

# Economy of Expression as a principle of syntax

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## ABSTRACT

The purpose of a grammatical theory is to specify the mechanisms and principles that can characterize the relations of acceptable sentences in particular languages to the meanings that they express. It is sometimes proposed that the simplest and most explanatory way of arranging the formal mechanisms of grammatical description is to allow them to produce unacceptable representations or derivations for some meanings and then to appeal to a global principle of economy to control this overgeneration. Thus there is an intuition common to many syntactic theories that a given meaning should be expressed in the most economical way, that smaller representations or shorter derivations should be chosen over larger ones.

In this paper we explore the conceptual and formal issues of Economy as it has been discussed within the theory of Lexical Functional Grammar. In LFG the metric of Economy is typically formulated in terms of the size of one component of syntactic representation – the surface constituent structure tree – but it is often left unstated which trees for a given meaning are to be compared and how they are to be measured. We present a framework within which alternative explicit definitions of Economy can be formulated, and examine some phenomena for which Economy has been offered as an explanation. However, we observe that descriptive devices already available and independently motivated within the traditional LFG formalism can also account for these phenomena directly, without relying

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on cross-derivational comparisons to compensate for overgeneration. This leads us to question whether Economy is necessary or even useful as a separate principle of grammatical explanation.

1

## INTRODUCTION

There is an intuition common to many syntactic theories that a given meaning must be expressed in the most economical way: that only smaller representations or shorter derivations should be classified as well-formed, and larger expressions of the same meaning should be discarded. In implementing this intuition, it is sometimes proposed that the simplest and most explanatory way of arranging the formal mechanisms of grammatical description is to allow them to produce unacceptable representations or derivations for some meanings and then to appeal to a general grammatical principle to control this overgeneration. Economy classifies a derivation as grammatical if and only if it is among the smallest or most economical according to the relevant Economy metric, and non-economical expressions of the same meaning are classified as ungrammatical.

For all theories of syntax, the question arises of whether there is a global Economy principle classifying derivations as grammatical or ungrammatical. In defining Economy any theory needs to consider (1) the candidate representations that provide the choice space for Economy, and (2) the nature of the strings that are involved in Economy comparisons. Different theories may appeal to different metrics in defining Economy; for some theories, the number of steps in a derivational process may be the relevant measure, while in other theories the number of nodes in a constituent structure tree or the number of components of some other grammatical structure may be relevant. Optimality-theoretic (OT) approaches (Morimoto 2001; Grimshaw 2001) assume a general constraint on expression that identifies smaller structures as grammatical in comparison to larger ones, and Collins (2003) discusses a class of what he calls “Economy of Representation” approaches which propose similar constraints, e.g. Emonds’ slogan “Use as few words as possible” (Emonds 1994).

In this paper we present a formal framework within which alternative explicit definitions of an Economy principle can be examined, cast within the theory of Lexical Functional Grammar (LFG: Kaplan

and Bresnan 1982). The metric of Economy as discussed in the LFG literature is typically formulated in terms of the size of one component of syntactic representation, the surface constituent structure tree, but it is often left unstated exactly which trees for a given meaning are to be compared and precisely how they are to be measured. Our aim is to shed light on the nature and definition of Economy; in doing so, we raise some issues about the nature of Economy as a principle of grammar, and call into question the necessity of such a principle.

Economy vs. pragmatic, stylistic, or processing-based metrics

It is important to separate the Economy metric from other stylistic, pragmatic, or processing-based preferences that may also value succinctness or brevity. According to Economy, the only grammatical means of expressing a given meaning are the smallest ones, and larger ones are classified as ungrammatical and discarded. Other linguistic modules may be involved in comparing ways of expressing broadly similar meanings: for example, Gricean maxims of quantity or manner (Grice 1975) may prefer more succinct expressions of a particular meaning over less succinct ones. Similarly, comparisons among grammatical derivations may be important in language acquisition and processing (Kuhn 1999, among many others), and such considerations may provide evidence for processing-based preferences or selection of particular grammatically well-formed structures over others. However, such preferential mechanisms always choose among grammatically well-formed expressions of the relevant meaning, each of which (according to the Economy principle) is among the smallest for the particular meaning it expresses. Since pragmatic, stylistic, or processing-based preferences choose only among grammatical utterances, they are orthogonal to the Economy-based classification of utterances as grammatical or ungrammatical upon which we focus.

Economy vs. Blocking

We also distinguish Economy as a syntactic metric from Blocking (Andrews 1990; Bresnan 2003; Embick and Marantz 2008) as a morphological metric. Though both Blocking and Economy involve competition among different ways of expressing a particular meaning, the vast majority of cases of morphological blocking involve comparison between single words, for example *\*goed* vs. *went*. In contrast, the

Economy metric in LFG evaluates alternative constituent structure trees, choosing smaller trees and rejecting larger trees; it is not considered when making the choice between alternative single words appearing in the same position in the same syntactic structure. Economy is, however, relevant for a particular subset of morphological blocking cases: those which have been termed “Poser blocking” (Poser 1992; Embick and Marantz 2008), where the availability of a single-word expression of a particular meaning is claimed to block the expression of that meaning as a multi-word phrase; we discuss Poser blocking in Section 6.2.

In Section 2, we introduce LFG, principle-based specification of LFG grammars, and explanatory concerns for the theory of syntax in adopting an Economy metric. We provide the background and definitions for our formal account of Economy in Section 3, proposing three alternative definitions of how Economy is measured. In the following three sections, we explore each of these three definitions, discuss how they relate to previous proposals, and evaluate some empirical evidence that has been proposed as motivation for each definition.

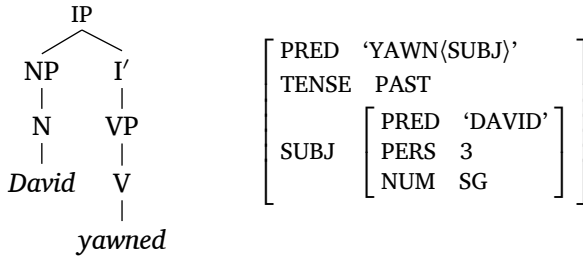
Based on our formalization of Economy and its proposed application to several phenomena that have been taken to motivate such a principle, we do not find Economy to be a compelling explanatory principle of grammar, at least from the perspective of LFG. Economy is unlike other commonly assumed grammatical principles in involving a global comparison among otherwise well-formed structures, rather than well-formedness conditions that must be met by grammatical structures or rules. Hence, the burden of proof is on proponents of Economy to show that its effects cannot be achieved by independently-motivated, pre-existing grammatical mechanisms. Our examination of some of the cases that have been taken to support an Economy metric reveal that alternative accounts are in fact available, and we suggest that a convincing case for Economy has not yet been made.

## 2 SPECIFICATION OF LFG GRAMMARS AND THE NATURE OF ECONOMY

An LFG grammar assigns to every string in its language at least one functional structure (*f*-structure) that corresponds to at least one constituent structure tree (*c*-structure). The constituent structure tree rep-

resents linear order and phrasal grouping, while the functional structure represents abstract predicate-argument relations and information about case, agreement, tense, and other grammatical features. The c-structure and simplified f-structure for *David yawned* is given in (1):

(1) Constituent structure:                      Functional structure:



An f-structure  $f$  belongs to a set  $F$  of attribute-value matrices that satisfy all of the f-structure well-formedness conditions specified by LFG theory, including at least the Uniqueness, Coherence, and Completeness conditions.<sup>1</sup> Similarly, a c-structure  $c$  belongs to a set  $C$  of valid phrase structure trees that satisfy additional well-formedness conditions: traditionally these include the formal prohibition against non-branching dominance chains (Kaplan and Bresnan 1982), though additional constraints, such as those requiring  $X'$ -theoretic configurations or the disallowance of empty nodes, have also been explored, as we discuss below. However the well-formedness conditions might be specified, the elements of  $F$  and  $C$  are the “valid” structures with respect to LFG theory: they are the only ones that serve as models of grammatical constraints and thus the only ones that figure in a meaningful discussion of grammar-based Economy.

An LFG grammar is traditionally specified by a system of node-admissibility constraints presented in the rewriting-rule format of a context-free grammar (Dalrymple *et al.* 1995a). The daughters in each rule are decorated with functional schemata, and these are instantiated to constraints on the corresponding f-structures. The f-structures are valid models for the functional constraints that are associated with at least one c-structure.

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<sup>1</sup> The Uniqueness condition guarantees that each attribute in an f-structure has exactly one value. Completeness and Coherence guarantee that the valency requirements of each syntactic predicate are satisfied appropriately.

An LFG grammar can be specified in other ways, however. It can be specified by a collection of more abstract conditions or “principles” that the grammar must satisfy. These grammatical principles are different from the well-formedness conditions on c-structures (such as the Non-Branching Dominance constraint) and f-structures (Completeness, Coherence, and Uniqueness) that all LFG grammars assume. Rather, such principles characterize the properties that grammar rules and lexical entries must have in order to be admissible in a well-formed grammar. For example, Bresnan (2001) proposes endocentricity principles to characterize possible arrangements of categories in c-structure rules, and structure-function mapping principles to indicate how functional schemata are distributed onto the c-structure rules. According to one such principle (Bresnan 2001, 103), a projecting node in a projection of the same kind (that is, a head) is annotated with  $\uparrow = \downarrow$ , meaning that a phrase and its head must correspond to the same f-structure. On this view, any traditional rule that satisfies the principles is assumed to be a well-formed rule of grammar, and rules that do not obey these principles are disallowed.

To be precise, for a grammar specified by means of a collection of grammatical principles  $\mathcal{G}$  to be interpretable within an LFG framework, there must be a traditional grammar  $G_{\mathcal{G}}$  that consistently realizes all of  $\mathcal{G}$ 's stipulations. We can then investigate the impact of alternative Economy proposals by examining the corresponding traditional LFG grammars  $G_{\mathcal{G}}$  in which annotated c-structure rules and lexical entries are enumerated explicitly. For instance, Toivonen's principles of phrase structure differ from Bresnan's in requiring a strict version of  $X'$  theory, without allowing for  $X'$  elision as described below. The details of the concrete LFG grammars are the basis for evaluating and comparing different Economy proposals.

### 2.1 *Economy and the optionality provision*

The Economy proposals of both Bresnan (2001) and Toivonen (2003) include a general provision that nodes that are obligatory according to other rules and principles are omitted from c-structure if semantic expressiveness and certain other syntactic conditions can be maintained without them. We can formalize two special cases of the optionality provision: the systematic omission of daughter nodes and the elision of nonbranching  $X'$  nodes.

2.1.1 Daughter omission

The convention of Daughter Omission stipulates that all daughters in a c-structure rule are optional:

(2) Daughter Omission:

If an LFG grammar  $G_{\text{eg}}$  contains an annotated rule of the form

$$Y \rightarrow \alpha Z \beta$$

(where  $\alpha$  or  $\beta$  may be the empty string  $\varepsilon$ ), it also contains a rule of the form

$$Y \rightarrow \alpha \beta$$

Thus, if the grammar (or a set of abstract grammatical principles) sanctions a rule such as (3a), independently omitting each of the daughters would provide for the additional rules (3b-d) and for the smaller trees that they would allow. These could be expressed in a single rule by using the parentheses notation that indicates optionality in traditional LFG grammars, as in (3e).

- (3) a.  $V' \longrightarrow V \quad NP$   
 $\quad \quad \quad \uparrow = \downarrow \quad (\uparrow \text{ OBJ}) = \downarrow$
- b.  $V' \longrightarrow V$   
 $\quad \quad \quad \uparrow = \downarrow$
- c.  $V' \longrightarrow NP$   
 $\quad \quad \quad (\uparrow \text{ OBJ}) = \downarrow$
- d.  $V' \longrightarrow \varepsilon$
- e.  $V' \longrightarrow (V) \quad (NP)$   
 $\quad \quad \quad \uparrow = \downarrow \quad (\uparrow \text{ OBJ}) = \downarrow$

Daughter omission in particular allows for rules that dominate no lexical material, as illustrated by (3d); we return to this point in Section 4.2.

Daughter Omission is not a necessary component or corollary of Economy: an Economy metric can be used to choose among larger and smaller derivations even when, contrary to a completely general principle of Daughter Omission, some nodes are obligatory in some configurations. Nevertheless, many researchers have adopted Daughter Omission as a central grammatical principle and see it as a key component of Economy.

Bresnan's (2001) specification of Economy allows for the omission of nodes in a broader range of configurations. Many versions of X' theory admit nonbranching single-bar-level X' categories whose annotations impose no constraints on the form of the corresponding f-structures. These nonbranching nodes may be optionally elided, creating alternative XP structures which do not contain an X' node. Doing this increases the number of candidate c-structures while still permitting the same meanings to be expressed. Other things being equal, Economy selects the trees without those nodes.

## (4) X' elision:

If an LFG grammar  $G_{\mathcal{L}}$  contains an annotated rule of the form

$$\begin{array}{ccc} \text{XP} \rightarrow \alpha & \text{X}' & \beta \\ & \uparrow = \downarrow & \end{array}$$

it also contains a rule of the form

$$\begin{array}{ccc} \text{XP} \rightarrow \alpha & \text{X} & \beta \\ & \uparrow = \downarrow & \end{array}$$

The elided X' nodes are redundant in the sense that their appearance has no impact on either the strings of the language characterized by the grammar or their corresponding f-structures. X' elision is consistent with Bresnan's pretheoretic intuition that redundant c-structure nodes need not appear in grammatically well-formed c-structures and should be ruled out by Economy considerations.

Bresnan (2001, 115) observes that the redundancy intuition does not apply to all nonbranching category configurations. In particular, VP nodes under S are retained even when they are nonbranching and even though they carry the  $\uparrow = \downarrow$  annotation which appears on functional heads. Bresnan's rationale for this is that there is no separate principle of structure-function mapping that would allow for the  $\uparrow = \downarrow$  annotation on a V or V' directly under S. Other principles may require omission or elision of otherwise mandatory nodes in other circumstances.

Not all LFG researchers adopt X'-elision, however. While also advocating for an Economy principle, Toivonen (2003) proposes a stricter version of the optionality provision that allows for daughters but not nonbranching X' nodes to be omitted. Compared to Bresnan's

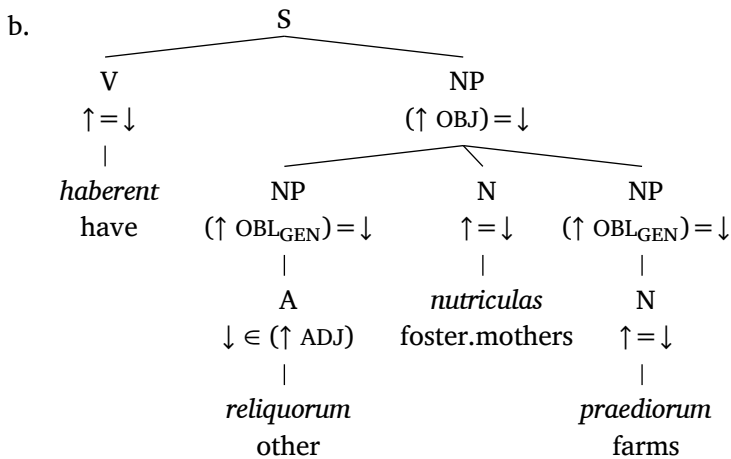


theory, Toivonen includes fewer c-structures as candidates to be evaluated by an Economy comparison.

2.2 *Optionality and discontinuity*

Nordlinger and Sadler (2007) point out that Daughter Omission allows a simple analysis of discontinuous constituents in some languages. If the head is optional in the c-structure expansion of a category, a phrase can occur in one position without its head and in another position with its head. This is a welcome result for languages that allow discontinuity, as Snijders (2012) shows for the following Latin example (which we have adapted from Snijders’s tree):

- (5) a. ... *haberent reliquorum nutriculas*  
 have.3PL.IMPV.CONJ other.GEN.PL foster-mothers.ACC  
*praediorum.*  
 farms.GEN  
 ‘...they might have foster mothers for their other farms.’  
 (Cic. Phil. 11.12, from Bolkestein 2001, 253 via Snijders 2012)



Here the genitive oblique ‘other farms’ does not form a constituent; the adjective *reliquorum* ‘other’ is separated from the noun it modifies by the noun *nutriculas* ‘foster mothers’. Since the head noun N is optional in the NP subtree, the adjective can appear as an NP constituent on its own, with the head N in a separate NP. Since the two NP nodes have the same annotation  $(\uparrow \text{OBL}_{\text{GEN}}) = \downarrow$ , they contribute to the same f-structure.

John Lowe (p.c.) further observes that headless phrases can lead to spurious ambiguity in the case where “discontinuous” constituents happen to be adjacent in the string. A multi-word constituent in such a situation might also be analyzed as separate but adjacent components of a single functional unit. This is shown abstractly in (6).

- (6) a. Single constituent:                    [NP A N] V  
       b. Two adjacent constituents:        [NP A] [NP N] V

We return to this point in Section 4.1, in our discussion of Same-String Economy.

Not all languages allow discontinuity, however, and additional principles must be introduced to control the appearance and distribution of headless constituents within and across languages if a fully general principle of Daughter Omission is adopted. We briefly explore some of the relevant issues in the rest of this section.

#### 2.2.1 Free word order without discontinuity

Japanese is a free word order language, allowing the arguments of a verb to appear in any order (subject to pragmatic constraints: Fry and Kaufmann 1998). Any order of the three arguments of the verb *ageta* ‘gave’ is acceptable, including the two orders presented in (7):

- (7) a. [Taroo ga] [yubiwa o] [kono onnanoko ni] ageta.  
       Taroo NOM ring ACC this girl DAT gave  
       ‘Taroo gave a ring to this girl.’  
       b. [kono onnanoko ni] [Taroo ga] [yubiwa o] ageta.  
       this girl DAT Taroo NOM ring ACC gave  
       ‘Taroo gave a ring to this girl.’

Under Daughter Omission, the head of the Japanese noun phrase is optional, as in Latin. The expectation is, then, that it should be possible to have part of the dative-marked argument *kono onnanoko ni* ‘to this girl’ in sentence-initial position, and part of it before the verb, since, as (7) shows, the entire phrase can appear in either position. However, this is not possible: splitting the noun phrase into two parts is unacceptable, whether or not the dative casemarker is repeated, and independent of the relative order of the two parts of the phrase. In example (8a), the noun *onnanoko* ‘girl’ appears sentence-initially and

the determiner *kono* ‘this’ appears preverbally, and in (8b) the order is reversed; both are unacceptable.

- (8) a.\* [onnanoko (ni)] [Taroo ga] [yubiwa o] [kono (ni)]  
girl            DAT Taroo    NOM ring        ACC this    DAT  
ageta.  
gave  
‘Taroo gave a ring to this girl.’
- b.\* [kono (ni)] [Taroo ga] [yubiwa o] [onnanoko (ni)]  
this    DAT Taroo    NOM ring        ACC girl        DAT  
ageta.  
gave  
‘Taroo gave a ring to this girl.’

In contrast, if we do not assume a completely general version of Daughter Omission, this problem is avoided by assuming that the difference between Latin and Japanese is that phrasal heads are optional in Latin, but obligatory in Japanese. If a noun phrase cannot appear without its noun head, discontinuity is disallowed and the examples in (8) are correctly ruled out.

Joan Bresnan (p.c.) raises the possibility that the crucial difference between Latin and Japanese lies not in head obligatoriness, but in principles for rule annotation in each language. In Latin, more than one phrase in a single clause can be annotated with the same grammatical function, while in Japanese only one nominal phrase per clause may be annotated with any particular grammatical function. For example (8), treating the difference between Latin and Japanese in terms of differences in permitted annotations on the daughter nodes of clausal categories would successfully control the availability of discontinuous phrases where both components of the phrase are daughters of the same clausal category.<sup>2</sup>

However, when taking this view, it is not clear how adjuncts can be treated, nor how one might predict adjunct discontinuity. In standard LFG treatments, the annotation  $\downarrow \in (\uparrow \text{ADJ})$  appears on all adjuncts, indicating that the f-structure for the phrase bearing the annotation should appear in the set of adjuncts of the f-structure of the

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<sup>2</sup>More complex constraints would be required to forbid discontinuity involving nonsister components, but this may also be possible through the use of special phrase structure categories or additional annotations on rules.

mother node. Restricting this annotation to appear only once incorrectly predicts that only one adjunct can appear. On the other hand, allowing this annotation to appear more than once, while maintaining Daughter Omission, predicts that adjuncts, and only adjuncts, can be discontinuous in languages like Japanese. Neither prediction is correct, and it is not clear how the proposal can be modified to allow for the correct treatment of both arguments and adjuncts.

Of more significance, however, is the theoretical difficulty of this proposal: it reduces the generality of the annotation principles and weakens their explanatory power. It admits the possibility that annotations can be parametrized to allow or disallow discontinuity or other variations in language-particular or construction-specific ways.

#### 2.2.2 Obligatoriness even where discontinuity is otherwise allowed

A further problem for Daughter Omission is raised by Snijders (2012), who provides an analysis of Latin phrase structure and proposes that the correct analysis must treat some nodes as obligatory. Following Bolkestein (2001), Snijders (2012) shows that the following constraint holds in Latin:

- (9) Constraint on Latin discontinuous NPs:  
No discontinuity is allowed between a P and the NP it governs (yet the NP may be internally discontinuous, meaning that part of the NP may be separated from the P).

Example (5) establishes that an NP constituent in Latin need not contain an N: this correctly allows for discontinuous nominal phrases, under the assumption that Bresnan's proposed analysis of Japanese, where an annotation for a particular grammatical role can appear only once, does not apply to Latin. However, Snijders shows that the generalization in (9) must be analyzed by specifying the NP complement within a PP as obligatory: some portion of the NP complement, not necessarily including the head, must appear adjacent to the P. If the NP complement of PP were optional, the P would be able to appear on its own, not adjacent to any component of its complement.<sup>3</sup> In sum, though optionality is well-attested in many constructions and in many languages, Daughter Omission appears to be non-viable as a general, exceptionless principle.

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<sup>3</sup>See Snijders (2012) for further discussion and exemplification.

In the current context, our key point is that the adoption of particular grammatical principles such as Daughter Omission is orthogonal to the adoption of an Economy metric. That is, adopting a principle of Daughter Omission does not require the concomitant adoption of Economy to choose among larger and smaller candidate trees. Conversely, adoption of an Economy principle is compatible with a theoretical view which rejects Daughter Omission and allows obligatory phrase structure nodes. The purpose of an Economy metric is to select derivations with smaller and therefore more desirable c-structures from among all of the derivations that a grammar (with or without Daughter Omission or other optionality principles) produces.

### 2.3 *The Economy principle as a cross-derivational constraint*

Economy as a principle of grammar has a different status from other grammatical principles and conditions. Economy is not a well-formedness condition on individual c-structures or f-structures (like Completeness or Coherence), nor is it a constraint on the form of possible grammar rules (like Bresnan's structure-function mapping principles). Instead, it is a global, cross-derivational constraint, classifying structures as ungrammatical that may be well-formed according to the other grammatical principles and conditions, but which are not the smallest such structures to express a particular meaning. This stands in sharp contrast to the LFG convention of assigning to a sentence the minimal f-structure satisfying its functional description or to the substantially equivalent provision of Construction Grammar that only fully-licensed representations are admissible (Kay 2002). The minimal f-structure can be determined by the incremental evaluation of the constraints of a single derivation's f-description without reference to the descriptions or structures of other derivations.<sup>4</sup>

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<sup>4</sup>It is also important to recognize that selecting the minimal f-structure for a particular LFG derivation is essentially unrelated to the notion of Economy of Expression. As we will point out in Section 3.3, an f-structure corresponding to a specific meaning forms the basis for the Economy comparison, and the issue is which of any competing strings are assigned to that f-structure by the derivation relation  $\Delta_G$ . The given f-structure may not be minimal with respect to the derivations of some of those strings, in which case those derivations fail on their own merits without comparison to other strings or derivations. They are simply disallowed as ways of expressing the meaning encoded in the given f-structure.

Potts (2002) points out that the machinery of cross-derivational comparisons substantially increases the logical complexity of several linguistic theories, including LFG. It requires a mathematical layer on top of the standard formal devices, mechanisms and other principles of grammar, and therefore introduces a significant — and not well understood — expansion of the expressive power of grammatical description. For this reason it is not something to be taken on without very careful justification. And at least with respect to other theories, Potts cites a range of papers that call into question its empirical consequences.

Economy may serve as an informal but useful summary for a collection of grammatical relationships without actually being posited as an independent operational linguistic principle. That is, it is perhaps best interpreted as a generalization about the combined effect of other principles and grammatical mechanisms, each functionally and/or psycholinguistically motivated, that together give rise to the appearance of a very general principle favoring smaller structures over larger structures. On this view, Economy is not an independent constraint but a by-product of formal devices and principles that must already be deployed in grammars of individual languages.

It is not clear whether Economy is a necessary or sufficient principle of grammar, and just its logical complexity militates against its inclusion in the theory of syntax. Thus, with Potts (2002), we suggest that the burden of proof is on proponents of Economy to show that such a fully general principle of comparison is not merely an illusion stemming from the operation of separately motivated mechanisms and principles that must be assumed in any case.

### 3 ECONOMY AND THE FORMAL STRUCTURE OF LINGUISTIC DERIVATIONS

Any theory in which an Economy principle plays a role must make explicit the structures that are candidates for the Economy comparison and how such structures are selected. In this section we offer the definitions necessary for a formal account of Economy in an LFG setting.

3.1 *LFG grammars as constraints over grammatical structures*

Wedekind and Kaplan (2012) observe that an LFG grammar  $G$  characterizes a derivation relation  $\Delta_G$  over string/f-structure pairs. They offer essentially the following definition:

(10) The derivation relation  $\Delta_G$

$\Delta_G(s, f)$  iff  $G$  assigns to the string  $s$  the f-structure  $f \in F$ ,  
where  $F$  is the set of well-formed f-structures.

We extend this definition so that  $\Delta_G$  explicitly takes account of the c-structure:

(11) The derivation relation  $\Delta_G$  (extended)

$\Delta_G(s, c, f)$  iff  $G$  assigns to the string  $s$  the c-structure  $c \in C$  and  
f-structure  $f \in F$ .

3.2 *The generation set for a grammar  $G$*

All definitions of Economy involve a comparison among alternative means of expressing a common meaning  $m$ . We define  $Exp(m)$  as the set of f-structures that express a meaning  $m$ :

(12) F-structures that express a meaning  $m$

$Exp(m) = \{f \in F \mid f \text{ expresses } m\}$

We make no assumptions here about the nature of meaning representations (logical formulas, attribute-value matrices, or other formal structures). We require only that all of the f-structures in  $Exp(m)$  express the target meaning  $m$ .

C-structure and f-structure are not the only linguistic levels assumed in many LFG-based proposals: rather, a variety of linguistic properties are spread out among a collection of related structures (e.g. information structure, discourse structure, prosodic structure: Kaplan 1987; Asudeh 2006; Dalrymple and Mycock 2011; Mycock and Lowe 2013) in addition to the syntactic predicate-argument dependencies that are typically represented in f-structure. For simplicity, in this paper we consider the f-structure as standing for all grammatical information that is relevant for the Economy ranking and not represented by c-structure.

Given the definition of the meaning-expression set  $Exp(m)$  in (12), the overt expression of a target meaning  $m$  is formalized as the  $\langle s, c, f \rangle$  triples that the grammar  $G$  assigns to any of the f-structures in  $Exp(m)$ . Again extending a definition of Wedekind and Kaplan (2012), this can be formalized as the generation set  $Gen_G(m)$ :

- (13) The generation set  $Gen_G(m)$  for a target meaning  $m$ , given a grammar  $G$

$$Gen_G(m) = \{ \langle s, c, f \rangle \mid f \in Exp(m) \text{ and } \langle s, c, f \rangle \in \Delta_G \}$$

This is specified for a grammar  $G$  in traditional LFG notation, but as indicated above, that grammar may be a standard grammar  $G_{\mathcal{G}}$  interpreting a more abstract grammatical specification  $\mathcal{G}$ . The generation set for  $\mathcal{G}$  is defined in the obvious way:

- (14)  $Gen_{\mathcal{G}}(m) = Gen_{G_{\mathcal{G}}}(m)$

That is, the generation set for a target  $m$  given an abstract grammar specification  $\mathcal{G}$  is the generation set for  $m$  given the traditional grammar  $G_{\mathcal{G}}$  that properly interprets the abstract one.

### 3.3 *The Economy ordering on $Gen_G(m)$*

Economy compares members of the generation set for a meaning  $m$ , under the assumption that a grammar (especially one presented abstractly) may include structures containing superfluous or unwanted elements. The intended effect of Economy is to identify a smaller generation set that contains only the linguistically motivated structures. This is formalized in terms of an Economy ordering  $\leq$  on  $Gen_G(m)$ :

- (15) The Economy ordering

$$\langle s, c, f \rangle \leq \langle s', c', f' \rangle \text{ iff } \langle s, c, f \rangle \text{ is more economical than } \langle s', c', f' \rangle$$

Alternative ways of defining the Economy ordering impose different constraints on the strings  $s$  and  $s'$  but all involve comparing the sizes of the c-structures  $c$  and  $c'$ . As for the f-structures  $f$  and  $f'$ , we argue below that they must be identical. Thus, the general form of the metric is given in (16), where  $c \leq_c c'$  if and only if the number of relevant nodes in  $c$  is less than or equal to the number of relevant nodes in  $c'$ .<sup>5</sup>

<sup>5</sup>Proponents of Economy do not generally agree on which nodes are relevant to defining the Economy ordering. According to Bresnan (2001, 91), for example, terminal and preterminal nodes are ignored. We return to this issue in Section 6.3.



(16) General schema for the Economy ordering  $\leq$

$$\langle s, c, f \rangle \leq \langle s', c', f' \rangle \text{ iff } c \leq_c c' \text{ and } \text{String\_rel}(s, s') \text{ and } f = f'$$

We represent constraints on the strings  $s, s'$  by the two-place relation *String\_rel*. In Section 3.5 we consider a set of alternative definitions of *String\_rel* that lead to different theoretical and descriptive consequences.

The  $f = f'$  condition addresses the fact that the set  $Exp(m)$  may contain distinct f-structures corresponding to ways of expressing a meaning  $m$  that should stand in free variation with respect to an Economy comparison. It would be descriptively incorrect, for example, if passive realizations of a given meaning were systematically suppressed in favor of their putatively more economical active counterparts. As another example, an unrestricted version of Economy might suppress the longer prepositional realization for verbs such as *give* (*He gave the book to her*) in favor of the equally acceptable but shorter ditransitive realization (*He gave her the book*). These unintended consequences could be avoided, of course, by postulating (perhaps subtle) differences in meanings that otherwise share the same underlying predicate-argument specifications. Because our formalization distinguishes meanings from the f-structures that express them, it allows alternative realizations for the same meaning to be derived from f-structures with distinct syntactic (e.g. active vs. passive) features. Restricting the domain of the Economy ordering to triples with identical f-structures thus provides for a natural account of free syntactic variation. This is consistent with the proposal of Toivonen (2003, 199) that “Economy only holds over c-structures with identical f-structure”.

Bresnan (2001, 91) extends the number of derivation triples under consideration by appealing to a subsumption relation between f-structures in her definition of Economy, proposing that “a phrase structure node is omitted if the f-structure arising in its absence is at least as specific as the f-structure arising in its presence”; that is, Bresnan’s definition requires that  $f' \sqsubseteq f$ . We note that in the special case that the smaller tree  $c$  is a subtree of the larger tree  $c'$  (and there are no disjunctive annotations on the nodes of the two trees), the monotonic mapping between c-structures and f-structures implies that  $f \sqsubseteq f'$ , and thus that the two f-structures are identical (since mutually subsuming f-structures are identical). Bresnan (2001) does not specifically mo-

tivate this condition on the two structures under comparison, and in the particular cases she discusses, the f-structures for the smaller and larger trees are identical and not in an asymmetric subsumption relation. Thus we see no argument against the simpler and more restrictive requirement that  $f = f'$ .

### 3.4 *Economical elements of $Gen_G(m)$*

Once we have established the Economy ordering, we can identify certain  $\langle s, c, f \rangle$  triples as the minimal, most economical elements of  $Gen_G(m)$ , given a grammar  $G$  and a target structure  $m$ :

#### (17) Minimal elements of $Gen_G(m)$

A triple  $\langle s, c, f \rangle$  is a *minimal* element of  $Gen_G(m)$  iff no  $Gen_G(m)$  element is smaller according to the Economy ordering relation  $\leq$ .

Economy classifies the minimal elements of  $Gen_G(m)$  as grammatical, and the nonminimal elements in  $Gen_G(m)$  as ungrammatical.

### 3.5 *Variant definitions of Economy*

We now have a formal framework for characterizing and comparing the alternative notions of Economy: which structures are in the domain of the Economy ordering  $\leq$ , and precisely how that ordering is defined on the elements within its domain. We provide the following three alternative definitions of *String\_rel*, differing as to whether (1) all alternative c-structures for the same string are compared, (2) all alternative c-structures with the same set of terminal nodes are compared, or (3) c-structures over strings with possibly different terminals are compared.

**Same-String Economy** compares different c-structures over the same string.

#### (18) Same-String Economy ordering

*String\_rel*( $s, s'$ ) iff  $s = s'$

Each string that expresses the target meaning is associated by Same-String Economy with the smallest c-structure that analyzes it, but there is no Economy comparison between c-structures for different strings.

**String-Permutation Economy** compares c-structures with the same terminal nodes, but possibly in a different order.

(19) String-Permutation Economy ordering<sup>6</sup>

$String\_rel(s, s')$  iff  $s \in Perm(s')$

String-Permutation Economy allows comparison of c-structures over permutations of the same string. There is no Economy comparison between c-structures over strings that are not related by permutation.

**Different-Words Economy** compares c-structures without placing any restriction on the strings that each c-structure analyzes. The smallest c-structures that express the target meaning are chosen by Different-Words Economy, and strings are ruled out that express the target meaning but are not analyzed by economical trees. In this case the relation  $String\_rel(s, s')$  holds vacuously for any pair of strings  $s$  and  $s'$ .

Relations among the definitions

There is an implicational relation among these three definitions, since the comparison is over increasingly larger sets of c-structures corresponding to the same target meaning. Given these implicational relations, any comparison that is relevant for Same-String Economy is also relevant for String-Permutation Economy and Different-Words Economy, and similarly any comparison that is relevant for String-Permutation Economy is also relevant for Different-Words Economy.

In the following sections, we explore each of these three definitions and their consequences. We show that several previously proposed definitions of Economy instantiate different definitions of the string requirement  $String\_rel$  while still adhering to the general definition of Economy as given in (16).

4 SAME-STRING ECONOMY:  
SPURIOUS AMBIGUITY AND EMPTY CATEGORIES

4.1 *Same-String Economy and spurious ambiguity*

Certain sets of  $Gen_G(m)$  triples for a grammar  $G$  differ only in c-structure, and have exactly the same string and f-structure.<sup>7</sup> These represent c-structure ambiguities that do not correlate with differences at

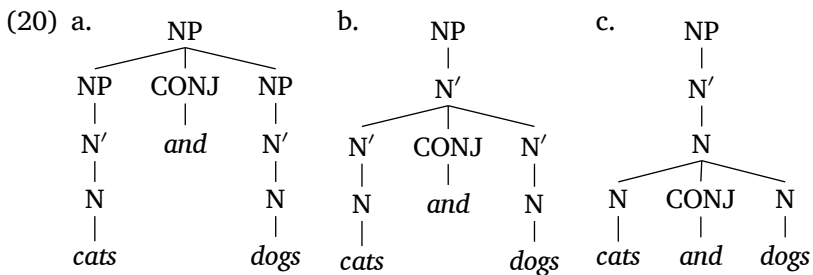
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<sup>6</sup>  $s \in Perm(s')$  iff  $s$  is a permutation of  $s'$ .

<sup>7</sup> Recall from Section 3.2 that we consider the f-structure to stand for all relevant levels of linguistic structure other than c-structure.

any other level of structure, since in such cases the choice of a particular c-structure has no effect on the relation established by the grammar between strings and f-structures. Such ambiguities are ruled out by all versions of Economy.

We mentioned in Section 2.2.1 that spurious ambiguities can arise over the same string if the elements of a putatively discontinuous functional unit appear next to each other in the string (John Lowe, p.c.). Spurious ambiguity also commonly occurs with single-word coordinated phrases. If coordination is possible at any X' level, all three trees in (20) are possible:



The Same-String Economy metric selects tree (20c) as the most economical, since it has fewer nodes than tree (20a) or (20b). As argued by Frank (2006), Economy of Expression would also prefer a symmetric coordination analysis for German VP coordination over an asymmetric analysis when both are possible, because the asymmetric structure contains more nodes than the symmetric structure, and both structures correspond to the same f-structure.

There is an alternative way of viewing classes of derivations that differ only in c-structure and cannot be empirically distinguished in any other way. Rather than relying on a principle like Economy to choose the *smallest* member of a set of derivations that are indistinguishable except for the size of the c-structure, we can recognize that the alternatives arise only as an artifact of our internal derivational machinery. On this view there is no theoretical or empirical reason to prefer one candidate over another, and we can thus dispense with the need to make a choice between such otherwise equivalent derivations. We formalize an equivalence relation on derivations in the obvious way, by abstracting over c-structure variation:

(21) Equivalence relation on derivations

For all  $d = \langle s, c, f \rangle$  and  $d' = \langle s', c', f' \rangle$  in  $\Delta_G$ ,  
 $d \cong d'$  iff  $s = s'$  and  $f = f'$

This relation induces a collection of equivalence classes over the derivations in  $Gen_G(m)$ , and we suggest that it is only the existence of the classes, not the individual derivations, that matter for the determination of grammaticality and ambiguity. We can present a class by listing its members (if it is finite), but it suffices to display one member of the class as its representative element. In that case one may select the smallest (most economical) element for rhetorical purposes, but in fact another less economical element may be the single most natural result of alternative computational implementations, either for parsing or generation, or for psycholinguistic or processing reasons. On this view, there is no conceptual purpose in invoking Same-String Economy considerations to choose between such equivalent derivations.

4.2 *Same-String Economy and empty categories*

Daughter Omission (Example 2, repeated here in (22)) is a key feature of Economy for both Bresnan and Toivonen: every daughter category in every c-structure rule may or may not be present in the admitted trees.

(22) Daughter Omission:

If  $G_{\mathcal{G}}$  contains an annotated rule of the form

$$Y \rightarrow \alpha Z \beta$$

(where  $\alpha$  and  $\beta$  may be empty),  $G_{\mathcal{G}}$  also contains a rule of the form

$$Y \rightarrow \alpha \beta$$

Daughter omission allows for empty categories: rules that dominate no lexical material. Such empty nodes were used in the earliest analysis of long-distance dependencies in LFG (Kaplan and Bresnan 1982), and Bresnan (2001) still appeals to empty nodes as a way of assigning proper grammatical functions in these constructions. Since a string can contain an unbounded number of unpronounced empty categories, Economy has been proposed to ensure that empty categories are not proliferated beyond necessity and can only appear when they are required to express a given meaning. This has been one of the stronger motivations in support of Economy of Expression.

However, Kaplan and Zaenen (1989) proposed another way of making the proper assignments of grammatical functions in long-distance constructions. They establish the proper grammatical relations in terms only of f-structure constraints that characterize *functional uncertainties*. Kaplan and Zaenen's account does not rely on empty c-structure categories in particular linear positions, and in fact their analysis specifically excludes trees with empty categories from the set of valid c-structures. This view aligns itself with the large body of literature arguing against the existence of traces or empty categories (Sag and Fodor 1994; Sag 2000; Dalrymple and King 2013). Weak crossover (Postal 1971; Wasow 1979) has been a recalcitrant challenge to proponents of eliminating traces from the c-structure tree, and Bresnan (2001) points to weak crossover phenomena as the primary source of evidence for traces. However, alternative accounts of weak crossover can be based on other f-structure or c-structure properties rather than the linear position of empty categories (Dalrymple et al. 2007; Nadathur 2013). If vacuous category expansions as in (3d) are not needed in the analysis of long-distance dependencies, including weak crossover, and are not permitted in valid c-structures, there is no need for a principle of Economy to impose an ordering over c-structures containing empty categories.

## 5 STRING-PERMUTATION ECONOMY: PROJECTING X' STRUCTURE

Toivonen (2003) proposes the following definition of Economy:

- (23) Economy of Expression (Toivonen): All syntactic phrase structure nodes are optional and are not used unless required by X'-constraints or Completeness. (Toivonen 2003, 200)

In fact, restricting the Economy comparison to syntactically valid triples  $\langle s, c, f \rangle$  obviates the need for concern about whether well-formedness criteria such as Completeness should be included in the definition of Economy: only valid c-structures and f-structures are considered in economy-based comparisons, and so it is not necessary to restate these conditions in defining Economy conditions. Similarly, the restriction on X' structure is part of the definition of a well-formed c-structure in Toivonen's version of LFG; hence, it is not a distinguish-

ing characteristic and is thus also unnecessary for the definition of Economy of Expression.

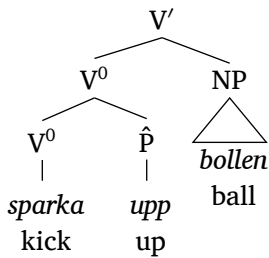
Toivonen (2003, 199) stipulates that “Economy only holds over c-structures with identical f-structure, semantic interpretation, and lexical forms”. The equivalence of semantic interpretation is already enforced by the expressivity condition of  $Gen_G(m)$ . Because of Toivonen’s restriction to identical words (lexical forms) in the string, her definition amounts to String-Permutation Economy:

(24) Toivonen’s Economy: String-Permutation Economy.

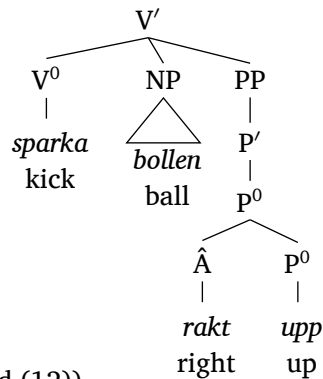
As we will see, Toivonen’s appeal to String-Permutation Economy means that her approach, unlike Poser Blocking and Bresnan’s definition of Economy (to be discussed in Section 6), does not privilege expression of meanings by words over phrases. The result is that Toivonen’s Economy comparison is defined for a smaller number of derivation triples than Poser Blocking or Bresnan’s Economy comparison.

String-Permutation Economy plays a central role in Toivonen’s (2002; 2003) analysis of word order in the Swedish VP. Toivonen proposes that prepositions and adverbs in Swedish vary as to whether they project phrasal structure. Projecting prepositions (represented as  $P^0$ ) can appear after the object phrase, while nonprojecting prepositions (represented as  $\hat{P}$ ) must adjoin to  $V^0$ . Some prepositions, such as *upp* ‘up’, are underspecified (represented simply as P), and may be either projecting or nonprojecting. For example, (25a) contains the non-projecting version of *upp*. Modifiers can only adjoin to projecting categories, so the presence of the modifier *rakt* in (25b) requires the projecting version of *upp*:

(25) a.



b.

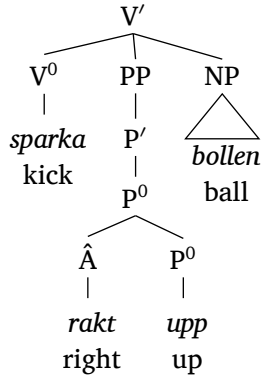


(Toivonen 2002, examples (11) and (12))

The phrase structure rules for the Swedish V' do not allow the order V PP NP, with the result that modified particles cannot appear adjacent to the verb preceding the object:

(26) \**sparka rakt upp bollen* (cf. Toivonen 2003, 101–103)

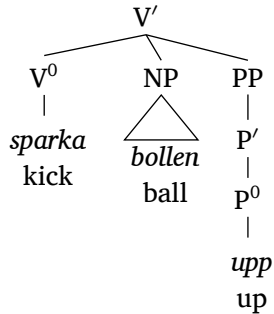
Not licensed by Swedish phrase structure rules:



Conversely, unmodified Swedish non-projecting or optionally projecting particles (unlike their English counterparts) must appear adjacent to the verb and cannot be separated from it.

(27) \**sparka bollen upp* (cf. Toivonen 2003, 34–35)

Ruled out in favor of (25a) by Economy under Toivonen's account:



The ungrammaticality of example (27) cannot be explained by appeal to the V' phrase structure rule, which allows the order V NP PP, as seen in example (25b). Furthermore, non-branching PP structures as in (27) are independently justified in Swedish in preposition stranding constructions such as interrogatives (Ida Toivonen, p.c.); these object-



taking prepositions are unambiguously lexically specified as projecting and hence must appear as the  $P^0$  head of a PP:

- (28) Vem gav du boken åt?  
who gave you book to  
'Who did you give the book to?'

According to Toivonen's theory, String-Permutation Economy is crucial in selecting the non-projecting c-structure (25a) and ruling out the projecting structure (27).

However, there is an alternative analysis of this particular pattern which does not appeal to a global comparison under the Economy ordering. On Toivonen's analysis, lexical specifications determine whether a word is assigned the projecting category  $P^0$  or the non-projecting category  $\hat{P}$ . Given the phrase structure rules of Swedish, words with the projecting category can only appear as the head of a full phrase, as in examples (25b) and (28), and non-projecting words can only appear adjoined to another head, as in example (25a). Some words, such as *upp*, are lexically ambiguous and so may appear in either position. However, when just those ambiguous words are assigned the projecting category and appear as the daughter of  $P'$ , they further require the presence of a modifier. This additional requirement can be captured in standard LFG theory by annotating the  $P^0$  categories of ambiguous words with an existential constraint ( $\uparrow$  GF) to guarantee the presence of a grammatical relation in the corresponding f-structure. This can be an object in the case of preposition stranding or a modifier in the case of the intransitive prepositions as in example (25b).<sup>8</sup> Under this alternative analysis no reference to Economy is required but the underlying intuition behind projecting and nonprojecting prepositions proposed by Toivonen is maintained.

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<sup>8</sup>Potts (2002) also provides an alternative analysis to the Swedish data, namely that a projecting  $P^0$  must appear in a branching PP. However, his analysis would have to be modified to account for examples with stranded prepositions, such as (28).

DIFFERENT-WORDS ECONOMY:  
AVOIDING REDUNDANT STRUCTURE

*Bresnan's Economy*

Economy of Expression is one of the major principles in Bresnan's (2001) abstract and principle-based characterization of an LFG grammar. Her principle is stated in the following way:

(29) Economy of Expression (Bresnan): All syntactic phrase structure nodes are optional and are not used unless required by independent principles (Completeness, Coherence, Semantic expressivity). (Bresnan 2001, 91)

As noted above, all definitions of Economy consider only  $\langle s, c, f \rangle$  triples in which the c-structure  $c$  and f-structure  $f$  are well-formed. This observation allows us to simplify Bresnan's definition: the Completeness and Coherence conditions in Bresnan's definition are subsumed by the restriction to grammar-relevant structures. Bresnan does not provide an explicit definition of Semantic expressivity, but we understand this condition as restricting application of Economy-based comparison to the triples expressing a target meaning  $m$ , as in definition (13).

We also understand Bresnan's definition (29) together with her principles of endocentricity, structure-function mapping, etc., as specifying a traditional LFG grammar  $G_g$ . The optionality provision of the Economy principle deals with the problem that the c-structure component of a  $G_g$  that realizes just the other abstract principles may not admit all trees that are linguistically desirable or necessary to express all meanings. The provision extends that c-structure component to allow many more smaller trees, and thus potentially larger generation sets  $Gen_{G_g}(m)$  for some meanings. Indeed, optionality may provide a non-empty  $Gen_{G_g}(m)$  for meanings that might be inexpressible if other principles demand the presence of certain nodes or annotations.

Bresnan's definition of Economy places no constraints on the string components of the derivation triples, and hence is an instance of Different-Words Economy:

(30) Bresnan's Economy: Different-Words Economy.

Thus, her definition encompasses cases of Poser blocking, privileging (single-word) morphological over (multi-word) phrasal modes of expression of f-structures with the same content (Bresnan 2001, 93).

6.2 *Poser blocking*

Many cases of Morphological Blocking involve comparison between alternative single words in the same syntactic context, and do not fall under the purview of Economy. However, Economy is relevant for a certain subset of cases that have been treated as Blocking: Poser (1992) was among the first to explore the possibility that a slot in a morphological paradigm could be filled periphrastically, i.e., by a sequence of words, and that the availability of a means of expressing a set of features by a single word blocks the periphrastic expression of the same features. Different-Words Economy has sometimes been suggested as an explanation for these cases of morphological blocking, cases where the phrasal expression of a meaning seems to be disallowed when a single word exists that expresses the same meaning. As Nordlinger and Bresnan (2011) point out, Economy “privileges lexical over phrasal expression – morphology over syntax”.<sup>9</sup> Thus the availability of *prettier* is claimed to block *more pretty*, whereas the non-existence of *\*beautifuler* is what allows for phrasal expression of the comparative of *beautiful* as *more beautiful*.

Embick and Marantz (2008) present a “generalized” formulation of Poser blocking (see also Hankamer and Mikkelsen 2002; 2005):

(31) Generalized Poser blocking (Embick and Marantz 2008, 38):

For each node in the syntactic structure, scan the lexicon for a word that expresses the same features. If such a word exists, use the word in place of the phrase.

Since comparison is over different strings – that is, single-word vs. periphrastic expression of the same meaning – string comparison in Poser blocking is an instance of Different-Words Economy. The definition in (31) can then be recast in the terms we have defined so far:

(32) Poser blocking: Different-Words Economy.

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<sup>9</sup>This is true irrespective of whether the Economy metric counts non-preterminals or non- $X^0$  categories (Section 6.3), since a single  $X^0$  category can block the expression of the same meaning by means of a larger c-structure.

There is an important difference between Embick and Marantz’s interpretation of Poser blocking and Different-Words Economy: as interpreted by Embick and Marantz (2008), Poser blocking involves comparison only between single words and multi-word phrasal constituents. Although it would be formally possible to define Economy as applying only to certain subtrees in a derivation, and in particular only to pairs involving one single-word constituent and one multi-word constituent, Bresnan (2003) argues that this restriction is unsatisfactory, since it would leave a large body of data unexplained. For example, Bresnan discusses the conditional verbal paradigm in Ulster Irish (Andrews 1990), where inflected forms disallowing pronominal subjects compete with the periphrastic uninflected verb + pronominal subject, pointing out that the verb + subject in Irish do not form a constituent and so would not be involved in an Economy comparison restricted to individual subtrees in a derivation. See Bresnan (2003) for further discussion and exemplification of this point.

Treating Poser blocking as an instance of Different-Words Economy raises some important issues. In at least some cases, preference for expressing a meaning as a single word rather than periphrastically seems to be a gradient phenomenon and not a matter of grammaticality: the word *prettier* is clearly preferred (in most contexts) to the phrase *more pretty*, but the periphrastic realization may still be included in the range of expressions that the grammar allows, and in fact the periphrastic form rather than the single-word form surfaces in certain situations. Indeed, Mondorf (2009) presents an in-depth study of factors influencing synthetic vs. analytic expression of comparatives: these include number of syllables, attributive vs. predicative use, and other factors. To take just one example, Mondorf (2009, 21) gives the following counts for the comparative of the adjective *slender* in attributive, predicative, and postnominal position in a corpus comprising British newspapers and the British National Corpus:

(33)

	Synthetic (slenderer)	Analytic (more slender)	Total	% Analytic
Attributive	14	27	41	66%
Predicative	16	23	39	59%
Postnominal	3	2	5	40%
All positions	33	52	85	61%

Economy would wrongly predict that the availability of a synthetic form like *slenderer* would suppress the analytic form *more slender*; in fact, *more slender* appears in 61% of the cases overall, with *slenderer* in the remaining 39%.

In his discussion of what has come to be called Poser Blocking, Poser (1992, pp. 124–125) warns against the application of a fully general principle such as Economy to these cases, stating that

“Under the pragmatic hypothesis, it should be possible for phrasal constructs of any size to be blocked. But in point of fact the examples of blocking of phrasal constructs known to me all involve blocking of small phrases; there appear to be no examples of blocking of large syntactic units. For example, *the red book* does not block *the book which is red.*”

Poser concludes that blocking may apply to morphological paradigms (e.g. *\*amn't*) but does not necessarily apply to larger syntactic units. This position was reiterated in subsequent work by Ackerman and Webelhuth (1998), Katzir (2008) and others. On this view, Poser blocking may be confined to the morphology component and should be accounted for by improved theories of periphrasis in morphology. Thus, we too believe that Economy of Expression as a general syntactic notion does not offer a proper explanation for Poser blocking.

### 6.3 *Nonprojecting categories and lexical sharing*

As in Toivonen's analysis of English and Swedish clitics, Economy considerations have been invoked to control whether X' and XP levels of structure are present if they are not otherwise needed (e.g. for adjunction or coordination). Broadwell (2007) proposes to use Lexical Sharing (Wescoat 2009, 2002) and adjunction to non-projecting words to account for the distribution of Zapotec adjectives, appealing to Economy of Expression to rule out ungrammatical patterns. He points to evidence from phonology and clitic placement to show that for nouns modified by unmodified adjectives with no complements, the one-word structure in (34a) is correct and the two-word structure in (34b) is unacceptable.

- (34) a. Acceptable:                      b. Unacceptable:
- NP

|

N

  /  \  
N      Â

ngìw+góórrd

man+fat

'fat man'

NP

  /  \  
N      AP

|      |

ngìw  A

man   |

      góórrd

      fat

As for Swedish particles, multiword adjective phrases behave differently, and do not participate in Lexical Sharing. Adjectives with comparative complements appear as the head of a separate phrase, and do not form a single word with the noun:

- (35)
- NP

  /  \  
N      AP

|      /  \  
ngìw  A      PP

man  |      △

      góórrd = ru    quèy nàà'

      fat = more    than me

'a man fatter than me'

This is similar to the Swedish patterns described by Toivonen in that separate multi-word phrases behave differently from single words, which may not form full phrases on their own; Zapotec differs from Swedish in that the adjective + noun combination forms a single word rather than a two-word sequence. The solution that Broadwell proposes is also similar: he appeals to Economy to properly discriminate between these structures, on the basis that Economy selects the smaller lexical sharing structure in (34a) to express the intended meaning, and rules out the larger structure in (34b).

Broadwell's analysis highlights an unresolved issue in the definition of Economy: which nodes are counted in determining the size of a c-structure tree? Bresnan (2001, 91) restricts attention to "syntactic phrase structure nodes", which she defines as excluding terminal and preterminal nodes: that is, to "those nonterminal nodes which do not

immediately dominate a lexical element". In (34) we have adopted Bresnan's X' Omission principle, with AP directly dominating A in example (34b). If the trees in (34) are correct, Bresnan's definition does not select the tree in (34a) over the tree in (34b). Both trees have two nonterminal nodes not dominating a lexical element, NP and N in (34a), and NP and AP in (34b), and thus should be equally economical according to Bresnan's criterion for counting nodes. If tree (34a) is to be selected on the basis of Economy, we must count non- $X^0$  nodes instead of non-preterminals: (34a) has only one non- $X^0$  node, NP, while the tree in (34b) has two non- $X^0$  nodes, NP and AP.

We pointed out earlier the possibility of accounting for the distribution of Swedish prepositions in terms of f-structure restrictions in the lexical entries of prepositions which optionally project, rather than an Economy-based comparison of different candidate structures. A similar constraint requiring the presence of a grammatical function may also account for the distribution of Zapotec free adjectives such as *góórrd*, but we leave details of this analysis to future research.

7

CONCLUSION

We have presented a formal framework within which explicit definitions of metagrammatical principles can be made, and we discussed three types of Economy of Expression in detail: Same-String Economy, String-Permutation Economy, and Different-Words Economy. We observed that it is important to separate the Economy metric from stylistic or pragmatic preferences that may also value succinctness or brevity. Under Economy, the only grammatical derivations for a given meaning are the smallest ones, while stylistic or pragmatic principles choose the optimal way of expressing a meaning from among grammatically well-formed derivations.

Economy as a grammatical principle is of a very different formal nature from other grammatical principles governing grammatical representations or the form of grammar rules or lexical entries: Economy requires a global choice among alternatives that are well-formed according to the other principles of the grammar. Thus, the burden of proof is on proponents of Economy to show that such a principle is necessary, and that Economy is not simply a generalization about the

nature and interaction of other, independently motivated grammatical mechanisms and principles. Our view is that previous proposals have failed to provide clear motivation for an independent principle of Economy, since in all of the cases we have examined, analyses appealing to independently-motivated mechanisms provide equally good accounts of the linguistic phenomena.

Economy has been offered as a broad explanatory principle for a range of linguistic phenomena that, on close examination, do not seem to form a natural class. Our formal characterization of Economy and our survey of its empirical applications suggests that it is not a compelling explanatory principle in an LFG setting. We do not know whether other theories adopting an Economy metric have the same independently motivated mechanisms that would make Economy superfluous, but we hope our discussion has clarified some of the major issues and will help to guide further research.

#### ACKNOWLEDGEMENTS

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