THE OXFORD HANDBOOK OF MORPHOLOGICAL THEORY

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OXFORD
UNIVERSITY PRESS
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CHAPTER 11

MORPHOLOGY IN
LEXICAL-FUNCTIONAL
GRAMMAR AND
HEAD-DRIVEN PHRASE
STRUCTURE GRAMMAR

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11.1 Background

Lexical-Functional Grammar (LFG) (Bresnan 1982a, 2001a; Dalrymple 2000; Bresnan et al. 2016) and Head-driven Phrase Structure Grammar (HPSG) (Pollard and Sag 1994; Sag et al. 2005; Kathol et al. 2012; Müller 2015a) are both lexicalist, non-transformational, constraint-based grammatical frameworks. While they differ in many respects—some of which are detailed in this chapter—they share a number of fundamental principles relevant to morphological theory and analysis, which guide the overall architecture of the grammar. The two frameworks also share a common commitment to being fully explicit and implementable, with strong links to computational implementations. (For HPSG see Bender et al. 2010; Flickinger 2000; Müller 2015b; inter alia. For LFG, see especially Halvorsen and Kaplan 1988; Dalrymple et al. 1995; Butt et al. 1999; Cahill et al. 2005; Crouch et al. 2008, among many others.)

First, they are both frameworks which incorporate a strong lexicalist perspective assuming the separation of syntax and morphology, such that the internal structure of words is opaque to the mechanisms of syntax (Pollard and Sag 1994; Müller 2015a; Bresnan 2001a). Syntax and morphology are distinct components of the grammar, with only the output of the morphology/lexicon relevant to the syntactic component. From this it follows that both frameworks eschew the syntacticization of inflectional (or derivational) morphological processes. Inflectional morphs, therefore, are not syntactically independent (as they are in some other frameworks). Rather, they combine into fully inflected words exclusively in the morphological component and their role in the syntax is limited to the information they contribute.

These two frameworks also share the property of being constraint-based—meaning that descriptions of linguistic structures essentially constrain the models of linguistic objects—and non-derivational, in the sense that the different dimensions of linguistic structure are co-present and do not stand in a derivational relationship to each other. This takes a different form in the two theories, because the overall architecture of levels looks very different, and will be made clear in more detail in the introductory sections for each framework.

LFG and HPSG are essentially syntactic frameworks and as such have not traditionally assumed any particular theory of morphology. In fact, given the separation of the morphological and syntactic components, both frameworks are essentially compatible with any (strong lexicalist) theoretical view of the morphological component. However, researchers within the respective frameworks have become interested in morphological questions, primarily those that relate to the morphology-syntactic interface, and so we will survey some of this work in this chapter. Given the constraints of space, we have focused on a few of the key themes that arise in morphologically related research in these two theories, but have made no attempt to be comprehensive. Different themes emerge in our discussion of each theoretical framework, often reflecting the different feel of the relevant researchers.

11.1.1 Overview of LFG

Lexical-Functional Grammar (LFG) (Bresnan 1982a, 2001a; Kaplan and Bresnan 1982; Dalrymple et al. 1995; Dalrymple 2001; Falk 2001; Bresnan et al. 2016) is a non-derivational, lexicalist, constraint-based theory with co-present parallel structures, linked by principles of correspondence. Each of the structures of LFG has a distinct formal character and models a different aspect of the structure of language. The primary syntactic structures are c-structure (constituent structure) and f-structure (functional structure). The former models precedence and phrasal dominance relations in the familiar terms of a phrase structure tree and the latter models syntactic predicate–argument relations in terms of grammatical functions. As discussed above, LFG is primarily a syntactic framework and can therefore interface with any theory of morphology that assumes the principle of lexical integrity (stated in LFG terms in (1)). Thus, the c-structure of LFG takes fully inflected words as its terminal nodes, but does not impose any particular constraints on how these words have been composed in the morphological component. This flexibility has allowed

1 Bresnan and Crystmans (2006) also provides an overview of approaches to morphology within these two theoretical frameworks, and nicely complements this chapter by taking a slightly different focus (and therefore dealing with some different phenomena).
different researchers interested in the morphology-syntactic interface to respond to trends and developments in the morphological literature and adapt their preferred morphological perspective to the LFG architecture. In this chapter we will present some of the morphological questions that have been addressed by researchers working within the broader LFG framework, but it is important to remember that none of these morphological perspectives is dictated by the framework itself. Furthermore, the bulk of such work relates to the interface between the morphology and the syntax (see, e.g., Kaplan and Butts 2002; Sadler and Spencer 2004; Andrews 2005; Dalrymple 2015), rather than morphological theory proper.

(1) Lexical integrity (Bresnan 2001: 92):

Morphologically complete words are leaves of the c-structure tree and each leaf corresponds to one and only one c-structure node.

Information is mapped to the f-structure from the nodes of the c-structure, including the individual words which form the terminal nodes. Formally, f-structures are finite functions from attributes to values, which may themselves be complex (i.e., f-structures), and they are conventionally represented as attribute-value matrices. Equations (known as functional (f)-descriptions) associated with lexical items and with nodes of the c-structure specify properties of f-structures: the mapping function or projection φ has nodes of the c-structure as its domain and f-structures as its range (the inverse of φ) maps f-structures to c-structures and is not a function). The notation ↑ refers to the f-structure associated with the node of the current node (i.e., it denotes the mother's f-structure) while ↓ refers to the f-structure of the node to which it is annotated. Feature assertions are satisfied by f-structures which contain attribute-value pairs corresponding to these assertions. Of particular importance is the smallest f-structure which satisfies a collection of constraints or feature assertions, known as the minimal model. The f-structure of an utterance is the minimal model or solution satisfying the constraints introduced by the words and phrases in the utterance. The formal correspondence between c-structure and f-structure is many-to-one: to each c-structure node there is assigned a unique (but not necessarily distinct) minimal f-structure. Nevertheless, individual c-structure elements, including words, may specify complex f-structures. For example, see in (2), which will associate with a single node V in c-structure, defines the f-structure shown in (3).

(2) sees, V

(↑ PRED) = 'see < SUBJ, OBJ >'

(↑ TENSE) = PRES

(↑ SUBJ) = ↓

(↓ PERS) = 3

(↓ NUM) = SG

(3) PRED 'see < SUBJ, OBJ >'

TENSE PRES

SUB J PERS 3

NUM SG

An important facet of LFG is its commitment to lexicalism. The Lexical Integrity Principle (i) (see also Simpson 1991; Bresnan and Mchombo 1995; Mohanan 1995 and references therein) distinguishes the morphological (lexical) and syntactic components as being subject to different principles of composition. Words are constructed in the morphology, while c-structure and f-structure form the core of the syntactic component. This means that the input to these syntactic levels—for example the terminal elements of c-structure trees—are fully inflected words, and that syntactic processes cannot manipulate the internal morphological structure of these items. Crucially, however, this does not rule out the possibility that both morphological and syntactic constituents may contribute information to the f-structure (e.g., Simpson 1983, 1991; Bresnan and Mchombo 1987, 1995; Bresnan 2001a). In the example above, we see that morphological information associated with the verb—in this case the PERS and NUM features—is unified directly with the f-structure associated with the subsect, as is the relevant information provided by the rest of the c-structure (i.e., the subject NP). In this way, the information contributed by the morphology is integrated with the syntactic component while maintaining lexical integrity, since the nodes of the c-structure contain only morphologically complete words (e.g., see).

Given the flexibility of the LFG architecture, it is not necessary to postulate otherwise unmotivated c-structure nodes in morphologically rich languages where the morphology directly encodes much f-structure or relational information, and indeed the Principle of Economy of Expression states that all syntactic nodes are optional unless otherwise required for the satisfaction of semantic expressivity or other independent principles (Bresnan 2001a). These assumptions, combined with the separation of c-structure from f-structure, makes it possible to represent the fact that different languages may express the same grammatical properties in very different ways. Thus, we might find two languages in which grammatical relations, for example, are encoded syntactically in one language (e.g., via the syntactic configuration of overt NP/DPs), and morphologically in another (e.g., via pronominal agreement morphology on the verb). In LFG this difference between the two languages would be captured at c-structure, while the similarity in function is captured at f-structure (see, e.g., Bresnan 2001a; and Nordlinger and Bresnan 2011 for detailed discussion, and the Chichewa example in (7)).

Work on the relative contributions of the morphology and the syntax to the f-structure has highlighted the interplay and competition between morphological and syntactic expression. Andrews (1990) (also Andrews 1982) is an example of early work on this issue. In this work, Andrews proposes a notion of 'morphological blocking', whereby the existence of a more highly specified form in the lexicon precludes the use of a less highly specified form. For example, if the verbal paradigm includes an inflected form encoding
1st person singular subject, then this form will 'block' the use of an unmarked verb form combined with a 1st person singular subject pronoun, even though the semantic content of the two constructions is apparently the same. Thus, this principle accounts for the Ulster Irish examples provided in (4) (from Andrews 1990: 512):

(4) a. Chuirfeadh m'í isteach ar an phost sinn.
   putCOND.SBJ in on the job that
   'I would apply for that job.'
   
   b. Chuirfeadh m'í isteach ar an phost sinn.
   putCOND.SBJ in on the job that
   'I would apply for that job.'

The ungrammaticality of the analytic form in (4b) follows from the presence of a synthetic form specifying the same information. The Principle of Morphological Blocking (see Andrews 1990: 519 for precise wording) states that a lexical entry whose associated f-structure subsumes that of another lexical entry is blocked (presuming, of course, that both are compatible with the sentence more broadly). Thus the more general verb form chuirfeadh (5) is blocked in the (4b) example, given that the paradigm also includes the more specific chuirfinn (6).

(5) [PRED 'CUIR <...>']
   [TENSE COND]

(6) [PRED 'CUIR <...>']
   [TENSE COND]
   [SUBJ [PRED 'PRO']
    [PERS 1]
    [NUM SG]]

The general theme that 'morphology competes with syntax' runs through much LFG work in the 1990s and early 2000s, especially that of Joan Bresnan (e.g. Bresnan 1998, 2000, 2001a, 2001b). It underlies one of the strengths of LFG, which allows it to easily deal with a wide range of morphosyntactic variation, from non-configurational languages, to head-marking languages, to highly syntacticized languages like English (see Nordlinger and Bresnan 2011 for an overview). For example, at its simplest level, the differentiation of the c-structure from the f-structure in LFG allows for the fact that the following two sentences have completely different surface expression and completely different c-structures, but essentially identical f-structures. Both examples mean If I see him; in

Chichewa (7) this is expressed with a single verb, whereas in English (8) it is expressed with a whole phrase. Crucially, however, the relations encoded in the f-structure are the same.

(7) ndi-ka-mi-ona
   SUBJ-COND-OBJ-see
   'if I see him'

(8) S
   ↑ =↓
   VP
   ↑ =↓
   V'
   ↑ =↓
   V
   ↑ =↓
   PRO
   ↓
   SUBJ
   ↓
   PRED 'SEE(SUBJ,OBJ)'
   ↓
   [PRED 'PRO'
    [PERS 1]
    [NUM SG]]
   ↓
   OBJ
   ↓
   [PRED 'PRO'
    [PERS 3]
    [NUM SG]]
   ↓
   NOUNCLASS 1A

3 Following LFG convention PAO ('pronoun') is used as the value of the PRED feature for pronouns in the f-structure.
The flexibility afforded by the LFG architecture in this respect underlies much of the work we discuss in this chapter, including the treatments of multiple exponence, auxiliary selection, and case stacking in Australian languages.

### 11.1.2 Overview of HPSG

The foundational publications in HPSG are Pollard and Sag (1987, 1994). HPSG has clear origins in both Generalized Phrase Structure Grammar (GPSG) (Gazdar et al. 1985) and Categorial Grammar. There are a number of quite significant architectural differences between the 1987 (Pollard and Sag 1987) and the 1994 (Pollard and Sag 1994) versions of HPSG. Since Pollard and Sag (1994) there have been two further major developments.

The first of these is that some work in HPSG separates constituent structure from the representation of the surface order of forms, taking a non-concatenative approach to linear order. This radical separation of constituent and linear structure originates within (new HPSG) with Reape (1993, 1994, 1996), and similar early proposals are found in Kathol (1995, 2000) (for implementations of this approach see also Müller 1996, 2002). The essence of such domain-based or linearization approaches is that daughters within a constituent can be "liberated" for linearization among the daughters of dominating constituents. These ideas have also found a place in the treatment of morphological phenomena, to which we return briefly below (see Kathol 1995; Cysy 2003).

The second is an increasing convergence with the ideas of Berkeley Construction Grammar. The hallmark of such approaches is essentially the generalization of multiple inheritance type hierarchies from the lexicon to syntax, where constructions, or multi-dimensional collections of linguistic information, are expressed directly in the type system. There are in fact two major current variants of construction-based HPSG: constructional HPSG (Sag 1997; Ginzburg and Sag 2000) and Sign-Based Construction Grammar (SBGC) (Sag 2012). Both of these descend very clearly from the earlier HPSG of Pollard and Sag (1987, 1994) and share many features including the fundamental modelling assumptions (feature structures model linguistic objects, attribute value matrices are descriptions of model objects), and both reflect a degree of contact and convergence with Construction Grammar.

In HPSG (including SBGC) feature structures model linguistic objects. Attribute value matrices (AVMs) are used to describe feature structures. Unlike LFG, HPSG analyses are expressed in a typed feature structure formalism: feature structures are grouped into classes instantiating linguistic types. Types are organized into a multiple inheritance hierarchy specified in the signature of the grammar: the most general type of words or phrases is the sign. Such inheritance hierarchies are used in HPSG (including SBGC) to capture syntactic and (some) lexical generalizations. Feature structures must instantiate a maximal type (that is, be fully specified), although of course descriptions will typically make significant use of underspecification. The use of typing in HPSG grounds many well-formedness constraints directly in the ontology in a way that does not occur in LFG.

In (all versions of) HPSG (again, in contrast to LFG), one single data structure is used to model all directions of a linguistic object, leading to a highly structured representation. The details of the precise geometry has changed considerably over the years, but the following very schematic representations of word and phrase (based on Müller 2015a) give the flavour, showing the parallel representation of phonological, syntactic, and semantic information. In the HPSG structures in this chapter, the italicized annotations at the top of the left brackets indicate the type of the feature description.

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*Although the later book generally supersedes the earlier, Pollard and Sag (1987) contains an extensive discussion of lexical generalizations and hierarchies, which is of interest from a morphological and morphosyntactic point of view.*

*By Berkeley Construction Grammar we refer to the Construction Grammar approach associated most notably with Paul Kay and Chuck Fillmore and the Berkeley group (Fillmore et al. 1988; Kay 2002).*
The (SYNSEM) feature is itself highly structured and represents both syntactic (CAT) and semantic (CONTENT) properties. The NONLOCAL feature is used in the description of various types of non-local dependency. The features HEAD-DTR ("head daughter") and NON-HD-DTRs ("non-head daughters") in (10) model the constituent structure of linguistic objects, and are often omitted from illustrative AVMs in favour of the use (for illustrative purposes) of tree-based representations. Good sources for detailed overviews of HPSG include Müller (2001a), Sag (2012), chapters 1 and 2 of Ginzburg and Sag (2000), and Kathol et al. (2011).

The lexicon plays a most important role in HPSG as the treatment of many syntactic phenomena is lexicalized. The lexicon as a whole and descriptions of individual words

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11.2 Basic issues

11.2.1 The representation of morphological processes

11.2.1.1 In LF

In a lot of LF research, there has been a tendency to provide lexical entries for morphemes, primarily as placeholders to reflect the fact that f-structure information is contributed by the morphology. Brennan (2001a: 82), for example, provides the lexical entry in (12) for the English third singular present tense verbal inflection:

(12) -s: \[\text{TENSE} = \text{pres} \]
    \[\text{SUBJ} = 1\]
    \[\text{PERS} = 3\]
    \[\text{NUM} = SG\]
Sub-lexical rules then constrain the ways in which lexical items of all types combine to form fully inflected words (cf. Selkirk 1982). Simpson (1991: 328), for example, provides the following morphological rule for the Australian language Warlpiri that adds a case suffix (Aff) to a nominal stem ($N^{-1}$) to produce a nominal word (N) which can then be inserted into the c-structure:8

$N \rightarrow N^{-1} \quad \text{Aff}$

In more recent years some authors have explored what the morphological component might look like, including an integration of realizational morphology with LFG (e.g. Spencer 2003; Butt and Sadler 2003; Ackerman and Stump 2004; Andrews 2005; Nordlinger and Sadler 2006; Dalrymple 2013). In the computational implementation of LFG (XLE), a finite-state morphological component is used to manage inflectional morphology, which can accommodate various theories of morphology (e.g. Karttunen, Kaplan, and Zaenen 1992; Kaplan and Kay 1994; Beesley and Karttunen 2003; Karttunen 2003; Selis 2011), and is therefore compatible with realizational, constructional, or morpheme-based theories of morphology. As discussed in §3.1.1.1, from the perspective of the syntactic component, the morphology is a ‘black box’: the c-structure of LFG takes fully inflected words as its terminal nodes, but does not impose any particular constraints on how these words have been composed in the morphological component. Thus, the framework of LFG is not committed to a particular theory of the morphology, and different researchers have taken different approaches.

A number of authors have put forward proposals aimed at separating out certain properties into morphological-structure, a morphosyntactic structure which models morphological well-formedness conditions. By assuming m-structure as the locus of language-specific constraints on forms, it is possible to maximize the extent to which f-structures are cross-linguistically similar. The m-structure proposals arose primarily out of work on compound tenses and the auxiliary system, in languages such as English with complex auxiliary selection facts.

Early studies in LFG analysed auxiliaries as raising verbs, assigning them a PRED value, and introducing the main verb in a complement clause (xcomp) (e.g. Falk 1984). Later analyses assume a flatter c-structure, with auxiliaries as non-subcategorizing elements which contribute functional information (e.g. tense, aspect) but without PRED features. On these analyses, the main verb is the functional head of the clause, with the auxiliary providing grammatical information only (e.g. King 1995; Butt, Niño, and Segond 1996; Bresnan 2001a). Among many arguments in favour of the flat analysis is the fact that it allows for a consistent analysis of constructions with similar functions cross-linguistically: the f-structure will be essentially the same irrespective of whether a language expresses its past perfective with a synthetic verb form, or with an analytic structure consisting of an auxiliary followed by an infinitive verb, for example. The positioning of a separate m-structure allows for the idiosyncratic morphological facts associated with the past perfective in each language to be captured while maintaining the cross-linguistic similarity at f-structure. Thus, it is at m-structure that information about combinatory possibilities is encoded (e.g. the fact that in English the have auxiliary requires the following verb to be in the -en form—I had eaten—while the be auxiliary requires the -ing form, as in had been eating).

The early proposal by Butt, Niño, and Segond (1996) introduces a mapping $\mu$ from nodes of the c-structure to elements of the m-structure, in addition to the function $\phi$ mapping c-structure nodes to f-structure. The form requirements within the verbal complex are stated not in f-structure, but at this level of morphosyntactic structure. This allows a clear separation of aspects of surface exponence from more cross-linguistically invariant aspects of temporal and aspectual specification.9

(14) Kim has been running.

(15) $V' \rightarrow V$

Franks and Zaenen (2001) make different assumptions about how the m-structure fits in the overall architecture. Working on the assumption that case and agreement features should also be represented in m-structure, they point out some issues with the architecture assumed by Butt, Niño, and Segond (1996). Their main focus is past participle agreement in object relative clauses in French: the participle shows agreement with its OBJ, just as in case it is preceded by it, a situation which arises in relative clauses. In this case, the participle must in fact have access to the agreement features of the relative pronoun, which agrees with

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8 Simpson’s rule is slightly more complicated than shown here, but the details are not relevant to the point at hand.

9 Here dep is an abbreviation for ‘dependent’, and vform for ‘verb form’. pastpart and prepart refer to ‘past participle’ and ‘present participle’, respectively.
the head noun and may be unboundedly distant—an example is (17b) (from Frank and Zaan 2002):

(17a) Les enfants adorent les histoires qu’on leur a déjà racontées mille fois.
Children are fond of the stories that one has told them already a thousand times.
(17b) Les enfants adorent les histoires qu’on sait bien qu’on leur a déjà racontées mille fois.
Children are fond of the stories that one knows perfectly well (that) one has told them already a thousand times.

Frank and Zaanen (2002) argue that in the architecture of Butn, Niño, and Segond (1996) long-distance functional uncertainty statements over the m-structures (which essentially recapitulate the hierarchy of the f-structure) are required to capture such long-distance agreement dependencies. Instead they propose a different architecture in which y is projected from the f-structure, so that morphological constraints can be stated locally; the m-structure is not connected, but simply encodes morphosyntactic aspects of that piece of f-structure. A simple example of subject–verb agreement on this view is illustrated with the lexical entry for the French verb tournera in (18), which shows the distribution of information to the f-structure (encoded with \( \uparrow \)) and the m-structure (encoded with \( \downarrow \)).

\[
\text{(18) tournera: } V \quad (\uparrow \text{pred}) = \text{'t'ourner<}{\uparrow \text{subj}}(\uparrow \text{obi}) > \\
\text{ (\( \downarrow \text{aux} \) = -} \\
\text{ (\( \downarrow \text{fin} \) = +} \\
\text{ (\( \downarrow \text{tens} \) = fut} \\
\text{ (\( \downarrow \text{subj}, \text{num} \) = sg} \\
\text{ (\( \downarrow \text{subj}, \text{pers} \) = 3}
\]

Sadler and Spencer (2001) expand on the m-structure analyses to propose a distinction between morphological features (m-features) and syntactic features (s-features), where the latter are the more familiar f-structure attributes while the former are those features which regulate morphological form in the m-structure. While the mapping between the two will be straightforward in many cases (such as when a verb form realizing the m-feature [Tense: Past] also contributes the f-structure information [tense past]), the distinction between the two types of features allows for an account of mismatch cases, where a verb marked with present tense morphologically is involved in a construction which means simple past, for example (Sadler and Spencer 2001). In a recent paper Dalrymple (2015) provides an explicit proposal for integrating the morphological component in the LFG architecture, incorporating much of this previous work.

\footnote{Another related proposal is that of Falk (2006) who argues for a level of grammatical marking structure projected from f-structure.}

11.2.1.2 In HPSG
A cornerstone of lexicalist theories such as HPSG (and LFG) is the clear separation of syntax from morphology: in particular, syntactic machinery is not extended into inferential morphology, and the principles which govern syntax are not assumed to extend to inferential or derivational processes.

The overwhelming majority of work in HPSG inflectional morphology espouses a realizational approach (such as that of Paradigm Function Morphology (PFM) (Stump 2001)) in which affixes are not themselves signs and affixation is carried out by morphological functions. However, alternative approaches are also found (e.g. the morpheme-based work of van Eynde 1994 and the constructional approach of Riehmann 1998, 2000). Providing an appropriate marriage of realizational morphology (such as PFM) with HPSG poses many non-trivial issues, leading to a rich vein of work on this topic, including Bonami and Boyé (2002, 2006), Crystmann and Bonami (2012, 2016), and Bonami and Crystmann (2013).

Among the issues relevant to a treatment of morphology which have been addressed to a significant extent in the HPSG literature are the following: (i) the nature and status of lexical rules; (ii) the role and status of the basic ontology, with respect to issues of morphological productivity, and the possible role of online type creation; (iii) the delimitation of syntax from morphology and the treatment of interface phenomena (e.g. status of 'clitics'); (iv) the role and nature of defaults; and (v) the development of a sign-based approach to morphophonology. We discuss some of these in the relevant sections below.

11.3 The subparts of morphology

11.3.1 Word formation

11.3.1.1 In LFG

Word formation and compounding in LFG are primarily lexical processes and are therefore dealt with in the morphological/lexical component, rather than the syntax. Since Bresnan's early work on the passive construction (Bresnan 1982b), the standard LFG approach has been to assume lexical redundancy rules that introduce lexical alternations in predicate–function mappings. The ensuing syntactic differences then result from the interaction of these alternative predicate–function mappings with regular syntactic principles (such as completeness, coherence, and function–argument bi-uniqueness) (see Bresnan 2001a: ch.3 for detailed discussion). This approach follows from the standard assumption in morphology (e.g. Aronoff 1976, 1994) that processes such as derivation and compounding are morphological and that, therefore, the inputs to these processes must also be morphological. From this it follows that relation-changing processes such as passivization, causativization, applicativization, and so forth, that can be shown to be inputs to lexical

\footnote{For example, Sag (2012: 28) observes: "I assume that a largely autonomous set of constraints characterize the relation between the phonological and morphological aspects of signs."}
processes of derivational morphology in some languages (such as nominalization, e.g.), must also be formed in the lexical component (Bresnan 2001:30). Bresnan and Moshi (1990) show how the formation of passives, applicatives, and reciprocal verbs in Bantu languages such as Kigaya and Chichewa can be captured in terms of morpholexical operations on argument structure which suppress, add, or bind roles. These operations can be considered to be associated with the corresponding derivational morphology so that they are unified with the verbal argument structure on affixation (see also Bresnan and Kanerva 1989). The passive operation, for example, suppresses the highest argument in the verb’s argument structure, which prevents it being linked to the subject grammatical function and results instead in the linking of the patient argument to subj (via regular argument linking principles) (see Dalrymple 2002: ch. 8 for detailed discussion of this aspect of the theory).

A similar approach to verb derivation is found in the analysis of Chichewa applicatives by Alsinà and Michombo (1993), and in the approach to applicatives in complex predicates in Murrinhpatha (Australia) taken by Sesia and Nordlinger (2010). Baker et al. (2010) also use a lexical alternation rule in their account of the external possession incorporation construction in Wubay (Australia) and its interaction with noun incorporation.

11.3.1.2 In HPSG

A major theme in HPSG work concerns the nature and role of the lexicon and the mechanisms by which lexical generalizations (and hence also derivational relations) between lexemes may be most adequately modelled. In early HPSG and related work, lexical rules were essentially external operations or functions applying to feature structures (Pollard and Sag 1987; Flickinger 1987). An important strand of work over the last twenty or so years has addressed in various ways the issue of bringing lexical generalizations inside the basic architecture (Meurers 1995, 2001).

In early work Krieger and Nerbonne (1993) (also Krieger and Nerbonne 1995) outline an approach to both inflection and derivation using complex feature descriptions. The basic proposal is to interpret a lexical rule as an information-bearing object "indistinguishable in its form and meaning from other entries of the lexicon". The leading idea is that derivation is within the lexicon, not an external process which then populates the lexicon. They propose an approach in which complex morphs (i.e. derived words) have HEAD-MORPH and COMP-MORPH features to encode morphological structure, regulated by constraints over the morphological structure (e.g. constraints over the order of HEAD and COMP, feature inheritance principles, subcategorization, and so forth).

In related work, Krieger (1993) proposes a morphemic, word-structure approach to the derivation of -bar adjectives and vor- prefixation in German, in which the morphotactics are handled by attributes representing internal structure (AFFIX and WORD) within a DTRES attribute, and realization is handled by a realization function which applies to the attribute WORD|WORD. The basic geometry for word formation is shown in (19). A slightly

| (19) | complex-word |
| MOPH | word-morphology |
| SYN | word-syntax |
| SEM | word-semantics |
| DTRES | affix-word-structure |
| AFFIX | affix |
| WORD | part-of-speech |

| (20) | bar-suffix |
| MOPH | affix-morphology |
| FORM | -bar |
| SUBCAT | bar-verb |
| OBJ | 1 |
| COMPS | 2 |

The account of derivational morphology in Krieger (1993) depends on having feature structures for affixes. An alternative aimed at avoiding the phrase structure (word syntactic) aspect of Krieger and Nerbonne (1993) and Krieger (1995) is Riehmann (1998), which develops an approach in which the formative -bar is not a suffix with its own lexical entry, or simply phonological material, but is represented essentially as a schema in a type-based approach to derivational morphology. Important considerations underlying this work are to capture both the very productive fully regular derivational process and the subregularities (for example, -bar adjectives from verbs with dative objects such as unabausweisbar 'inessable'). Her approach uses only monotonic multiple inheritance (i.e. it does not have recourse to defaults). She posits a productive maximal subtype of trans-bar-adjective to model the productive regular case and a number of lexicalized maximal types for other-bar adjectives. The idea is that any appropriate stem (of type verb) can be used with the productive reg-bar-adj type, shown in (21) (Riehmann's original also contains constraints

\[ \text{valence in (22), comps stands for complements. the feature ma}[\text{com}] \text{encodes parts of speech information. in later work, the feature arg-st lists the syntactic arguments of a head.} \]

\[ \text{12 in fact, argument structure and LF's lexical mapping theory have been the subject of a large amount of research and debate in recent years, and there is not space in this chapter to do it justice. for further discussion see, among others, Asselbergh, Giorgolo, and Toivonen (2014), Muller and Wochler (2016), and the enormous array of references provided in Bresnan et al. (2016: 545-8).} \]
over the content feature, representing the semantic argument structure, but we abstract away from these details here for simplicity and greater readability. On this approach, derivational affixes do not have lexical entries. In (21) and elsewhere ⊕ indicates the relational constraint append, used to concatenate two lists.

\[
\begin{align*}
(21) & \quad \text{reg-bar-adj} \\
\text{PHONOLOGY} & \quad 1 + \text{bar} \\
\text{MORPH-B} & \quad \langle \text{trans-verb} \\
& \quad \langle \text{1} \\
& \quad \text{SYNSEM LOC} \quad \langle \text{CAT[VAL[COMPS <NP[lec]] 2 ⊕ 3]]} \\
& \quad \langle \text{HEAD adj} \\
& \quad \langle \text{CAT} \quad \langle \text{SUBJ <NP 2}> \\
& \quad \langle \text{COMPS 3} \\
\text{SYNSEM LOC} & \quad \langle \text{valence} \\
& \quad \langle \text{adj} \\
& \quad \langle \text{adj} \\
& \quad \langle \text{v-lex} \\
& \quad \langle \text{STEMS \langle SLOT1 3 ⊕ 4}}
\end{align*}
\]

The issue of how morphological productivity can be captured is discussed in Koenig and Jurafsky (1995) who observe that Pollard and Sag (1987, 1994) use a compiled-out type hierarchy to capture the common properties of words and lexical rules for productivity, and propose instead to underspecify the type system to deal with lexical productivity. They store a type for each root and for each productive morphological template and propose an algorithm for building types for surface forms, called online type construction (OTC). Koenig (1999) provides extensive further discussion of this issue within an HPSG context. The fundamental idea is that the lexical type hierarchy is organized into essentially orthogonal, conjunctive dimensions: maximal (leaf) types are inferable (by OLTC) by inheritance from one maximal (leaf) type in each dimension. This cross-classificatory approach using the intersection of leaf types captures horizontal generalizations across the lexicon.

The relatively small literature on derivation and compounding in HPSG includes Desmet and Villoing (2009), which offers a morphological approach to French VN compounds such as tournevis ‘screwdriver’ and grille-pain ‘toaster’. They use the type hierarchy in (22) (Bonami and Boyé 2006) where objects of type lex-sign (words and lexemes) have an attribute MORPHOLOGICAL-DAUGHTERS with values of type lexeme, and lexeme has the attribute STEMS with a value of type stem-space.

\[
\begin{align*}
(22) & \quad \text{sign} \\
& \quad \langle \text{syn-sign} \langle \text{lex-sign} \\
& \quad \langle \text{phrase} \langle \text{word} \langle \text{lexeme} \\
\end{align*}
\]

14 Riehemann’s MORPH-B attribute stands for morphological bases.

Desmet and Villoing (2009) extend this type hierarchy to allow for lexemes with ‘complex morphology’ by introducing an additional dimension of classification for lexemes called formation. Lexemes which are morphologically complex (of type morph-complex-lex) are subclassified into compound, derived, and converted subtypes. The essence of the approach to the representation of compounds can be ascertained from the following constraint on the type vn-lexeme, which specifies that a Verb–Noun compound (in French) is syntactically a Noun formed by combining a verbal and a nominal stem in the morphology.

\[
\begin{align*}
(23) & \quad \text{vn-lexeme →} \\
& \quad \langle \text{STEMS \langle SLOT1 3 ⊕ 4}}
\end{align*}
\]

11.3.2 Inflection

11.3.2.1 In LFG

As discussed in §11.3.1, the framework of LFG is not committed to a particular treatment of inflection, and thus there has been little LFG work on a general theory of inflectional morphology. However, the flexibility of the LFG architecture has enabled interesting accounts of certain inflectional phenomena that have been less straightforwardly handled in other frameworks. In this section we focus particularly on multiple exponence and constructive morphology.

11.3.2.1.1 Multiple Exponence

Cases of multiple exponence, especially those where the same inflectional category is marked across multiple words in the clause, can be problematic for approaches which hold that inflectional morphology is related to abstract functional nodes in the syntax (see Niño 1997 for a more detailed discussion of such approaches and the difficulties). The unification-based nature of LFG, and the fact that all morphosyntactic information unifies into the same clausal f-structure, means that the number of times that compatible information can be contributed (and unified) is limitless, and will always result in the same f-structure. Thus, cases of multiple exponence are not only straightforwardly captured in this framework, but require no additional mechanisms or assumptions; the multiple instances of the same inflectional feature are simply unified in the f-structure, as shown in the Finnish example below (from Niño 1997).
In the Finnish example in (24), we see that both the negative polarity item and the verb carry inflection encoding singular number for the subject. In the LFG analysis of this sentence, a simplified form of which is shown in (25), this information is unified with the same f-structure associated with the subject in both cases. Thus, the appearance of the singular subject inflectional feature on multiple parts of the clause does not change the f-structure of the sentence, but is an issue of relevance for the morphological component only. If the morphology generates words of different word classes which mark the same inflectional feature, this situation will be accommodated by the syntactic component. In contrast, syntactic models of inflectional morphology treat each inflectional feature as being associated with a functional head, and thus multiple instantiations of a single feature can only be accounted for through other processes such as feature percolation or copying (e.g. Mitchell 1991).

Nordlinger and Bresnan (1996) show that this general approach can also be extended to account for situations in which distinct, yet compatible, information is contributed by different parts of the clause, and unified at the f-structure. They discuss the case of distributed tense/aspect/mood (TAM) marking in the Australian language Wambaya. In Wambaya, TAM is marked on both a second position auxiliary and on the verb. These two elements need not be contiguous in the clause, since Wambaya clauses have grammatically free word order (apart from the second-position auxiliary). Crucially, however, the TAM information contributed by each element is not identical; rather the two interact to mutually determine the TAM for the clause. According to the Nordlinger and Bresnan (1996) analysis, this is accounted for by treating the categories of tense and mood in Wambaya as composites of three primitive binary features, as follows:

```
(26) a. PAST:  
   [FUTURE - ] 
   [UNCERTAIN - ]
```

The TAM inflections on the auxiliary and verb each encode (partial) combinations of these features which then combine in the clausal f-structure to fully specify the TAM value for the clause as a whole. An example (taken from Nordlinger and Bresnan 2011) is provided in (27); for a more complete discussion of the analysis see Nordlinger and Bresnan (1996).

```
(27) a. Ngauw nguy-wo  ngauj-ba.
   1SG 2SG.A-1.O-[PAST+-FUTURE+]  see-[UNCERTAIN+] 
   'You will see me.'
```
Crucial to this analysis is the LFG notion of co-heads (Bresnan 2001a), and in particular the fact that complements of functional categories are f-structure co-heads. It is this principle which determines that both I and V (via S) in (27) are f-structure heads (indicated with the annotation $\uparrow = 1$), and therefore their f-structures are identified with the f-structure of the clause as a whole. This allows for them to each provide partial information about the clause-level property of TAM, which information is then unified into the clause f-structure.\textsuperscript{15}

\subsection{Constructive Morphology}

The ‘constructive morphology’ approach grew out of Nordlinger’s (1998) analysis of case stacking in the Indigenous languages of Australia. In this approach, Nordlinger argues that the morphological concept in these largely non-configurational languages encodes information directly about the larger syntactic context in which the nominal appears. Inflecting a nominal with ergative case, for example, does not just mark the nominal as having ergative case, but also encodes the fact that the nominal is functioning as the transitive subject in the larger clause. Thus, on this view, case markers do not just reflect grammatical relations, but actually play a central role in constructing them. Nordlinger (1998) shows how this approach can provide a natural and straightforward account for a range of complex morphological phenomena in these languages that are challenging for other theoretical frameworks, such as multiple case marking (case stacking) and the use of case morphology to encode clausal tense/aspect/mood (on this, see also Nordlinger and Sadler 2004).

As a simple illustration of the model, consider the Wambaya ergative nominal \textit{galalarirni}-ni ‘dog-erg’. A traditional approach to case might assume that the ergative case marker here contributes the case information \textit{case} = \textit{erg}, and that elsewhere in the grammar this information will interact with the argument structure of the verb to ensure that the nominal is only licensed as a transitive subject. On the constructive case approach, however, the ergative case marker constructs the larger f-structure in which this nominal belongs, specifying that the nominal must hold the grammatical relation of \textit{subj} in a transitive clause. The information associated with the ergative case marker is shown in (28), and the f-structure constructed by the whole nominal \textit{galalarirni}-ni is shown in (29).\textsuperscript{16}

\begin{equation}
(28) \text{ERG: } \langle \text{(SUBJ } \uparrow \text{ OBJ) (CASE } = \text{ ERG) \rangle}
\end{equation}

\begin{equation}
(29) \begin{bmatrix}
\text{SUBJ} & \text{FRED \textquoteleft doo	extquoteright} \\
\text{CASE} & \text{ERG} \\
\text{OBJ} & \]
\end{bmatrix}
\end{equation}

\textsuperscript{15} See Sells (2004) for discussion of multiple exponence in Swedish and its analysis within OT-LFG, a combination of Optimality Theory with the framework of LFG (Bresnan 2001a).

\textsuperscript{16} Note that Nordlinger’s original analysis assumes a morphemic morphological approach, but Nordlinger and Sadler (2006) show how it can also be cast within a realisation morphology.

The idea that pieces of case morphology can contribute information to the larger f-structures within which they are contained (enabled by LFG’s inside-out function application (e.g. Halvorsen and Kaplan 1988; Dalrymple 2001)) allows Nordlinger (1998) to account for the phenomenon of case stacking (see also Andrews 1996) and opens up possibilities for such morphology to encode information about other aspects of this broader syntactic context, such as clausal tense/aspect/mood (Nordlinger 1998; Nordlinger and Sadler 2004) or interclausal relations (Nordlinger 2000). This idea has also been extended to other morphological contexts as well, such as pronominal clitics and phrasal affixes (O’Connor 2002) and word order freezing (Mahowald 2011).\textsuperscript{17}

\subsection{In HPSG}

From the outset there has been a fairly general consensus in favour of adopting broadly inferential-realizational approaches to inflectional morphology in HPSG, although of course the framework itself does not preclude the development of other theoretical approaches (see, e.g., the remarks in Krieger and Nerbonne (1991) on the advantages of adopting a ‘lexemic’ view over a ‘morphemic’ view, and similar views in Miller and Sag (1997)).

\subsection{Paradigms}

Krieger and Nerbonne (1993) present an early attempt to define the central notion of paradigm in feature structures directly associated with syntactic information. Their approach makes use of defaults in the lexicon. They express paradigms directly in feature structures by defining them as disjunctions and using distributive disjunction to link the alternation on morphosyntactic features to that in formal expression. In (30) for the present tense weak paradigm of German, $pi$ is the name of the distributive disjunction which associates pairwise elements from the ENDING and AGR (‘agreement’) attributes.

\begin{align}
\text{STEM} \quad \text{ENDING} \\
\text{FORM} \quad \text{SYN}\langle \text{LOCAL}\rangle \text{AGR} \\
\begin{bmatrix}
\text{SYN}\langle \text{LOCAL}\rangle \text{HEAD} \text{AGR} \{ \text{PER 1ST NUM SG PER 2ND NUM SG PER 3RD NUM PL} \} \\
\end{bmatrix}
\end{align}

In contrast, Malouf (2001) argues that HPSG is able to account for the Australian case stacking data within the use of inside-out function application by assuming a coindexed constraint that recursively propagates the case feature of a head onto all of its dependents (which must necessarily include adjects as well).

\textsuperscript{17}
accommodated in the HPSG architecture. A brief outline of Bonami and Boyé (2006) gives the flavour of this strand of work. They propose that the feature stems is appropriate for members of the type lexeme (the relevant portion of the type hierarchy is given in (22) above). Classes of lexemes default to showing a regular stem pattern, while irregular lexemes are lexically specified with the appropriate stem phonologies, as shown in (33) for the (French) verb valoir. The constraint in (33) specifies that elements of the type lexeme have a stems attribute (with a value of type stem-space) while (34) states that the value of stems defaults to the type regular (the default value is preceded by ’/’), in which all the stem forms are in fact identical. Note that attributes under stems have phonological forms as values (here val and vo), and hence the treatment is entirely morphemic. Example (34) illustrates the approach, showing the first person present indicative inflectional rule, which is realized by appending 5 to the phonological form which is the value of slot1 in the stems feature structure.

(31) lexeme \(\rightarrow\) [stems stem-space]

(32) verb-lexeme \(\rightarrow\) [stems /regular]

(33) valoir:

\[
\begin{bmatrix}
\text{word} \\
\text{phon} \ \ \ 1 \odot 5 \\
\text{synsem}
\end{bmatrix} =
\begin{bmatrix}
\text{head}
\end{bmatrix} =
\begin{bmatrix}
\text{verb}
\end{bmatrix} =
\begin{bmatrix}
\text{tense present}
\end{bmatrix} =
\begin{bmatrix}
\text{mood indicative}
\end{bmatrix} =
\begin{bmatrix}
\text{subj} <np[1pl]> \\
\text{stems} \{\text{slot1} \} \\
\text{m-dtrs}
\end{bmatrix}
\]

(34) prot-indic-1pl \(\rightarrow\)

The use of default values as in (32) is not simply an abbreviatory device permitting compact statements of generalizations: as Bonami and Boyé (2006) point out, it is intended to constrain the members of an open lexicon, so that new or unknown verbs will be inflected as regular items.

11.3.2.2.3 VARIABLE MORPH ORDERING

Crysmann and Bonami (2006) address the issue of encoding an inferential, realization treatment of variable morphotactics in HPSG (and see also earlier, related papers on this topic: Crysmann and Bonami 2013; Bonami and Crysmann 2013). The approach is templatic, differing crucially from the inferential, realizational approach of PEM in that it characterizes the placement of morphs without reference to the stem, and hence eschews the organization of realization rules into successively applied rule blocks. Generalizations over classes of rules are expressed by organizing realization rules into inheritance type hierarchies.\(^{16}\) The templatic approach allows a simple treatment of a range of departures from canonical (stem-centric) placement, including misplaced alignment where elements which are in opposition occur in different linear positions, conditional placement where the placement of a morph is dependent on the presence of other morphosyntactic features which it does not express, free ordering, partial ordering, and cases where shared forms are positionally disambiguated (such as the Swahili subject and object markers which are largely identical but appear in different positional slots).

The fundamental units of description are morphs or segmentable formattives, associated with position class and phonological information. Realization rules are expressed as typed feature structures. A rule typically encodes what features it realizes and specifies its form: the attribute mud stands for morphology under discussion and miph encodes the phonological form (pf) and the position class (pc) information of the morph. A crucial component of the approach is the distinction between conditioning and expression, so that rules can also impose constraints on features which they do not realize, by means of the ms feature which captures any such (co-occurrence) constraints on the morph. For example, in the context of negation, past tense in the Swahili verb is realized by a morph kwa in position class 3 while it is realized by /i/ in other contexts. Example (35) shows the negative (context) allomorph, where \(\cup\) denotes set union.

(35) \[
\begin{bmatrix}
\text{mud} \{\text{past}\} \\
\text{ms} \{\text{neg} \} \cup \text{set} \\
\text{miph} \left\{\begin{bmatrix}
\text{ph} <\text{ka}> \\
\text{pc} 3
\end{bmatrix}\right\}
\end{bmatrix}
\]

Portmanteau forms are captured by associating a set of features (as value of mud) with a single exponent and null exponent by assuming a non-realization default for a morphosyntactic property. Discontinuous exponence is exemplified by (36) for regular negation in Chintang, which involves the circumfix ma-...-yokt.

(36) \[
\begin{bmatrix}
\text{mud} \{\text{neg}\} \\
\text{miph} \left\{\begin{bmatrix}
\text{ph} <\text{ma}> \\
\text{pc} 1 \lor 2 \lor 3 \\
\text{ph} <\text{yokt}> \\
\text{pc} 5
\end{bmatrix}\right\}
\end{bmatrix}
\]

\(^{16}\) In fact, to deal with cases of horizontal redundancy such as the systematic relationship exhibited by the Swahili subject and object marker paradigms, which are mainly identical but in different position classes, Crysmann and Bonami (2006) additionally use online type construction (Koenig and Jurafsky 1995) which involves a closure operation on a type underspecified hierarchical lexicon partitioned with conjunctively interpreted dimensions.
In this approach, rules pair morphosyntactic properties and sets of exponents (building on Cryssman 2003) in a flat structure of segmentable morphs, rather than incrementally adding exponents to a stem. Stem introduction rules introduce the stem, associated with a particular templatic position. For example, (37) (for the Swahili verb) places the stem shape associated with (the lexical identity of) a lexeme in position class 6.

Two principles of well-formedness constrain the type word. Inflectional morphology is represented as the value of the attribute morph which encodes the relation between the MS set, the set of realization rules (RR) and the set of morphs (MPH) indexed for position. Morphotactic well-formedness is ensured by a constraint on the type word shown in (38). The MS value of the word is the union of the MPH values of the morphs, ensuring that every morphosyntactic property is realized, that is, it ensures that the morphosyntactic features expressed by the rules must match up to produce the property set of the word.20

In terms of exponence, morphs are required to occur in the order given by their position class indices (which are a property of morphs rather than of rule blocks in this approach): this is captured by two further constraints, constituting the Morph Ordering Principle (MOP). Example (39a) requires the phonology of the word to be the concatenation of the phonologies of the set of morphs while (39b) requires position class order to be respected.

20 $\cup$ is non-trivial set union and ensures that each property is contributed only once.
treated as a morphosyntactic hybrid in that the agreement marker is syntactically visible ‘floating’ phonology.22 The supertype of the stems with this type of mobile morphology, such as the past (participle) /stem/, does not order the number of the stem and affix in the morph list, as shown by the use of shuffle (C) in (42), where pst-ogr (for past tense agreement markers) is the most general type corresponding to the inventory of person/number markers—for example, it is a supertype of the 1st sing marker [ PH < m > ].

(42) Morph ([ stem ] HEAD verb ) ○ list(pst-ogr)

Linearization in HPSG is extended in this analysis to permit words to project more than one single domain object (see Kahl 1995, and Crystmann 2003 for this idea). Lexical integrity is preserved since it is only the phonological contribution (of the morph) which may ‘float’ beyond the word. Where morphologically attached agreement markers are inseparable from the stem, a constraint expresses this restriction by requiring the lexical domain (domain) list to be of length 1.

11.4 Interface with Syntax

As we have made clear, in both LFG and HPSG morphology and syntax are separate and autonomous subsystems in these frameworks, with the interface between them regulated by lexical integrity. Many of the issues discussed so far in this chapter relate to the morphology–syntax interface. In this section we touch (briefly) on work in both frameworks concerning clitics and edge inflection.

11.4.1 In LFG

Sadler (1998) shows how the framework of LFG can be used to capture Spencer’s (1991) insight that non-syllabic reduced auxiliaries in English are more appropriately treated as affixes, while the syllabic reduced auxiliaries are clitics. Examples using the auxiliary will are given in (43) and (44); analogous facts are also found with would, and tensed forms of be and have.

(43) Mary’s flu’ll (‘/ll/, /sl/) be gone by tomorrow.
John and Sue’ll (‘/ll/, /sl/) be singing all day long.
The boy who’s laughing’ll (‘/ll/, /sl/) go to the party.

The past tense markers -ed, -edy, -ice are treated as exponents of agreement (and not as tense markers).

(44) You’ll (‘ll/) be able to go home at two o’clock.
I’ll (‘ll/) be leaving tomorrow.

The syllabic reduced forms in (43) behave like clitics: they attach phonologically to the final element of the preceding constituent, without showing any (lexical) selection as to their host. In LFG such clitics are treated as syntactic terminals in the c-structure (just like the corresponding full auxiliary), with their particular phonological properties a matter for the interface between syntax and prosodic structure.23 The non-syllabic forms in (44) however, are quite different, and can be shown to behave like inflectional affixes (bound morpha) rather than clitics. The evidence is laid out in detail in Spencer (1991) but, in brief, amounts to the following: (i) the non-syllabic forms can attach only to non-coordinate pronominal subjects (as in (44)) and are therefore highly selective as to their ‘host’ in a way that is expected of affixes, but not clitics; (ii) word-internal phonological processes apply within the ‘pronoun + non-syllabic reduced auxiliary’ unit suggesting that it is a single morphological unit; (iii) the stem to which the non-syllabic auxiliary attaches shows stem allo-morphy that is not predictable on phonological grounds (e.g. we’ll /wil/ becomes [will]), again suggesting word-internal structure as opposed to a post-lexical clitic; and (iv) the fact that the non-syllabic auxiliary cannot scope over a coordinated subject, whereas the syllabic clitic auxiliary can, is behaviour that we would expect of an affix that is combined within the morphological component rather than the syntax.

Sadler (1998) shows how these tense-inflected pronouns can be given a straightforward account within LFG using inside-out function application (as we saw in the discussion of constructive case in §11.3.2.1.2). The inflected pronoun you’ll (as in You’ll like it) has the lexical entry shown in (45), corresponding to the f-structure information shown in (46).

As shown in this f-structure, the inflected pronoun contributes both information about the subject of the clause and tense information to the clause itself, thus allowing for the clausal contribution of the non-syllabic auxiliary to be contributed to the f-structure without violating lexical integrity.

(45) you’ll ( [ t pred ] = ‘pro’
[ t pers ] = 2
[ (subj ‘f’) tense ] = fut

(46) tense fut
[ subj [ pred ‘pro’]
[ pers 2 ]]

The basic c-structure (47) and f-structure (48) for the full sentence You’ll like it are given below.

(47) the basic c-structure
(48) the f-structure

22 See Butt and King (1998) and Bögel et al. (2009), among others, for a discussion of prosodic structure in LFG and the treatment of clitics.
(47)
\[\begin{array}{c}
\text{IP} \\
\text{DP} \\
\text{VP} \\
you'll \\
\text{like} \\
\text{it}
\end{array}\]

(48)

### An alternative approach to the affixal nature of non-syllabic reduced auxiliaries in English

An alternative approach to the affixal nature of non-syllabic reduced auxiliaries in English is provided by Wescoat (2002), who develops a model of 'lexical sharing' within the LFG framework which allows a single word to co-constitute more than one adjacent terminal node in the c-structure. Wescoat applies this approach to a number of different morphosyntactic phenomena. Broadwell (2008) also uses it to account for suspended affixation phenomena in Turkish. There are clear conceptual similarities between lexical sharing and approaches to co-analysis in other models, such as Sadock (1991), Lapointe (1991), or, within HPSG, Crismann (2005).

Clitics and related phenomena have been the subject of a large amount of work in LFG, and space limitations preclude us from discussing it all here. See, for example, Grimshaw (1982), Sadler (1997), Sharma (1999), O’Connor (2002, 2004), Luis and Sadler (2003, 2004), Luis and Otogo (2004, 2005, 2011), Bögel (2010), Spencer and Luis (2012a, 2016) and the references therein.

### 11.4.2 In HPSG

In this section we very briefly discuss two issues: (i) the affixal treatment of what are pretheoretically described as object clitics, and (ii) the treatment of \textit{edge} phenomena.

A substantial body of work in HPSG argues for affixal (word-internal) treatments of various pronominal clitics, following the early influential analysis of French pronominal clitics as affixes developed in Miller and Sag (1997), building especially on the work of Miller (1992). Miller and Sag (1997) draw a distinction between \textit{plain-words} and \textit{cliticized-words}, the latter being inflected words which also realize (at least) one argument affixally, with concomitant changes in the word’s valency requirements, shown in (49).

(49)

\[
\begin{array}{c}
\text{MORPH} \\
\text{FORM} \\
\text{FProf}(0, \ldots) \\
\text{1-FORM} \\
\text{VERB} \\
\text{SYNSEM} \text{LOC}\text{CAT} \\
\text{HEAD} \text{VERB} \\
\text{VAL} \text{SUBJ} \\
\text{ARG-ST} \\
\text{ARG-ST} \\
\text{ARG-ST} \\
\end{array}
\]

The function \textit{FProf} spells out the form of the inflected word on the basis of the 1-FORM value (the ‘classic’ inflectional form, without the pronominal affixa), the head value and the \textit{ARG-ST} value. The approach is modelled on FPM although the morphological details are not fully specified. Similar accounts have been developed for other Romance clitics (see Monachesi 1998; Bildhauer 2008, among others).

Tseng (2005) argues that the sandhi phenomenon of consonant liaison in French is subject to a range of lexical, syntactic, and stylistic considerations rather than being a purely phonological process.\(^{24}\) The target (adjectival) forms are treated allomorphically in a paradigm-based approach (Bonami and Boyé 2002, 2003), such that the forms are distinguished in terms of a \textit{RIGHT-LIAIS} +/− feature in the morphosyntactic feature set. Trigger (versus non-trigger) words are distinguished in terms of a liaison-trigger feature—words are marked as \textit{LEFT-LIAIS} + if their left edge can trigger liaison. Because contexts are syntactically conditioned, propagation of these features in the syntax (as edge features) is required; for example, the + liaison allomorphy of the masculine singular adjective \textit{grand ‘large’} is required in a liaison context (e.g. before \textit{appartement ‘flat’}), even if the adjective is embedded in an AP such as \textit{très grand ‘very large’}. The essence of the account is the following. Values of the \textit{edge} feature are propagated in the syntax by virtue of the Edge Feature Principle in (50), which makes reference to the surface order \textit{(via domain)}. A constraint which applies to all phrases then ensures the realization of liaison, specifying that an element with the feature \textit{RIGHT-LIAIS} + must be immediately followed by an element with the feature \textit{LEFT-LIAIS} +.\(^{25}\)

\[
\begin{array}{c}
\text{phrase} \Rightarrow \text{[EDGE LEFT 1 \text{RIGHT 2}] DOM\{ [EDGE LEFT 1], \ldots, [EDGE RIGHT 2] \}}
\end{array}
\]

\(^{24}\) An alternative, purely phonological, account in HPSG is developed in Asudeh and Klein (2009).

\(^{25}\) See also Miller’s (1992) treatment of the definite article as a phrasal affix.
Samvelian and Tseng (2010) discuss mobile object 'clitics' in Persian, and build on both Miller and Sag's (1997) approach to pronominal affixes and Tseng's (2003) use of edge features. The object 'clitic' in Persian is relatively mobile, permitting realization on a range of hosts to the left of the verb. Samvelian and Tseng (2010) argue that it is a suffix permitting a degree of promiscuous attachment to a range of different hosts. The basic generalization which they put forward concerning the distribution of the preverbal 'clitic' is that it is hosted by the least oblique complement of the verb (when not hosted by the verb itself). An example, with the pronominal object realized on the PP dependent, is shown in (51b).

   on-IZ table put-1PL-3SG
   ‘We put it on the table.’

b. [PP ru-yə miz]-aš gozəlit-im.
   on-IZ table-3SG put-1PL
   ‘We put it on the table.’

In such cases, the affix does not bear any syntactic argument relation to the host on which it is realized. A fully lexical treatment of these cases of phrasal affixation is afforded by separating the morphological effect (of suffixation) from the syntactic and semantic contribution, at the phrasal level. The mechanism by which this is achieved involves postulating an additional parameter to the function PRAF, namely an ERG/RIGHT feature which permits the information about the presence of the pronominal affix to be recorded and passed to the head which syntactically selects it.

11.5 Further Reading and References

In this chapter we have attempted to provide an overview of the general approach to morphology and morphological theory taken by researchers working within the frameworks of HPSG and LFG. We have seen that the two frameworks share the property of lexicalism and the clear separation of morphology from syntax. This means that there is flexibility within the two frameworks as to the theoretical treatment of the morphological component, although a number of researchers have addressed morphological questions of various types. In this chapter we have surveyed some of the key research in this area in each framework, but for reasons of space have not been able to do due justice to all relevant work in this general domain.

For further interesting work on the relationship between morphology and syntax in LFG, see for example, Choi and Sells' (1999) work on case markers and verbal inflectional suffixes in Korean, Sells' (2008) discussion of multiple exponence in Swedish, and Otooguro's (2012) analysis of the interaction between inflectional and periphrastic tense/aspect/mood marking in Japanese. The morphosyntactic treatment of periphrasis is also taken up in a number of works by Ackerman (e.g. Ackerman 2000; Ackerman and Stump 2004; Ackerman, Stump, and Webelhuth 2011).

For other work on embedding morphological realization functions in HPSG see also Kathol (1999). See Bonami and Samvelian (2013) on a PFM-based approach to Persian inflectional periphrasis in HPSG. Sag (2012) gives a brief exemplification of compounding and derivation in SBCG. For work on Sorani morphology, see Bonami and Samvelian (2008), Walther (2012), and Bonami and Crysmann (2013). Different HPSG analyses of the Polish data discussed in §13.3.1 are given in Borsley (1999) and Kupiś and Tseng (2005).

Miller (2017) addresses the issue of using default inheritance to capture derivational morphology, arguing that the cost of such a move (which avoids the need for lexical rules, however encoded) is too high. In particular this paper gives a very clear statement of the 'closure problem' which arises in attempting to encode productive morphological processes directly in the type system. Bonami and Crysmann (2018) provide an up-to-date overview of morphology in HPSG.

Both LFG and HPSG have active research communities and annual conferences. We have no doubt that researchers working within these frameworks will continue to explore the nature of morphology and its representation, and we would encourage interested readers to keep an eye on their online proceedings for future developments: http://cslipublications.stanford.edu/LFG, and http://cslipublications.stanford.edu/HPSG. Comprehensive bibliographies of work within each framework are available at http://ling.uni-konstanz.de/pages/home/lg/index.html (for LFG) and http://hpsg.hu-berlin.de/HPSG-Bib (for HPSG).

Acknowledgements

We would like to thank the editors for inviting us to contribute this chapter and for their guidance on how to reduce two complex theoretical frameworks into a limited amount of space. For helpful comments and suggestions which led to significant improvements in the final version we are grateful to Olivier Bonami, Berthold Crysmann, Stefan Müller, and an anonymous reviewer.