# Lexical Functional Grammar as a Construction Grammar

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## ABSTRACT

Lexical Functional Grammar (LFG) is a lexicalist, constraint-based grammatical theory that shares a lot of the basic assumptions of Construction Grammar (CxG), such as a commitment to surface-oriented descriptions (no transformations), and the simultaneous representation of form, meaning, and other grammatical information (no derivations). Nevertheless, LFG is not standardly viewed as a kind of CxG, in particular since its adherence to the principle of Lexical Integrity means that it insists on a strict morphology-syntax distinction where CxG canonically rejects such a divide. However, such a distinction is in fact entirely compatible with CxG assumptions; the actual problem with viewing LFG as a CxG is the difficulty it has in describing the more substantive end of the schematic-substantive spectrum of constructions. I suggest that by replacing the limited context-free grammar base of LFG responsible for this shortcoming with a tree-adjoining grammar, we can obtain a fully constructional LFG, suitable as a formal framework for CxG.

*Keywords: Lexical Functional Grammar, Construction Grammar, Lexical Integrity*

# 1 INTRODUCTION

In grammatical theory, there is an important division between which parts of linguistic competence involve storage/memory and which involve computation. Exactly where the line between these two categories should be drawn is an open, and heavily debated, question. The creativity and productivity of human language means that it is untenable to claim that everything is stored; if this were the case, it would be impossible to say anything new – we would only be able to repeat what we had already heard and memorised. This is the aspect of human language emphasised by work in mainstream generative grammar (MGG),[1] and claims about the 'discrete infinity' of human language are commonly seen in the opening pages of textbooks which introduce students to natural language syntax from this perspective. On the other hand, the arbitrariness in human language means that we cannot claim that everything is computed, either: some form-meaning pairings are the way they are for no other reason than convention, and conventions must be learned. This is the Saussurean observation about the arbitrariness of the linguistic sign: there is no more reason for *dog* to be used to refer to the domestic canine than any other sequence of sounds, which is precisely why languages vary in this respect (e.g. the German for 'dog' is *Hund*, the French *chien*, etc.). This arbitrariness also exists above the level of the word (see below), and it is this aspect of human language which is emphasised by work in the tradition of Construction Grammar (CxG).[2]

A traditional view in MGG is that the things which are stored are *words*, collected in the LEXICON, and that objects larger than the word – phrases, clauses, etc. – are arrived at by the application of general

[1] This term is borrowed from Culicover and Jackendoff (2005), and is used to refer to work in the Chomskyan tradition, i.e. that strand of theoretical thinking that begins with *Syntactic structures* (Chomsky 1957) and continues to the present day with work in the Minimalist Programme (Chomsky 1993, 1995).

[2] CxG refers to a family of theories which originated in the work of Charles Fillmore and colleagues in the 1980s (Fillmore 1985, 1988; Fillmore *et al.* 1988; Kay and Fillmore 1999), and that recognise the construction, a pairing of form and meaning of arbitrary size and varying abstraction, as the basic unit of analysis in grammatical theory. More details will be given about CxG below.

and abstract rules of syntactic composition to these lexical atoms. One problem with this view is that the arbitrariness of natural language does not stop at the word level: there are a variety of phrasal objects which do not behave as we would expect from the normal syntactic processes of the language in question, and whose meanings (and sometimes forms) therefore apparently have to be memorised. The most striking examples are idioms, whose meanings are often wholly unpredictable given the meaning of their parts in other contexts (if they even exist outside the idiom), and whose syntactic structures are often anomalous or archaic:

(1) Holden **pulled a rabbit out of the hat**.
≈ 'Holden found an unexpected solution to the problem.'
(Anomalous semantics: no rabbits or hats need be involved.)

(2) The thieves have **flown the coop**.
≈ 'The thieves have escaped.'
(Anomalous semantics: no coops or flying need be involved. Anomalous syntax: *fly* does not normally take a Source direct object in contemporary English.)

(3) We've tried **every which way** to solve this problem, and there's just no solution.
≈ 'We've tried every possible means of solving this problem, and there's just no solution.'
(Anomalous syntax; not possible with other quantifiers, for example: **each which way*.)

(4) We've let these pirates **run amok** for too long.
≈ 'We've let these pirates cause chaos for too long.'
(Anomalous lexical content: *amok* does not exist outside of this expression.)

But there are more schematic phrasal configurations which also bear unpredictable meanings, illustrated in (5)–(7):

(5) The more you tighten your grip, Tarkin, the more star systems will slip through your fingers.
≈ 'As you tighten your grip, the number of star systems slipping through your fingers will correspondingly increase.'
(The *the X-er the Y-er*/comparative correlative construction:

Fillmore 1987; Culicover and Jackendoff 1999.)

(6) What's a nice girl like you doing in a place like this?
≈ 'How come a nice girl like you is in a place like this?'
(The *what's X doing Y/WXDY* construction: Kay and Fillmore 1999.)

(7) Bill belched his way out of the restaurant.
≈ 'Bill left the restaurant while belching.'
(The *way*-construction: Jackendoff 1992.)

Fillmore *et al.* (1988, 505f.) call these FORMAL IDIOMS, in contrast to the SUBSTANTIVE IDIOMS in (1)–(4). Formal idioms have more open slots which can be filled in with any appropriate word or phrase, whereas substantive idioms require specific words for their idiomatic meaning to come off. In fact, idioms exist on a spectrum from more substantive to more formal (or schematic).

Because of the existence of these larger-than-single-word expressions whose meaning and/or form cannot be computed on-line, CxG takes a different view from MGG: the building blocks of phrasal syntax are not words, but CONSTRUCTIONS, pairings of form and meaning of *any* size. Word-internal syntax is also often understood to fall under this umbrella, so that constructions extend both above and below the level of the word, with the distinction between phrasal syntax and the lexicon therefore breaking down. Instead, the grammar is simply a repository of constructions – the CONSTRUCTICON (Jurafsky 1992) – and some means of combining them (often unification, where constructions are represented as feature structures).

There is quite some diversity in how this insight is cashed out, leading to an array of sometimes quite disparate theories all bearing the moniker 'Construction Grammar', e.g. Berkeley Construction Grammar (Fillmore 1985, 1988; Kay and Fillmore 1999), Embodied Construction Grammar (Bergen and Chang 2005), Fluid Construction Grammar (Steels 2011; Steels and van Trijp 2011), Sign-Based Construction Grammar (Sag 2010; Boas and Sag 2012; Michaelis 2015), Cognitive Construction Grammar (Lakoff 1987; Goldberg 1995, 2006), and Radical Construction Grammar (Croft 2001). Nonetheless, there are certain overriding meta-theoretical assumptions that basically all CxGs have in common, which are identified below:

1. WYSIWYG: Linguistic descriptions are surface oriented, or 'WYSIWYG' in nature ('What You See Is What You Get') – that is, no phonologically empty elements are assumed, and there is no abstract 'underlying' form which must be transformed to reach the surface representation.
2. PARALLEL-REPRESENTATION: All levels of linguistic analysis, both in terms of form and meaning, are present in parallel – that is, no level of representation is derived from another (e.g. meaning is not derived from form, nor *vice versa*).
3. EDL: Linguistic description has an 'extended domain of locality' – that is, the notion of the Saussurean sign extends above and below the level of the word: grammatical and morphological constructions can be arbitrary pairings of form and meaning just as well as words can.
    (a) CONSTRUCTIONS-ALL-THE-WAY-DOWN: Taken to its logical conclusion, EDL means that the usual distinction between morphology and syntax does not exist, since words and phrases are built out of the same things: "it's constructions all the way down" (Goldberg 2006, 18).
4. HIERARCHY: Linguistic knowledge is structured, and organised in a hierarchical fashion – often in some kind of inheritance network or type hierarchy, of the sort also assumed to structure non-linguistic knowledge.
5. CROSS-LX-VARIETY: There is a greater emphasis on cross-linguistic variety, on 'unusual' constructions, and on subtle connections of form and meaning than is found in MGG, for instance, where the focus is much more on 'core' constructions and cross-linguistic similarity.
6. USAGE-BASED: Knowledge of language is based on usage – that is, there is no strict competence-performance distinction, and we store both linguistic generalisations and specific episodic memories of linguistic events.

Within these assumptions, we can draw a dividing line between the first four, which are more about the architecture of the grammar, and the final two, which are about what you do with that grammar – i.e.

what kinds of questions linguists should be asking, and where they should look for their explanations.

In this paper, I want to argue that Lexical Functional Grammar (LFG: Kaplan and Bresnan 1982; Bresnan *et al.* 2016; Dalrymple *et al.* 2019), a constraint-based, declarative grammatical theory, can be seen as another kind of Construction Grammar – or, more precisely, that it can be viewed as a suitable framework for formalising CxG ideas and analyses.[3] For this reason I will be focussing on the first four assumptions above, since my interest is in the formal properties of LFG as a system, rather than to what ends researchers make use of the framework.

I begin in Section 2 with an introduction to LFG, highlighting its key features and pointing out to what extent these allow it to satisfy assumptions 1–4 above. It will be seen that it already satisfies all of them to some extent, with the notable exception of CONSTRUCTIONS-ALL-THE-WAY-DOWN: LFG self-avowedly adheres to the principle of LEXICAL INTEGRITY (LI), which means that it rejects the claim that there is no distinction between morphology and syntax.

In Section 3, however, I argue that *some* version of LI should be adopted by CxG (and already is in frameworks like SBGC), and therefore that the assumption of CONSTRUCTIONS-ALL-THE-WAY-DOWN ought not to be a *sine qua non* of CxG. On the other hand, I also argue that LFG should (and sometimes already does, albeit often implicitly) loosen the absolute distinction between morphology and syntax, since some apparent LI violations do seem to be genuine.

In fact, the problem with viewing LFG as a formalisation of CxG lies not with LI, but with its inability to handle substantive idioms satisfactorily, owing to the difficulty of describing multiword stretches in the lexicon. Section 4 examines how LFG handles some constructional phenomena, showing that existing machinery allows it to analyse many formal idioms well, but that it falls short when it comes to substantive idioms. I discuss some existing inadequate proposals, and conclude that Findlay's (2019; to appear) proposal to replace the context-free grammar backbone of LFG with a tree-adjoining gram-

[3] Cf. Lichte and Kallmeyer (2017) and Müller (2021), who undertake a similar exercise for Tree-Adjoining Grammar (TAG) and Head-Driven Phrase Structure Grammar (HPSG), respectively.

mar would give the appropriate level of descriptive freedom to enable LFG to capture substantive idioms. With this move, LFG's notion of 'extended domain of locality' is expanded to include phrase structure, meaning that lexical entries become nothing more or less than a declarative description of every level of linguistic structure in parallel – exactly what we would expect from a Construction Grammar.

## LEXICAL FUNCTIONAL GRAMMAR 2

LFG is a declarative/constraint-based (i.e. non-transformational) grammatical theory, an off-shoot of MGG stemming from a desire in the late 1970s and early 1980s to develop a more psychologically plausible and computationally tractable theory (Kaplan and Bresnan 1982, 173f.; Dalrymple and Findlay 2019, 123).[4] In this section, I introduce some of its key machinery while considering how well it adheres to the assumptions of CxG identified in Section 1.[5] We will see that LFG in its canonical form already shares many of them. Assumption 4, HIERARCHY, is not met by LFG 'out of the box', but is easily accommodated with the addition of TEMPLATES, a tool already common in computational work in LFG, and now gaining ground in theoretical work (to be introduced in Section 2.3). The status of EDL is more challenging: we will see in Section 2.1 that LFG has very powerful tools for describing non-local relationships, but there are two caveats

[4] Although the focus on psychology has not been sustained in contemporary work, LFG does still play a role in psycholinguistic work – for instance, some of its insights underpin the influential Bock-Levelt model of language production (Bock and Levelt 1994). There has been a far bigger focus on computational implementation, most notably the Xerox Linguistic Environment (XLE: Crouch *et al.* 2017), in which grammars for a very large number of different languages have been written as part of the Parallel Grammar (ParGram) project (Butt *et al.* 2002).

[5] Of course, this will by necessity be a fairly superficial introduction. For further details, the reader is directed to the relevant parts of Dalrymple *et al.* (2019). For an article-length overview of LFG, see Asudeh and Toivonen (2015), and for textbook-style introductions, see Bresnan *et al.* (2016) and Börjars *et al.* (2019).

which I turn to later in the paper. Firstly, LFG's adherence to Lexical Integrity (LI) means that it does not assume CONSTRUCTIONS-ALL-THE-WAY-DOWN (Section 3). Secondly, LFG's commitment to EDL is hamstrung by the format of its lexical entries, which make it impossible to handle certain kinds of constructions, especially substantive idioms, in a satisfactory way (Section 4.3).

## 2.1 *Two levels of syntactic structure*

What is generally called 'syntax' refers both to more imminent, 'surfacey' phenomena such as word order (which vary widely across the world's languages) and to more abstract, 'deeper' phenomena such as subjecthood (which exhibit many more commonalities cross-linguistically). LFG formalises this distinction by positing two distinct levels of syntactic structure, C(ONSTITUENT)-STRUCTURE and F(UNCTIONAL)-STRUCTURE, which encode the different kinds of information in different data structures, and which are related by correspondence (not by derivation). C-structure is a phrase-structure tree, and represents constituency, part-of-speech categories, and word order. F-structure is a feature structure/attribute-value matrix (AVM), and represents abstract relational information about grammatical functions, agreement, long-distance dependencies, etc. The two are connected by a PROJECTION FUNCTION, $\phi$, which maps c-structure nodes onto their corresponding f-structure ($\phi$ is a function, so more than one c-structure node can be mapped to the same f-structure, but each c-structure node only maps to a single f-structure). Figure 1 gives the c- and f-structures for the sentence *Jadzia loves them* by way of illustration.[6]

[6] Figure 1 only represents the $\phi$ function on the three c-structure nodes which correspond to maximal functional projections (and which map to the three f-structures), so as to avoid visual clutter (see Dalrymple and Findlay 2019, 137f.). This does not conceal any information, since daughter nodes in each of these three projections will be annotated to indicate that they share the same f-structure as their mother, with the effect that their functional information is 'passed up' the tree – see below.

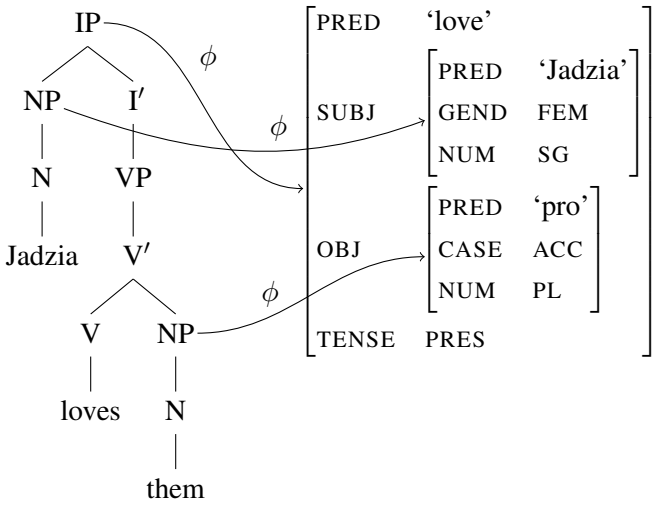



Figure 1: C- and f-structures for *Jadzia loves them*, with correspondences

C-structure is loosely based on X-bar theory, but makes a number of simplifying assumptions:[7]

1. All right-hand elements of phrase-structure rules are optional, so that there can be headless phrases (VPs without Vs, IPs without Is, etc.) – this avoids positing empty heads where no overt material fills the slot (e.g. in the analysis of English, an I node is only assumed when there is an auxiliary or modal that fills it, otherwise it is simply omitted).
2. Some categories are NON-PROJECTING (Toivonen 2003), indicated by a circumflex accent over the category label: e.g. a $\hat{\text{P}}$ is a non-projecting P. This means that they do not project a phrase.
3. We assume there is always a rule XP → X, for any category X, which omits extraneous bar levels (this is part of a general principle called ECONOMY OF EXPRESSION; see Dalrymple *et al.* 2015).

In addition, no phonologically empty elements are assumed.[8] All of

[7] For a fuller account of the formal details of c-structure, see Dalrymple *et al.* (2019, ch. 3).

[8] The one occasional exception is traces: some earlier versions of LFG did continue to make use of traces at c-structure, including Kaplan and Bresnan (1982), along with e.g. Bresnan (1995, 1998); but since the introduction of functional uncertainty (Kaplan *et al.* 1987; see below), it is not usually seen as part of the

this makes LFG c-structures a much more direct representation of surface syntactic structure than trees in other frameworks where the phrase-structure tree is overloaded and expected to encode functional information as well as constituent structure. LFG takes the view that different kinds of information require different kinds of data structure to represent: syntactic trees are very good at encoding constituency and linear order, but much less good at representing dependency relations between constituents (which may involve re-entrancy, cyclicity, etc.), for which a feature structure is much better suited. By factoring out abstract functional information from the tree, we therefore obtain a much more WYSIWYG c-structure: assumption 1 of CxG described above.[9]

Formally, an LFG grammar is a context-free grammar where the phrase-structure rules bear annotations that describe how f-structure is projected from the c-structure. Annotations are written using the following abbreviations:

(8) a. $* :=$ the current node (the node bearing the annotation)
b. $\hat{*} :=$ the current node's mother

(9) a. $\downarrow := \phi(*)$ (the f-structure of the current node)
b. $\uparrow := \phi(\hat{*})$ (the f-structure of the current node's mother)

We can indicate that a node and its mother share the same f-structure by writing $\uparrow = \downarrow$:

(10) NP → N
$\uparrow = \downarrow$

And we can indicate that a phrase bears some particular grammatical function by using paths through f-structure in our annotations. The rule in (11), for example, says that the f-structure of the NP in the specifier of IP is the SUBJect of the f-structure corresponding to the

mainstream theory. Various handbook and textbook presentations of LFG, such as Dalrymple (2001), Falk (2001), and Dalrymple *et al.* (2019) do not employ traces, for instance, although they do still appear in Bresnan *et al.* (2016), albeit only in a heavily restricted set of cases.

[9] Zaenen (1989) makes this explicit in a 'WYSIWYG Principle'.

IP:[10]

(11) IP → NP I′
(↑ SUBJ) = ↓ ↑ = ↓

In words, the annotation below the NP says that the f-structure corresponding to its mother node, IP ("↑"), has a subject attribute ("SUBJ"), whose value is the NP's f-structure ("↓").

It is important to recognise that although we say that f-structure is *projected* from c-structure, this does not mean that f-structure is *derived* from c-structure in any sense. Rather, the two structures are both simultaneously present, and constrain each other *mutually*. (This is an important component in LFG's adherence to PARALLEL-REPRESENTATION, which we return to in Section 2.2, where I introduce the wider LFG projection architecture.) The directionality inherent in the projection function is related to information flow, not derivation: owing to the functional nature of $\phi$, structure present at c-structure can be lost at f-structure (many nodes can correspond to a single f-structure), and cannot then be recovered in reverse (in the same way that mergers are irreversible in sound change).

Lexical entries in LFG are formally just phrase-structure rules, as in (12):

(12) N → Jadzia
(↑ PRED) = 'Jadzia'
(↑ NUM) = SG
(↑ GEND) = FEM

But they are usually written in a different format, shown in (13):

(13) Jadzia N (↑ PRED) = 'Jadzia'
(↑ NUM) = SG
(↑ GEND) = FEM

The feature PRED was originally used to indicate the semantic predicate of an f-structure, but given developments in the LFG approach

[10] For reasons of space, I will not motivate or list the grammatical functions and features usually assumed at f-structure. For a full treatment, see Dalrymple *et al.* (2019, ch. 2).

to semantics (see Section 2.4), its role is now really just to uniquely identify lexical items (see Andrews 2008 and Findlay 2019, 152ff. for some discussion) – cf. the role of the LID feature in SBCG (Sag 2012, 84). Lexical entries almost always therefore contain a statement identifying their PRED value at a minimum.

Annotations, whether in lexical entries or other phrase-structure rules, can refer to non-local parts of f-structure. We have seen how annotations can include paths through f-structure; in principle there is no limit to the length of these paths. Therefore as well as simple annotations like $(\uparrow \textsc{subj}) = \downarrow$, or $(\uparrow \textsc{num}) = \textsc{sg}$, which describe relationships between the f-structures of a c-structure node and its mother, or simply ascribe values to attributes within a lexical item's own f-structure, we can also express more distant relationships, such as FUNCTIONAL CONTROL, illustrated in the second line of this lexical entry for the raising verb *seem*:

(14) seem V $(\uparrow \textsc{pred}) = \text{'seem'}$
$(\uparrow \textsc{subj}) = (\uparrow \textsc{xcomp subj})$

The second constraint here identifies the subject of *seem* with the subject of its open complement clause (e.g. connecting *Jadzia* and *leave* in *Jadzia seemed to leave*), i.e. it expresses a cross-clausal dependency.

In fact, by making use of FUNCTIONAL UNCERTAINTY (Kaplan *et al.* 1987), we can express relationships over *arbitrarily* long paths through f-structure. Functional uncertainty uses regular expressions over f-structure attributes to abbreviate potentially infinite numbers of different paths. (15) shows this employed in a (simplified) phrase-structure rule for a fronted *wh*-phrase in English constituent questions:

(15) $\text{CP} \rightarrow$ XP C′
$(\uparrow \textsc{focus}) = \downarrow$ $\uparrow = \downarrow$
$(\uparrow \textsc{focus}) = (\uparrow \textsc{comp}^* \textsc{gf})$

The first annotation under XP identifies its f-structure with the 'grammaticized discourse function' FOCUS (Bresnan and Mchombo 1987; Dalrymple 2001, 182f.) – this is the special function assumed to be fulfilled by questioned material. But displaced constituents must also play a grammatical role at the 'gap' where they are interpreted; this is what the second annotation ensures. It says that the FOCUS also bears

some grammatical function (GF), which may be in the same clause or may be embedded in any number of COMPlement clauses – the '$*$' following COMP is a Kleene star, indicating zero or more occurences of COMP on this path.

With the use of functional uncertainty, it is obviously possible to describe extremenly non-local dependencies between elements. Additional tools, such as OFF-PATH CONSTRAINTS (Dalrymple *et al.* 2019, ch. 6.6), have also been developed to allow further constraints to be imposed on the paths described by such expressions, which enables very precise specifications of very detailed and complex long-distance relationships through the f-structure. Thus, the description language of LFG allows constraints to be placed on dependencies that extend way beyond a word and its immediate sisters or dependents, which clearly affords LFG some version of EDL, assumption 3 of CxG described above.

### *The parallel projection architecture* 2.2

Although the original formulation of LFG in Kaplan and Bresnan (1982) includes only c-structure and f-structure, subsequent developments have expanded the number of different levels of representation, i.e. the different 'structures', which are assumed. A contemporary view of the so-called (PARALLEL) PROJECTION ARCHITECTURE is given in Figure 2, showing the different structures and correspondence functions which map between them. All of these different structures are taken to have "their own primitives and organizing principles, and therefore their own internal structure and formal representation" (Dalrymple *et al.* 2019, 265 – although in practice almost all are represented as AVMs like f-structure), meaning that LFG takes a highly modular view of the grammar. Crucially, meaning is also included in this extended view of the LFG architecture, as well as information-structure, so that all kinds of form *and* function are, at least in principle, brought within the scope of the framework. This shows that LFG shares assumption 2 of CxG, PARALLEL-REPRESENTATION: all levels of linguistic analysis, both form and function, are represented simultaneously.

What is more, although each of these structures represents a different plane of linguistic analysis, they are not derived from one

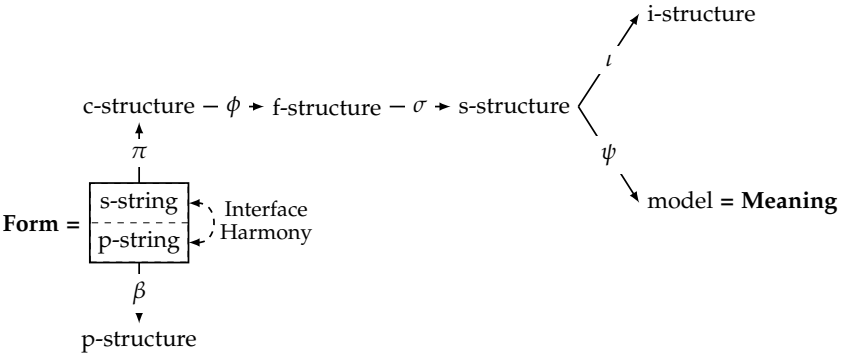



Figure 2: The parallel projection architecture (Findlay 2021, 344). On the division of the string into the s-string and p-string, see Dalrymple and Mycock (2011) and Mycock and Lowe (2013). The other structures shown here are p(rosodic)-structure (Mycock and Lowe 2013), s(emantic)-structure (Dalrymple 1999; Lowe 2014; Findlay 2021), and i(nformation)-structure (Dalrymple and Nikolaeva 2011). Not shown are a(rgument)-structure, which appears between c-structure and f-structure in some conceptions of the architecture (Butt *et al.* 1997), but which other approaches have omitted entirely (Asudeh and Giorgolo 2012; Findlay 2016); and m(orphosyntactic)-structure (Butt *et al.* 1996; Frank and Zaenen 2004), which has likewise been dispensed with in modern treatments (Dalrymple 2015)

another, and instead are present in parallel, and are mutually constraining. Just as phrase-structure rules can be annotated to describe f-structure, they can also bear annotations referring to any level, e.g. a person's name like *Jadzia* might specify that the ANIMate feature in its s-structure has the feature +:

(16) Jadzia N $(\uparrow \textsc{pred}) = \text{`Jadzia'}$
$(\uparrow_\sigma \textsc{anim}) = +$

The subscript convention here is used to make such annotations more readable. $\uparrow_\sigma$ is equivalent to $\sigma(\uparrow)$, and, more generally, for any structure $s$ and any projection function $\omega$, $s_\omega := \omega(s)$. Such subscripts can also be iterated, so that, for instance $\downarrow_{\sigma\iota}$ is equivalent to $\iota(\sigma(\downarrow))$, or, in other words, this node's i-structure.

Thus, descriptions (on both phrase-structure rules and in lexical entries) can constrain all levels of representation simultaneously – or, rather, all levels except c-structure. For, since the annotations appear on phrase-structure rules in a context-free grammar, the scope of

c-structure constraints remains within a single generation (a mother node and its daughters). We will return to this problem in Section 4.3.

## *Templates* 2.3

It is common in programming languages to use *macros* of some kind to abbreviate chunks of code when they will be repeated. This has the pragmatic benefit of saving typing time, but it also makes maintaining code much easier: if something has to be changed in the chunk of code in question, it need only be changed in one place, where the macro is defined, rather than having to be changed at every instance of its use. This saves time too, but, more crucially, it also avoids errors creeping in as some instances are inevitably missed.

The computational implementation of LFG, the Xerox Linguistic Environment (XLE: Crouch *et al.* 2017), also provides a means of writing macros – in this case they are called TEMPLATES. In addition to their practical uses, there has, over the past two decades, been a growing interest in the *theoretical* applications of templates in LFG, as a means of expressing generalisations across different lexical entries or parts of the grammar (Dalrymple *et al.* 2004; Asudeh *et al.* 2014; Findlay 2020, 132f.). Since templates are just abbreviations, a grammar with templates is extensionally equivalent to one without, but the former will be able to express generalisations that the latter cannot.

One area where templates can capture generalisations is in abbreviating annotations that frequently co-occur. For instance, any distinctively third-person singular verb in English will share the second and third lines of this lexical entry for *loves*:[11]

(17) loves V $(\uparrow \textsc{pred}) = \text{`love'}$
$(\uparrow \textsc{subj pers}) = 3$
$(\uparrow \textsc{subj num}) = \textsc{sg}$

[11] These annotations illustrate how agreement works in LFG: an agreeing subject (e.g. *Jadzia loves …*) will provide the same values for these features as the verb does, meaning the specifications are compatible; by contrast, a non-agreeing subject (e.g. **We loves …*) will cause a feature clash in its f-structure, since it will specify different values for its PERSon and NUMber features (e.g. 1 and PL in this case).

We can therefore define a template 3SG-SUBJECT that abbreviates this information:

(18) 3SG-SUBJECT :=
  (↑ SUBJ PERS) = 3
  (↑ SUBJ NUM) = SG

Now we can rewrite the lexical entry for *loves* by 'calling' this template, indicated by prefixing the template name with an '@' symbol:

(19) loves V (↑ PRED) = 'love'
  @3SG-SUBJECT

Templates can be parametrised, as in (20), so that they take one or more arguments, allowing even more flexibility:

(20) TENSE($t$) :=
  (↑ TENSE) = $t$

Notably, templates can also be nested, as shown in (21) and (22):

(21) a. 3-SUBJECT :=
  (↑ SUBJ PERS) = 3
  b. SG-SUBJECT :=
  (↑ SUBJ NUM) = SG

(22) 3SG-SUBJECT :=
  @3-SUBJECT
  @SG-SUBJECT

That is, a template can call one or several other templates in its definition. This nesting creates an implicit hierarchy between templates:

(23)



Such a hierarchy is different from a typical inheritance hierarchy – it is an *inclusion* hierarchy instead (Asudeh *et al.* 2013, 17ff.). This is because templates, in common with LFG descriptions generally, allow the use of Boolean operators like negation or disjunction. For exam-

ple, alongside the 3SG present tense form *loves*, we have the complemetary form *love*, used for all other person/number combinations in the present tense. We can describe this distribution by simply negating the 3SG-SUBJECT template:

(24) love V (↑ PRED) = 'love'
¬@3SG-SUBJECT

But now both *love* and *loves* will be daughters of 3SG-SUBJECT in the template hierarchy, since both *include* the template, even though in one case this is only under negation:

(25) 3SG-SUBJECT

*love* *loves*

In principle, all functional annotations in a grammar could be abbreviated in templates and appropriately related to one another. This would provide LFG with a hierarchical organisation of linguistic knowledge, bringing it in line with assumption 4 of CxG, HIERARCHY. In practice, however, theoretical work in LFG has not pursued this endeavour in a thoroughgoing way (though see Asudeh *et al.* 2013 and Przepiórkowski 2017 for case studies), and so the framework does not yet live up to the claim by Goldberg that in CxG "the network of constructions captures our grammatical knowledge of language *in toto*"(Goldberg 2006, 18).

## *Meaning in LFG* 2.4

Any theory which purports to explain human language needs to have an account of meaning. In particular, it needs to explain how meanings can be arrived at compositionally, allowing us to express new ideas with existing, limited, resources. LFG remains wholly agnostic about how meanings *per se* should be represented – in keeping with its modular approach, this is not a question for the framework overall, but for the particular module which deals with semantics. What is crucial, though, is how this module connects to the rest of the grammar: in other words, the syntax-semantics interface. There has been some variation over the years in how this has been conceptualised within

LFG, and in particular about the necessity and/or role of s-structure in this (on which see Findlay 2021, especially §3), but the *de facto* standard approach to the syntax-semantics interface in contemporary LFG is GLUE SEMANTICS (Glue: Dalrymple *et al.* 1993; Dalrymple 1999). For our purposes, most of the details of this theory are not relevant, but it will nonetheless be useful to have some tools to describe how LFG handles the pairing of form and meaning, and so in this section I give a brief introduction to Glue for LFG. For a fuller introduction to the theory, the reader is directed to Asudeh (2012, ch. 4) or Dalrymple *et al.* (2019, ch. 8).

Meaning contributions in Glue are handled by so-called MEANING CONSTRUCTORS, which pair an expression in some meaning language (here a simple predicate calculus) with a logical expression that both gives the type of that meaning and connects it to the syntax – this logical expression is called the glue term, since it bonds the semantics to the syntax. Semantic composition is logical deduction: parsing a sentence gives us a collection of meaning constructors, and we use their glue terms to construct a proof terminating in the type of the sentence itself.

Glue Semantics uses LINEAR LOGIC (Girard 1987) as the logical language for the second part of a meaning constructor – since it lacks the sub-structural rules of Weakening and Contraction, this logic has the property of RESOURCE SENSITIVITY, meaning that premises are 'used up' in deriving a conclusion. This has the – desirable – consequence that meanings cannot be re-used or discarded in the process of composition. For example, *Jadzia loves Worf* cannot mean **love**(**jadzia**, **jadzia**) ('Jadzia loves herself'), where we use the meaning of *Jadzia* twice and ignore the meaning of *Worf*.[12]

A simple meaning constructor is given in (26):

(26) **jadzia** : $e_{\uparrow}$

The meaning language side introduces a constant **jadzia**, while the linear logic side says that this is of type $e$ and is associated with ↑: in

[12] On the more widespread relevance of resource sensitivity to linguistic theory, see Asudeh (2012, ch. 5).

a lexical entry this means the pre-terminal node's f-structure, i.e. the lexical item's own f-structure.[13]

A more complex meaning constructor appears in (27):

(27) $\lambda x.\lambda y.\mathbf{love}(x, y) : e_{(\uparrow \text{SUBJ})} \multimap e_{(\uparrow \text{OBJ})} \multimap t_{\uparrow}$

This has a two-argument function on the left-hand side, and on the right-hand side a linear logic expression with two implications. This second part shows the $\langle e, \langle e, t \rangle \rangle$ type of the function on the left ('$\multimap$' is right-associative), and also links its first argument to its f-structure subject and its second to its f-structure object. Read as an implication, the glue term can be thought of as saying the following: "If I am provided with something of type $e$ corresponding to my subject, and if I am then provided with something of type $e$ corresponding to my object, I will provide something of type $t$ corresponding to my own f-structure (i.e. the f-structure of the clause)".

Of course, combining types means nothing if we don't also combine meanings. Glue achieves this by appealing to the CURRY-HOWARD CORRESPONDENCE (Curry and Feys 1958; Howard 1980): proof steps in a constructive logic (like linear logic) correspond to specific operations in the lambda calculus. Most notably, implication elimination (i.e. *modus ponens*) corresponds to functional application, while implication introduction (i.e. hypothetical reasoning) corresponds to lambda abstraction. This means that as we compose the types on the right-hand side of a meaning constructor, the left-hand meanings are also combined appropriately. Let us see how this works with an example.

[13] In much of the Glue Semantics literature, types are associated with s-structures rather than f-structures, but for our purposes f-structures are sufficient, and avoid us being drawn into unresolved disputes about the exact content of s-structure (on which see Findlay 2021, §3). I also make use of so-called FIRST-ORDER GLUE here (Kokkonidis 2008), where the atomic expressions in the linear logic are type constructors that take structures in the projection architecture (here f-structures) as arguments (here represented as subscripts), rather than the more common approach which takes the atoms to be the structures themselves (appropriately typed). This is mostly for the sake of clarity, since it makes the role of the linear logic in driving composition based on types more explicit (see also discussion in Kokkonidis 2008 and Findlay 2019, 181ff.).

Figure 3:
Glue proof for
*Jadzia loves Worf*

$$\dfrac{\dfrac{\textbf{jadzia} : e_j \quad \lambda x \lambda y.\textbf{love}(x,y) : e_j \multimap e_w \multimap t_l}{\lambda y.\textbf{love}(\textbf{jadzia},y) : e_w \multimap t_l} \quad \textbf{worf} : e_w}{\textbf{love}(\textbf{jadzia},\textbf{worf}) : t_l}$$

Meaning constructors are included in lexical entries just like other annotations. For the sentence *Jadzia loves Worf*, we can assume the (very simplified) lexical entries in (28)–(30):

(28) Jadzia N $(\uparrow \textsc{pred}) = \text{`Jadzia'}$
$\textbf{jadzia} : e_{\uparrow}$

(29) Worf N $(\uparrow \textsc{pred}) = \text{`Worf'}$
$\textbf{worf} : e_{\uparrow}$

(30) loves V $(\uparrow \textsc{pred}) = \text{`love'}$
$\lambda x.\lambda y.\textbf{love}(x,y) : e_{(\uparrow \textsc{subj})} \multimap e_{(\uparrow \textsc{obj})} \multimap t_{\uparrow}$

The (abbreviated) f-structure for the sentence is shown in (31). The different structures have been labelled to allow us to refer to them directly.

(31)
$$l\begin{bmatrix} \textsc{pred} & \text{`love'} \\ \textsc{subj} & j\big[\textsc{pred} \quad \text{`Jadzia'}\big] \\ \textsc{obj} & w\big[\textsc{pred} \quad \text{`Worf'}\big] \end{bmatrix}$$

We can now obtain a set of *instantiated* meaning constructors from the lexically contributed meaning constructors in (28)–(30) by replacing the descriptions on the linear logic side with the names of the f-structures they describe in (31):

(32) $\textbf{jadzia} : e_j$
$\textbf{worf} : e_w$
$\lambda x.\lambda y.\textbf{love}(x,y) : e_j \multimap e_w \multimap t_l$

Finally, we can use these to construct the proof in Figure 3, where each step corresponds to an instance of *modus ponens*/function application. As we can see, we arrive at the correct meaning for the sentence, namely **love**(**jadzia**, **worf**).

### *Summary* 2.5

We have now seen briefly some key components of LFG, and I believe this has illustrated how many of the core assumptions of CxG it already shares. Its surface-oriented syntax, represented at c-structure, means that it adheres to WYSIWYG. The parallel projection architecture gives us PARALLEL-REPRESENTATION: all levels of linguistic structure exist in parallel, mutually constraining one another. The existence of tools like functional uncertainty gives us an important degree of EDL; although c-structure remains problematic, something we will explore more fully in Section 4, it is clear that overall LFG is perfectly capable of expressing a variety of complex constraints across arbitrary distances. Lastly, HIERARCHY can be achieved through the use of templates to organise and modularise linguistic description, even though this approach has not been followed through to completion in theoretical work in LFG.

One problem arises, however, when it comes to CONSTRUCTIONS-ALL-THE-WAY-DOWN. LFG professes to adhere to the principle of Lexical Integrity (LI), whereby syntax and morphology are strictly separated, and the morphological structure of words is invisible to the syntax. Crucially, the LI claim that "words are built out of different structural elements and by different principles of composition than syntactic phrases" (Bresnan and Mchombo 1995, 181) would appear to be at odds with the CxG credo that "no strict division is assumed between the lexicon and syntax" (Goldberg 1995, 7). Since "LFG assumes a strict version of the Lexical Integrity Principle" (Dalrymple *et al.* 2019, §3.3), this would seem to be a serious obstacle to viewing LFG as a CxG. In the next section, we will examine LI and see that it may not prove as great an obstacle as appearances would suggest.

## LEXICAL INTEGRITY 3

The principle of Lexical Integrity claims that the smallest items the (phrasal) syntactic component of the grammar can 'see' are words. That is, word-internal morphological structure is not accessible to the

syntax, and so there is an important division between the syntax on the one hand and the lexicon on the other, which may also be taken as an important division between the computational system underlying syntax and that underlying morphology. Building on the proposals of Chomsky (1970), the principle of Lexical Integrity was first formulated by Lapointe (1980, 8) as the Generalized Lexicalist Hypothesis:

(33) **Generalized Lexicalist Hypothesis:**
No syntactic rule may refer to elements of morphological structure.

In the forty plus years since this original formulation, many different versions have been proposed, but all make the same basic claim: there is some kind of 'firewall' between syntax and the lexicon, with the latter feeding the former, but not *vice versa*. Perhaps the simplest specification of this is given by Anderson (1992, 84):

(34) **Principle of Lexical Integrity:**
The syntax neither manipulates nor has access to the internal structure of words.

A whole paradigm of linguistic theories exist, called LEXICALIST theories, which are defined by their adherence to the principle of Lexical Integrity – LFG is one such theory. LI has featured explicitly in LFG analyses from the very start (Bresnan 1982; Simpson 1983), and appears in textbook/handbook presentations of the theory (Falk 2001, 26; Bresnan *et al.* 2016, 92; Börjars *et al.* 2019, 28; Dalrymple *et al.* 2019, §4.4). And there are good *prima facie* reasons to believe that LI is valid: many phenomena that it predicts to be impossible are indeed ruled out by the world's languages. For example, gapping can be applied to words but not sub-lexical elements (examples from Simpson 1991, 51):

(35) a. John liked the play, and Mary, the movie.
(gapping of *liked* permitted)
b. *John liked the play, and Mary dis- it.
(gapping of *-liked* not permitted)

And sub-parts of words cannot be modified independently of the whole (examples from Williams 2007, 354):

(36) a. How complete are your results?
b. *[How complete]-ness do you admire?

Although *how* can modify *complete* in (36a), it cannot do so when *complete* is part of a larger word, *completeness*, as in (36b). Note that the deviancy of (36b) is not because its meaning is incoherent: its meaning is perfectly grammatically expressed by (37a). And it is entirely possible for *how* to modify *complete* inside a nominal expression (provided that nominal expression is phrasal), as shown in (37b) (Williams 2007, 354):

(37) a. What degree of completeness do you admire?
b. How complete a record do you admire?

These data notwithstanding, CxG is often understood as rejecting a strict separation of morphology and syntax – this is the assumption I called CONSTRUCTIONS-ALL-THE-WAY-DOWN above. Since constructions are pairings of form and meaning, and morphemes also fit this description, then there is no fundamental distinction between morphemes and words. Rather, all constructions exist on a lexicon-syntax spectrum, varying in particular in terms of SCHEMATICITY, i.e. how much the phonological form is specified by the construction. At the more lexical end of the spectrum, we have words and morphemes, which are fully specified for phonological form (e.g. *cat* has the form /kæt/, at least in British English); at the more syntactic end, we have abstract phrasal constructions, which are radically underspecified for phonological form (e.g. the English resultative has the syntactic form [NP V NP AP], as in *Clarissa smashed the doors open*, but none of the open slots have their phonological form specified by the construction).

Taken naïvely, the LFG and CxG positions are clearly incompatible, and so LFG would be unsuitable as a formalisation of CxG. But whether or not LI is valid is an empirical question, not (just) a matter of formalism. And answering it would resolve the rift between LFG and CxG one way or the other. If it is valid, then CxG should abandon CONSTRUCTIONS-ALL-THE-WAY-DOWN in its strictest interpretation and move closer to LFG. Alternatively, if it is not, then LFG should abandon LI and move closer to CxG. So, what are the facts?

Alongside the putative evidence in favour of LI presented above, there is also apparently equally clear counterevidence. For instance,

phrases and even entire clauses can host derivational and inflectional suffixes in English:

(38) a. His general [ok-with-less-than-we-should-aim-for]-ness makes him an undesirable candidate. (Bruening 2018, 6)
b. He [I-don't-care]-d his way out of the room. (Carnie 2000, 91)

This seems to be a clear example of syntax being 'visible' to morphology, since phrasal material can be used as input to a morphological process (suffixation).

Another apparent counter-example is the possibility of coordinating certain prefixes:

(39) a. [pre- and even to some extent post]-war (economics)
b. [pro- as opposed to anti]-war
c. [hypo- but not hyper]-glycaemic (Spencer 2005b, 82)

(40) a. [mono- and tri]-syllabic
b. [pro- and en]-clitics
c. [socio- and politico]-economic (Siegel 1974, 147, cited in Strauss 1982, 43)

Here it seems that morphology is visible to syntax, since coordination is an operation in the phrasal syntax but it can apply to parts smaller than words.

Some have seen evidence such as this as damning. Marantz (1997, 207), for example, declares that "[l]exicalism is dead, deceased, demised, no more, passed on …". And yet, more than 20 years later, Bruening has to again declare the lexicalist hypothesis "both wrong and superfluous" (the subtitle of Bruening 2018) – clearly, earlier reports of lexicalism's death were greatly exaggerated (to – further – misquote Mark Twain). In fact, the empirical situation is fraught, and none of the data presented in this section are unproblematic. For instance, Bruening (2018, 23ff.) purports to explain the sub-lexical gapping and modification data in (35) and (36) in syntactic terms which make no reference to the notion of word, thus rendering LI superfluous. At the same time, the phenomenon of sub-lexical coordination illustrated in (39)–(40) is not at all as thoroughgoing as we might expect were morphology and syntax truly underpinned by ex-

actly the same combinatory sytem. For although some English prefixes can be coordinated, others emphatically cannot:[14]

(41) a. *[un- or re]-tie
b. *[in- or ex]-port (Spencer 2005b, 82)
c. *[ex- and se]-cretions (Siegel 1974, 147)

And it does not seem to be possible at all with suffixes:

(42) a. *fear-[some and -less]
b. *thought-[ful and -less]
c. *interest-[ed and -ing] (Strauss 1982, 43)

Lieber and Scalise (2007, 3) express a sort of compromise position, admitting that LI cannot be valid in a strict sense, but viewing it as a kind of default or strong tendency: "we know that morphology and syntax interact, and that this interaction is not a one way affair: morphology sees syntax and syntax sees morphology. Nevertheless this two way interaction is highly constrained". This is echoed more recently by Cappelle (to appear, 204), who points out that "[a]ny randomly selected stretch of discourse is likely to prove that morphologically complex words stay together as undivided units and that they tend not to include any above-word-level components".

Ultimately, a large part of the problem is this: deciding whether one or another piece of linguistic data is a LI violation depends hugely on one's other theoretical assumptions (Desjardins 2022), and so the enterprise of proving or disproving LI by looking for supportive or problematic constructions in the world's languages is a largely hopeless one. There are, however, systematic differences between morphology and syntax at a higher level of abstraction that plead for a principled separation between the two.

[14] The distinction appears to be between what Siegel (1974) calls Class I and Class II prefixes. Class I prefixes are both morphologically and functionally 'closer' to the stem: they always appears nearer to the stem than Class II prefixes, for example, and unlike their Class II counterparts they can affect lexical stress assignment. It is perhaps unsurprising then that the prefixes in (41) that resist coordination are Class I – their closeness to the stem is reflected in their inability to be separated from it by a syntactic process like coordination.

Firstly, morphology applies strict ordering constraints on morphemes, even in languages where the syntax imposes no ordering constraints. For example, case markers and verbal inflection in Latin always follow the stem, even though any of the six permutations of the three *words* in (43) is grammatical:

(43) a. mil-es coqu-um laud-at.
*soldier*-NOM *cook*-ACC *praise-3*SG.PRES.INDIC
'The soldier praises the cook.'
b. *es-mil coqu-um laud-at
c. *mil-es um-coqu laud-at.
d. *mil-es coqu-um at-laud.

And, of course, morphemes from different words cannot be interleaved, even though discontinuous *constituents* are permitted (Snijders 2012, 2015, 211ff.). That is, so-called 'free word order' languages are *not* 'free morpheme order' languages.

Secondly, and perhaps more foundationally, there are important differences in the computational complexities of morphology and syntax (Asudeh *et al.* 2013, 4–5). Morphology falls almost entirely within the class of finite-state languages (Roark and Sproat 2007, ch. 2), with the sole exception being unbounded reduplication (Culy 1985). Syntax, on the other hand, falls almost entirely within the class of context-free languages,[15] with the sole exception being cross-serial dependencies (Shieber 1985). Assuming there is no formal difference between morphology and syntax, as CONSTRUCTIONS-ALL-THE-WAY-DOWN would have it, then this contrast is puzzling. As Asudeh *et al.* (2013, 5) put it:

> [i]f morphology has the full power of syntax, why are there no clear morphological equivalents of unbounded or nested dependencies? […] Similarly, why do we fail to find reduplication in the syntax, if there is no important formal distinction between morphology and syntax?

[15] See Partee *et al.* (1990, 480–482) for a proof that English is not a finite-state language, and see Gazdar *et al.* (1985) for a comprehensive syntactic theory which is nonetheless self-avowedly context free.

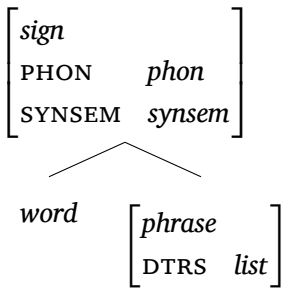
Note that the claim here is not merely that morphology is less powerful than syntax, but that the two systems are in fact *disjoint*: there are syntactic phenomena, like unbounded dependencies, which we do not observe in morphology, and there are morphological phenomena, like reduplication, which we do not observe in syntax.

I am not aware of any arguments in the literature which have addressed these concerns, and they seem to strongly suggest that we need to be able to distinguish between processes happening above the level of the word and processes below. Any framework that makes this *impossible* ought to be treated with a degree of suspicion, therefore. So, is CxG such a framework?

In fact, the CxG position may have been overstated by its critics (or, alternatively, the CxG position is indecisive and non-committal, depending on your point of view). On the same page that Goldberg (1995, 7) makes her oft-cited claim that "[i]n Construction Grammar, no strict division is assumed between the lexicon and syntax", she goes on to clarify that "[i]t is not the case, however, that in rejecting a strict division, Construction Grammar denies the existence of any distinctly morphological or syntactic constraints (or constructions)". Our choice is not, therefore, between a strict version of LI where syntax and morphology are computationally distinct processes on the one hand, and on the other the obliteration of LI and total collapse of the syntax-morphology boundary. Rather, a third way is possible (and indeed espoused by Goldberg), where syntax and morphology operate under the same computational system, but where a formal distinction is drawn between morphemes, words, and phrases, meaning that linguistic processes can be sensitive to these contrasts (see Ackema and Neeleman 2004 for a similar approach outside of CxG).

This approach is readily embodied by any type-driven framework. For example, a standard HPSG type signature includes the sub-section shown in (44) (Przepiórkowski and Kupść 2006, §3.3):

(44)




Here we see that words and phrases are both sub-types of *sign*, and that what defines a sign is the pairing of PHONological form with syntactic and semantic information (SYNSEM). That is, "both lexical and syntactic constructions are essentially the same type of declaratively represented data structure: both pair form with meaning" (Goldberg 1995, 7). But since *word* and *phrase* are distinct types, it is possible for other constructions in the grammar to be limited to one of the two: for example, 'morphological' constructions can require that their mother be of type *word*, whereas syntactic constructions can require that their daughters (DTRS) be of type *word*. I have illustrated this point with HPSG since it makes the cut so clearly and succinctly, but the same point could be made with HPSG's explicitly constructionist cousin, Sign-Based Construction Grammar (SBCG: Boas and Sag 2012; Michaelis 2015),[16] which likewise recognises an early cleavage between lexical constructs and phrasal constructs (cf. Sag 2010, 499). In other words, even existing implementations of CxG do not take rejection of LI as a *sine qua non*.

CxG can therefore be made to fit with Lieber and Scalise's (2007, 18) conclusion "that the interaction between word formation and syntax goes both ways, but that nevertheless it is quite restricted": there are formalisms for CxG which do not in themselves preclude syntax-morphology interactions, but do give a means of restricting it and/or only permitting it on a construction-by-construction basis. What of LFG, then? LI must be weakened, it seems; but how easy is this to do?

[16] In fact, HPSG is also fundamentally constructionist, even though it does not bear the 'construction grammar' name (Müller 2021).

As it happens, LFG already sanctions a weaker than strict interpretation of LI. In one common LFG formulation of LI, its scope is limited to c-structure:

(45) **Lexical integrity:**
Morphologically complete words are leaves of the c-structure tree, and each leaf corresponds to one and only one c-structure node. (Bresnan *et al.* 2016, 92)

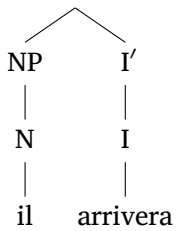
That is, words are syntactic atoms when it comes to phrasal constituency, but when it comes to functional information, the internal morphological features of a word may very well be visible to syntax.

This view is well motivated, since there are numerous instances where what is expressed analytically in one language is expressed synthetically in another (Asudeh *et al.* 2013, 7ff.). For instance, future tense in Romance languages can be expressed via verbal inflection, whereas English uses an auxiliary (Asudeh *et al.* 2013, 7):

(46) a. Il arriver-a. (French)
*He arrive*-3SG.FUT
'He will arrive'
b. He will arrive.

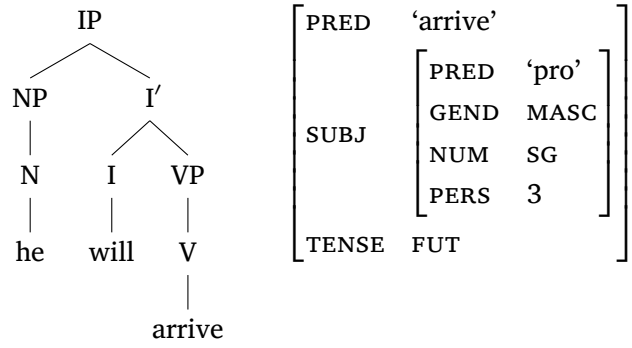
While the c-structures of these sentences will differ, since the French tree has two terminal nodes and the English three, their f-structures will be identical:

(47) a.




$$\begin{bmatrix} \text{PRED} & \text{'arrive'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'pro'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \\ \text{PERS} & 3 \end{bmatrix} \\ \text{TENSE} & \text{FUT} \end{bmatrix}$$

b.




In English, the attribute-value pair ⟨TENSE, FUT⟩ is contributed by syntax, whereas in French, it is contributed by morphology.[17] In the latter case, the syntax, in the form of f-structure, can clearly 'see' the morphological features of words, even though c-structure is blind to morphological structure. So it is not true that morphology is wholly isolated from syntax in LFG.

Falk (2001, 26) makes this point explicitly, observing that "[l]exical integrity as understood by LFG […] is a limited sort of lexical integrity, which is better able to deal with featural equivalence of words and word sequences than an approach in which all aspects of the internal structure of a word is invisible to the syntax". Thus, the orthodox view in LFG is perhaps more in line with Cappelle's (to appear, 196) conclusion that LI should be reformulated "as a principle forbidding the manipulation of words, rather than access to word-internal structure".

However, even this weakened version of LI would disallow the coordination of affixes seen in (39)–(40), and certainly the phrases hosting affixes seen in (38). So it may well be that LFG has to accept even greater concessions. Partly this hinges on which view of morphology is adopted. LFG work on morphology has most naturally aligned with realisational morphology in the vein of Stump (2001, 2002), e.g. as outlined in Dalrymple (2015) (see also Biswas 2017 and Dalrymple *et al.* 2019, ch. 12). But as with semantics, the exact theory of morphology adopted is moot, as long as an interface with the rest of the projection architecture can be provided. It could well be

[17] An instance of the cross-linguistic phenomenon whereby, to use the LFG slogan, "morphology competes with syntax" (Bresnan 1998).

that a more incremental ('Item-and-Arrangement') style morphology is required, at least in some cases. I will note in passing that there is apparently some lurking awareness of this in LFG. Analyses occasionally make use of 'sub-lexical' entries; that is, lexical entries for morphemes, written as if they were leaves in the c-structure tree, in clear violation of LI (e.g. King 1995; Nordlinger 1998; Marcotte 2009). Usually, it is implied (though often not stated explicitly) that these have no formal status, and should instead be viewed as descriptions of generalisations over lexical entries (of the sort that would nowadays be captured by templates), but sometimes suggestions are made to incorporate actual sub-lexical phrasal syntax (Marcotte and Kent 2010). What is more, the use of non-projecting categories (Toivonen 2003), especially to permit adjunction at the $X^0$ level in the analysis of case (Spencer 2005a) and compounding (Lowe 2015), obviously weakens the word-phrase distinction, and opens the way to a potentially richer theory of sub-lexical syntax in LFG.[18]

To sum up: the abolition of the distinction between word and phrase or morphology and syntax implied by a strict reading of CONSTRUCTIONS-ALL-THE-WAY-DOWN is not a necessary (or indeed empirically justified) tenet of CxG; at the same time, the *absolute* separation of the two implied by a strict reading of LI is not a necessary (or indeed empirically justified) tenet of LFG either. There is therefore ample room for common ground between the approaches, and we need not see the conflict between CONSTRUCTIONS-ALL-THE-WAY-DOWN and LI as a reason to dismiss LFG as a formalisation of CxG. But we are not home and dry yet! The proof of the pudding is in the eating, and the best way to validate a theoretical claim is to see it implemented. In the following section, therefore, I will demonstrate how LFG handles constructions. We will see that many formal idioms, including argument structure constructions, can be handled comfortably, and that the formalism actually accommodates divergent theoretical perspectives. However, when it comes to substantive idioms, we run into problems, and a change to the framework is needed.

[18] Michaelis (2022) has made similar observations in the context of SBCG: she suggests that the commitment to realisational morphology might have been overzealously applied, and that there is a need for more syntactic structure below the level of the word in some cases.

# 4 CONSTRUCTIONS IN LFG

So far, although I have argued that LFG has potential as a formal framework for CxG, we have not seen any examples of LFG analyses of constructional phenomena. This section will provide just that. We begin in Section 4.1 with Goldberg-style argument structure constructions, and show that LFG is compatible with either a lexical or constructional view of argument structure. Section 4.2 then shows how LFG can handle (some kinds of) formal idiom, but concludes that the presence of arbitrary phonological material (i.e. words) that does not (appear to) contribute compositionally to the meaning of the construction causes problems: the more lexically filled a construction is, the more difficult it is for LFG to accommodate it. This is clearly most problematic for substantive idioms, which are the subject of Section 4.3.

## 4.1 *Argument structure constructions*

Recent work in LFG+Glue has treated argument structure not as a separate level of the projection architecture (as in e.g. Butt *et al.* 1997; Kibort 2007) but as a phenomenon at the syntax-semantics interface (Asudeh and Giorgolo 2012; Asudeh *et al.* 2014; Findlay 2016, 2020; *i.a.*). This research adopts a neo-Davidsonian event semantics (Parsons 1990), whereby the meaning contribution of a verb is not a predicate of or relation between individuals, but rather a predicate of eventualities (events or states) conjoined with a number of semantic role predicates that relate participants to that eventuality. For example, rather than the traditional meaning in (48), a verb like *sneezes* would have the meaning in (49):

(48) $\lambda x.\mathbf{sneeze}(x)$

(49) $\lambda x.\lambda e.\mathbf{sneeze}(e) \wedge \mathbf{agent}(e, x)$

This opens up the possibility of splitting the valency information apart from the lexically-specified eventuality predicate, as in (50):

(50) a. $\lambda e.\mathbf{sneeze}(e)$

b. $\lambda P.\lambda x.\lambda e.P(e) \wedge \mathbf{agent}(e, x)$

The result of applying (50b) to (50a) is (49), but by factoring out these two components of meaning we have separated out the core lexical meaning from what would be seen in CxG as the constructionally-provided argument structure meaning (Goldberg 1995). This means that the same core lexical meaning can be used across diathesis alternations (Asudeh and Giorgolo 2012) or other argument structure frames (Asudeh *et al.* 2014).

Of course, in Glue Semantics these meaning terms are paired with a linear logic type which anchors them in the syntax:

(51) a. $\lambda e.\mathbf{sneeze}(e) : v_{\uparrow} \multimap t_{\uparrow}$
b. $\lambda P.\lambda x.\lambda e.P(e) \wedge \mathbf{agent}(e, x) :$
$(v_{\uparrow} \multimap t_{\uparrow}) \multimap e_{(\uparrow \textsc{subj})} \multimap v_{\uparrow} \multimap t_{\uparrow}$

Using $v$ as the type of events, we can see that the meaning constructor in (51b) consumes the meaning constructor in (51a) to produce a dependency on the verb's subject.

We can combine the core meaning with other valency templates to produce other constructional meanings. For instance, we can represent the English caused-motion construction (Goldberg 1995, ch. 7), exemplified in (52), with the meaning constructor in (53):[19]

(52) Frank sneezed the tissue off the table.

(53) $\lambda P.\lambda x.\lambda y.\lambda Q.\lambda e.P(e) \wedge \mathbf{agent}(e, x) \wedge \mathbf{theme}(e, y) \wedge \mathbf{goal}(e, Q) :$
$(v_{\uparrow} \multimap t_{\uparrow}) \multimap$
$e_{(\uparrow \textsc{subj})} \multimap e_{(\uparrow \textsc{obj})} \multimap (e_{(\uparrow \textsc{obl})} \multimap t_{(\uparrow \textsc{obl})}) \multimap v_{\uparrow} \multimap t_{\uparrow}$

This will require that the verb be accompanied by an OBJect and an OBLique in the syntax. If these dependents are not present, this meaning constructor will be unusable, since there will be no meaning constructors which match the types required. (We return to this point momentarily.)

[19] I assume the second argument of the **goal** predicate is a relation expressing a location, e.g. $\lambda x.\mathbf{off}(x, \iota y[\mathbf{table}(y)])$ in this case, and therefore has a functional type in the linear logic.

For the sake of brevity, let us name our two argument structure frames using templates:

(54) AGENT-FRAME :=
$$\lambda P.\lambda x.\lambda e.P(e) \wedge \textbf{agent}(e,x) : (v_{\uparrow} \multimap t_{\uparrow}) \multimap e_{(\uparrow \textsc{subj})} \multimap v_{\uparrow} \multimap t_{\uparrow}$$

(55) CAUSED-MOTION-FRAME :=
$$\lambda P.\lambda x.\lambda y.\lambda Q.\lambda e.P(e) \wedge \textbf{agent}(e,x) \wedge \textbf{theme}(e,y) \wedge \textbf{goal}(e,Q) : (v_{\uparrow} \multimap t_{\uparrow}) \multimap e_{(\uparrow \textsc{subj})} \multimap e_{(\uparrow \textsc{obj})} \multimap (e_{(\uparrow \textsc{obl})} \multimap t_{(\uparrow \textsc{obl})}) \multimap v_{\uparrow} \multimap t_{\uparrow}$$

One possibility is to associate these with the verb *sneezes* in the lexicon, as shown in (56). This represents what Müller and Wechsler (2014) call a lexical approach to argument structure, as opposed to the phrasal, or constructional, approach of e.g. Goldberg (1995), and which we discuss below.

(56) sneezes V $(\uparrow \textsc{pred}) = \text{`sneeze'}$
$\lambda e.\textbf{sneeze}(e) : v_{\uparrow} \multimap t_{\uparrow}$
$\{ @\textsc{Agent-Frame} \mid @\textsc{Caused-Motion-Frame} \mid \ldots \}$

The third line in (56) expresses a disjunction, and is intended to include all the other potential argument structure constructions that a verb like *sneezes* might enter into. Recall that if we choose the CAUSED-MOTION-FRAME, the verb must be accompanied by an object and an oblique argument. If these dependents are not present in the syntax, we will have a situation of RESOURCE DEFICIT in the semantics (Asudeh 2012) – there will be too few meaning constructors for the valency frame constructor to consume, and so no valid proof for the sentence. This results in ungrammaticality. The effect of this is that the various argument structure constructions are only licensed when the verb is in the correct syntactic environment, but this is achieved without actually placing any constraints on the syntax: the constraints are instead on the syntax-semantics interface.

In addition to the lexical approach, LFG is also compatible with the alternative, constructional view, whereby the argument structure frames are associated not with the lexical entries of verbs, but with particular phrasal configurations, as illustrated in (57) and (58). This

is because LFG annotations can be added to phrase-structure rules just as well as to lexical entries (since formally lexical entries just *are* phrase structure rules).

(57) $\text{IP} \rightarrow \underset{(\uparrow \text{SUBJ}) = \downarrow}{\text{NP}} \quad \underset{\substack{\uparrow = \downarrow \\ \{@\text{AGENT-FRAME} \mid \ldots\}}}{\text{I}'}$

(58) $\text{VP} \rightarrow \underset{\substack{\uparrow = \downarrow \\ \{@\text{CAUSED-MOTION-FRAME} \mid \ldots\}}}{\text{V}'}$

Notice that we are still underspecifying the phrase structure associated with these templates; for example, CAUSED-MOTION-FRAME will still be present on a V′ node even when it does not have the correct number of daughters, *viz.* an object and oblique alongside the verb. This is possible because of the disjunctive approach, which relies on resource sensitivity to select only the appropriate meaning constructor(s). But of course nothing stops us associating the constructional meaning with more specific phrase-structure rules either, if this is preferred for theoretical reasons:

(59) $\text{V}' \rightarrow \underset{\substack{\uparrow = \downarrow \\ \{@\text{CAUSED-MOTION-FRAME} \mid \ldots\}}}{\text{V}} \quad \underset{(\uparrow \text{OBJ}) = \downarrow}{\text{NP}} \quad \underset{(\uparrow \text{OBL}) = \downarrow}{\text{PP}}$

Recent work in LFG on argument structure has thus furnished the framework with tools for divorcing constructional argument structure effects from individual lexical entries, making it eminently suitable as a formal framework for expressing traditional CxG views. At the same time, though, the formalism is compatible with either a lexical or constructional analysis, allowing appropriate analytical flexibility: in keeping with the CxG focus on diversity and variety in linguistic phenomena, we can allocate meanings lexically or constructionally on a case by case basis.

## *Formal idioms* 4.2

These same techniques can be applied quite liberally to all manner of constructional meanings. For example, Asudeh *et al.* (2013) give a very

detailed analysis of related 'traversal' constructions in Swedish, English, and Dutch, illustrated in (60) by the English *way*-construction:

(60) a. Sarah elbowed her way through the crowd.
b. Sarah whistled her way across the room.
(Asudeh *et al.* 2013, 12)

This has the special meaning that Sarah traversed the crowd/room, and that either the means (60a) or the manner (60b) of this traversal was the activity described by the main verb. None of the words in (60) normally convey a meaning of traversal, so this seems to emerge from the construction itself.

However, Asudeh *et al.* (2013) argue that the constructional meaning need not be hosted by a phrasal configuration, since in English there is nothing special about the syntax of the *way*-construction. As in (60), it employs a standard [V NP PP] configuration, which is witnessed by many other constructions. Rather, what is special about the *way*-construction is the obligatory presence of the word *way* – Asudeh *et al.* (2013, 30) therefore choose the lexical entry for this word as the host of the constructional meaning (highlighted here with a box):[20]

(61) way N $(\uparrow \textsc{pred}) = \text{'way'}$
$\lambda x.\mathbf{way}(x) : e_{\uparrow} \multimap t_{\uparrow}$
$\boxed{(@\textsc{English-Way})}$

This is the normal lexical entry for run-of-the-mill *way*, with the addition of an optional constructional meaning constructor (optionality is indicated by surrounding a piece of description in parentheses), abbreviated by the template ENGLISH-WAY. I will not unpack this meaning here, since the higher-level principle can be grasped without going into the details of the analysis, but it adds the additional traversal meaning to the clause, and makes the verb of which *way* is the ob-

[20] When reproducing formal analyses from Asudeh *et al.* (2013), I omit some detail to avoid unnecessary exposition, and modify some expressions to bring them into conformity with the choices made in this paper. This does not affect any of the arguments made here, but the reader should be aware of the discrepancies, and should consult Asudeh *et al.* (2013) for the formal details.

ject either the means or the manner of this traversal event. Note that the normal meaning of *way* is not optional in (61), and therefore survives in the constructional use too; in fact, it is equated with the **path** through which the traversal event proceeds (Asudeh *et al.* 2013, 30f.), enabling a straightforward analysis of instances where *way* is modified or possessed by something other than the subject (Asudeh *et al.* 2013, 13):

(62) a. As ambassador, Chesterfield negotiated [Britain's way] into the Treaty of Vienna in 1731.
b. In these last twenty years Richard Strauss has flamed [his meteoric way] into our ken – and out of it.

The Swedish traversal construction analysed by Asudeh *et al.* (2013), called the directed motion construction (DMC) by Toivonen (2002), is illustrated in (63):

(63) a. Sarah armbågade sig genom mängden.
*Sarah elbowed* SELF *through crowd.*DEF
≈'Sarah elbowed her way through the crowd.'
(Asudeh *et al.* 2013, 13)
b. Han ljög sig ut ur armén.
*he lied* SELF *out of army.*DEF
≈'He lied his way out of the army.' (Toivonen 2002, 315)

This differs from the English construction in that it only has a means (not a manner) interpretation, and that there is no equivalent of *way*, i.e. a fixed word which is always present. Although the presence of the (simplex) reflexive, here illustrated by *sig*, is obligatory, its form will change depending on the person and number of the subject, with which it agrees (e.g. it will be *mig* for a 1SG subject, *dig* for 2SG, etc. – see Toivonen 2002, 322). Asudeh *et al.* (2013) therefore suggest that the constructional meaning here *should* be associated with a particular phrasal schema (Asudeh *et al.* 2013, 22):

(64)

| | | | | |
|---|---|---|---|---|
| V′ → | V | NP | PP |
| | ↑ = ↓ | (↑ OBJ) = ↓ | (↑ OBL) =↓ |
| | | (↓ PRONTYPE) = SIMPLEX-REFL | |
| | | @SWEDISH-DMC | |

Once again, note that all of the normal meanings for the words involved in the DMC persist in the constructional meaning. The construction adds additional meaning, in the form of a new traversal event etc., but does not replace any existing meanings.

Just as we saw above with argument structure constructions, the approach of Asudeh *et al.* (2013) illustrates the analytical flexibility that LFG affords researchers: constructions, in the theory-neutral sense, can be given either a lexical or phrasal analysis, depending on (i) the details of the construction itself and/or (ii) broader theoretical concerns (or preferences). It would, for instance, be wholly possible to associate the ENGLISH-WAY template, and its associated constructional meaning, with a special phrase-structure rule if that was felt to be a more direct way of encoding the construction, but nothing in the formalism forces this choice.

So far so good, then! We have seen that LFG has tools at its disposal which enable it to handle constructional phenomena. However, what these constructions all have in common is that they involve *additional* meaning being added on top of the standard, literal meanings of their parts. Sometimes meanings are 'realigned', e.g. the main verb of the *way*-construction is relegated from expressing the main predicate of the clause to merely expressing the means or manner of the traversal event, but none are discarded. Indeed, the resource sensitivity of Glue Semantics makes this quite difficult to do. But plenty of constructions have meanings that do not merely make unconventional use of the meanings of their parts, but actually override or ignore them.

For example, in the *WXDY* construction, illustrated in (65), both *what* and *doing* do not contribute their usual semantic content: the construction is not asking for the identity of an activity being undertaken – indeed, there need not be any 'doing' happening at all (this is especially clear when the subject is inanimate as in (65b) and (65c)).

(65) a. What are your children doing in my garden?
b. What do you think your name is doing in my book?
c. I wonder what the salesman will say this house is doing without a kitchen.
d. What's a nice girl like you doing in a place like this?

(Kay and Fillmore 1999)

It seems the only way to give a satisfactory LFG analysis of this construction would be to have special versions of *what* and *doing* which either contribute no meaning or contribute some part of the overall constructional meaning instead of their usual semantic content.[21] Such a move may be empirically adequate, but it rather flies in the face of CxG assumptions, since now the construction is distributed through the lexicon and grammar rather than being represented in one place: even if the whole constructional meaning can be encoded in a single template on a special phrase-structure rule, we still need to have two new lexical entries for the special versions of *what* and *doing*. And this will only multiply as more constructions are considered. (See Section 4.3.2 for further discussion.)

So, we can conclude that LFG is well suited to handle highly schematic idioms, since these involve overlaying additional meaning on existing lexical resources, but that as constructions become less schematic and more substantive, problems begin to arise. In the next section, I examine some attempts to confront these challenges, and suggest a different solution.

## 4.3 *Substantive idioms*

Alongside intermediate constructions like *WXDY*, there are fully substantive idioms like the following:

(66) a. Don't worry; we still have our **ace in the hole**.
(*ace in the hole* ≈ '(hidden) resource or advantage')
b. Chrisjen likes to be kept **in the loop**.
(*in the loop* ≈ 'informed (about a particular matter)')
c. **Pull yourself together**, man! We're not giving up that easily!
(*pull oneself together* ≈ 'calm down/compose oneself')
d. These new import regulations really **take the biscuit**.
(*take the biscuit* ≈ 'be especially egregious/shocking/annoying')

[21] Equivalently, one could stick to a single lexical entry for each word, but give a disjunctive specification of their meanings, with the 'empty' or construction-specific meaning as one of the disjuncts.

e. If you **let the cat out of the bag** too early there will be trouble.
(*let the cat out of the bag* ≈ 'reveal the secret')

In these kinds of idioms, the literal meanings of the words involved simply do not appear – they are replaced wholesale by different, idiomatic meanings. This is a major problem for the approach of Asudeh *et al.* (2013). *Taking the biscuit*, for instance, involves no taking event and no contextually salient biscuit, but unless we do something to prevent it, precisely these meanings will be introduced by the standard lexical entries for *take*, *the* and *biscuit*. So even if we also introduce a meaning for 'be especially egregious' via some constructional template (associated with a phrase-structure rule or with one or more of the words themselves), we still need to do something with the 'left over' literal meanings – that is, we find ourselves in a state of RESOURCE SURPLUS: there will be no way to successfully incorporate these meanings into the linear logic proof, and so the sentence will be ruled out by the grammar.

There is also the secondary challenge of ensuring the idiomatic meaning only appears when all of the required words appear in the correct configuration. This is precisely what makes these idioms substantive: their parts cannot be switched out, even for semantically very similar constituents. E.g. *in the ring* does not have the idiomatic meaning of *in the loop*, nor *yank oneself together* the idiomatic meaning of *pull oneself together*.[22]

The fundamental problem is that the only level at which phonological form is paired with meaning in LFG is in the lexicon, and the lexicon contains only words.[23] As we saw in the previous section, ab-

[22] There are, however, cases where substantive idioms are distorted for communicative effect, e.g. using *shatter the ice* as an intensified version of *break the ice* 'remove or lessen the tension at a first meeting' (McGlone *et al.* 1994). See Findlay (2019, 43ff., 84ff., 92ff.) and references therein on lexical flexibility in substantive idioms more generally and on metaphorical extensions to idioms.

[23] This is not exactly true of the LFG formalism *stricto sensu*, since there is no obstacle to writing phrase-structure rules whose right-hand sides contain a mixture of terminals and non-terminals. In practice, however, this does not happen, presumably because it runs contrary to the lexicalist style of theorising. It is important to note, though, that such mixed rules still only permit description of a

stract phrasal configurations can also be paired with meanings, and words can be associated with complex meanings that reference structurally distance parts of the phrase, both of which give LFG the appearance of licensing phrasal constructions more generally. But there is no way of assigning specific meanings to structurally complex *multiword* units, and this is why substantive idioms are challenging. In this section, I will present two potential solutions to this problem, before advocating for a third way, more in keeping with the intuitions of CxG.

### Words with spaces 4.3.1

Since the only locus of phonological form-meaning pairing in LFG is the lexicon, one very simple solution to the problem of substantive idioms is to deny their multiword status and instead treat them as 'words with spaces' (Sag *et al.* 2002), so that they can be given lexical entries. This is probably the correct analysis for lots of the more morphosyntatically rigid idioms, i.e. what Sag *et al.* (2002) call FIXED EXPRESSIONS – those whose parts do not inflect and cannot be manipulated by syntactic processes – such as the examples in (67):

(67) a. all the same
b. by the by
c. in short
d. no can do

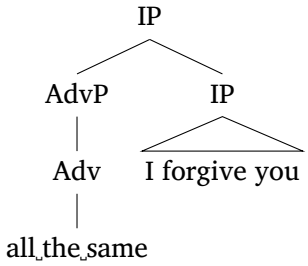
These can be represented in the grammar as if they were single words, i.e. single c-structure terminals (Dyvik *et al.* 2019), since they cannot be interrupted or split up (i.e. they obey the strictures of LI):

(68) all_the_same Adv (↑ PRED) = 'all-the-same'
*etc.*

---

single generation in the tree, i.e. the daughters of a single mother node, so it does not make it possible to associate phonological form and semantic content across truly unbounded spans of c-structure – on which see Section 4.3.3.

(69) All the same, I forgive you.




Indeed, there exist several expressions which are superficially very similar to these but which are written without spaces, and therefore treated as single words:

(70) a. although (cf. all though)
b. nonetheless/nevertheless (cf. none/never the less)
c. notwithstanding (cf. not withstanding)

If the difference here is purely an accident of orthography, then we are right to treat the expressions in (67) analogously, as single words.

### 4.3.2 Lexical ambiguity

Of course, many substantive idioms are not so fixed as to be amenable to an analysis as single words. This is clear from the fact that their sub-parts can be inflected, modified, and manipulated syntactically:

(71) INFLECTION:
That takes/took/has taken/will take the biscuit.

(72) MODIFICATION (Findlay 2017, 212):
a. Musicians keep composing songs 'til they [kick the proverbial bucket].
(*kick the bucket* ≈ 'die')
b. Britney Spears […] [came apart at the mental seams].
(*come apart at the seams* ≈ 'to be in a very bad state; to fall to pieces')
c. Maybe by writing this book I'll offend a few people or [touch a few nerves].
(*touch a nerve* ≈ 'annoy/upset someone by referring to a sensitive topic')

d. Tom won't [pull family strings] to get himself out of debt.
(*pull strings* ≈ 'exploit connections')

(73) SYNTACTIC MANIPULATION:

a. They finally [spilled the beans].
(*spill the beans* ≈ 'reveal the secret(s)')
b. [The beans] were finally [spilled].
(passivisation)
c. I really want to see [the beans] he [spills] under oath.
(relativisation)
d. But [which particular beans] did he [spill]?
(*wh*-fronting)

Each of these phenomena would be extreme violations of LI if the expressions in question were really single words.

It is this kind of data which motivates the CxG view that constructions (which can be of any size), not words, are the real building blocks of the grammar. Nonetheless, much recent theoretical work on idioms has sought to avoid this conclusion and instead view idioms as licensed lexically.[24] In these theories, substantive idioms are treated as being made up of special versions of the words they contain, whose meanings combine to give an appropriate meaning for the whole construction. For example, there will be a special version of *spill* that means 'reveal', and a special version of *beans* that means 'secrets', so that the meaning of *spill the beans* can be 'reveal the secrets'. We will call this the LEXICAL AMBIGUITY approach (hereafter 'LA'; cf. Findlay 2017, 213), since it (i) treats idioms lexically, and (ii) does so by introducing ambiguities (e.g. *beans* is now ambiguous between literal 'beans' and idiomatic 'secrets').

This kind of theory naturally explains the data in (71)–(73): it is no surprise that the parts of such expressions can be manipulated or modified, since they are just ordinary words, with their own meanings. It also explains why these expressions inhabit ordinary syntactic structures (like a verb+object VP).

[24] This trend can be observed in many different frameworks, including, surprisingly, those which are or have the potential to be constructional: Sailer (2000) in HPSG, Kay *et al.* (2015) in SBCG, Lichte and Kallmeyer (2016) in LTAG, and Arnold (2015) in LFG. See also Bargmann and Sailer (2018).

However, this approach faces a number of issues (see Findlay 2019, 58ff. for a detailed critique). Firstly it must address the "collocational challenge" (Bargmann and Sailer 2018, 12): if *beans* can mean 'secrets' in *spill the beans*, how do we stop it having this meaning elswhere?

(74) #Have you heard the beans?
(≠ 'Have you heard the secrets?')

Although this may ultimately be surmountable through the use of extreme selectional restrictions, it is not as straightforward as might be assumed, especially when parts of idioms can be separated across clausal boundaries and may not bear any direct syntactic relationship to each other (Findlay 2017, 214–215).

Secondly, although LA makes sense for so-called decomposable idioms (what Nunberg *et al.* 1994 call IDIOMATIC PHRASES), where the meaning of the idiom can be distributed among its parts, it is much less clear what the motivation might be for applying it to non-decomposable ones (what Nunberg *et al.* 1994 call IDIOMATICALLY COMBINING EXPRESSIONS), where this is not the case. For example, we can well imagine a special meaning for *pull* such that it means 'exploit' and *strings* such that it means 'connections', which explains why (72d) has the meaning it does: *family* modifies the meaning 'connections' of *strings*, so that the sentence means that it is family connections which Tom refuses to exploit. But now consider idioms like *kick the bucket* (≈ 'die') or *shoot the breeze* (≈ 'chat'). In neither case can we readily assign meanings to the parts individually; rather, the complex whole has a simplex meaning – expressible by a single word in English.[25] Only one word need host the meaning, therefore, and it is a wholly arbitrary decision which one we choose. Perhaps we assign the head *kick* the meaning 'die', and then have versions of *the* and *bucket* which make no semantic contribution at all (or at most a vacuous one).

[25] Of course, in keeping with the Principle of No Synonymy (Bolinger 1968; Goldberg 1995, 67), these paraphrases are necessarily inexact. *Kick the bucket* possesses entailments lacking in *die*, for instance, such as punctuality (*#she was kicking the bucket for months* is decidedly infelicitous when compared with *she was dying for months*); and *shooting the breeze* refers to a particular kind of aimless chit-chat, not just chatting in general.

But we could equally well assign the 'die' meaning to *the* or *bucket* and then have the others words empty of meaning. For non-decomposable idioms, LA is purely a technical solution, and no longer has any empirical motivation – unlike the decomposable idioms where the parts were individually modifiable.

What is more, this strategy will lead to a massive proliferation of semantically empty lexical items – the lexicon will expand by as many entries as there are words in substantive idioms. This is because each semantically empty word must have its distribution constrained to a particular idiom so as to meet the collocational challenge. But this means the semantically empty *the* of *kick the bucket*, constrained to appear as the specifier of idiomatic *bucket*, cannot be the same as the semantically empty *the* in *shoot the breeze*, and so on.

Findlay (2019, 58ff.) discusses several more problems for LA, including difficulties with syntactically idiosyncratic expressions, and incompatibility with psycholinguistic evidence. But in fact what I consider the most damning objection is this: LA does not capture (in fact rejects) the most significant fact about substantive idioms – namely, that they have an ontological status as wholes. As Williams (2007) somewhat sardonically puts it, "[a] traditional view of idioms is that they are 'things', that is, linguistic units". But LA bends over backwards to deny this: substantive idioms have no status as linguistic units; instead, they are conspiracies of single words. In a framework like LFG, where the only pairings of phonological form and semantic content allowed are words, this is the only strategy available. But such a strategy is flagrantly opposed to the CxG view of idioms, making this the real obstacle to considering LFG a suitable formalism for CxG.

### Constructional LFG 4.3.3

If substantive idioms are to be 'things' in the grammar, we need to have a way of listing them. At present, LFG cannot do this, since phrase-structure rules, the basic building blocks of the grammar (of which lexical entries are a subset), only describe c-structure relations between a mother and her daughters, nothing more remote. But of course, "constructions need not be limited to a mother and her daughters, but may span wider ranges of the sentential tree" (Fillmore *et al.* 1988, 501), so in order to adequately describe constructions, something needs to change.

There is in fact another reason to reach the same conclusion, this time from within the LFG worldview. At present, LFG lexical entries include a functional description which gives details of all levels of structure *except* c-structure. This description can also include very long-distance relations within or between structures expressed by functional uncertainty paths. But descriptions of c-structure are limited to mother-daughter relations: the lexical entry identifies the category of the pre-terminal node which hosts it (i.e. its mother) and nothing else. Such a discrepancy is striking, and it is natural to want to remedy it.

One natural way to attempt to do so would be to use a description language over trees to add specifications of c-structure to existing lexical entries. Let us see how this might work. Kaplan (1995, 10) provides the following formal description language for c-structures:

(75) $\mathrm{N}$ : set of nodes, $\mathrm{L}$ : set of category labels
$\mathscr{M} : \mathrm{N} \rightarrow \mathrm{N}$ (the mother relation)
$\prec \subseteq \mathrm{N} \times \mathrm{N}$ (the linear precedence relation)
$\lambda : \mathrm{N} \rightarrow \mathrm{L}$ (the labelling function)

Using these tools, we could write annotations that place constraints on (non-local) parts of c-structure. For example, we can already escape the 'one-generation' restriction on locality of a context-free grammar (CFG) by referring to a node's grandmother via $\mathscr{M}(\mathscr{M}(*))$. But we can also define other functions based on those in (75): let $\mathscr{S}^{+}$ be the successor function on c-structure nodes, for example, which returns the next right-hand sister of a node if it has one (this is ultimately definable in terms of $\mathscr{M}$ and $\prec$, but I omit the formal details here). Then the following constraint states that the current node's *nearest right-hand aunt* has the category NP:

(76) $\lambda(\mathscr{S}^{+}(\mathscr{M}(*))) = \mathrm{NP}$

Clearly these kinds of constraints can be arbitrarily complex, and therefore allow us to describe very distant parts of c-structure.

However, such constraints are in fact not legitimate objects in LFG. As Kaplan and Bresnan (1982, 176) note, "c-structure nodes can be derived only by phrase structure rules". Only once the phrase-structure rules have produced a c-structure for a sentence is the func-

tional description (collection of constraints) obtained, by then *inspecting* that c-structure and reading off the annotations. It is therefore formally incoherent for the functional description to *constrain* c-structure, since it in fact presupposes it. For c-structure to be subject to such constraints would mean a fundamental change in the LFG parsing algorithm, and an abandonment of the CFG foundation of c-structure.

This is exactly the solution Findlay (2019, ch. 5, to appear) advocates: since the limitation on c-structure description ultimately arises from the smaller domain of locality provided by context-free phrase-structure rules, we replace the CFG with something more expressive, namely a tree-adjoining grammar (TAG). There is no real advantage to limiting ourselves to the more constrained CFG; in terms of computational complexity, for example, LFG already has more than context-free power (Berwick 1982; Nakanishi *et al.* 1992), and, even at its most constrained, is still slightly more powerful than a TAG (being equivalent to a LCFRS – see Wedekind and Kaplan 2020). By moving to a more expressive tree formalism, LFG can more completely embrace the CxG assumption of EDL.

Findlay's (2019, ch. 5) proposal employs a description-based TAG (Vijay-Shanker 1992) and makes use of lexical entries which contain descriptions of the tree corresponding to the maximal functional projection of the lexical item (as is standard in LTAG – e.g. nouns are represented as NPs, but verbs are represented as clausal trees containing positions for their arguments). Parsing, in this version of LFG, consists of gathering up all the descriptions associated with the lexical items in a sentence, and then finding the minimal structures – *including* c-structure – which jointly satisfy them.

Under this view, lexical entries are not phrase-structure rules, but descriptions *simpliciter*, i.e. lists of constraints, which cover all levels of the projection architecture simultaneously. Of course, there is now no requirement that such lexical entries describe only a single word, or indeed that they describe *any* word – the objects we are talking about are simply descriptions of pieces of linguistic structure. The class of such objects subsumes what are called constructions in CxG, i.e. descriptions of form-meaning pairings, but will also include purely formal objects that have no meaning associated with them. Another way of looking at this is that we no longer have a lexicon, but instead have a constructicon. Substantive idioms now pose no problem, since

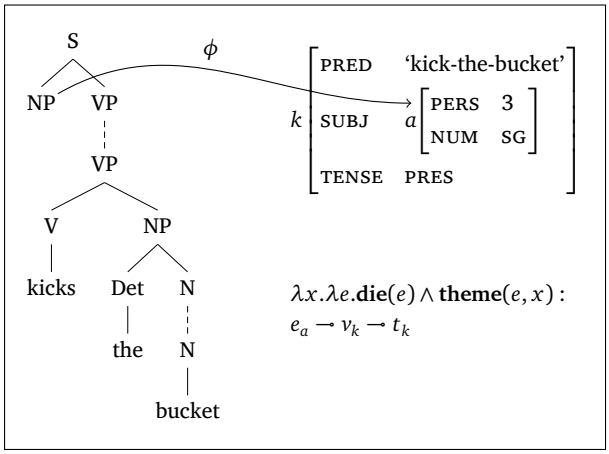



Figure 4: Constructional LFG entry for *kicks the bucket*

trees containing multiple words can be described in a single place, without privileging one of the words over the others.

By way of illustration, Figures 4 and 5 show (simplified) constructional LFG entries for *kicks the bucket* and *pulls strings*. A number of conventions are employed here. Firstly, for the sake of exposition, I use diagrams of c-structure and f-structure to stand in for the full list of constraints which describe these structures – for the formal details, see Findlay (2019, ch. 5) and Findlay (to appear, §6). Secondly, I use simplified c-structures which follow X-bar theory even more loosely than is common in LFG; this is both because many intervening bar-level nodes become unnecessary in a TAG as compared to a CFG, and because it saves space. Thirdly, dashed lines in c-structure trees represent dominance rather than immediate dominance: this enables adjunction at these nodes (see Vijay-Shanker 1992, 487f. and Findlay 2019, 2127ff.), but if nothing is adjoined then the two nodes will be unified. Fourthly, to avoid clutter, I only show the $\phi$ projection from c-structure to *embedded* f-structures – assume therefore that all undecorated c-structure nodes map to the outermost f-structure shown. Lastly, I only show c- and f-structures, along with the Glue Semantics meaning constructors, but of course full entries might also include information at other levels of representation within the projection architecture.

The parallel representations of LFG allow us to illustrate what is the same and what is different across these two idioms. The fact that

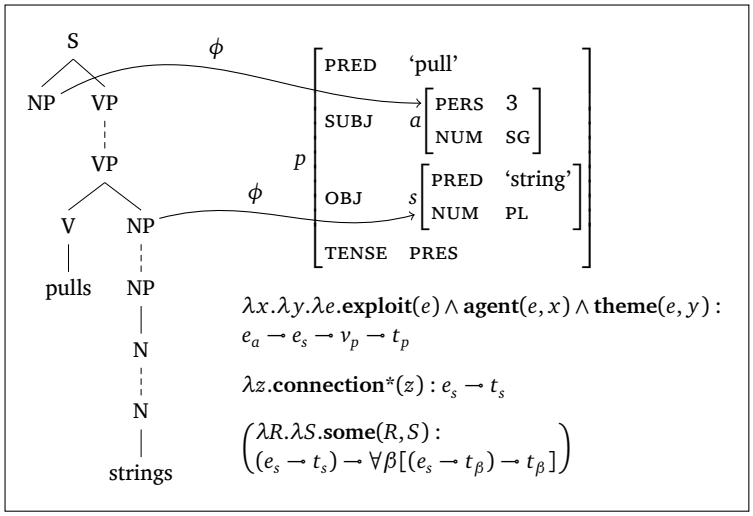



Figure 5: Constructional LFG entry for *pulls strings*

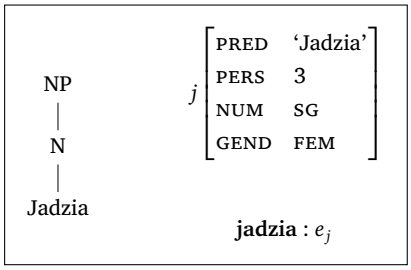
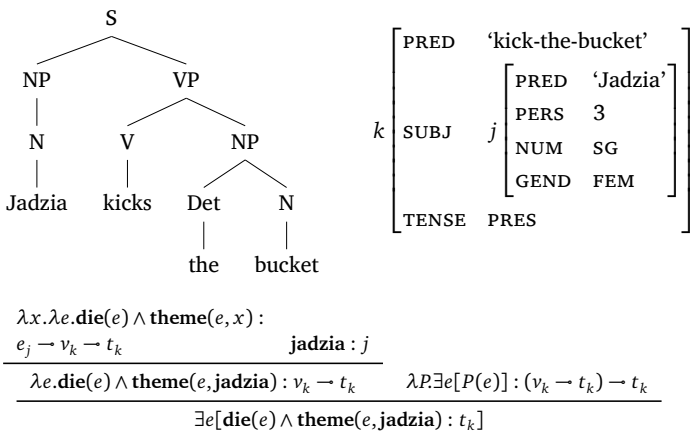



Figure 6: Constructional LFG entry for *Jadzia*

they both share the same surface form, that of a normal transitive VP, is shown by their c-structures, which are almost identical (the only difference is that *the bucket* already has its determiner fixed in the idiom, whereas the determiner position of *strings* is open). The fact that *kick the bucket* cannot be decomposed but *pull strings* can is represented by (i) the latter having an articulated f-structure where the former does not, and (ii) by the latter contributing two different meaning constructors where the former only contributes one.

Both idioms take one external argument; for example, either of the descriptions in Figures 4 or 5 can combine with the entry for *Jadzia* in Figure 6, whose root node matches the open NP slot, and whose f-structure therefore unifies with the f-structure corresponding to that node. The resulting structures and Glue proof for *Jadzia kicks the bucket* are shown in Figure 7.

Figure 7: Structures and Glue proof for *Jadzia kicks the bucket*




## 4.4 *Summary*

Because of the flexibility LFG permits in whether constraints are associated with lexical entries or with phrase-structure rules, the framework already has the ability to associate meaning with either words or phrases. It is therefore very capable of describing things like argument structure constructions and formal idioms. However, as idioms become more substantive, the framework begins to struggle. Although some substantive idioms can be treated lexically, as 'words with spaces', many cannot, and the most natural LFG solution, the lexical ambiguity approach, flies in the face of CxG dogma. The best solution, therefore, is to replace the unnecessarily restrictive CFG base of LFG with a more expressive TAG. By doing this, we give LFG the power to describe any kind of construction, formal or substantive, in a single place, just as is required of a CxG.

# 5 CONCLUSION

This paper has aimed to demonstrate that Lexical Functional Grammar (LFG) is a suitable framework for formalising Construction Grammar (CxG). I began by discussing some central assumptions of CxG, and then showed that LFG also subscribes to many of them. One area

of disagreement is over the principle of Lexical Integrity (LI), which states that there is a strict separation between morphology and syntax. We saw that in fact both camps need to cede ground: LI in the strictest sense is too rigid, but a total abandonment of the morphology-syntax divide cannot be justified either.

Recent work in LFG (Asudeh *et al.* 2013) supports the contention that LFG is suitable for formalising CxG, in that it shows that the framework already has the capacity to handle many constructional phenomena. However, it turns out that this capacity is limited to formal idioms, and that substantive idioms are much more trouble. However, if the context-free base of LFG is replaced with a description-based TAG, LFG acquires the ability to describe arbitrarily large structures pairing phonological form with semantic content, enabling it to handle substantive idioms just as well as formal ones. In this new version of LFG, the morphology-syntax divide is maintained, but the lexicon-grammar distinction is collapsed: since parsing just involves combining and satisfying stored collections of constraints, the lexicon, in a very real sense, *is* the grammar. Perhaps ironically, then, taking a more constructional view of things emphasises the *lexical* aspect of Lexical Functional Grammar.

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