not also fail when negative preposing occurs in the XP complement to V? If we get a grammatical sentence by failing to invert in a subordinate interrogative, why don't we get a grammatical sentence by failing to invert in an XP complement to a V? The two sentences have the same constraint profile and certainly look identical.

(45) a. He wondered when *she would* arrive.
b. *He said never *he had* arrived so late.

The solution rests on the comparative nature of OT. In the XP case another candidate is available—namely, the one that includes the CP, which is more successful. In contrast, for an interrogative complement there is no way to enlarge the extended projection to protect the CP, making inversion possible. The reason is that any additional projection will add an OB-HD violation, given that *that* does not occur outside an interrogative. Thus, the uninverted form of the interrogative is optimal, but the inverted form of the negative is optimal. The very same pattern of constraint satisfaction and violation can yield a grammatical sentence or an ungrammatical sentence, depending on the competition.

Why does *that* not occur outside the *wh*-phrase? More generally, why does English not have a way to fill a higher functional head above the projection used for *wh*-fronting? Sten Vikner (personal communication) suggests that this follows from OP-SPEC. In section 2 it was suggested that OP-SPEC is satisfied for a *wh*-operator only when the operator is in a position from which it c-commands the entire extended projection. When a higher projection is present, then, OP-SPEC will be violated for *wh*-operators. The successful candidate will be one with the *wh*-phrase in the specifier of the highest projection in the extended projection. Hence, there is no way to enlarge the extended projection to allow inversion with the interrogative.

In sum, the question of why the complementizer is obligatory with topicalization or preposing to specifier position is answered in terms of the principles laid out here. The question of why *that* is obligatory reduces to the question of why a CP projection is obligatory, and this follows from PURE-EP. OB-HD, responsible for the inversion patterns analyzed in earlier sections, forces the presence of *that* in the optimal CP. A possible extension of these results (suggested by Sten Vikner and Viviane Déprez, personal communication) would take the general obligatoriness of the complementizer in Romance and Germanic languages to follow from their having V-to-I movement in finite clauses. This will cause them to violate PURE-EP unless the complementizer is present. In contrast, since no head movement is involved in the English auxiliary system, *that* is not obligatory in subordinate clauses in general.

9.2 *A Note on* That-*Trace Configurations*

Extraction of an adjunct or a complement is unaffected by the presence of *that*, whereas extraction of a subject is possible only if *that* is omitted—except in relative clauses, where *that* must be present when it is the highest subject that is extracted. This effect has been widely attributed to the Empty Category Principle (ECP) (e.g., Kayne 1981, Lasnik and Saito 1984, Rizzi 1990), and the proposal made here is based on such solutions. It builds on the insight of Déprez (1991, 1994) that English *that*-trace configurations are ungrammatical because English offers an alternative, in the form of a *that*-less clause. The proposal to be given here depends crucially on the results presented above concerning clause structure, and on the assumption that (all) heads govern both their complements and the specifiers of their complements. We then posit these government constraints:

T-Gov
Trace is governed.
T-Lex-Gov
Trace is lexically governed.

T-Gov is violated when a trace is not governed by any head, T-Lex-Gov when a trace is not governed by a lexical head.

Let us begin by examining the extraction of complements and adjuncts, both of which are unaffected by the presence or absence of *that*. The reason is that in each case the candidates with and without *that* are equally successful at satisfying the constraints.

(46) a. Who do you think (that) they will see t?
b. When do you think (that) they will see them t?

When the object is extracted, as in (46a), both constraints are satisfied, so both candidates are optimal, as can be seen in tableau 27, which shows only the government constraints (the italicized and unindexed trace is the relevant one). When the adjunct is extracted, as in (46b), neither constraint is satisfied, since an adjunct is not governed at all. Again, then, the candidates with and without *that* are equally successful and both are grammatical (see tableau 28).

It is precisely in the case of extraction of a subject that the presence of *that* makes a difference.

(47) a. Who do you think will see them?
b. *Who do you think that t will see them?

Tableau 27
Extraction of an object

Candidates	T-Gov	T-Lex-Gov
☞ V [$_{IP}$ DP$_i$ I [$_{VP}$ t$_i$ V *t*]]		
☞ V [$_{CP}$ **that** [$_{IP}$ DP$_i$ I [$_{VP}$ t$_i$ V *t*]]]		

Tableau 28
Extraction of an adjunct

Candidates	T-GOV	T-LEX-GOV
☞ V $[_{IP}$ DP_i I $[_{VP}$ t_i V] $t]$	*	*
☞ $[_{CP}$ **that** $[_{IP}$ DP_i I $[_{VP}$ t_i V] $t]]$	*	*

When *that* is present, it governs the trace, so the trace is governed; but it is not lexically governed, since C is not lexical. Hence, the second candidate violates T-LEX-GOV (see tableau 29). When the complement is just an IP, however, as in the first candidate, the complement-taking verb governs the trace, which is therefore lexically governed and satisfies both constraints. Hence, the *that*-trace configuration is ungrammatical because the V-trace configuration is optimal.

Relative clauses, being adjuncts, are not governed. It follows that the specifier of a relative clause is not governed by any element from outside the clause. This is the key to the paradigm in (48) (and see tableau 30).

(48) a. *The people t will see them . . .
b. The people that t will see them . . .

The trace in [Spec, IP] is governed by *that* in (48b); hence, it is governed, although not lexically governed. The trace in [Spec, IP] is not governed by any head in (48a); hence, this candidate violates both government constraints.[18] The essential point of this solution is that the *that*-trace configuration is not always ruled out: under certain circumstances it may be the optimal configuration, and be grammatical. Whether it is good or bad for a trace to be governed by C depends on what the alternatives are: it is better to be governed by C than not to be governed at all. Keer (1996) argues that this general idea also explains anti-*that*-trace configurations in Norwegian.

This point holds crosslinguistically as well. The prediction is that languages in which there is no better candidate will simply not show *that*-trace effects, so that extraction corresponding to (47b) will be grammatical. This is exactly the situation in Dutch, as illustrated in this example from Weerman 1989:

(49) Wie denk je dat t ons gezien heeft?
who think you that t us seen has

[18] I have represented the relative clause with no *that* as just an IP in tableau 30. A more traditional analysis, based on Chomsky 1977, would posit a CP here with a null operator in its specifier.

(i) The people [Op e [t will . . .]]

(ii) The people [Op that [t will . . .]]

Assuming that HD-LFT is violated in (ii), if HD-LFT is outranked by T-GOV, we will get the right result under this representation. There is a problem, however, since if HD-LFT is violated because of the empty operator to the left of C, the prediction is that the candidate with no *that* will be optimal whenever anything other than the highest subject has been relativized, contrary to fact. If, on the other hand, HD-LFT is not violated because the operator is empty, then (ii) will still be the optimal version, but we encounter a different problem: OB-HD will require *that* to introduce all relative clauses. This is the reason for choosing the IP analysis.

Tableau 29
Extraction of a subject

Candidates	T-GOV	T-LEX-GOV
☞ V [$_{IP}$ t_i I [$_{VP}$ t_i V . . .]]		
V [$_{CP}$ **that** [$_{IP}$ t_i I [$_{VP}$ t_i V . . .]]]		*!

Tableau 30
Extraction of a subject in a relative clause

Candidates	T-GOV	T-LEX-GOV
N] [$_{IP}$ *t* I [$_{VP}$ V . . .]]	*!	*
☞ N] [$_{CP}$ **that** [$_{IP}$ *t* I [$_{VP}$ V . . .]]]		*

The observation that *that*-trace configurations are not universally ruled out has been challenging to understand (see, e.g., Maling and Zaenen 1978, Sobin 1987, Bayer 1984, Bennis and Haegeman 1984). But in the OT constraint satisfaction perspective, it is just what is expected. In a language that does not allow complementizer-less subordinate clauses, the route to optimality followed by English is not available, so the language must settle for only nonlexical government in this configuration.

The violability of the constraint system governing *that*-trace effects is visible within English and lies behind the final puzzle to be analyzed here. Culicover (1993) shows that the presence of an expression adjoined to IP can make a *that*-trace configuration legitimate (see also Browning 1996).

(50) a. *Who did she swear(,) most of the time(,) t accepted this solution?
b. Who did she swear that(,) most of the time(,) t accepted this solution?

Culicover concludes that ECP-based accounts of the effect must be incorrect. However, note that in exactly these configurations there is a conflict between PURE-EP and the lexical government constraint. Tableau 31 shows the effects. PURE-EP requires *that* here because of the adjunction. But if *that* is present, then T-LEX-GOV is violated, since the trace is not lexically governed. The correct ranking of these two constraints will therefore automatically give the right result: PURE-EP dominates T-LEX-GOV.

10 General Discussion

Every projection is optional and is present only if it is needed. The size of an extended projection is variable and depends on the effects of grammatical constraints (see Haider 1989, Ackema, Neeleman, and Weerman 1993, and Heycock and Kroch 1993 for related proposals). This is inconsistent with the hypothesis that what constructs phrase markers is either phrase structure

Tableau 31
PURE-EP conflicts with T-LEX-GOV

Candidates	PURE-EP	OP-SPEC	OB-HD	FULL-INT	STAY	T-GOV	T-LEX-GOV
☞ V [$_{CP}$ **that** [$_{VP}$ *adjunct* [$_{VP}$ *t* V]]]					*		*
V [$_{VP}$ *adjunct* [$_{VP}$ *t* V]]	*!				*		

rules or selectional statements. Optional projections are difficult to make sense of in such systems, because they always involve complicating the phrase structure rules or selectional statements. Instead, it seems that what is involved is free combination of heads and their projections, regulated by constraints of the kind discussed here, among others. At this point, however, we can take a more radical step: there is no reason to label the projections that make up extended projections. Every projection is just that, a projection, which has a grammatical category, may have a lexically realized head, may have acquired a head by movement, or may lack one completely. The properties of a projection are just a function of what happens to head it. If it has no head, it has no properties other than those imposed by its role in the extended projection; for example, ''XP'' is just a verbal projection. Strongly consistent with this is the fact that selectional statements make no reference to distinctions among projections, at least those that are of the same category, such as VP, IP, and CP. Moreover, none of the constraints refer to projection labels: a *wh*-phrase need not be in [Spec, CP], for example—any specifier that c-commands the extended projection will suffice. Adjunction occurs freely, its effects being reined in by PURE-EP. From this perspective, there is, of course, no such thing as ''CP recursion'' (Rizzi and Roberts 1989, Vikner and Schwartz 1996, Suñer 1991, McCloskey 1992, Watanabe 1993), even for cases like Dutch with its three ''C'' positions (Hoekstra 1993). The ''extra'' projections that have sometimes been given this analysis are really no different from all other projections: just part of the indefinitely expandable verbal extended projection, which is regulated by the constraints examined in this article, among others.

Since there is no fixed limit on the number of projections that can be included in an extended projection, the number of competitors also has no fixed limit. However, there is a way to eliminate all but a few candidates; adding projections eventually and reliably leads to worsening status on the constraints. If the addition of, say, two projections leads to a less satisfactory candidate, the addition of yet another projection will never yield improvement. Thus, candidates that are yet larger need not be considered.

There is a clear affinity between the OT model presented here and research using notions like ''economy.'' As I pointed out earlier, STAY is an economy principle, which chooses representations containing the fewest traces. OT provides a way to understand such notions as ''economy'' as just subcases of the total universal set of violable constraints. Moreover, under OT there is an explicit way to determine how constraints will interact with each other. This is of course essential to making sense of any theory that is based on constraint interaction. Consider, for example, the

idea that short derivations are less costly than longer ones, and that universal devices are less costly than language-particular ones, as in Chomsky 1991. Without a means of computing the comparative cost of the two expensive items, there is no way to calculate the results of interaction between them. What happens when we have to choose between a derivation with fewer steps but more language-particular devices and one with fewer language-particular devices but more steps? OT provides a theory of constraint interaction that makes such questions answerable: the choice will depend on the ranking of the constraints in the grammar.

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