

Economy of Structure in OT^{*}

Jane Grimshaw
Rutgers University
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grimshaw@rucss.rutgers.edu

1. Introduction

Many recent studies have appealed to the idea that linguistic systems are subject to *economy* of structure or representation, e.g. Chomsky 1995, Rizzi 1997, Bresnan 2001. The guiding idea of economy of structure is that *small structures are preferred over large ones, other things being equal*. Other things being equal, projections with fewer elements are preferred over projections with more elements, and structures containing fewer projections are preferred over structures with more projections.

This paper argues that economy of structure is a theorem of the theory of phrase structure: no special principle needs to be posited in order to explain economy effects. The argument has two parts. First, conflicting alignment constraints prefer projections with fewer elements over those with more elements. Second, the set of alignment constraints and constraints requiring the presence of structural elements, together guarantee that *any* projection in *any* language, incurs at least one constraint violation. Therefore a structure containing $n + 1$ projections is guaranteed to incur at least one more violation than the same structure with the additional projection removed.

The constraints are universal constraints on the internal structure of projections (based on those proposed in Grimshaw 1997). They are motivated by the directly empirical goal of characterizing the set of structural options for syntactic projections. Essential to the argument is that the theory posits a set of universal constraints which are guaranteed to conflict in every projection, a possibility inherent in Optimality Theory (Prince and Smolensky 1993). Some alternative sets of constraints with the right properties are discussed here. The central point is that these constraints are not in any sense “economy constraints”; in fact, individually they can prefer larger, more complex structures over smaller, simpler ones, as I will show. It is the collective effects of general constraints on structure which enforce economy. The same constraints entail, for the same reasons, that any projection into which movement occurs, necessarily violates at least one more constraint than the otherwise identical projection with an unfilled position. Such syntactic movement is

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therefore impossible unless further constraints require it, and this economy effect is a by-product of the theory. It follows from the constraint system in just the same way as economy of structure.

The choice of economical structures over less economical alternatives is *general*: it holds for all kinds of projections under all rankings of the responsible constraints, i.e. for all grammars. The choice of less economical structures over more economical alternatives is *contingent*: it holds for some kinds of projections under particular rankings. Thus under particular circumstances, particular languages can favor “extra” structure in order to satisfy a high priority linguistic requirement, in the form of a constraint with the necessary ranking. Such additional structure must itself always be minimal, since excessive structure will result in gratuitous violation of the constraints responsible for the economy of structure. The constraints entail, for example, that small extended projections (in the sense of Grimshaw 1991, 2000) are generally preferred to larger ones, hence functional structure will be present only if some constraint is violated in its absence, is satisfied in its presence, and dominates the conflicting structural constraints which enforce economy.

2. The core constraints on the structure of projections

The constraints on projections which enforce economy are those which determine the basic structure of phrases, and thus the structure of combinations of phrases and clauses. The constraints are of two fundamentally different kinds: alignment constraints, and what I will call “obligatory element” constraints. The alignment constraints (McCarthy and Prince 1993, Grimshaw in press, Legendre 1996, 1999, to appear) posited here all align the core elements of phrases leftwards; informally all are competing for initial position. The ranking of the alignment constraints determines the order of elements in a projection.

McCarthy and Prince 1993 lay out a general template for alignment, and the alignment constraints proposed here fall within that general theory. The constraint HEADLEFT employed here is stated in (1):

- (1) HEADLEFT (HDLFT) *Every X-zero is at the left edge of an X-max.* More precisely:
 Align (X-zero, Lft, XP, Lft)
 = by defn. $\forall X\text{-zero} \exists XP$ s.t. left edge of X-zero and left edge of XP coincide

This constraint governs the relationship between any X-zero and its maximal projection. It is violated by a mis-aligned head: an X-zero which is not at the left edge of its projection. It cannot be violated if no X-zero is present. This property of HDLFT plays a crucial role in the analysis given in Grimshaw 1997: the fact that the constraint is satisfied in every projection with no head lies at the heart of the absence of inversion and complementizers in subordinate interrogatives in English, and, according to Grimshaw in prep, explains a variety of special effects found at the left edge of subordinate clauses.¹

¹ The second option for alignment laid out in McCarthy and Prince would allow the formulation in (i) for HDLFT.

- (i) HDLFT *Every X-max has an X-zero at its left edge.* More precisely:
 Align (XP, Lft, X-zero, Lft)
 =_{def} $\forall XP \exists X\text{-zero}$ s.t. left edge of X-zero and left edge of XP coincide

(continued...)

The two other alignment constraints position specifiers and complements, i.e. maximal projections immediately dominated by a maximal projection and maximal projections that are sister to a zero-level head.

- (2) **SPECLFT** *Every specifier is at the left edge of an X-max.* More precisely:
 Align (Spec, Lft, XP, Lft)
 = by defn. \forall Specifier \exists XP s.t. left edge of specifier and left edge of XP coincide
- (3) **COMPLFT** *Every complement is at the left edge of an X-max.* More precisely:
 Align (Comp, Lft, XP, Lft)
 = by defn. \forall Complement \exists XP s.t. left edge of complement and left edge of XP coincide

In these formulations, the constraints enforce alignment of a piece of syntactic structure (head, specifier, or complement) with a maximal projection, and not with the X' level of structure. It is quite possible that alignment constraints relative to X' are also motivated. This would in no way undermine the argument of the present paper, but for reasons of simplicity I limit consideration to phrase edge alignment.

The alignment constraints posited here are not identical to those posited in Grimshaw 1997. That analysis proposed a HDRT alignment constraint, and no COMPLFT constraint, and thus involved the three alignment constraints: SPECLFTL, HDLFT, and HDRT. There is empirical evidence favoring the existence of COMPLFT, which I will point out. Possible alternative constraint sets will be discussed in Section 4.3.

The remaining constraints are those which require the presence of a head and a specifier:

- (4) **OBLIGATORY HEAD (OB-HD)** A projection has a head
OBLIGATORY SPECIFIER (OB-SPEC) A projection has a specifier

OBHD played a central role in the analysis of Grimshaw 1997. OBSPEC, which mandates that a projection has a specifier, has an obvious similarity to ONSET (Prince and Smolensky 1993), which requires that a syllable have an onset. It was satisfied (and hence not of interest) in most candidates in Grimshaw 1997, since in that analysis VPs and IPs generally contain a subject or its trace, and interrogative CPs have a *wh* specifier. However, the constraint SUBJECT posited there and in Grimshaw and Samek-Lodovici 1998 is, in the present analysis, a special case of OBSPEC. This constraint is responsible for the widespread obligatoriness of subjects; OBSPEC lies behind the

¹(...continued)

This formulation incorporates the effects of OBHD – it enforces the presence of a left-aligned head in every XP. Constraints of this form may indeed exist, but they are not motivated in the present work. The interesting consequences of alignment constraints depend, as noted above, on their being satisfied in the absence of the aligning element, the head in the case of HDLFT.

“Extended Projection Principle” (Chomsky 1981, McCloskey 1996, 1997, Holmberg 2000, Svenonius to appear).

The constraints posited in (1) (2) (3) and (4) have some non-obvious properties. One question, which I will not take up here, is whether, in addition to OBHD and OBSPEC, we might expect to find a constraint, OBCOMP, which requires the presence of a complement in a projection. My assumption is that in fact complements are truly structurally optional, that there is no OBCOMP constraint. Drawing on constraints proposed for syllable structure, one might even consider that there is a NOCOMP constraint, in parallel with NOCODA (Prince and Smolensky 1993), which would be violated by every complement. However, none of these issues is crucial in what follows: the argument to be made holds, *mutatis mutandis*, regardless of whether OBCOMP, NOCOMP or no constraint at all governs the structural presence of complements.

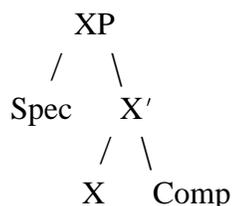
None of the proposed alignment and obligatory element constraints is an economy constraint, in any sense. The obligatory element constraints are, if anything, anti-economy constraints, since they require the presence of syntactic elements. The alignment constraints explain positional regularities, and in Section 6 I will show that they can actually choose more complex structures over simpler structures, under certain rankings. Both are motivated by empirical considerations concerning the form of syntactic projections. Nevertheless, the economy of structure follows from these constraints.

3. The Optimal Output in a Simple Phrase

The constraints under discussion govern any projection, regardless of the input, or the relationship of the output structures to the input. Since it is entirely irrelevant what inputs the various output forms correspond to (faithfulness constraints not being at issue), I will not specify inputs for the tableaux in this paper. In order to abstract away from the details of lexical items, and the mappings of lexical items into structural positions, I will consider only outputs which involve an appropriate mapping between lexical arguments and syntactic structure, e.g. where the external argument is a specifier and the internal a complement. The structures to be examined first all satisfy OBHD and OBSPEC: the question is what order of the three elements is the best.

The typical structure of an English projection is given in (5), and the tableau in (6) shows how the constraints select this as the optimum. Of the six logically possible orders, two (head-specifier-complement and complement-specifier-head) are ruled out in advance, if phrases in which a head and a complement are not sisters are not among the candidates constructed by GEN. (I will assume that this is the case, although it is not crucial). There are thus four choices for the constraints to evaluate. See Section 4.3 for discussion of the typology predicted by this constraint set.

(5) English projection structure



(6) English: orders for Specifier, Head and Complement

		SPECLFT	HDLFT	COMPLFT
a. 	[Spec H Comp]		*	**
b.	[Spec Comp H]		**!	*
c.	[H Comp Spec]	*!*		*
d.	[Comp H Spec]	*!*	*	

We can hold constant the constraint violations incurred by the internal structure of the specifier and the complement; in fact I will do so throughout the paper, and will never show violations internal to “Spec” or “Comp” in tableaux. The tableau for English thus shows only violations incurred by the phrase headed by H. The optimal structure has a leftmost specifier but violates both HDLFT and COMPLFT. This structure is selected as optimal if SPECLFT dominates HDLFT, as the comparison between candidates *a* and *c* shows. Since the optimal structure has a HDLFT violation but is still selected over the left-headed candidate, the SPECLFT violation in candidate *c* must take precedence over the HDLFT violation in candidate *a*.

HDLFT must dominate COMPLFT ; this is revealed by the comparison of candidates *a* and *b*. Candidate *a* has a head which is as close as possible to the left edge, and it is preferred over candidate *b*. because it better satisfies HDLFT, even though it is less successful on COMPLFT. This decision depends crucially on the violation of the alignment constraint HDLFT being *gradient* (McCarthy and Prince 1993), so that the head in *b*. violates HDLFT once because it is separated from the left edge by one element, whereas the head in *a*. violates HDLFT twice because it is separated from the left edge by two elements: the specifier and the complement.²

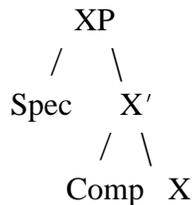
(7) Ranking for English: SPECLFT >> HDLFT >> COMPLFT

The analysis illustrates how a ranking of these universal constraints chooses an unmarked projection structure for English: Specifier-head-complement. Deviation from the unmarked structure

² The gradient interpretation of head alignment violations is not required if head alignment is relative to X', rather than to XP. In this case, the head satisfies alignment if it precedes the complement, despite the fact that it is preceded by the specifier.

will occur only if there is disruption by some other constraint. Since the constraints are universal, they are also in the grammar of right-headed languages, such as Japanese. Both the constraints and the set of candidates provided by GEN are exactly the same as for English; only the ranking of the constraints differs.

(8) Japanese projection structure



(9) Japanese: orders for Specifier, Head and Complement

		SPECLFT	COMPLFT	HDLFT
a.	[Spec H Comp]		**!	*
b. ☞	[Spec Comp H]		*	**
c.	[H Comp Spec]	*!*	*	
d.	[Comp H Spec]	*!*		*

Just as in English, the optimal structure for Japanese satisfies SPECLFT, at the cost of violating COMPLFT and HDLFT. As in English, then, SPECLFT must dominate COMPLFT and HDLFT, in order for candidates *c* and *d* to be eliminated. Comparison of candidates *a* and *b* shows that COMPLFT must dominate HDLFT in Japanese, in order to select the actual winner, which incurs fewer COMPLFT violations, over candidate *a*, which incurs fewer HDLFT violations. In this analysis, a right-headed projection is one which maximally violates HDLFT.

(10) Ranking for Japanese: SPECLFT >> COMPLFT >> HDLFT

While the constraint ranking, and hence the optimum, is different in English and Japanese, the candidates are of course always the same. Thus the candidates evaluated in tableaux (6) and (9) are identical. The constraints are also the same in every grammar, and thus the violations incurred by each candidate are the same for every grammar. The only difference is the optimum selected, because this is decided by the ranking of the constraints, which is not constant across grammars.

The alignment constraints have the important property that *no order can satisfy all three of the alignment constraints in a simple projection which contains a specifier, a head, and a complement*. (Cf the analyses of clitic alignment in Grimshaw in press and Woolford 2001). Thus every candidate violates the alignment constraints (the patterns will be more precisely characterized in the next section), hence the optimal candidate itself must always violate the alignment constraints.

We have proved, therefore, that every grammatical phrase containing a head, a specifier and a complement must violate the alignment constraints in every language. While the exact distribution of alignment violations depends on the ranking of alignment constraints, the existence of the alignment violations is *ranking independent*. This is the foundation of my argument.

In a parametric account (see Saito and Fukui 1998, and papers in Alexiadou and Hall (1997) for recent discussion) this generalization does not hold, and nor does any counterpart generalization. For example, consider a parametric system such as that in (11).

- (11) Japanese: X final in X', X' final in XP
English: X initial in X', X' final in XP

In such an analysis, the difference between the two systems is the result of their being subject to different (versions of the) constraints. Both the English and the Japanese outputs satisfy their respective constraints fully. There is, then, no cost to a projection, as measured by constraint violation. This is, I argue here, the fundamental reason why OT can explain economy of structure, while parametric theories do not. Instead, they must resort to positing additional special principles of some kind.

3.1 Patterns of Constraint Violation in Projections Containing a Head plus a specifier and a complement

A more precise examination of the already discussed case of a projection containing a head, a specifier and a complement shows that, since only one of the three elements can be at the left edge of the projection, *two of the three alignment constraints must be violated in every candidate*. Moreover, since one of the three elements must be separated from the left edge by the other two, the rightmost element necessarily incurs two violations of the alignment constraint governing its position. Thus the total number of alignment violations in such a projection must be three. This is true for every candidate, hence true for every optimal candidate, hence true in any grammar/constraint ranking. The existence of these three violations is invariant. The variation lies only in which of the three constraints is violated, and how many times. The same argument is made in Grimshaw in press for violations of alignment constraints governing Romance clitics.

This is confirmed when we compare the constraint violation patterns in the optima analyzed above for English and Japanese. While the English optimum violates COMPLFT twice and HDLFT once, the Japanese optimum violates COMPLFT once and HDLFT twice. (The other two candidates violate SPECLFT, and either COMPLFT or HDLFT in addition.)

(12) The English and the Japanese optima (not a tableau)

		SPECLFT	COMPLFT	HDLFT
E.	[Spec H Comp]		**	*
J.	[Spec Comp H]		*	**

The conclusion is then that, for every grammar (i.e. under any ranking, i.e. for any output order): *any projection with three elements incurs 3 violations of the alignment constraints {HDLFT, SPECLFT, COMPLFT}*.

3.2 Patterns of Constraint Violation in Projections Containing Two Elements

The logic of conflicting alignment constraints similarly dictates that when a phrase contains two elements, one of the alignment constraints will always be violated, since it is impossible for both elements to be at the left edge. There are three such structures: A head and a specifier, a head and a complement, and a specifier and a complement.

(13) shows the possible optima for phrases containing just a head and a complement. Both violate exactly one alignment constraint: either COMPLFT, as in the English optimum, or HDLFT, as in the Japanese optimum. As always, the constraints under discussion govern any projection which contains these elements, regardless of the input; (13) might correspond to an unaccusative verb input, or a complementizer with an IP complement, among many other possibilities.

(13) Possible Optima for a Head and a Complement (not a tableau)

		SPECLFT	HDLFT	COMPLFT
a.	[H Comp]			*
b.	[Comp H]		*	

(14) shows the possible optima when a phrase consists of a head and a specifier, corresponding for example to an unergative verb and its subject. Again, each output incurs one violation of alignment. HDLFT is violated in the English optimum, SPECLFT in a head initial projection.

(14) Possible Optima for a Head and a Specifier (not a tableau)

		SPECLFT	HDLFT	COMPLFT
a.	[Spec Head]		*	
b.	[Head Spec]	*		

The tableau in (15) shows the possible optima when a phrase consists of a specifier and a complement (an example being the structure assigned to subordinate interrogatives in the analysis of Grimshaw 1997). Again, each output incurs one violation of head alignment. COMPLFT is violated in the first candidate, SPECLFT in the second.

(15) Possible Optima for a Specifier and a Complement (not a tableau)

		SPECLFT	HDLFT	COMPLFT
a.	[Spec Comp]			*
b.	[Comp Spec]	*		

The conclusion is that for every grammar (i.e. under any ranking, i.e. for any output order), *any projection which contains two elements incurs one violation of the alignment constraints.*

3.3 Patterns of Constraint Violation in Projections Containing One Element

Projections which contain only one element satisfy all of the alignment constraints. Two of them (those which impose alignment on elements that are not present in the projection) are vacuously satisfied. The third alignment constraint is satisfied because the element that is present is left aligned with the phrase containing it. There are three one-element projections, shown in (16). A projection can contain just a specifier (a phrase immediately dominated by an XP node), just a head, or just a complement (a phrase immediately dominated by an X' node). Candidate *a*, for example, vacuously satisfies HDLFT and COMPLFT, and satisfies SPECLFT. Thus, projections of this type escape incurring violations of alignment. However, each violates at least one of the obligatory element constraints. (Note that some of the projections containing two elements also incur violations on the obligatory element constraints: Head-complement projections violate OBSPEC, and specifier-complement projections violate OBHD.)

(16) Obligatory element violations in one-element projections (not a tableau)

		OBSPEC	OBHD
a.	[Spec]		*
b.	[Head]	*	
c.	[Comp]	*	*

In sum, projections of these three types satisfy all alignment constraints but violate OBHD. and/or OBSPEC. We can conclude that for every grammar (i.e. under any ranking, i.e. for any output order): *a projection which contains one element incurs at least 1 violation of the obligatory element constraints.*

3.4 Empty Projections

An empty projection satisfies all the alignment constraints, since it contains no mis-aligned elements. However *an empty projection violates both of the obligatory element constraints: OBHD and OBSPEC.*

3.5 Summary

Any projection containing three elements incurs three violations on the alignment constraints. Any projection containing two elements incurs one violation on the alignment constraints. Any projection containing one element satisfies all alignment constraints. Any projection containing no elements also satisfies alignment. However, all projection types which incur no alignment violations necessarily violate either OBSPEC or OBHD, or both. Since this exhausts the set of possible projections, we have shown that every projection in every language necessarily has a cost; it necessarily violates at least one member of the set of constraints on projections.

4. Economy of Structure

Economy of structure as defined here involves two components. The first is a preference for projections which contain fewer elements over projections which contain more. The second is a preference for structures which contain fewer projections over structures which contain more. In this section, I will argue that both of these preferences are consequences of the constraints proposed here. The argument is foreshadowed in my own earlier work, where a constraint called “Minimal Projection” in Grimshaw 1993, 1994 was argued in Grimshaw (1997; 381) to be redundant, given the constraints proposed there.

4.1 Projections with more elements versus projections with fewer elements

The more elements a projection contains the worse it does on alignment: a projection with three elements incurs more alignment violations than a projection with two elements, which incurs more alignment violations than a projection with one or zero elements. Thus the alignment constraints entail a general preference for projections containing fewer elements.

(17) Violations of alignment constraints (not a tableau)

	{SPEC LFT, HD LFT, COM LFT}
a. [Spec H Comp]	***
b. [Spec H], [Spec Comp], [H Comp]	*
c. [Spec], [H], [Comp], []	

When a candidate which contains only a complement is compared to a candidate which contains both a head and a complement, as in (18), we find evidence which distinguishes the set of constraints posited here from those posited in Grimshaw 1997.

(18) Spec-Comp projections compared to Comp only projections (not a tableau)

		COMPLFT	HDRT
a.	[Comp]		
b.	[Spec Comp]	*	

Both candidates satisfy HDLFT and SPECLFT. The first incurs no alignment violations; the second incurs a COMPLFT violation. In this analysis, then, candidate *b* is (presumably correctly) treated as more complex than candidate *a* since *b* violates more constraints.

While the present constraint set makes the correct prediction here, the alternative from Grimshaw 1997 does not. If the constraints are {SPECLFT, HDLFT, HDRT}, as proposed there, then the candidates in (18) have the same alignment violations. HDRT does not distinguish *a*. from *b*, since it is satisfied in both candidates, just as HDLFT is. This constraint set therefore predicts that candidates *a*. and *b*. will tie on alignment, and OBSPEC will favor the complex structure, hence there will be an anti-economy effect: a preference for the more complex over the less. Such considerations distinguish among alternative constraint sets; see Section 4.3 for further discussion.

There is one comparison where a projection with more elements is always chosen over one which contains fewer. A projection which contains just a head necessarily satisfies alignment, and incurs an obligatory element violation, since it contains no specifier. The projection which is completely empty also satisfies alignment, and it violates both OBSPEC, and OBHD. It is thus harmonically bounded by the projection which consists of just a head, since the violations incurred by the head-only projection are a proper subset of those incurred by the empty projection. We thus conclude that in this one case, a projection containing more elements is better than one with fewer.³ We also conclude that a completely empty projection can never be selected as an optimum.⁴

³ Projections which contain just a specifier or a complement do not harmonically bound the empty projection, since the specifier or complement, being projections themselves, necessarily incur violations internally.

⁴ To pursue this point further, consider the question of whether a structure with an entirely empty projection as its specifier could ever be preferred over the same structure with no specifier at all – see candidates *a* and *b* in the tableau below. The presence of an empty projection has a negative effect on alignment and cannot improve faithfulness. However, its presence does satisfy OBSPEC, so one might think it would be allowed under the appropriate ranking. This is not correct. Since the empty projection itself violates OBSPEC, the number of OBSPEC violations is constant across the two candidates. Candidate *a* is harmonically bounded by candidate *b*.

(continued...)

A priori it is not clear whether economy of structure should value a completely empty projection over a projection containing just a head, or vice versa. An empty projection is, after all, as simple as a projection can be. A projection which contains a head, on the other hand, has the virtue of being motivated in some sense, e.g. providing a structural position for a lexical element. The intrinsic vagueness of a notion like economy is highlighted by the un-answerability of this question. However, the conflicting constraints give a perfectly clear answer.

The cases discussed so far illustrate complexity induced by the presence of heads, specifiers or complements, but the argument extends to adjuncts. Since any projection incurs violations on the alignment and obligatory element constraints, an adjunct XP will always contribute violations to the structure it is part of. Moreover, a projection which contains a left adjoined adjunct in addition to another element will induce violations of alignment, if we follow Zepter 2000 in hypothesizing that alignment is assessed relative to the outside layer of a projection. In the structure in (19), for example, the adjunct separates the specifier, head and complement from the left edge of XP. The total number of alignment violations in (19) is thus six (one violation of SPEC_{LFT}, two violations of HD_{LFT}, and three violations of COM_{LFT}.)⁵

(19) [_{XP} Adjunct [_{XP} Spec H Comp]]

In general then, projections with fewer elements are preferred by the alignment constraints to projections with more elements. Among projections which satisfy alignment, there is a preference for a projection containing just a head over a projection which is completely empty, hence empty projections can never be selected as optimal.

4.2 Structures with more projections versus structures with fewer projections

The argument of Section 3 shows that every projection incurs at least one violation on the alignment and obligatory element constraints. Thus a structure with multiple projections is guaranteed to violate these constraints at least once for each projection. More precisely, since any projection containing more than one element incurs violations on the alignment constraints, the more such projections a structure contains, the more alignment violations it incurs. Since any projection

⁴(...continued)

		OBSPEC	HD _{LFT}	OBHD
a.	[[] V ...]	*	*	*
b.	[[V ...]]	*		

⁵ Note that with the constraint set under discussion, no alignment violation is induced by a right adjoined element.

containing one or no elements violates either OBSPEC or OBHD, or both, the more such projections a structure contains, the more obligatory element violations it incurs.

Suppose we compare, for example, three structures built from specifier-head-complement projections; one containing one projection, one containing two, and one containing three. In order to factor out the effects of ranking among the alignment constraints, we can count the violations of the three constraints together, since the total number of violations of the set of constraints is constant across different optima. Since each projection incurs a total of three alignment violations, a structure containing two projections incurs six, and a structure containing three projection incurs nine, and so forth. The more projections the structure contains, the greater the total number of alignment violations. While the order of elements in the structure will be different under different rankings, the violation pattern illustrated in (20) will be unchanged.

(20) Projections containing three elements

	{ SPEC LFT, HDLFT, COMPLFT }
a. [Spec H Comp]	***
b. [Spec H [Spec H Comp]]	*****
c. [Spec H [Spec H [Spec H Comp]]]	*****

If the complexity is differently located in a structure, for example, if the projections are arranged in such a way that the specifier becomes more complex, rather than the complement, the same general result obtains.

(21) Projections containing three elements

	{ SPEC LFT, HDLFT, COMPLFT }
a. [Spec H Comp]	***
b. [[Spec H Comp] H Comp]	*****
c. [[[Spec H Comp] H Comp] H Comp]	*****

The same point holds for projections consisting of two elements. Since each such projection incurs one alignment violation, the more such projections a structure contains, the more alignment violations it accumulates:

(22) Projections containing two elements

	{ SPEC LFT, HDLFT, COMPLFT }	OBHD
a. [Spec __ Comp]	*	*
b. [Spec __ [Spec __ Comp]]	**	**
c. [Spec __ [Spec __ [Spec __ Comp]]]	***	***

For example, when every projection contains just a specifier and a complement as in (22), there is one violation of alignment for the single projection of candidate *a*, two for projection *b* which contains candidate *a* as its complement, three for the projection containing candidate *b* as its complement, and so forth. Two element projections may also violate OBSPEC and/or OBHD, depending on which element is missing, so these violations will also accumulate as alignment violations accumulate. In order to make these violations more transparent, I indicate the absence of any element (head, specifier or complement) from a projection by the symbol “__”, which should be ignored for computations of alignment, since it indicates the absence of an element. It aids in computing obligatory element violations, which now begin to play a crucial role in the argument.

In sum, the more multi-element projections there are in a structure, the more violations of the alignment constraints there will be. Increasing numbers of obligatory element violations will also be incurred if the projections lack a specifier or a head.

In one-element projections, alignment is satisfied, but at least one of OBHD and OBSPEC must be violated. The more such projections there are in a structure, the more violations of OBHD and/or OBSPEC there will be. For example, consider projections containing only a head, which violate OBSPEC. If such a projection occurs in the complement position of a higher projection, which contains no other elements, OBSPEC is violated twice, once in each projection, and OBHD is also violated in the higher projection. If this higher projection is now embedded into yet another projection with no other elements, yet another OBSPEC violation, and another OBHD violation are incurred.

(23) Projections containing one element

	OBSPEC	OBHD
a. [__H]	*	
b. [__ __ [__ H]]	**	*
c. [__ __ [__ __ [__ H]]]	***	**

Finally, projections with no contents violate both of the obligatory structure constraints: OBHD and OBSPEC; the more of them there are in a structure, the more violations of these constraints

will be incurred. However, we have seen that these projections are harmonically bounded by projections containing just a head, see Section 4.1, so this case has no further consequences.

No matter how projections are combined, the entire structure incurs more violations of the alignment and/or obligatory element constraints as the number of projections it contains increases. Any projection necessarily incurs more total violations on this set of constraints than any projection it contains. The table in (24) illustrates this. The basic projection in candidate *a* incurs three alignment violations, because it contains three elements. Once an additional projection is constructed on top of the basic one, the violations of the original projection remain, and in addition, the higher projection incurs violations. In candidate *b* the additional projection, which is bolded, is a headless projection containing a specifier, and taking the basic projection as a complement. It violates OBHD, and in addition it violates COMPLFT, because the specifier intervenes between the complement and the left edge of the overall projection. Now suppose that the specifier in candidate *b* is complex, and consists of a projection containing just a head, as in candidate *c*. This projection violates OBSPEC, and it inherits, of course, all of the violations already analyzed. Finally, suppose that the complement in candidate *c* is a projection consisting of a specifier but no head, as in *d*. This projection violates OBHD, so the entire structure incurs three obligatory element constraint violations and four alignment violations. Clearly if the complement or specifier is made yet more complex, or if an adjunct is added to the structure and its complexity is varied, the number of violations of alignment and/or obligatory element constraints will continue to increase as a reflection of the increasing complexity.

(24) Mixed structures

	OBSPEC	OBHD	HDLFT	COMPLFT
a. [Spec H Comp]			*	**
b. [Spec __ [Spec H Comp]]		*	*	***
c. [[[__ H] __ [Spec H Comp]]]	*	*	*	***
d. [[[__ H] __ [Spec H [Spec __]]]]	*	**	*	***

Note that even projections which incur no alignment violations themselves will induce alignment violations in projections above.⁶ This is exemplified by candidate *b* in (24). Although one-element projections have no alignment violations *internally*, they do induce violations *externally* when they appear in a syntactic structure: e.g. as a specifier, a complement, or an adjunct, in another projection. (They also contribute obligatory element constraint violations, of course.) So if the specifier is omitted from candidates *b* and *c*, the result is elimination of the COMPLFT violation in the higher projection, even if the specifier incurs no alignment violations internally.

⁶ The one exception to this is the case where the higher projection is itself a one-element projection, e.g. [_{XP} [_{YP} Y]]. This structure is harmonically bounded by [_{YP} Y], unless some yet-to-be-discovered constraint can prefer the more complex structure.

4.3 Alternative Constraint Sets

While it is crucial that the theory posit a set of constraints which are guaranteed to conflict in the way just described, it is not crucial that it be exactly the set of constraints posited in this paper. Here I will examine a couple of alternative constraint sets, and analyze their consequences for economy. In this analysis, I will hold constant the obligatory element constraints, OBHD and OBSPEC, and focus on alternative versions of alignment. All of the alignment constraints posited discussed so far align items at the left edge of a projection: no rightward alignment constraint plays a role. There are two rather obvious alternatives which do posit rightward alignment. The first is the one proposed in Grimshaw 1997, which posits a mixed set of left and right alignment constraints: SPECLFT, HDLFT and HDRT. In this system SPECLFT and HDLFT conflict with each other, and HDLFT and HDRT are in conflict also. The rather odd property of this system, that it has right and left alignment for heads but no rightward alignment for specifiers, is eliminated in the second alternative to be considered: a fully symmetric set of constraints: SPECLFT, SPECRT, HDLFT, HDRT. In this section I will briefly analyze the consequences of these three alternative constraint systems: the left alignment system, the mixed system, and the symmetric system.

The three constraint sets are almost, but not quite, equally compatible with the fundamental argument for economy. There is one important difference between the mixed system of Grimshaw (1997) and the alternatives, which lies behind the decision to develop the economy argument using the present set of constraints, rather than those previously proposed. Recall that a set of constraints which entails economy of structure must guarantee that every projection under any ranking incurs a violation of at least one member of the set, and that any projection with n elements incurs more violations than an otherwise identical structure with $n-1$ elements. As observed above in Section 4.1, the mixed constraint system, SPECLFT, HDLFT and HDRT gives odd results in a headless projection, and as a result, these constraints fail to predict a general economy effect. The two candidates in (25) have the same alignment violations (as do the two simpler candidates in (18)). The presence of a specifier in a headless projection adds no violation of HDRT or HDLFT, and SPECLFT is satisfied in the output structure. Moreover, OBSPEC is satisfied in the more complex structure and violated in the simpler one, predicting that candidate b. must be preferred by all grammars. In the absence of any other relevant constraints, this theory predicts, for example, obligatory filling of a specifier position (perhaps by an expletive). As a special case, the analysis predicts that movement from the lower specifier into the higher specifier will be preferred by all grammars. In the absence of empirical evidence favoring this prediction, the prediction provides an argument against the mixed constraint system.

(25) Candidates with a headless higher projection

	SPECLFT	HDLFT	HDRT	OBHD	OBSPEC
a. [__ __ [Spec H]]		*		*	*
b. [Spec __ [Spec H]]		*		*	

Both the left alignment system analyzed in this paper and the symmetric four constraint system predict, in contrast, that the simpler structure is preferred. The source of the rather odd

prediction made by the asymmetric constraint system is that both HDRT and HDLFT are satisfied in the absence of a head, so no constraint is sensitive to the position of the complement in the absence of a head. In particular, the position of the complement relative to the specifier goes unrecorded in constraint violations. In the left-alignment system, in contrast, COMPLFT is violated in candidate *b* and satisfied in candidate *a*. ((26) replaces HDRT with COMPLFT, with the new column bolded.) With these constraints, the more complex candidate will be optimal if OBSPEC dominates COMPLFT, and the simpler candidate will be optimal if COMPLFT dominates OBSPEC.⁷

(26) Candidates with a headless higher projection, HDLFT and COMPLFT

	SPECLFT	HDLFT	COMPLFT	OBHD	OBSPEC
a. [__ __ [Spec H]]		*		*	*
b. [Spec __ [Spec H]]		*	*	*	

The crucial difference between the left alignment constraint set and the asymmetrical set is that one system posits HDRT, where the other posits COMPLFT. These are not, in general, equivalent constraints. The difference that is relevant here is that HDRT is satisfied if the head is at the right edge or *there is no head*. COMPLFT is satisfied if the complement is at the left edge or *there is no complement*. In the problematic cases under discussion, the structure being assessed always contains a complement, but does not contain a head. Hence the additional structure incurs a violation of COMPLFT but not of HDRT.⁸

The symmetrical four constraint system is also capable of preferring the simpler candidate over the more complex one. Here SPECRT is the constraint that is violated by a specifier-complement sequence, in the absence of a head. The bolded column in (27) shows that SPECRT is violated once in the simpler structure but twice (because there is now a specifier in the higher projection, separated from the right edge of this projection by the complement) in the complex structure.

⁷ This is a case like the one analyzed below in (40), where the very constraints that impose economy in general can locally prefer a more complex structure, under some rankings. Here a projection with more elements is preferred over one with fewer, in this case by ranking the obligatory element constraint OBSPEC above the alignment constraint COMPLFT.

⁸ Note that this is not an argument against HDRT, but an argument that any system must posit an alignment constraint which is violated in a two element projection with no head.

(27) Candidates with a headless higher projection, SPECRT

	SPECLFT	SPECRT	HDLFT	HDRT	OBHD	OBSPEC
a. [__ __ [Spec H]]		*	*		*	*
b. [Spec __ [Spec H]]		**	*		*	

The fully symmetric alignment constraint system is effective in favoring the simpler structures here, since the presence of the specifier adds a violation of the SPECRT constraint. The left alignment system also properly penalizes the more complex candidates at issue, because the presence of a specifier affects the alignment of the complement, even when the head is missing.

In sum, the mixed constraint set does not predict a fully general economy of structure effect, and can be rejected. Of course, the discussion has not covered all possible and reasonable constraint sets. Moreover, considerations of economy are not the only ones which will decide on the ultimately correct set of constraints. The other considerations which play a role are the typological predictions of the constraints, and their language-internal grammatical effects.

Typological considerations prove inconclusive in deciding among the alternative systems. Both the symmetric constraint set and the left alignment set generate all four of the candidates which group the head and complement together, as discussed in Section 3.⁹ This is shown in (28) for the left-alignment set, evaluating single projections containing a specifier, a head and a complement.

(28) Typological effects of left alignment constraints

	COMPLFT	HDLFT	SPECLFT
a. [Spec H Comp]	**	*	
b. [Spec Comp H]	*	**	
c. [H Comp Spec]	*		**
d. [Comp H Spec]		*	**

When SPECLFT is at the top of the hierarchy, the winner will be either candidate *a* or candidate *b* depending on the relative ranking of HDLFT and COMPLFT. If HDLFT is at the top of the hierarchy, then candidate *c* is the optimum. When COMPLFT is the dominant constraint, candidate *d* is the winning candidate, since it is the only candidate which satisfies COMPLFT. Thus, despite the asymmetric, left-aligning character of the constraint set, all four potential orders of the three

⁹ Thus despite the asymmetric character of the constraints, this theory is not asymmetrical in the same sense as Kayne's 1994 proposal.

elements of a projection are predicted to be possible. In fact, the typological prediction (at this level of detail) of the fully symmetric constraint and set and the left-alignment set are identical.¹⁰

In sum, any constraint set which is guaranteed to be violated in every projection and violated more by more elements will be satisfactory in deriving economy of structure. We can reject the mixed set of Grimshaw 1997, because it does not entail a fully general economy of structure effect. *The general economy effects will follow from any constraint system which includes either the left alignment or symmetric sets.*

I do not wish to leave the impression, however, that there are no grounds to choose among alternative sets of alignment constraints. They are equivalent with respect to the argument of this paper, but not in general; they make fundamentally different empirical predictions. Left alignment constraints are violated by the presence of intervening material at the left edge of a phrase, right alignment constraints by the presence of intervening material at the right edge. An alignment constraint on heads is satisfied in the absence of a head, an alignment constraint on specifiers is satisfied in the absence of a specifier. Many relevant arguments can be found in the literature on OT; for example there are decisive examples of right alignment constraints in syntactic systems. There is similarly decisive evidence for left alignment. Relevant studies include Samek-Lodovici 1998, Grimshaw and Samek-Lodovici 1998, Grimshaw in press, Legendre 1996, 1999, to appear, Woolford 2001, Zepter 2000. The argument of this paper is that the economy of structure is a theorem of a OT, provided that the theory posits a set of constraints with the properties identified above. Considerations of economy alone will not choose among the alternative constraint sets which meet this condition. However, since the constraints must support the fundamental structure of phrases in natural languages, their role in linguistic theory is extensive, and the evidence concerning their nature comes from many different considerations of grammatical well-formedness.

4.4 Conclusion

The arguments of this section show that together alignment and obligatory element constraints favor small structures, thus entailing the economy of structure. A projection with fewer elements is preferred over one with more, and any structure incurs more violations of these constraints than any projection that it properly contains. Thus there is a guaranteed “cost” to additional structure. The result is quite general. It establishes an anti-complexity preference for all projections, regardless of where they appear in syntactic structure. It also establishes an anti-complexity preference for all grammars, since the preference does not depend in any way on the ranking of constraints. Section 6 shows how, under specific rankings, more complex structures can be optimal, despite the general preference for simplicity.

¹⁰ From a typological perspective, it is the mixed system of Grimshaw 1997 that is interestingly different from the two four constraint systems under discussion. The three constraints {SPECLEFT, HDLEFT, HDRT} generate three of the possible outputs, but not candidate *d* of (28), which is harmonically bounded by candidate *a*. Both candidates violate HDLEFT and HDRT exactly once, but candidate *d* also violates SPECLEFT twice.

One central example of the economy effect concerns functional projections. A structure containing fewer functional projections will always incur fewer violations of the alignment and obligatory element constraints than one containing more functional projections. Whatever violations the lower projection incurs are unaffected by the presence of a higher projection on top of it. However, the higher projection necessarily incurs internal violations, of alignment and/or obligatory element constraints.

This obviously has profound implications for the theory of functional structure. For example, consider the alternation between complement clauses with and without the complementizer *that*. In Grimshaw 1997 I proposed that the two candidates, a bare IP and a CP headed by *that* are not distinguished by the constraints (though see p 411 on the effect of HDRT on this proposal). The economy of structure, as analyzed here, is entirely incompatible with this view: The IP is the same in the two structures, and thus incurs the same violations, but the CP projection in the more complex candidate necessarily adds violations: of OBSPEC (since it has no specifier) and of COMPLFT, since it contains a complement which is not at the left edge. The CP complement structure, therefore, can be optimal only if a constraint higher ranked than OBSPEC and COMPLFT is satisfied by the presence of the CP layer and violated in its absence (Keer and Baković 1997, Baković and Keer in press, and Grimshaw in prep). See Section 6 for related examples.

Similar reasoning shows that this theory never allows literal repetition of structure and lexical content, such as that in (29).

- (29) a. * [that [that IP]]
 x. [that IP]

Whatever the violations the projection in *b* incurs, they are constant across the two candidates. Whatever substantive constraints may require the presence of a complementizer are satisfied in both structures.¹¹ The larger structure incurs more violations of the alignment and obligatory element constraints than the projection that it properly contains; as just discussed, any projection with a head-complement structure violates OBSPEC and COMPLFT. In sum, the larger structure is harmonically bounded by the smaller, and can never be optimal.

5. Economy of movement

Certain cases of economy of movement follow from the logic of the economy of structure. Since the alignment constraints disfavor projections with more elements, they disfavor projections which contain more elements by virtue of the existence of chains. The economy of movement in these cases is entailed by alignment since movement, as I will show, increases the number of alignment violations incurred by the structure.

¹¹ The structure of the top projection is the same in both cases, so any constraints which govern the top projection (Grimshaw in prep) are equally satisfied/violated.

Let us consider first the case of head movement: The argument is that *movement always adds alignment violations*. One assumption is critical here; that a moved head and the trace of a moved head are exactly like other heads with respect to the constraints. The evidence that this must be so is based on OBHD. This constraint explains some cases of movement, in particular those involved in subject-auxiliary inversion in English (see Grimshaw 1997 for details). The explanation holds only if both the moved head and its trace satisfy OBHD; otherwise OBHD cannot force raising of the auxiliary verb.

The point is illustrated in (30). If OBHD is satisfied by both V and its trace (represented by “v”), as I propose, the candidate with inversion (e.g. *Which books **have** the students t read?*) is selected over the uninverted candidate (e.g. *Which books __ the students **have** read?*), as desired. Otherwise, the two candidates tie, each violating OBHD once, and we are left with no explanation for inversion.

(30) Traces must satisfy OBHD

		OBHD satisfied by V and v	OBHD satisfied by V only
a.	[Wh V [Subj v VP]]		*
b.	[Wh __ [Subj V VP]]	*	*

Since the trace acts like any other head with respect to OBHD, I conclude that it does so with respect to any other structural constraint. This interpretation of the evaluation of traces with respect to obligatory element and alignment constraints is really the only coherent one, if we accept the view that movement/chain-formation is truly a case of the copying of linguistic material (see Chomsky 1995, Roberts 1997), or the projection of material into multiple syntactic positions, with various linguistic principles determining which position is pronounced.

Under this assumption, head movement always adds alignment violations:

(31) Movement of a head adds alignment violations in Spec-H-Comp structure

		HDLFT	COMPLFT
a.	[Spec __ [Spec H]]	*	*
b.	[Spec H [Spec h]]	**	**

The tableau shows that movement of the head adds a violation of HDLFT and COMPLFT in the top projection. The top projection in the movement structure is a three element projection, which must therefore have three alignment violations. (The head is separated from the left edge of the projection by one element, and the complement by two). The total number of alignment violations in the movement structure is thus four, including the HDLFT violation incurred by the lower projection. The total number of alignment violations in the no-movement structure is two, one

violation of COMPLFT in the higher projection and one of HDLFT in the lower. Raising the head thus adds both a HDLFT violation and a COMPLFT violation.

If the higher projection happens to contain no specifier, as in (32), raising the head adds just a COMPLFT violation in the higher projection.

(32) Movement of a head adds alignment violations in H-Comp structure

		HDLFT	COMPLFT
a.	[__ [Spec H]]	*	
b.	[__ H [Spec <i>h</i>]]	*	*

This pattern is no surprise. We already know that projections containing three elements violate the alignment constraints three times, and those containing two elements violate them once.¹² Comparing a grammatical structure where the higher projection contains three elements and an alternative in which it contains two, or one where the higher projection contains two elements and the alternative contains only one, must always favor the simpler structure. Movement is just a special case of this.

Moreover, we know that the pattern is going to be cross-linguistically valid. It is not dependent on ranking, so it is invariant across grammars, just as the basic finding concerning alignment violations is invariant across grammars. For example, consider head movement in a right-headed system, using an example which otherwise matches (31) exactly. Again both candidates have a lower projection which incurs one alignment violation, on HDLFT. In both candidates, the higher projection incurs one violation of COMPLFT because the specifier intervenes between the complement and the left edge of the projection. In the movement structure, the higher projection incurs two additional violations of HDLFT, since the moved head is separated from the left edge by both the specifier and the complement. Hence, just as for the SVO case, and just as expected, the total number of alignment violations in the movement structure is four, while in the no-movement counterpart it is two.

(33) Movement of a head adds alignment violations in right headed structures

		HDLFT	COMPLFT
a.	[Spec [Spec H] __]	*	*
b.	[Spec [Spec <i>h</i>] H]	***	*

¹² A projection with two elements is the smallest projection which can house both the moved item and the projection from which the moved item was raised.

In sum, movement of a head is subject to economy by virtue of the alignment constraints: it will be possible only if a constraint crucially satisfied by movement dominates all alignment constraints violated by the movement. Section 6 illustrates this pattern.

The argument just made for heads applies directly to movement/chains involving XP positions. The crucial assumption is again that a moved XP and the trace of a moved XP are exactly the same, and exactly like other XPs with respect to the constraints. The empirical argument parallels that made for chains involving heads. Consider, for example, raising to subject driven by OBSPEC, consistent with the analysis of subject positions in Grimshaw and Samek-Lodovici1998, and with the general idea that OBSPEC lies behind the “EPP”. The argument is schematized in (34). OBSPEC can never motivate movement from one specifier position to another, unless both positions in the chain satisfy OBSPEC, otherwise the number of OBSPEC violations incurred in the two cases will be identical.

(34) Traces must satisfy OBSPEC

		OBSPEC satisfied by XP and <i>xp</i>	OBSPEC satisfied by XP only
a.	[XP V [<i>xp</i> V VP]]		*
b.	[___ V [XP V VP]]	*	*

Since the trace acts like any other phrase with respect to OBSPEC, I conclude that it does so with respect to all structural constraints. As for heads, this interpretation of the evaluation of traces is really forced by the theory of movement.

With this assumption in place, we can show that XP movement is worse for alignment than non-movement. Note first that since any XP incurs violations of the set of alignment and obligatory element constraints, the more occurrences of a given XP there are in a structure, the more such violations there will be. So internal violations of XP alone are sufficient to derive economy of movement for XP. However, there is also an economy effect based, like that for heads, on violations external to XP. A structure in which a specifier is moved from a lower projection to a higher projection containing a head, will incur two additional alignment violations. Recall that this is true regardless of the ranking of the alignment constraints, i.e the particular grammar at issue. In an SVO system, the violated constraints are HDLFT and COMPLFT, as illustrated in (35).

(35) Spec-to-Spec Movement of an XP results in additional violation of alignment

		HDLFT	COMPLFT
a.	[___ H [XP H]]	*	*
b.	[XP H [<i>xp</i> H]]	**	**

The raised specifier in candidate *b* separates the head from the left edge of its projection, and the presence of the specifier adds one more element intervening between the complement and the left edge of the projection. In a right-headed system, raising a specifier into the higher projection will add one violation of HDLFT and COMPLFT.

Movement of a phrase from a complement position to subject position has similar consequences, illustrated in (36).

(36) Complement-to-Spec Movement of an XP results in additional violation of alignment

		HDLFT	COMPLFT
a.	[___ H Comp]		*
b.	[XP H <i>xp</i>]	*	**

The candidate with a chain linking the specifier and complement positions violates HDLFT and violates COMPLFT twice, since both the specifier and the head separate the complement from the left edge of the projection. In effect, the movement turns a two element projection into a three element projection, necessarily increasing the total number of alignment violations from one to three, so an economy effect is imposed here too, by the alignment constraints. Recall again, that this will be the case under any ranking of the alignment constraints.

The comparisons analyzed in this section do not exhaust all cases of economy of movement hypothesized in the literature, because they concern only structurally non-equivalent candidates. Obviously constraints on structure cannot and should not distinguish structurally equivalent candidates; Such cases are discussed briefly in Section 7.1.

In sum, alignment imposes economy of movement for both X-zero and XP chains, preferring projections with no head, or no specifier, over alternatives with a head or a specifier position filled by movement. Economy of movement, in these structurally non-equivalent instances, is just a special case of economy of structure.

6. Violations of economy

Since every projection violates one of the constraints under discussion, and fewer projections are therefore always better with respect to these constraints than more projections, what makes larger structures possible at all? Why does any syntactic structure exist, since no projection at all is the most economical structure? The best candidate from the point of view of the constraints is the null candidate (Prince and Smolensky 1993). It satisfies all alignment constraints, and it satisfies both obligatory element constraints, since it contains no projection which lacks a head or a specifier. Any actual projection at all, as shown above, violates either alignment or obligatory element requirements, in every language.

6.1 Structure required for parsing of lexical input

A certain amount of syntactic structure is forced by the need to parse the input. In syntactic systems, perhaps unlike their phonological counterparts, omission of input material is not routinely resorted to as a way of solving conflicts between constraints. For example, all alignment constraints can be satisfied in any projection if all but one element is omitted, creating a one-element projection (see section 3.3). However, this kind of pattern (as opposed to rearrangement of elements) does not seem to be encountered. I assume that this is due to the transparently meaning-bearing character of the items concerned in syntax.

As a practical choice, then, I am assuming here that all lexical items in the input are parsed in all winning candidates: The verb, the lexical head of its arguments, the lexical head of any adjuncts.¹³ This material is organized into X-bar theoretic projections, and the constraints analyzed here select among alternative organizations of this kind. (Of course, it is perfectly possible that organization into projections is itself just one of a variety of choices for the realization of arguments and functional specifications, and that further constraints and optimization are involved in determining syntactic structure.) Given the assumption that inputs consist of lexical heads and argument structures, all candidates will contain at least lexical projections

Such considerations will require that for an input consisting of a verb plus two arguments, all candidate structures must contain at least three projections: one headed by the verb, one housing the external argument and one the internal argument. I have assumed here that the three projections are always further organized into a specifier, a complement, and the projection which contains both of these and the verb. It is not, of course, crucial for the argument here whether this is enforced by GEN or the result of ranked constraints. For example, it is perfectly possible that arguments appear as specifiers and complements when constraints which require this organization are the dominant ones. In contrast, arguments might be realized outside the projection of V, e.g. as adjuncts (see Jelinek 1990, and, for a different view, Baker 1996), if alignment constraints dominate the constraints which impose a specifier-head-complement structure, a suggestion due to Alan Prince, p.c.

I conclude that a certain minimal amount of syntactic structure is required simply in order to parse an input into legitimate structural forms. Roughly speaking, this consideration motivates the analysis of a verbal input as a VP, i.e. as a projection with the V as a head, and the argument(s)

¹³ What enforces this? Positing faithfulness constraints and allowing them to rank freely with respect to markedness constraints does not entail faithfulness to lexical input, since ranking the faithfulness constraints below all alignment constraints, for example, chooses an unfaithful optimum. Thus some additional assumptions concerning recoverability have to be brought into the equation to yield the whole picture. Alternatively, we could hypothesize that GEN does not construct lexically unfaithful candidates. There can be no languages which resort to silence to resolve syntactic constraint conflict, and no languages where, for example, verbs are always deleted. There are obvious functional advantages to linguistic systems which at least preserve lexical distinctions.

as specifier and/or complement. Any and all further structure is not imposed by GEN, but simply available for potential optima.

6.2 Structure required for constraint satisfaction

Structure above and beyond the lexical projection will be present in a winning candidate only if the constraints enforcing economy are dominated by constraints that require the presence of the further structure. The constraint OPSPEC, which plays a crucial role in the analysis of English interrogatives given in Grimshaw 1997, can force the presence of more structure than is required or allowed in declaratives. OPSPEC requires that operators be in specifier position, and can only be satisfied in candidates which contain a projection which can house the specifier. The analysis is exemplified in (37); Cf. Grimshaw 1997, tableau 1, p378. (For concreteness, I assume in (37) that the subject is raised from Spec of VP to Spec of IP position). The larger structure in candidate *b* incurs more alignment violations than candidate *a*, since it contains all of the projections of candidate *a* and one more. However, the larger structure satisfies OPSPEC, so the ranking of OPSPEC above the alignment constraints chooses the larger structure as the output.

(37) Satisfaction of OPSPEC forces presence of an “extra” projection

input: seen (they, what) perfect	OPSPEC	HDLFT	COMPLFT
a. [They have [<i>they</i> seen what]]	*!	**	****
b.  [What have [they <i>have</i> [<i>they</i> seen <i>what</i>]]]		***	*****

This example shows that the presence of “extra” structure, and the presence of chains in an output, are not excluded entirely. They are excluded under some rankings of the constraints, allowed by others. The choice of the larger structure as the optimum is entirely dependent on the ranking of the OPSPEC constraint relative to alignment. Clearly, if either or both of the alignment constraints dominate OPSPEC, then the smaller structure will be chosen in tableau (37). The choice of larger structures over smaller is crucially *ranking dependent*

The choice of larger structures over smaller is also crucially *dependent on input properties*. When the input contains a *wh* phrase, OPSPEC is not satisfied vacuously, because the output contains an operator which must be properly positioned. However, if the input contains no *wh* phrase, OPSPEC is satisfied vacuously, and alignment forces the choice of the smaller structure as the output. Cf. Grimshaw 1997, tableau 2, p379.

(38) OPSPEC vacuously satisfied

input: seen (they, it) perfect	OPSPEC	HDLFT	COMPLFT
a.  [They have [<i>they</i> seen it]]		**	****
b [It have [they <i>have</i> [<i>they</i> seen <i>it</i>]]]		***	*****

Since candidate *b* (which matches candidate *b* of (37) in form) incurs more alignment violations than candidate *a*, and there is no difference between them with respect to OPSPEC, the smaller structure is the optimal output for this input. (Similar candidates which contain a higher projection with no specifier or no head also violate alignment and/or obligatory element constraints, so the same point holds, *mutatis mutandis*, for them.) Unnecessary movement is thus prevented.

The same example shows how a particular ranking of the constraints can prefer a projection with more elements over a projection which contains fewer. Compare the two candidates in (39).

(39) Satisfaction of OBHD forces presence of an “extra” element

input: seen (they, what) perfect	OBHD	HDLFT	COMPLFT
a. [What ___ [they have [they seen what]]]	*!	**	*****
b.  [What have [they have [they seen what]]]		***	*****

Candidate *a* does better on alignment because its highest projection contains fewer elements than the highest projection of candidate *b*: candidate *a* incurs one less HDLFT violation and one less COMPLFT violation than candidate *b*. Candidate *b*, however, satisfies OBHD, which candidate *a* violates. So if OBHD dominates HDLFT and COMPLFT, the more complex structure is chosen over the less complex. If either of the alignment constraints dominates OBHD, the less complex structure is optimal.

As this last example illustrates, the very group of constraints which enforces economy can have the effect of choosing large structures over smaller ones under some rankings (and for some inputs). While the alignment constraints and the obligatory element constraints jointly guarantee the overall preference for smaller structure over larger, they actually conflict with each other. Alignment, which always prefers fewer elements in a projection, is better satisfied in the absence of heads and specifiers, but the absence of heads and specifiers violates the obligatory element constraints, which prefer fewer projections. So, as individual constraint types they prefer different types of projections, and hence the ranking between them can choose larger structures over smaller.

The obligatory element constraints favor fewer projections and more elements in each, giving more compact structures as optima. In contrast, when the alignment constraints dominate the obligatory element constraints, as in (40), the optimum is a less compact structure, with more projections but fewer elements in each, since these are preferred by alignment. Such examples establish quite clearly that this theory does not posit “economy constraints” or “anti-economy constraints”. (40) shows the two-projection candidates which are compatible with the SPECLFT>>HDLFT>>COMPLFT ranking.

(40) Alignment forces an additional projection

	SPECLFT	HDLFT	COMPLFT	OBSPEC	OBHD
a. [Spec H Comp]		*	**		
b.  [__ H [Spec __ Comp]]			**	*	*
c.  [Spec __ [__ H Comp]]			**	*	*
d. [Spec H [__ __ Comp]]		*	**	*	*

The candidates which separate the head and specifier into two projections tie on SPECLFT, and on COMPLFT. However, the single projection candidate (as well as candidate *d*) violates HDLFT, which is satisfied by the candidates which separate the head and the specifier. The two-projection candidates violate OBHD and OBSPEC, so the ranking between HDLFT and the obligatory element constraints determines whether the single projection candidate, or one of the structurally more complex candidates, is the winner. If OBHD or OBSPEC dominates HDLFT, candidate *a* will win. If HDLFT dominates both OBHD and OBSPEC then candidate *b* or *c* is optimal.¹⁴

The selection of larger over smaller structures is highly limited, even in this case. While a two-projection structure can be chosen in (40), a three-projection structure can never be. The reason is this: the alignment violation (of HDLFT in candidate *a*) that is improved by use of a higher projection can be eliminated by adding one more projection, and separating the elements which compete for alignment. Adding yet another projection can never improve alignment any further. This is illustrated in (41), for candidates where the Spec is in the highest projection – the same violations are incurred if the head and the specifier switch positions. The same argument holds, *mutatis mutandis*, for the other possible rankings of the alignment constraints.

(41) Alignment forces an additional projection: the limit

	SPECLFT	HDLFT	COMPLFT	OBSPEC	OBHD
e. [Spec __ [__ __ [__ H Comp]]]			**	**	**
f. [Spec __ [__ H [__ __ Comp]]]			**	**	**

COMPLFT is violated twice in every candidate; every candidate contains exactly two elements which (under the ranking which establishes basic projection structure for the language) precede complements, and thus induce COMPLFT violations. These are the head and the specifier. Regardless of where they appear in the structure, each always induces a COMPLFT violation. Thus while the presence of one “extra” projection can improve alignment, additional projections have no

¹⁴ These two candidates tie on the constraints discussed here. Other constraints, however, will distinguish them, see Grimshaw in prep.

effect, and they simply accumulate violations of OBHD and OBSPEC. As a consequence, only the candidates in (40) can ever be optimal. Those in (41) can never be since they are harmonically bounded by the candidates in (40).

How does the analysis in (40) relate to the overall argument about economy? Every projection in (40), like any other projection, incurs at least one violation of the obligatory element constraints and/or the alignment constraints. Each of the projections in candidates (a)-(c) violates COMPLFT; in addition each projection either violates an obligatory element constraint (both projections in candidates b and c) or violates COMPLFT twice (the only projection in candidate a.). None of the projections is cost-free, hence the overall economy of structure argument holds here just as above. *Regardless of ranking*, the alignment and obligatory element constraints impose economy of structure.

However, since it is never possible to satisfy all of these constraints, some form of complexity must be endured in any output. The more compact structure exhibits one kind of complexity (more elements per projection) and the less compact structure exhibits another (more projections). The ranking among the constraints thus determines just what the pattern of violations will be in the optimal candidate. With obligatory element constraints at the top of the hierarchy, the compact structure is optimal, with the alignment constraints at the top of the hierarchy, the less compact structure, with more projections, will be the output.

The structure with more projections can never be optimal when the comparison is between a given structure and that same structure with additional projection(s) added, as in (42). In this situation, no ranking of the alignment and obligatory element constraints will result in the choice of the larger structure. The two kinds of constraints do not conflict here, and the smaller structure will always win in such a comparison, unless other constraints intervene. The tableau shows that the larger structures in such a comparison violates all of the constraints violated by the smaller structure, and others in addition. In such a situation, the ranking of the alignment and obligatory element constraints is irrelevant, since the optimum is the same in any case.

(42) Larger structures are harmonically bounded

	SPECLFT	HDLFT	COMPLFT	OBHD	OBSPEC
a. [Spec H Comp]		*	**		
b. [___ H [Spec H Comp]]		*	***		*
c. [Spec ___ [Spec H Comp]]		*	***	*	

In sum, the obligatory element and alignment constraints are in conflict within projections, and this conflict centers on the two different notions of “complexity”; fewer projections with more elements or more projections with fewer elements. It follows that rankings among them will favor one or the other kind of structural organization for phrases. These rankings, like those between this group of constraints and others such as OPSPEC, can force the presence of additional structure, but

only minimally. That is, the presence of structure above and beyond that which allows best-satisfaction of the constraints is prohibited, and hence the economy of structure maintains its hold over syntactic representations.

Here again we see that the choice of a larger structure over a smaller alternative is *ranking dependent, and hence language particular*. There is no general preference for larger structure. In contrast, the preference for less complex structure is independent of ranking, and it holds for all inputs, and all comparisons. There is no set of constraints which reliably prefers complexity; which are always better satisfied by more complex structures than by simpler structures. The choice of more complex structures is not general. It depends on ranking, and thus is language specific; it depends on the input and thus holds in some cases but not in others, and it depends on the comparison: it is found only in comparisons where there is conflict among the relevant constraints. The preference for simpler structures is found for all rankings and thus is universal, it is independent of the input, and thus holds in all cases, and it holds regardless of the nature of the interaction between the relevant constraints.

7. The status of economy

At the heart of the argument of this paper is the claim that no projection is cost free, and (virtually) no element of any projection is cost free. Every projection incurs a violation on at least one of the alignment and obligatory element constraints, and every additional element in a projection induces at least one additional violation of alignment. To derive economy of structure, the constraints must *reliably* penalize structure: it is not enough for some projections under some rankings or in some configurations to incur violations. This will not enforce a general economy effect. The result argued for here is fully general, because it has nothing to do with the ranking of the constraints, simply with the patterns of violation, which are constant, unaffected by ranking, and hence universal. Thus all projections, in any grammatical system, fall under the analysis.

The economy result holds because the grammar of each language contains constraints which conflict in any projection. Every element costs something because the alignment constraints conflict with each other, and cannot be satisfied in any projection which contains more than one element in a projection. Every projection costs something because in every projection the alignment constraints conflict with the obligatory element constraints, so both cannot be satisfied. Without conflicting constraints, it is not possible to *derive* the economy of structure. Suppose, for example, that English had only the constraints in (43):

(43) SPECLFT, COMPRT

These constraints will pick the right output for English, in all cases. Moreover, the constraints will be unviolated, for all cases. Thus every projection will be cost-free, and every element will be cost-

free. No economy effect will follow from this system (the same point was made above concerning a parametric theory such as (11)).

(44) Non-conflicting constraints

	SPECLFT	COMPRT
a. [Spec H Comp]		
b. [Spec H [Spec H Comp]]		
c. [Spec H [Spec H [Spec H Comp]]]		

Compare this tableau with the one in (20). In (20), the number of alignment violations increases as the number of projections increases. In (44), in contrast, the number of alignment violations is constant at zero, because the constraints do not conflict with one another, and both are satisfied. Alignment violations do not reflect the complexity of the structure. Economy of structure does not follow in such a system.

The grammar in (43) is not a possible one in OT, which requires all constraints to be in the grammar of every language – OT constraints are universal. The pair of constraints in (43) does not even approach being adequate for all languages. But as soon as the constraints in (43) are supplemented by a constraint which allows a right headed structure to be generated, such as COMPLFT or HDRT, the set of constraints in the theory will necessarily be in conflict with each other. The logic of Optimality Theory forces constraints into conflict, allowing economy of structure to be derived.

Thus economy does not follow just from the existence of a set of constraints on structure. It follows from the existence of a set of constraints which conflict in every projection, and which therefore together guarantee that every projection and every element in a projection, incurs a “cost”, as reflected in constraint violation.

7.1 Alternatives within OT: Economy Constraints

According to the argument made here, economy of structure follows from OT, with the appropriate constraints as analyzed in the previous section, in a quite fundamental way. If it should turn out that in fact there are no economy effects, the entire theory would have to be rethought, perhaps discarded. This contrasts sharply with the proposals found in the literature, in which economy effects are attributed to specific economy constraints, quite independent of other aspects of the theory.

As I have emphasized throughout, the constraints that entail the economy of structure are in no sense economy constraints themselves. They are constraints which regulate the structure of phrases, and they can, under certain circumstances, even select larger over smaller structures, as shown in tableaux (40) and (28). It is a priori possible within OT to posit a constraint or set of

constraints which are clearly identifiable as economy constraint(s). In this kind of proposal, economy of structure in OT follows from constraints such as *Structure (Prince and Smolensky 1993), or *XP. My argument is that such a constraint is redundant.¹⁵ (See Grimshaw 1997; 381 and note 5, for the idea that as the set of constraints posited by the theory develops, an economy constraint can become more or less redundant.)

It is redundant, since it always selects the same optimum as the alignment and obligatory element constraints. Consider *XP, which is violated by every maximal projection. In a comparison between a phrase containing two other phrases (three XPs in total) and a phrase containing one other phrase (two XPs in total), the smaller structure will incur fewer violations of *XP. Hence it will be optimal unless some other constraint requires the presence of the extra phrase, and this constraint dominates *XP. Note that *XP will also disfavor movement in exactly the same circumstances as the alignment constraints, that is, when movement has the effect of creating a more complex phrase. *XP by itself, however, does not match the predictions of the alignment constraints, since it does not generalize to the cost of the presence of a head (and therefore to head movement as a consequence). Thus an additional constraint for heads, *X, might be posited also.

The violations incurred on *XP and *X are illustrated in (45) (which can be compared with (37) above). The structure which places the *wh* phrase in the specifier position contains more XP nodes than candidate *a*, which leaves the *wh* phrase in situ. If the clause in candidate *b* contains seven XPs, the CP, IP and VP plus specifiers for each, and the complement of the V, then the clause in candidate *a* contains only five. Hence candidate *a* violates *XP five times, and candidate *b* violates *XP seven times. Thus *XP will prefer the candidate with less structure. It is only when some higher ranked constraint such as OPSPEC forces the presence of additional structure that the larger structural option is the optimal one. *X has the same result here if each phrase contains a head.

(45) Effect of Economy Constraints (*XP/*X)

input: seen (they, what) perfect	HDLFT	COMPLFT	*X	*XP
a. [They have [<i>they</i> seen what]]	**	****	*****	*****
b.  [What have [they <i>have</i> [<i>they</i> seen <i>what</i>]]]	***	*****	*****	*****

The important point is that *X and *XP select the same optimum as the alignment constraints HDLFT and COMPLFT. When the structures being evaluated contain single-element or completely empty projections, alignment is satisfied but the obligatory element constraints are not. So in such a situation, it will be these constraints which match the choice of optimum made by *XP and *X.

¹⁵ *XP is an OT-internal formulation of the constraint which I called “Minimal Projection” in Grimshaw 1993: “Projections are legitimate only when they are motivated”. OT eliminates the “only when motivated” part of such constraints. “Projections are legitimate” turns into “Projections are illegitimate” i.e. *XP. The “only when ...” in the original formulation is entirely unnecessary, since *it follows from the theory* that the constraint will be minimally violated when dominated by a conflicting constraint.

The same holds for a comparison of the role of STAY (*t) in Grimshaw 1997 and the alignment constraints, in head movement and XP movement. This is illustrated for head movement in (46). STAY is violated by every trace. As violations of STAY increase, so do violations of alignment, hence STAY and the alignment/obligatory element constraints always select the same optimum.

(46) Effect of Economy Constraints (STAY / *t)

	HDLFT	COMPLFT	STAY
a. [Spec __ [Spec__ [Spec H Comp]]]	*	****	
b. [Spec __ [Spec H [Spec h Comp]]]	**	*****	*
c. [Spec H [Spec h [Spec h Comp]]]	***	*****	**

If specific economy constraints always select the same optima as the general constraints on structure, as I am arguing, then specific economy constraints can be eliminated from the theory altogether.

Does any evidence remain for specific economy constraints? A possible role for an economy of movement constraint such as STAY was mentioned in Section 5. Structural constraints distinguish structurally non-equivalent candidates, such as those in (31) and (35). Candidates which are structurally equivalent incur exactly the same violations on purely structural constraints. Thus, for example, the difference between a candidate which contains a trace and its antecedent and an otherwise identical candidate which contains two independent items, can never be reflected in the alignment and obligatory element constraints. (This is the comparison that is involved in the discussions of “merge versus move” in the literature on minimalism; Chomsky 1995, 1998; Shima 2000.) Consider, for example, a candidate which is identical to *c* in (46), but has separate heads in each of the two lower projections, in place of the traces. Nothing changes in its evaluation by the alignment constraints, since it is structurally equivalent to the candidate with traces. The same holds, *mutatis mutandis*, for XP movement.

It is certainly possible that these comparisons do motivate a specific economy of movement constraint, such as STAY/*t. However, the choice between filling positions by movement and filling positions with independent material is also governed by markedness and faithfulness constraints (Grimshaw in prep). In order to motivate an economy constraint for movement, it is necessary to establish that the combination of faithfulness, markedness and structural economy do not already yield the key results. If these factors do explain the key results, what has been labeled as involving “economy” dissolves into a complex of rather different epiphenomena, each resulting from a different aspect of the theory, and each a by-product of the grammatical system.

The conclusion is that there is no clear motivation for constraints whose function is specifically to impose economy within OT. Economy is already imposed by general constraints on syntactic structure, given the logic of constraint violation in OT, which naturally imposes minimality

of violation, yielding the economy of structure. OT, with conflicting alignment constraints and obligatory element constraints, entails the economy of structure in natural language in a rather deep way.

7.2 Economy outside OT

Since the explanation for economy of structure proposed here crucially depends on the existence of conflicting constraints, clearly no theory which admits only inviolable constraints can follow the same avenue of explanation. Such a theory must therefore stipulate one or more economy constraints. It is also impossible for such a theory to sensibly posit constraints like *XP, or *X. Such a constraint is violated in every sentence in every natural language. Instead, the constraint must attempt to spell out the conditions under which it is violated, in the form of an “unless ...” clause included in its statement.

Bresnan 1998, 2001 posits a principle of “Economy of Expression”, in which the conditions under which economy is violated are spelled out in the constraint.

(47) Economy of Expression (Bresnan 2001: 91)

All syntactic phrase structure nodes are optional and are not used unless required by independent principles (completeness, coherence, semantic expressivity).

Rizzi 1997: 314 gives the statement in (48), and then goes on to note in the text that “.. a principle of parsimony cannot win over the fundamental structure building principles”. So (48) might instead read “Avoid structure unless required by fundamental structure building principles”. (Rizzi’s analysis requires that economy prevents the addition of an extra structural layer to avoid an ECP violation, while an extra structural layer does appear if the language has a functional head to be realized.)

(48) Avoid structure

It is worth pointing out that this formulation is strictly inconsistent with any claim that grammatical principles are inviolate. Clearly those that are overridden by economy (those that parsimony “wins” over) are violated when they are so overridden. Economy itself is overridden by the “fundamental structure building principles”.

The challenge for formulations of economy outside OT is to make good on the “unless ...” components of the theory. If it is the case that for all languages there is a fixed set of constraints or principles which can override the economy constraint, as Bresnan’s formulation implies, then the project will succeed by providing a list of what can override economy and what cannot.

If, on the other hand, what overrides economy is a matter which is cross-linguistically variable, as the OT proposal here predicts, then specifying the “unless” component will require specifying lists of over-riding constraints on a language-by-language basis. Cross-linguistic variation in the syntactic complexity of various structures, if analyzed as variation in the relationship between the economy principle and others, will lead to this outcome. (None of the examples discussed here or in Grimshaw 1997 is strictly universal in character viewed from the perspective of interacting constraints. It remains to be seen whether they can be made consistent with a universalist view.)

However, there are major theoretical concerns which undermine the interest of a proposal which gives lists of overriding and overridden principles for each language. A proposal of this kind makes economy unique – as the only constraint for which the notion of overriding/overridden is relevant. To generalize the notion to all constraints is to shift the perspective to one in which all constraints are violable, and hence to some version of OT. The second difficulty with a solution which gives lists of overriding and overridden principles is that it makes no connection between the principles which, in a given language, override or are overridden by economy, and other grammatical properties of the same language. This is because the statement as to which principles behave which way is completely independent of all other grammatical matters.

In contrast, the OT characterization of economy is intimately connected to the grammar of each language. In order for a constraint to “override economy”, it must dominate all of the alignment and obligatory element constraints that it conflicts with (see e.g. (37) and (39)). In order for a constraint to “be overridden by economy” it must be dominated by at least one such constraint. It follows, therefore, that all constraints which override economy must dominate all constraints which are overridden by economy, and thus *that every member of the set of overriding constraints must dominate every member of the overridden set*. By the logic of ranking it also follows that if a constraint dominates any member of the first set of constraints, it must also dominate the economy enforcing constraints. If a constraint is dominated by any member of the subordinate set of constraints it must be dominated by the economy enforcing constraints too. These deductions about what will override what in a given grammatical system make very powerful predictions indeed. The constraints which impose economy of structure are an integral part of the grammatical system of any language and their role in any grammatical system is determined by their ranking.

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